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# THE STANDARDIZATION OF A TECHNICAL PRACTICE:
## Typing (1883 - 1930)



Delphine GARDEY

Translated by John Krige and Anna Pusztai

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# 5 THE STANDARD-IZATION OF A TECHNICAL PRACTICE: Typing (1883 - 1930)[1]

Delphine GARDEY

Economists have shown an interest in how standards are imposed on the market notwithstanding the fact that the limitations in performance they prescribe might be far from ideal. By 'standard' they usually mean a convention which demands uniformity, even if the notion of standard can be used more broadly to refer to all manner of social conventions. The QWERTY keyboard has thus become a topic of interest to economists concerned with standards since it was forcefully and, apparently, irreversibly imposed on the typewriter and then the personal computer market, even though 'inferior' to the ergonomic keyboards DIATHENSOR or DVORAK.[2] Even though it is less efficient than the keyboard designed to reflect the frequency of use of letters in the English language, like the ideal keyboard 'DIATHENSOR' – which collects together in one line and ten letters 70 per cent of English words[3] – the QWERTY keyboard designed by Sholes has nevertheless been retained by the manufacturers of typewriters, and has become the 'universal keyboard'.[4]

Economists have thus turned into historians and have tried to reconstruct the circumstances whereby the QWERTY keyboard came to monopolise the market. Indeed, one of the aims of the economist Paul David is precisely to understand and to recognize the need to integrate history or historical accidents into economic thinking.[5] History is thus invoked to explain the presence of these 'economic traps'. The 'trap' for these authors is that the existence of an obsolete standard leads to a suboptimal situation.

Our aim in these pages is to initiate a dialogue with this literature from an historian's point of view. It emerges that the questions which economists ask of history miss many of the very different problems which confronted the first secretaries in that part of their activity concerned with typing. The emphasis placed in scholarship on the QWERTY keyboard, crucial to develop the theory of 'Path Dependence', does not take account of the large number of different techniques distinguishing typewriters, nor of the differences between possible ways of using these machines. What is more, apart from the question of the (best) arrangement of letters on the keyboard, manufacturers and secretaries discussed

vigorously for many years the number of keys per keyboard, the best way to have capital and lower-case letters, and also the number of figures to use, the most suitable position of the body, the best way to learn typing, etc. This debate was obviously embedded in the human and industrial rivalry which was expressed through various championships and typing contests organized for decades in the United States and in France.

If there was indeed a progressive and then definitive acceptance by typists of the standard AZERTY, the French version of the universal keyboard QWERTY, this acceptance was just one dimension of the standardization of an ensemble of practices. The standardization of the technical object that is the typewriter, and the victory of a certain type of machine and the AZERTY keyboard on the French market, went along with an ensemble of modes of use of the object which, being transmitted, led to the professionalization of a practice. What we want to suggest then is that in the history of the emergence, the affirmation and the development of technical standards, this aspect of the incorporation of practices must not be ignored.

We also want to show in this way that the human and technical investments explain why it became more and more difficult to abandon what was far more than a mere technical standard, and rather the interrelation of technical choices and of practices which had become constitutive of the self-identity of a professional group. 'Lock in' is not simply of an industrial and technical kind; it works on the social and professional level too (or at least it incorporates the social and the professional).

In this paper we shall necessarily have to look at the state of the typewriter market in France at the end of the last century and at the dawn of our own as well as at the variety of kinds of competition to which the QWERTY keyboard was exposed. To this end we will describe the process of standardization of objects and of the imposition of uniformity of practices which occurred around 1910.

## The development of the typewriter market: the variety of objects (1874-1910)

The successive generations of Remington typewriters, conceived by Sholes and Glidden, and first manufactured in 1874 by the famous weapons firm, remained the only examples of their kind in the world for a little under 10 years. The Yost American Writing Machine Company produced the Calligraph in 1883. The market never ceased to diversify thereafter. By 1890 there were about 30 typewriter manufacturers in the United States and about 90 by 1910.[6] The variety of makes and of objects was accompanied by the rapid growth in the production of typewriters. There was a quantitative leap at the end of the 1880s. To give an idea of this, we note that whereas in 1886 all firms together produced 15,000 machines per year, only two years later Remington alone was manufacturing 15,000 machines per month.[7]

Remington never seems to have had a monopoly in France. It was introduced onto the French market in about 1883, where it was immediately in competition with the Calligraph machines. In 1884 Remington N°1 and 2 were sold by M. Lahm, the representative of the company with offices in rue Tronche, Paris, while the Calligraph was sold by the Fenwick Brothers, in rue Martel.[8]

One of the first typing contests organized in France in 1889 by Georges Buisson, stenographer at the Chamber of Deputies and ardent propagandist of the typewriter, featured two brands. The contest was held at the town hall of the 4th *arrondissement* in Paris, the two French representatives lent machines to the participants, but we do not know who won the day.[9] The number of brands increased considerably after these contests. The demonstration of speed was an essential element of their commercial policy. It was the speed with which the operators could type which convinced the first buyers of Remingtons, and different producers continued to pit their products against each other in competition up to the interwar period.

The first typewriters available in France were very different objects. The Remington N°1 had a simple keyboard which allowed one only to type capital letters. Sholes then designed a double keyboard obtained by commutation, which he fitted onto the Remington N°2. A lever enabled one to have lower-case or capital letters, and doubled the number of characters from 40 to 8.[10] This option was not adopted by the manufacturers of the Calligraph who offered a double keyboard without commutation, ie having twice as many keys to enable one to type both capital and lower-case letters. We find here 40 keys enabling one to type 40 characters, 40 keys enabling one to type 80 characters, and 80 keys enabling one to type 80 characters (Fig. 1).

From the outset, therefore, French typists like their American colleagues, were confronted with a range of machines very different in their conception and functioning. This first form of technical diversity was rather basic, and it persisted. The typewriter market made considerable strides in France[11] between 1900 and 1914.[12] Orders increased steadily: 12,000 machines were imported in 1911, 28,000 in 1913, to which one should add a French output of 4,000 machines. American imports dominated the local market, though France also imported typewriters from Germany, as well as from Britain and Italy. The increase in the number of imported machines, and those manufacturered in the country was accompanied by a diversification in the brands and models available. In 1889, one could find in Paris not only the Remington and the Calligraph, but also the Columbia Bar-Lock, Dactyle, Densmore, Empire, Hammond, Hartford and Rem-sho machines.[13] In 1910 a variety of foreign typewriters were sold in France, such as Adler, Bar-Lock, Continental, Empire, Hammond, Monarch, Oliver, Remington, Smith-Premier, Stoewer, Sun, Underwood and Yost.[14] The typewriter market remained highly competitive during the years preceding the First World War. Specialized journals were filled with advertisements for different brands of typewriter and for several months in 1912 they indicated the launch of the new Smith Bross ball typewriter, the birth of the Star, then the Gallia, and then the Mentor.[15] The variety of models on the market was commensurate with the wide range of manufacturers.

At the start of the century 'historians' and users of typewriters drew up all kinds of lists. They identified inventions, patents, and prototypes, as well as the available and usable typewriters. Different modes of classification were possible (Fig. 2). The most basic criterion was the size of the keyboard and the existence (or not) of a way of extending it. For some

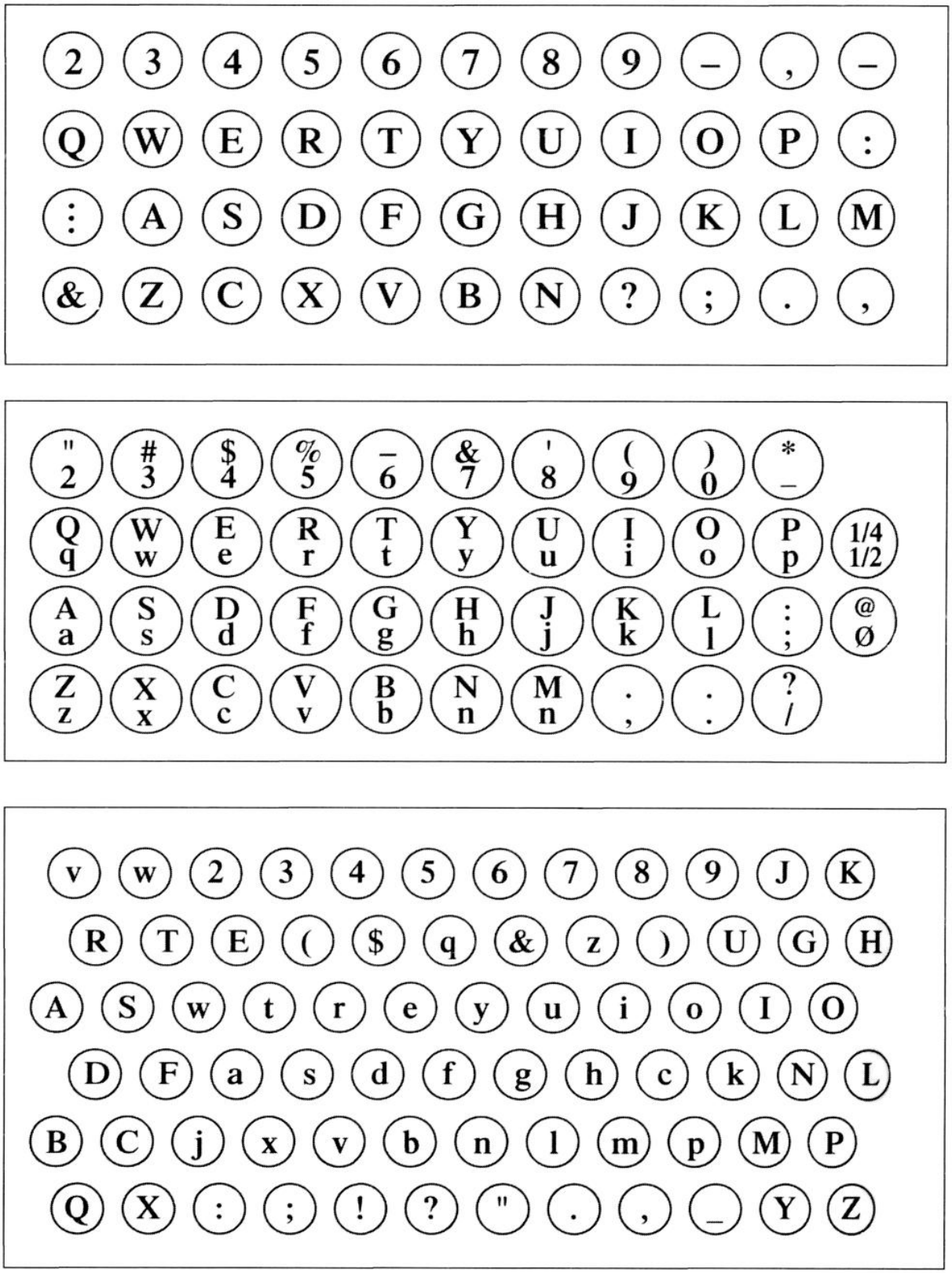


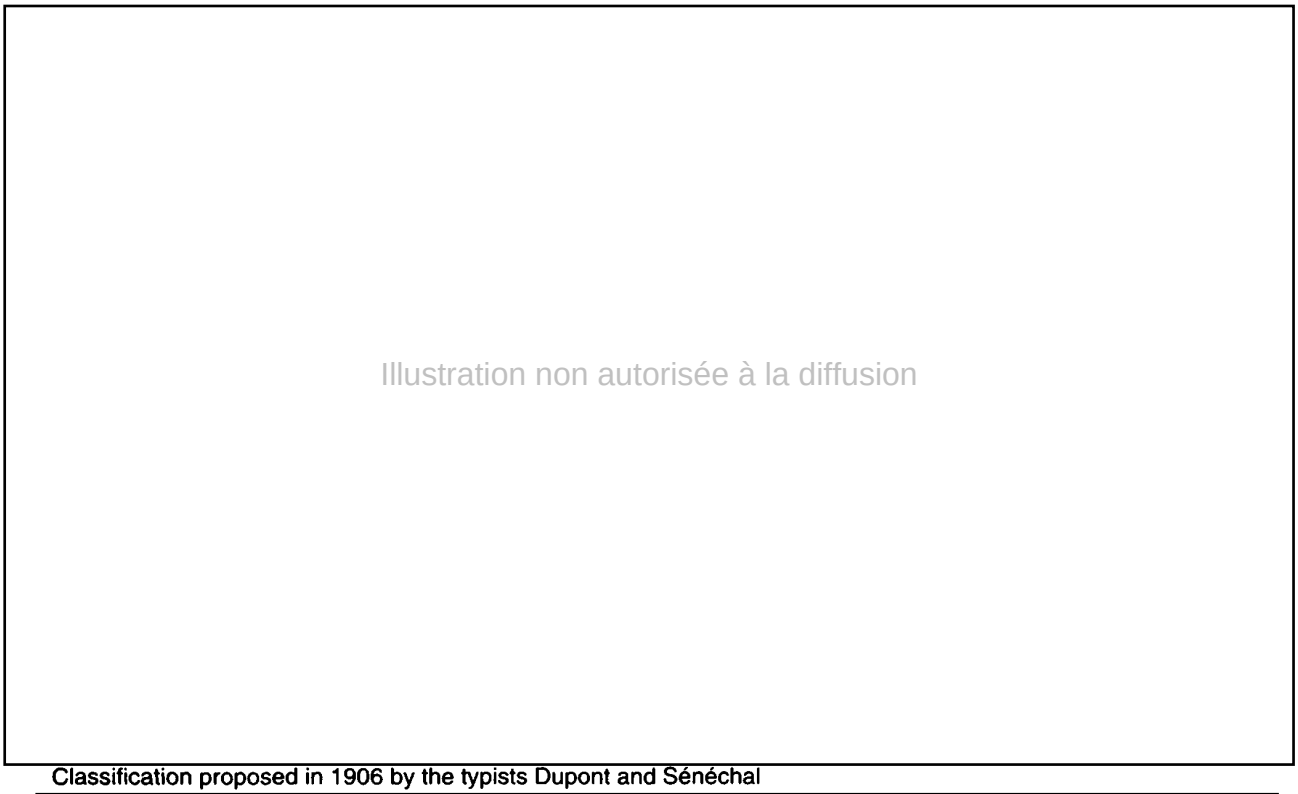

**Figure 1.** The three original types of keyboard (sources: B. Bliven, *The Wonderful Writing Machine* (New York: Random House, 1954( and W. Beeching, *Century of the Typewriter* (London: Heineman, 1974)

**Dupont & Canet's Classification in 1901**

| Machines with concealed text | Machines with concealed text | Machines with visible text | Machines with visible text |
|---|---|---|---|
| *Full keyboard (one character per key)* | *Combined keyboard (2 characters per key)* | *Full keyboard (one character per key)* | *Combined keyboard (2 characters per key)* |
| New Century | Remington | Columbia Bar-lock | Underwood |
| Caligraph | Manhattan | Horton | Pitsburgh-Visible |
| Yost | Densmore | Prouty | North |
| Smith-Premier | Rem-sho | | Williams |
| Jewet | Fox | | Waverley |
| Hartford | Cleveland | | Condé |
| Peerless | International | | Germania (2nd model) |
| Duplex | Elliot & Hatch | | Granville Automatic Typewriter |
| Germania (1st model) | *(3 characters per key)* | | |
| Frister & Rossman | National | | |

**Figure 2.** Classification of Typewriters (1901-1911)

authors the visibility of the characters was also an important way of differentiating machines from one another. In the earliest models the typed characters were hidden, so that the secretaries could only check what they had done once they had advanced several lines down the page. In 1898 Underwood put out a typewriter which made one's work was immediately visible; Remington followed suit a decade later in 1908. Visibility while typing was undoubtedly an important change for typists, and explains why Dupont and Canet made a point of mentioning it in 1901.[16] In any event, the way in which these different authors of manuals defined and categorized machines is indicative of the variations which they deemed important. The arrangement of letters on the keyboard (the QWERTY issue) as a way of distinguishing machines was of no interest to typewriter specialists until 1910. In this wide variety of formats and of alphabetical and technical solutions retained by the manufacturers, it was the size of the keyboard and the visibility of the text, rather than the arrangement of letters on the keyboard, which differentiated machines and the everyday practice of typing (Fig. 3).




Classification proposed in 1906 by the typists Dupont and Sénéchal


Classification proposed by Navarre in 1910


Classification proposed by Jean Rousset in 1911

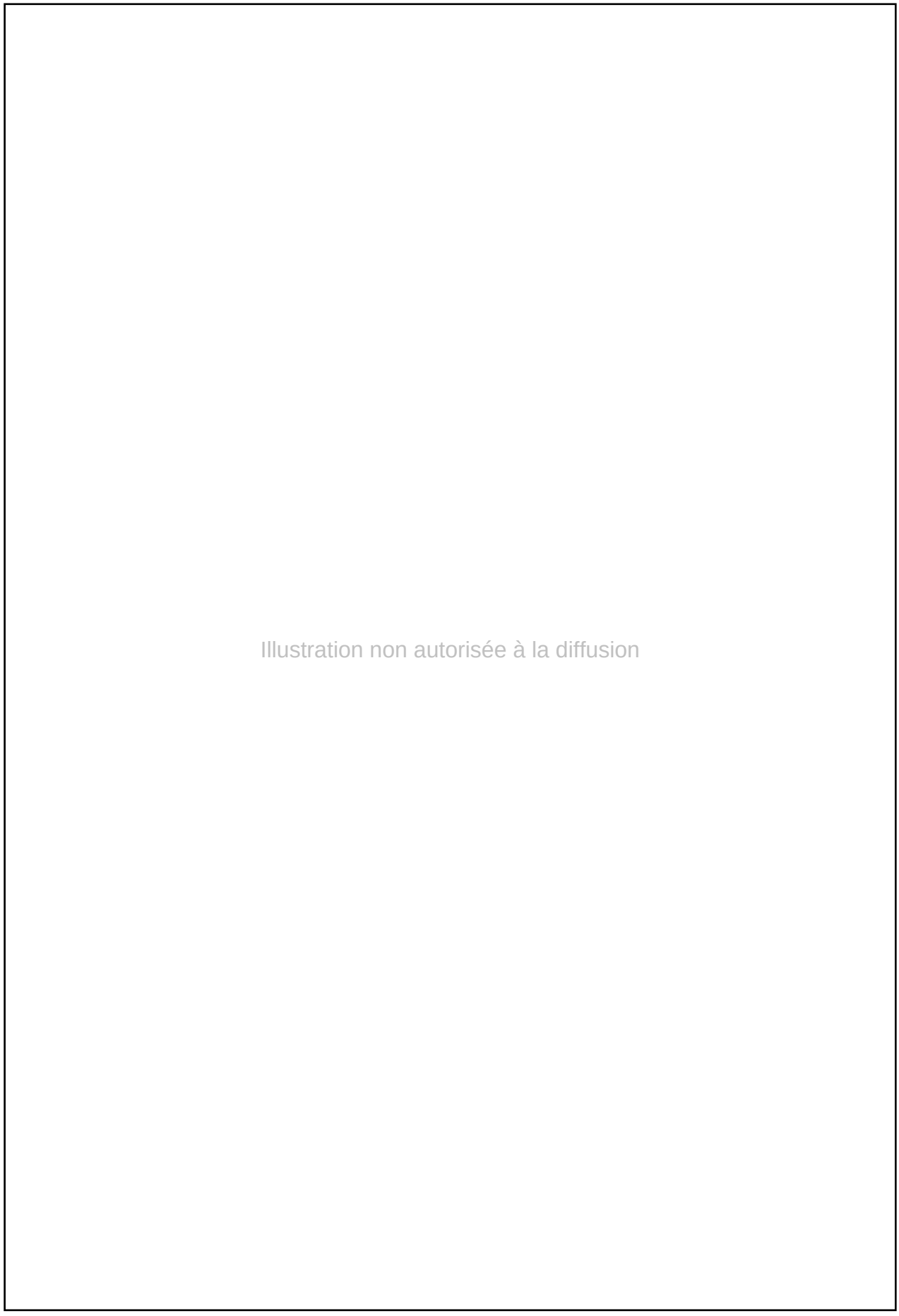
**Sources:** H. Dupont and L.-F. Canet, Les machines à écrire. Historique advantages, description et traité complet de dactylorgraphie, ou art d'écrire à la machine (Paris: Éditions de la plume sténographique, 1901); H.Dupont and G. Senechal (eds) Les machines à écrire. Premier partie. Leur évolution (Limoges: Canet, 1906); A. Navarre, Traité pratique de sténographie et de dactylographie (Paris: Librarie Delagrave, 1910); J. Rousset, Les machines à écrire (Paris: Gauthier Villars, 1911).


Illustration non autorisée à la diffusion

**Figure 4.** The Adler: from QWERTY to AZERTY

1. Adler keyboard as described by H. Dupont and L. Canet in 1901:
   QWERTZUIOP
   PASDFGHJKL
   éYZCVBNMO

2. Adler keyboard as described by J. Rousset in 1911:
   AZERTYUIOP
   QSDFGHJKLM
   ˆWXCVBNOé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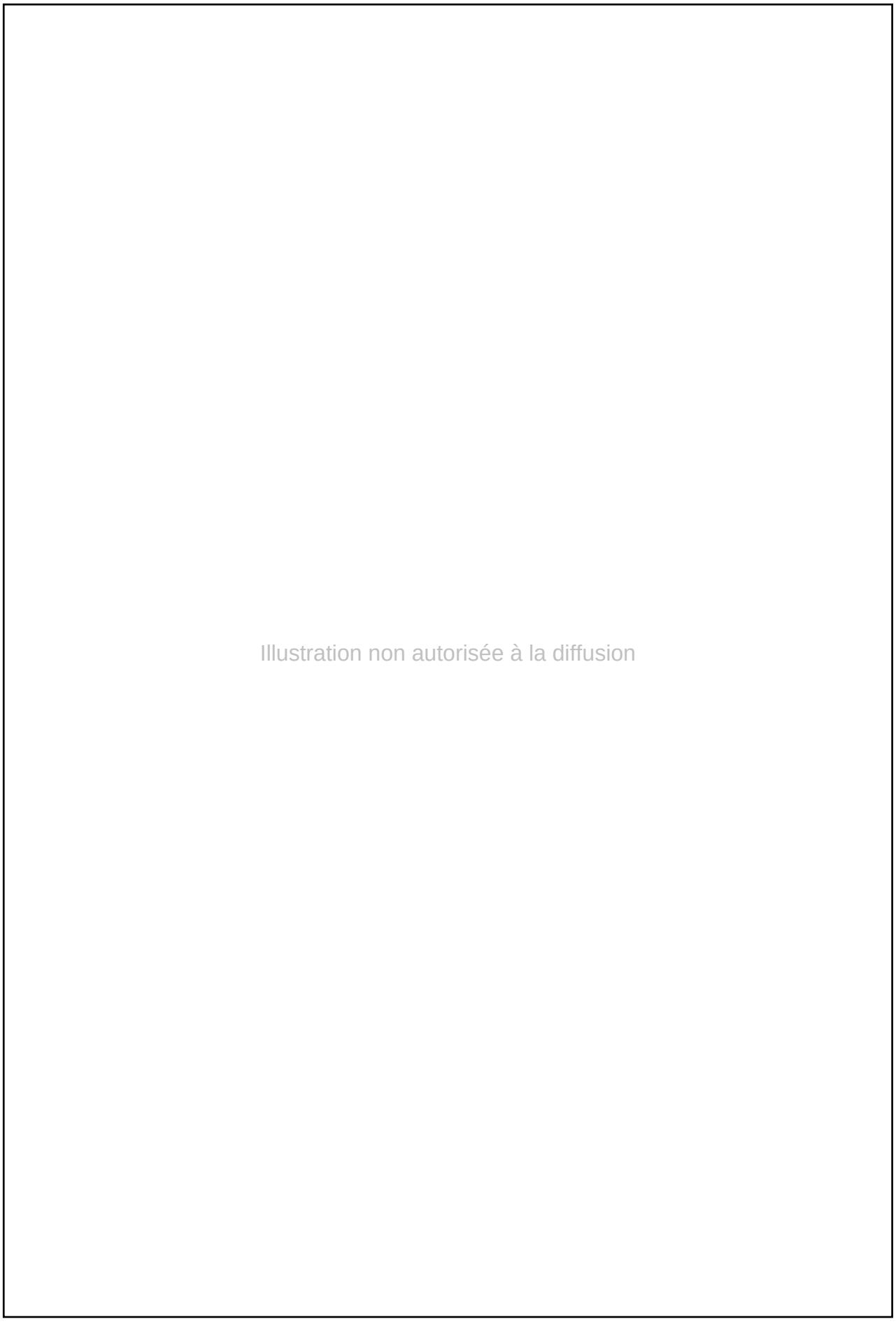
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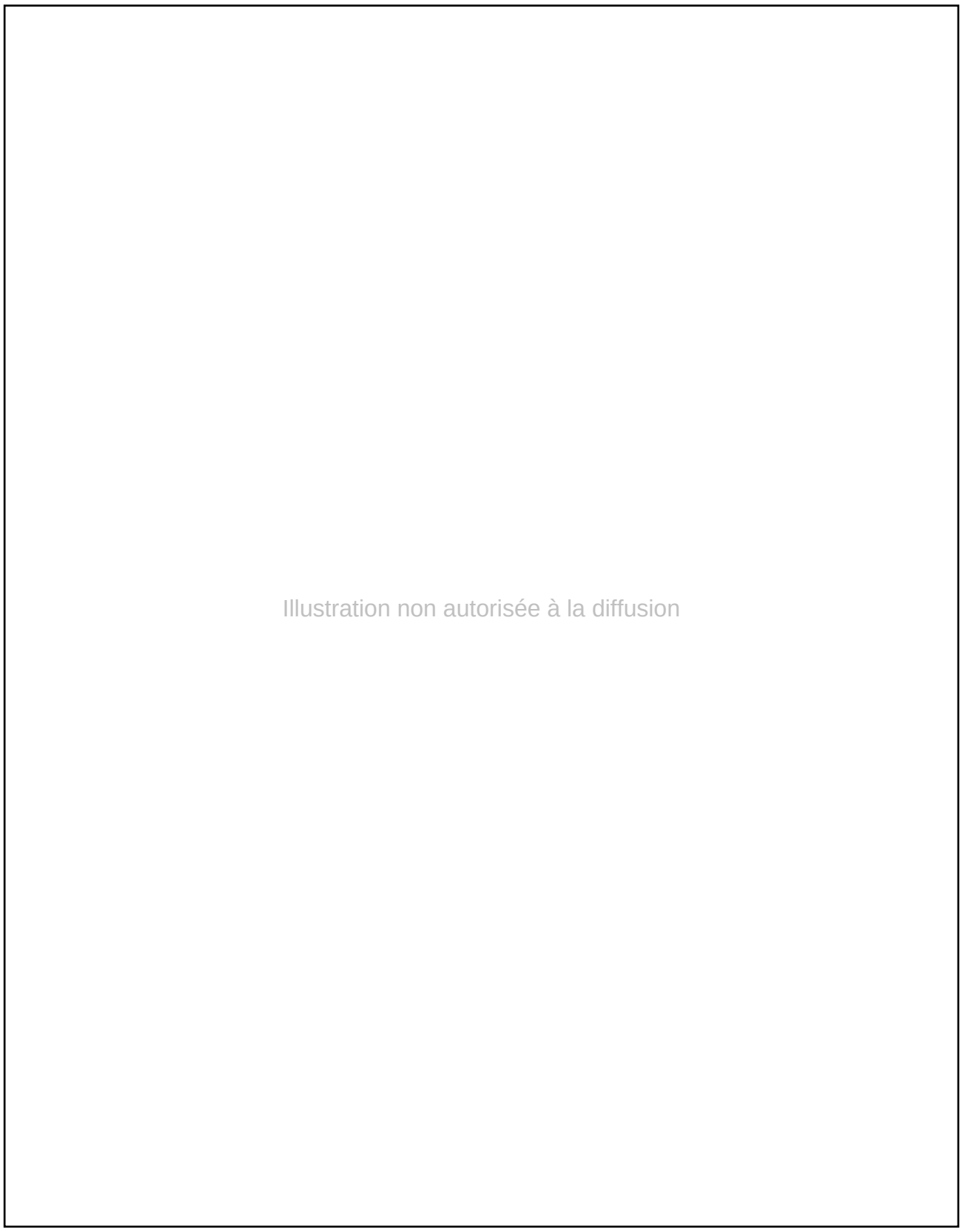
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## QWERTY: a heavily contested technical option

This overview of the large range of typewriters available in the United States and France from their early manufacture up to the 1910s is indicative of the strong opposition to the 'standard' based on Remington N°2, and summarized in the formula the QWERTY keyboard.

During the early history of the development of the typewriter, the competition between the Remington N°2 and the Calligraph, and their later models, was particularly brutal. The contest was fought around the double keyboard accessed by commutation with just one key to switch between them (Remington) and the keyboard of the Calligraph, adopted by the brand Smith-Premier where there was a double keyboard without commutation.

Typists evaluated the merits of these two keyboards with respect to the techniques of fingering which they allowed or encouraged. The merits and disadvantages of having to stop the movement of the hand while one levered between keyboards, and the distribution of the fingers over a wide keyboard were vigorously debated.[17]

The opinions of the professional secretaries are divided over the comparative advantages of different keyboards. Those who prefer the single keyboard point out that the operator only has to hit the keys and the spacebar without having to act on an additional lever, and so claim to be able to type faster. Those who prefer the switching system point out that, given the large number of keys (about 85) on the single keyboard, the secretary's hands have to cover a far greater surface, and this reduces typing speed. What is more the keys are necessarily smaller and more closely spaced, so that one strikes them less cleanly.[18]

Even if the first historians of typing later presented it as a more 'primitive' technical choice, the fact remains that the Calligraph and Smith-Premier approach had many supporters.[19] The significant success enjoyed by the Calligraph in the United States, followed by that of the Smith-Premier, which also had a double keyboard, shows that the currently 'standard' keyboard was far from generally accepted in the early years. The Smith-Premier was particularly popular in the United States in the 1900s.[20] The Calligraph and later the Smith-Premier had many adherents in France. Georges Buisson, one of the pioneers of typing in France, and one of the main propagandists for this technique, enthusiastically promoted the Calligraph.[21] According to remarks made by competitors at the time, the Smith-Premier was also much liked in France at the dawn of this century by participants in typing contests.[22] Purchases by the state also reveal an preference for large keyboards: the French Ministry of Foreign Affairs bought 100 Smith-Premier machines in 1907 after an identical order had been placed by the War Ministry.[23]

Subsequently a more competitive situation prevailed between these two systems and a new type of machine with a so-called reduced keyboard, marketed in France above all by Adler, Oliver and Empire. Having only 28 to 32 keys,[24] these machines could type three times as many characters thanks to their two transfer keys. What one had here was a double extension of the keyboard, each key carrying three characters.

Finally strong competition from a third source emerged in 1898 with Wagners' invention for Underwood of the system in which what was typed was immediately visible. One of the reasons for the major

commercial success of machines with a reduced keyboard like Adler, Oliver and Empire, was that, like Underwood, they offered models with visible type. Sales of Remington, pioneer and leader in the production of typewriters, were overtaken by those of Underwood during the first decade of the 20th Century. Remington was then forced to market in 1908 a model of its own with visible type.[25]

It must be stressed that the fact that the Remington brand could impose its arrangement of letters on the keyboard as from the mid-1890s did not reduce the intensity of the competition between manufacturers in other aspects of the technology. We must then ask what was the real impact of the process of standardization of this one aspect, the alphabetical organization of the keyboard, in the context at the time of a great variety of types and sizes of keyboards. What was the process which led nevertheless to a certain homogenization of the arrangements of letters on the keyboard?

The earliest manufacturers of typewriters originally proposed very different alphabetical arrangements. No rule which could serve as a basis for rationalizing the organization was in force to shape the choice then made. This is obvious when we look at the Calligraph's extended keyboard, or at capital and lower-case letters, at accents, and at punctuation, all of which are mixed, without any clear logic.[26] As far as Remington was concerned, it was technical contingencies which led Latham Sholes to adopt the QWERTY system. As American historians of the typewriter have shown, and as P David points out in his analysis, this keyboard is in fact the result of mechanical constraints encountered by the inventor, who originally wanted to arrange the keys in strict alphabetical order. Notwithstanding its poor 'linguistic rationality," Sholes's keyboard designed for Remington was actually adopted by the majority of American manufacturers only after much hesitation.[27] This apparent progress can be relativized when one looks closely at the configuration of the different technical options adopted. The homogenization of the arrangement of letters on the keyboard did not impede, as we have stressed, the development of otherwise very different objects.

These differences were accentuated by linguistic specificities and the place accorded to one form of accentuation or another. It was not only the arrangement of letters on the keyboard that changed but also that of numbers, of punctuation, etc. Thus even if the majority of typewriters available in France were organized on the French version AZERTY, there were important specific differences between one machine and another, as is clear from the comments made by the following specialist in 1910:

*The keyboard found on most typewriters in use in France has a generally adopted arrangement of letters called the universal keyboard. One should not conclude from this that all letters and all symbols are to be found in the same place. One easily understands why this cannot be so when one realizes that some typewriters have 80 characters while others have 96(...). The English do not use letters with accents, so their typewriters do not have an é,è,à,etc(...). The German alphabet has ö,ä,ü which are conveniently placed. In France, some typewriters, like the Lambert, and the Dactyle, have different keyboards.*[28]

The generality of the standard QWERTY, and its French equivalent AZERTY, must thus be relativized during this period. Even

if more and more typists became familiar with a particular arrangement of letters on the keyboard, lower-case letters, numbers, and punctuation marks were rarely situated in the same places, and one had access to them using different manoeuvres.

It should be stressed that we do not yet have a history of the French version of the universal keyboard. Most countries use the QWERTY standard, while France has its universal Anglo-American standard, the AZERTY. No French historians, pioneers, or propagandists of the typewriter refer to this issue in the many available books and journals I have consulted. The question of the AZERTY keyboard is not known in detail by American historians and collectors.[29] It seems that most of the foreign machines available in France were initially supplied with their original keyboard then with a QWERTY keyboard, and finally with the AZERTY keyboard. Thus the Adler, whose first model was marketed in 1898, was described in 1901 as having a QWERTY keyboard, and in 1911 as having the AZERTY (Fig. 4). The question of the existence of a French version of the universal keyboard was not raised during the long and lively debate on the French keyboard between French typists and the promoters of American brands.

## A major national shift: the French keyboard against QWERTY

The apparent irreversibility of the American option was, as a matter of fact, opposed at the initiative of French typists. Once the Americans had arrived at standardizing the way characters were arranged on their keyboards, a discussion arose in France on the quality of the AZERTY keyboard, and on the possibility of defining a French keyboard.

The question of having a 'French keyboard' was raised by Albert Navarre, a major figure in the development of French typing and stenography, in an enquiry into the topic in *La Revue Dactylographique et Mécanique*. In October 1907 Navarre presented the definitive version of the French keyboard established by the commission for the French keyboard, which was set up by the journal.[30] Their proposed arrangement was as follows:

ZHJAYSCPG
XVIEQRTND
KWOULMBF

In 1907 *La Revue Dactylographique et Mécanique* wrote of "the keyboard establishing itself", while in January 1908 it spoke of "the victory of the French keyboard" since it had been adopted by the manufacturer Underwood and was already being supplied by the firm Smith-Premier.[31] It was clear to these specialists that the French keyboard was notably better, and allowed one to type more rapidly. In 1909 Albert Navarre invented the teaching keyboard, a keyboard without a machine. This was inexpensive and modelled on the French keyboard. It was intended to help future typists memorize keys and fingering at little cost, as well as to spread the learning of typing in primary schools and commercial colleges.[32]

The most important victory of the French keyboard, however, was its use by the Manufacture d'Armes et de Cycles de Saint-Etienne. In 1909 this firm launched a new kind of machine similar to the Underwood.[33] *La Chasseur français* publicized it in August 1909, speaking of a machine with a visible sys-

tem and a French keyboard which gave one 'very significant returns'.[34] This was the Typo whose main features were a visible type (like Underwood), 'the two coloured ribbon, moved automatically', and above all 'the French keyboard'.[35]

The Typo was a French version of British Imperial's model B. It was not a genuine French typewriter, but simply built and assembled in France.[36] For the conceivers and propagandists of the French keyboard this was still a victory, as is clear from the title of the article. Yet even if they insisted that 'all models of the Typo were built with the French keyboard', they had to admit too that "on special request the manufacturer can, at no increase in cost, deliver it with the universal keyboard". This article also clearly identified the principles and the advantages of the French keyboard for French typists:

*The French keyboard has many advantages over the universal keyboard. It is surely superior to it notably when one uses French. Thanks to the rational arrangement of the French keyboard the keys used frequently and continually, like the keys for the vowels for example, are grouped together in the centre of the keyboard, beneath the strongest fingers of each hand. Consequently the two hands work alternatively in an altogether rational way, allowing the typist to achieve the greatest speed with the least fatigue.*[37]

The journal accompanied this with a diagram of the arrangement of the keyboard and of the fingering recommended to users of the machines (Fig. 5).

This debate is interesting as it was the French equivalent of similar debates in the Anglo-Saxon world. On both sides of the Atlantic the main question asked was the rational use of each language. The French were extremely hostile to a keyboard imposed by foreigners which they deemed was poorly adapted to the specificities of their language. They claimed that typists were slowed down by the arrangement of keys on the keyboard, an arrangement which had little if anything to do with the regularities and irregularities of the French language. The promoters of a French keyboard thus justified the differences in performance (in speed trials) between Anglo-Saxon typists (often 'better') and French typists, ignoring the fact that the QWERTY keyboard was not adapted to the specificities of either English or French. Indeed, it was precisely this obvious lack of adjustment which fuelled the arguments of some defenders of the 'rational' keyboard in the United States, like the DVORAK or the DIATHENSOR. In America the definition of rational criteria was taken up in the work of French Gilbreth, who was close to Taylor, and was assisted by William Dealey. The latter, along with his brother-in-law Dvorak, did research into the ideal keyboard which later became the Dvorak Simplified Keyboard in 1932.[38]

Even if the economists who favour the theory of 'Path Dependence' take into consideration the practices and discourses of the inventors of 'rational' keyboards, the validity of the inventors' arguments is contested by the critiques of David's theory who question the real superiority of DVORAK.[39] Liebowitz and Margolis, for example, criticize the experimental tests conducted by Dvorak and by him alone to demonstrate the value of his proposal. Our aim here is not to take sides with one or the other but to insist on the diversity of technical and professional solutions proposed by the actors at the time, whether French or American, and to draw attention to the liveliness of the debate between them.

The debates on the French keyboard were of a similar nature, and engaged many actors: elite typists, who practised and usually also taught typing, manufacturers of typewriters, physiologists and enthusiasts of Taylorism. These debates were still very lively between the wars, as we shall see shortly, notwithstanding the progressive stabilization of objects and practices.

The partisans of the French keyboard never stopped proving, by observation and by experiment, the superiority of their technical option. To illustrate the excellence of its machine, the Manufacture d'Armes et de Cycles, for example, invoked the fact that the Typo was used by 150 of its typists, and that they produced 5,000 to 10,000 letters each day. This was an argument based on sheer size since, according to Albert Navarre, the Manufacture had at the time the highest number of typists in its service, and its administrative organization had no equivalent in France. In 1911 the French keyboard was acclaimed when a 17-year-old typist won the second prize at the French championships in Grenoble. She had been trained on a Typo by the Manufacture d'Armes et de Cycles at their School of Typing. The following year the Typo won the first prize for practical work, and the second prize for speed in Orleans. The catalogue produced by the Manufacture d'Armes et de Cycles could thus announce: 'at 275 Francs the Typo permits all speeds'.[40]

These various achievements persuaded the French typing elite that the French keyboard was superior to the 'universal keyboard' notwithstanding the evolution in the market and the range of typewriters on offer.

Apart from numerous successes, which were obviously valuable selling points, we do not know what commercial success the Typo in its French version enjoyed in these years. It remained the only typewriter produced in the country until 1910, when the Japy appeared. Annual French production of typewriters never rose above the 4,000 units of 1913, against 28,000 machines imported. Of the 4,000 produced, the proportion of Typos and of the French keyboard are difficult to establish, but was marginal compared to the stock of machines (mostly American) already in service. Indeed the typewriter market was dominated by imports and so was massively subordinated to the choices and technical options made across the Atlantic. This situation was consolidated after the first world war with the destruction of national industry and the lack of typewriters. In this context demand for the French keyboard remained limited, and there was none at all after the war.

The tale of the French keyboard shows that it was possible to change one of the standard features of the typewriter up to this time, and even one of the oldest, ie the arrangement of the letters as adopted on the universal keyboard. This last attempt at difference was located in the framework of other aspects of a standard typewriter which were dominant thereafter: Remington's keyboard which was doubled by commutation, and, above all, visible writing, which was not a feature of the earliest Remingtons but which was now irreversible. The seeming success of the Typo was due to its being able to combine these three features in a pre-war context notable, *inter alia*, for all kinds of French chauvinism.

## Towards a unification of practices

The principles which led to the elaboration of the French keyboard rested on a

theory which was convincing, even if not really formalized, on how best to use a keyboard. Before returning to this technique of fingering, called 'the ten fingers', and associated with both the French and the universal keyboards, we would like to describe how typists practised their art in the early years of the typewriter. The evidence we have on the methods used by the first typists shows that very different techniques were employed. It seems as though the first typists had very personal ways of using their machines, teaching themselves typing or being taught informally by another user:

*Most of our European typists, not to say all of them, learnt good or bad ways of using typewriters, without any fingering method and with the help of a few but rare instructions which were given them.*[41]

In the USA, as in France, the first typists spontaneously used one or two fingers. At least this is the view of Miss Rose Fritz, world champion in 1909, who remembered that initially many typists used just one or two fingers.[42]

In their manual of 1901 Dupont and Canet, even if deploring the arbitrary techniques used by most typists, suggested for their part 'a rational method for learning fingering' applicable for two, three or four fingers. They indicated a distinct preference for the use of three fingers, which they judged to be the most widespread.[43] In this approach the most important issue was not, then, the number of fingers used, but rather the gradual acquisition of typing skills by a number of successive exercises. Final success depended on one respecting certain rules like 'pull back your finger as soon as possible after striking the key, as if you had been burnt on touching it'.[44] The persistence of important differences between different brands of typewriter as late as 1910 led some to believe that it would be difficult for a typist who had been taught on one machine to move to another: 'All practitioners agree that, to be an extremely capable user, and to produce quality work at high speed, one must always work on the same machine'.[45] In a context in which there was a wide variety of alphabetic configurations and technical organization, the achievement of a certain speed seemed to require familiarizing the typist with one model or with one kind of model, or at least with the use of certain fingers so that she could pass easily from one keyboard to another. This heterogeneity of products was also clearly referred to by French shorthand typists to explain, in the first decade of the century, the limited diffusion of the 'ten-finger' method adopted in the United States: 'in my opinion the ten-finger method would be ideal if, as for the piano, there was a unique keyboard.'[46] French shorthand typists apparently became aware of this approach at the turn of the century,[47] and thought it particularly suited to simple keyboards.

The so-called 'ten-finger' method, which was used by the American champion MacGurin in 1878, had been theorized and taught in 1881 by the Longley's Shorthand and Typewriter Institute of Cincinnati.[48] This technique has two characteristic features: one uses all one's fingers, and one does not look at the keyboard.[49] The debate in France over the value of this method and its diffusion never really got under way until after 1907, when the first French championship was won by one of its practitioners. Here again it was the American which was progressively imposed on the behaviour of French typists, through the performance of various champions. The

typewriting and mechanical journal, for example, published in 1911 a long interview with the American champion Wiese, who gave his 'advice on how to become a competent typist'. He stressed the need to use all ten fingers, to learn to read without looking at one's keyboard, but also to have a touch which was light and rhythmic, to learn to return the carriage very quickly, and to know how to remove a page and replace it very quickly.[50] One sees thus how it was through typing contests, and the extremes of practice which they demanded, that methods were elaborated and tested, and through which, to some extent, the norms for the work of typists were defined.

The idea that it was beneficial to use all ten fingers was increasingly accepted in the profession by the 1910s. This new technique of fingering became closely linked to the growing conviction that one should free the eyes of the typist and have her memorize the keyboard. Two attitudes are found at this time in the profession. Albert Navarre pragmatically proposed several ten-finger methods, adapted to different existing keyboards (Fig. 6). He advised typists to know the features of their keyboards, to memorize the keys, and to correlate each finger with one or two characters (depending on the size of the keyboard). The keyboard was divided into two equal parts, and 'on no account should one hand cross the dividing line between them, invading the part reserved for the other'. Several diagrams depicted for each kind of keyboard (complete, reduced or universal) the different letters or signs allotted to each finger.[51] The manual explained in ten lessons the range of exercises needed to acquire a good knowledge of the keyboard and a speed compatible with then current typing practices.

Navarre's efforts can be seen as a last attempt to reconcile an increasingly uniform practice with the large range of technical objects still in circulation. Most typing manuals subsequently published and diffused in France favoured the ten-finger approach, now conceived strictly in terms of the universal keyboard. This was the case, for example, with the methods published by Jean Jouzeau which were developed for the so-called 'universal keyboard' and actually applicable only to keyboards doubled by commutation.[52] We might say then that the choice of a practice (that of ten fingers) was articulated along with the 'universal' keyboard, and thereby reinforced its use. The uniformization of learning approaches and typing practices went hand-in-glove with the stabilization of a certain technical system. The growing influence of taylorism in the organization of office work and the preference shown by the taylorians for the ten-finger method, contributed significantly to this process. Figure 7 shows how the taylorians presented fingering techniques.

## The demand for professionalism

One might think that the 'turning point' in the second decade of this century was partly a symptom of the interiorization by the elite of the typing community of the new and potential expectations of their employers and that it would lead them to organize the transfer of knowledge and to structure the profession along particular lines.

In the early years of the development of the typewriter, the typist employee brought with him into the firm his skills as a 'secretary' or 'co-worker', and two additional items of technical know-how: the ability to take notes in shorthand, and to transcribe them on the typewriter. Often indepen-

dent, the shorthand typist was a polyvalent and autonomous worker. His typing activities were only a part of what he did.

At the turn of the century, the practice of typing spread through firms and the administration in France, and the number of shorthand typists increased considerably,[53] as did the number of typewriters sold. Women entered the profession in greater numbers, which came to be seen more and more as a female occupation.[54] Places where one could learn typing were set up in all small towns and classes were taught with the support of many partners: associations of shorthand typists, typewriter manufacturers, grants, commercial schools, municipal authorities, and Pigier-like commercial colleges. While most of these courses were directed at adults, people were also beginning to be taught how to type in practical colleges of commerce and of industry, then in the higher grades of primary school, and then as children.

As the use of the typewriter expanded, so the question arose of how to transfer skills and *savoir-faire* from one typist to another, and to elaborate methods and rules intended to professionalize the function of the typist. This push towards professionalization was certainly stimulated by employers who sought reliable typists and who wanted to recover the purchase costs of their typewriters. If shorthand typists became professionals in a certain number of ways of using an increasingly standardized technical object, this was also in response to new demands placed on them by those who recruited shorthand typists. The adjustment of the method of using ten fingers to the universal keyboard was a notable feature of this new context, confirmed by a number of other signs which show clearly that new explicit and implicit norms were embodied in the definition of the work of a 'good' typist. One now expected a shorthand typist to be a 'pan-typist', and to memorize his keyboard so as to free his direction of vision. Simultaneously lecterns were invented, along with dedicated tables and chairs, and a range of office equipment intended to improve the efficiency of the interaction between typist and machine.[55] The search for greater speeds and the obsession with output became omnipresent and were used in the sales pitch for the Balaban lectern:

*...careful tests in different commercial and typing colleges in England have shown that the use of this instrument allows one to increase speed by 10 per cent.*[56]

All these developments are signs of the emergence of a new way of using this object based on reinforcing the relationship between typist (now more often a woman) and typewriter.

The invention of the commercial dictaphone and its marketing in France in the second decade of the century illustrates perfectly the new kind of organization around the professional use of the typewriter. Dictaphones allowed one to bypass the taking of notes by hand. All that typists now had to do was to transcribe documents previously registered on waxed rolls. Office equipment specialists in France discovered in these years the vast typewriting services set up in the United States, at Sears, Roebuck and Co, for example.[57] In the US it was the same people, notably around the taylorian Leffingwell, who suggested the technique of 'rational' fingering (ie using ten fingers), the centralization of typing activities in one and the same service, and the distribution of typing work. Even if these new forms of organization were very rare in

France before World War I,[58] they served as a point of reference, a model which introduced new ways of thinking about how the work of the typist might be arranged.

## The difficulty of assessing the work of typists: ongoing debates in the postwar period

Notwithstanding the now evident trajectory towards a uniformization of practices, the regular holding of contests and typewriting championships continued to inspire thinking about the professional work of typists in the interwar years. In 1921 Lucien Magny, secretary of the Society for Shorthand Typists of the Ardennes, came back to the question of the keyboard to explain why the French were performing badly in international competitions. He insisted that the universal keyboard was not suitable for the French language, that it impeded the correct use of alternate hands, and that it forced the typist to use the left hand excessively: 'For a French text the universal keyboard requires about 600 strokes with the left hand and 400 with the right hand', he claimed.[59] Magny thus fought for the French keyboard, which enabled one to distribute the work more evenly between the fingers of both hands. To support his arguments he presented two graphs which illustrated the work done by the fingers of each hand in each case (the universal keyboard and the French keyboard). He also insisted on the 'mental work' that the typist had to do, meaning the mental combination of the elements of a word, and the need to work with 'ranges' in typing as in shorthand.

Jean-Maurice Lahy, an eminent psychophysiologist, now entered the fray, interested and disturbed by 'the differing opinions among typing technicians regarding teaching methods, and the question of establishing a rational keyboard'.[60] Lahy seemed to be motivated by the wish to define criteria for identifying an aptitude for typing work, and to develop rational methods of teaching people how to type. Keen to show, against Taylor,[61] 'how the scientific study of human work can contribute to the perfection of professional techniques',[62] he began to study the concrete conditions under which different professions worked. His approach is to be situated among those which Georges Ribeill called 'the first ergonomists' who wanted to 'elaborate practical norms for the physiological organization of work'.[63] Against the taylorians, who associated themselves squarely with the employer's point of view, and who sought above all to establish the conditions for improving output, the ergonomists, and J.M. Lahy in particular, were interested in 'the employee's satisfaction' and were 'concerned to measure the physiological effort exerted in an operation, and to identify the circumstances under which one gets tired...'.[64]

Beginning in 1905 Lahy studied the work of typists with a view to applying experimental science to the organization of work.[65] From this he drew a certain number of conclusions regarding the professional qualities of typists. In his view, the superiority of certain typists was not reducible to a particular element, but was due to the combination of an ensemble of characteristics which varied between individuals. One thus finds in good typists: a good memory for numbers and phrases, similar muscular strength in both hands, distinct tactile and muscular sensitivity, the ability to concentrate – all qualities to be found in both men and women. Lahy suggested

that one should choose typists with reference to this ensemble of qualities.

Lahy also explained his experimental approach to readers of *Mon Bureau.* Wanting to start again from scratch and put aside all current opinions on the matter, he had decided to make a series of experiments in which he recorded the movements of the best typists. This work had begun in 1912, was interrupted by war in 1914, and got under way again in 1921. Now Lahy could extend his studies by taking advantage of a 'large number of elite typists' in Paris, attracted by the organization of the typing championships at the Grand Palais. It was clear to him that by studying the movements of the best workers one could distinguish between aptitudes which were mixed together in less competent people, and determine the requirements for a good professional.[66]

Thus the skills of typing champions like Mille. Piau, M. Grandjean or Mme. Prévost served to construct the professional rules for typing at this time. They show the extent to which the norm of speed was the underlying obsession in all assessments of typing ability. The experiments were undertaken with the assistance of the firm Réal and of its typewriter Smith and Bross.[67] Lahy developed a complex system of graphic analysis of strokes which enabled him to illustrate the movement of each key. He was able to conclude that the time during which a key was depressed varied from one to another, and that strikes with the left hand were briefer than those with the right. He also showed that when two letters were struck with different hands the time between them was far shorter than if they were struck with fingers on the same hand. On the basis of many such experimental findings, supplemented by interviews and comments made by typing champions, Lahy elaborated a number of rules aimed to establish practical ways of teaching typing. He claimed that one ought, above all, to encourage the use of each hand alternately, and he felt that it was important to use the fingers on one hand one after another. He also suggested that the principle informing the French keyboard was mistaken:

*The rule that one should use alternate hands shows that the most important statistic was the letters used most often in sequence, and they should be situated on opposite sides of the keyboard.*[68]

Finally, he turned to an important achievement of typing in the postwar period: the use of ten fingers. Based on the mistaken analogy of the stroke of the typist with that of the pianist, Lahy said, the use of ten fingers was not the most rational approach:

*Indeed, using our physiological data the rational method would demand that one uses alternate hands. The use of ten fingers with predetermined positions on each key of the keyboard, and now the near-stationary hands on each half-keyboard with fingers only used to push keys near their extremities, both reduce the use of alternate hands.*[69]

*You Will be a Typist,* the book written by Charles Dellion who collaborated in various phases of these experiments, applied in practice the main rules drawn up by Lahy. It proposed an individual form of training in which the prior determination of the physiological characteristics of each candidate enabled the teacher to devise an approach best suited to her natural aptitudes.[70]

It is thus all the more remarkable to see *La Revue du Bureau* claiming that Lahy's scientific experiments 'justify most of the theories which this journal has sup-

ported for the last twenty years'[71] when it had, after all, been a strong advocate of the French keyboard. After all Lahy challenged the ten-finger method, as the proponents of typing practice like Albert Navarre or the specialists of *Mon Bureau* eventually came to admit. And in fact the result of experimental research on psychophysiology reopened the debate on the best way to type. In October 1923 the journal *Mon Bureau* told its readers that it had received many letters from people who preferred the ten-finger approach and who disagreed with Lahy's research results.[72] Indeed the *Revue de Bureau* opened its columns to those who preferred this method, and to the comments made by professionals.[73]

Even if Lahy's experiments and conclusions had some impact, it was on how personnel were selected rather than on the teaching of typing or the determination of teaching methods.[74] More generally, the idea of selecting personnel scientifically and shaping them professionally was developed in parallel with Lahy's work, bringing to the fore the psycho-professional. As for teaching, it seems that the ten-finger approach was already too well entrenched in the 1920s, notably in typing colleges, for it to be replaced by any others. What is more, the French keyboard posed no real threat and apparently was not able to mobilize the profession or change the enormous influence of typewriters with the universal keyboard.

The intensity of the technical and 'scientific' debates around the practice of typing in this period illustrates in any case, the different 'rationalities' mobilized by different actors to justify their positions. The richness and variety of these controversies indicates that it is really not possible to identify one reason for the superiority or inferiority of one system or the other. QWERTY gained pre-eminence even if DVORAK or the French keyboard were clearly better. The ten-finger method was not adopted because it was intrinsically better. Different social groups, mobilizing different scientific, economic and discursive resources, sometimes confronted each other, sometimes combined forces, and finally managed to impose certain technical and professional choices rather than others.

## Conclusion

If one reads the history of the early days of the typewriter and of the profession of shorthand typing in France from the point of view of its complexity and diversity one sees emerge, from a world replete with objects and with practices, by successive eliminations, a certain kind of relation between an object, a practice and the definition of a craft.

One can say that different irreversible processes arose at different moments, narrowing the field of acceptable objects and practices. In this development, the adoption by American manufacturers in the middle of the 1890s of a particular arrangement of the keyboard and the definition of the universal keyboard was just one step. It only assumed its full significance when subsequently reinforced by the adoption of even more potent norms. Underwood's choice of the Remington keyboard, which offered the possibility of seeing what one wrote as one typed it, consolidated the QWERTY standard, which was based on a certain kind of keyboard, and added a norm as novel as it was essential: visibility. The manufacturers of Smith-Premier thus abandoned the double keyboard without commutation in the 1910s when faced with the success of the other system as enhanced by the provision of visibility.

Finally the establishment of the ten-finger method, an approach intended to unify the practice of typing and to improve the output of typists, further reinforced the standard keyboard, to which it was adapted: the assignment of fingers to keys was more easily achieved on keyboards of limited size, and the need to memorize the keyboard demanded that it be standardized.

The standardization of objects and of the practices of typists seems to have occurred just when, thanks to the early success of the typewriter, employers systematically began to demand personnel able to type rapidly without looking at the keyboard. Around the 1910s a new conception of the work of the typist began to be defined, though it was massively implemented in France only in the 1920s.

In this history the standardization of objects and the uniformization of practices are *a posteriori* constructions. The typewriter did not need to be a standard object to be produced, but a certain level of standardization of machines articulated around a certain uniformization of professional practices was increasingly needed to reply to the quantitative and qualitative demands now made by employers. The elite of the French shorthand typing profession, influenced by American organization of office work, took the initiative in specifying a certain way to use the typewriter, in which they then trained successive generations of shorthand typists.

In this regard, one must not lose sight of the role of both the manufacturers of typewriters, who were also those who defined and so prescribed the use of the object, and of the 'enlightened' consumers comprising the elite of the typewriting profession. The market, the uses, and the definition of the profession itself, were largely constructed by negotiation and by the balance of forces between these two specific milieux, the ultimate choices made depending on the labour force available, and its level of education, its social origins and its gender.

## Notes

1 An earlier version of this paper was presented at the seminar "Règles, standards et normalisation" held in 1996-97 at the Centre de Recherche en Histoire des Sciences et des Techniques at the Cité des Sciences et de l'Industrie. It has benefitted from remarks and comments of various participants in the seminar, in particular those of Monique Peyrière and of Pierre-Emmanuel Mounier-Kuhn. This paper first appeared in French in *Reseaux*, No. 87, January-February 1998, pp. 75-103. It has also been published in *History and Technology* 1998.

2 For a critical account of the role of the QWERTY keyboard in the economic history of standards, see S.T. Liebowitz and Stephen E. Margolis, "The Fable of the Key", *Journal of Law and Economics*, Vol. XXXIII, April 1990, pp. 1-25. We discuss later the issue of the assessment of one keyboard or the other.

3 Michael Adler, *The Writing Machine* (London: Allen and Unwin, 1973) pp. 206-207.

4 Latham Sholes's QWERTY keyboard was adopted by computer manufacturers. For more on this issue, see studies by historians of the typewriter, the article by Paul David, "Clio and the Economics of 'Qwerty'", *American Economic Review*, May 1985, and the analysis by Monique Peyrière in "Machines à écrire", Autrement, N.146, 1994, pp. 22-23.

5 Paul A. David, "Understanding the Economics of QWERTY: the Necessity of History", in William Parker (ed.), *Economic History and the Modern Economist* (Oxford: Basil Blackwell, 1986), pp. 30-48.

6 For the history of the typewriter in the US, see my thesis: Delphine Gardey, *Un monde en mutation, les employés de bureau en France, féminisation, mécanisation, rationalisation (1890-1930)*, Université Paris 7, 1995, pp. 206-218. We have benefited from many studies by American and British historians, notably Bruce Bliven, *The Wonderful Writing Machine* (New York: Random, 1954); Richard Current, *The Typewriter and the Man who Made it* (University of Illinois: 1954); Wilfred Beeching, *Century of the Typewriter* (London: Heinemann, 1974); Michael Adler, *The Writing Machine* (London: Allen and Unwin, 1973).

7 "Les premiers 'typewriters' n'avaient pas pensé à son utilisation commerciale", *Revue du Bureau*, N.126, August 1921.

8 Information from several enquiries made by the *Revue du Bureau* among its readers early in the 1920s, and successive articles entitled "Quels sont les plus anciens dactylographes français?", *Revue du Bureau*, 1920, 1921.

9 "Les débuts de la machine à écrire en France", *Revue du Bureau*, N.1, January 1922, p. 14.

10 Henri Dupont and Georges Senechal, *Les machines à écrire, Première partie, leur évolution* (Limoges: Canet 1906), p.117.

11 Bruno Delmas pointed this out in 1980. "It is not easy to estimate the diffusion of the office typewriter in the administration. A long, thankless and uncertain enquiry, based on inventories of the furniture and equipment of various services, will surely provide one with reliable data. On the other hand, customs statistics are impossible to use. Forms and administrative language change slowly. For a long time typewriters were classified under the heading of small mechanical equipment. It was only in the 1930s that a distinct category was established for them, and even then they were counted in fifties and not as units", Bruno Delmas, "L'introduction de la machine à écrire dans l'administration français de 1880 à 1910", *La machine à écrire*, Proceedings of the Conference held on 23 and 24 October 1980 (Paris: Solin, 1982), p.22.

12 *Mon Bureau*, April 1921, p.254.

13 Bruno Delmas, *op. cit.*, p.20.

14 *Revue Dactylographique et Mécanique*, N.38, May 1910, p.146.

15 Publicity in *Revue du Bureau* from January to August 1912.

16 Henri Dupont and L. Canet, *Traité pratique de sténographie et dactylographie* (Paris: Librairie Delagrave, 1910).

17 *Le sténographe illustré, organe des comités sténographiques*, N.38, 15 August 1901, presents these different systems.

18 Jean Rousset, *Les machines à écrire* (Paris: Gauthier Villars, 1911), p.109.

19 Henri Dupont and Georges Senechal, *Les machines à écrire, op.cit.*, p.117

20 Wilfred Beeching, *op.cit.*, p. 165

21 Georges Buisson, *Instruction et conseils pour l'emploi et l'entretien de la Calligraphe*, copy revised and corrected according to the *Méthode pratique de dactylographie et miméographie* (Poitiers: Typographie Oudin et Compagnie, 1894), p.48.

22 *Le sténographe illustré, organe des comités sténographiques*, N.38, 15 August 1901.

23 Publicity for the Smith-Premier in *Revue Dactylographique et Mécanique*, N.5, August 1907.

24 Albert Navarre, *Traité pratique de sténographie et de dactylographie* (Paris: Librairie Delagrave, 1910), p. 209.

25 Bruce Bliven, *op.cit.*, p. 160.

26 See Figure 1.

27 Wilfred Beeching, *op.cit.*, p. 163.

28 Albert Navarre, *Traité pratique...op.cit.*,p. 214.

29 Catalogues, descriptions and reminiscences of different makes and generations of typewriters at the end of the 19th and the start of the 20th century often include photographs, but the keyboards are not visible.

30 *Revue Dactylographique et Mécanique*, N.7, October 1907.

31 "Le clavier français fait son chemin", *Revue Dactylographique et Mécanique*, N.8, November 1907, p. 234; N.10 January 1908, p.14.

32 *Revue Dactylographique et Mécanique*, N.24, March 1909, p.76.

33 *Revue Dactylographique et Mécanique*, N.25, April 1909.

34 *Revue Dactylographique et Mécanique*, N. 29, August 1909, p. 239, republication of an article from the *Chasseur français*.

35 "Un succès de la revue dactylographique: la machine à écrire français 'la Typo' a construit tous ses modèles avec le clavier français rationnel que nous préconisions", *Revue Dactylographique et Mécanique*, N.41, August 1910, pp. 240-244.

36 Anglo-Saxon historians overlook the existence of the Typo in France before the war, and believe that it dates from 1919. See Wilfred Beeching, *op.cit.*, p. 243, Michael Adler, *op.cit.*, p. 208.

37 "Un succès de la revue dactylographique...," *art.cit.*, p. 241.

38 Monique Peyrière, *art.cit.*, p.22.

39 S.T. Liebowitz and Stephen E. Margolis, *op. cit.*

40 1914 Catalogue, p. 247, cited in George Ribeill, "Aperçu historique sur le travail dactylographique", *La machine à écrire, op.cit.*, pp. 32-33.

41 Henri Dupont and L.F. Canet, *Les machines à écrire, op.cit.*, p.1.

42 *Mon Bureau*, N.2, August 1909, p.18.

43 Henri Dupont and L.F. Canet, *Les machines à écrire..., op.cit.*, p. 251.

44 Henri Dupont and L.F. Canet, *Les machines à écrire..., op.cit.*, p. 252.

45 Albert Navarre, *Traité pratique..., op.cit.*, p. 215.

46 "La méthode des dix doigts", *Revue Dactylographique et Mécanique*, N.40, July 1910, p. 207.

47 A note on this sent by the firm Remington to *Le Sténographe illustré* in 1901 suggested that just a few months before many shorthand typists did not know this. *Le Sténographe illustré, organ comité sténographiques*, N.36, 15 July 1901, p. 87.

48 "Le cinquantenaire de la machine à écrire", *op.cit.*, p. 530.

49 Albert Navarre, *Traité pratique de sténographie, op.cit.*, p. 185.

50 *Revue Dactylographique et Mécanique*, N.50, May 1911, p. 134.

51 Albert Navarre, *Traité pratique de sténographie, op.cit.*

52 Jean Jouzeau, *Méthode française de doigté s'appliquant à toutes les machines à écrire à clavier universel* (Paris: l'Auteur, Institut sténographique de France) (editor) 61pp.; *Manière simple et rapide d'apprendre seul la dactylographie, méthode des dix doigts*, (Boulogne sur Seine: l'Auteur,1920), p.38.

53 It is not possible to establish the growth in the number of shorthand typists in this period

from available surveys. To have an idea of the expansion of the profession around 1900 note that there were about 50 female shorthand typists in Paris in 1886, and some 6.000 in 1900. See "Déposition de Mme Lévy, déléguée de la Chambre syndicale des dames sténodactylographes, au conseil supérieur du travail" in 1901.

54 On the specific question of the feminisation of the profession and its consequences, see our article, Delphine Gardey, "Sténodactylographes...," art.cit. For a general analysis of feminisation of clerical work see Delphine Gardey, "Employées de bureau", in La Machine à écrire, *Autrement*, N. 146, June 1994, pp. 44-56; *Un monde en mutation*, *op.cit.*, pp. 155-195.

55 On different aspects of the history of office equipment, see our thesis p. 294 *et seq.*

56 *Revue Dactylographique et Mécanique*, N.44, November 1910, p. 341.

57 *Mon Bureau*, 1912; Richard Herbert Howe, "Early Office Proletariat, a Reconstruction of Sear's Order Processing", *Studies in Symbolic Interaction*, Vol. 5, 1984, pp. 155-170.

58 The only firmly established case fitting this model is that of the Manufacture d'armes et de Cycles de Saint-Etienne, a mail order firm which employed 100 typists in 1900, typists who were fairly polyvalent in their work. *Mon Bureau*, N.1, July 1909, pp. 7-9; *Revue Dactylographique et Mécanique*, N.22, January 1909, pp. 10-11.

59 Lucien Magny, "La vitesse en dactylographie", *Mon Bureau*, May 1921, pp. 336-337.

60 Jean-Marie Lahy, "Les bases scientifiques du travail des dactylographes", (1st article), *op.cit.*, p. 743.

61 Anson Rabinbach considers Jean-Marie Lahy to be the most incisive critic of Taylor in the European community of scholars of the science of work; Anson Rabinbach, *The Human Motor, Energy, Fatigue and the Origins of Modernity* (Berkeley: University Press, 1992), pp. 249-253.

62 Jean-Marie Lahy, "Les bases scientifiques du travail des dactylographes" (1st article) *Mon Bureau*, September 1923, pp. 743-745; (2nd article) *Mon Bureau*, October 1923, pp. 827-832; (3rd article) *Mon Bureau*, November 1923, pp. 935-937. The main points of these articles were published as "Expériences dactylographiques scientifiques," *Revue du Bureau*, March 1925, pp. 129-136. They re conclusions published elsewhere: "Etude graphique de la frappe des dactylographes", *Compte-rendu de l'Académie des Sciences*, 14 May 1923; *La profession de dactylographe, étude des gestes de la frappe* (Genève BIT, 1924) series J, N.3.

63 Georges Ribeill, "Les débuts de l'ergonomie en France à la veille de la première guerre mondiale", *op.cit.*, p. 14. See also Aimée Moutet, *La rationalisation industrielle dans l'économie française au Xxe siècle. Etude sur les rapports entre changements d'organisation technique et problèmes sociaux* (1900-1939), thèse de doctoral d'Etat, 1992, pp. 399-407; William H. Schneider, "The Scientific Study of Labor in Interwar France", *French Historical Studies*, Vol. 17, N.2, 1991, pp. 410-446.

64 Georges Ribeill, "Aperçu historique sur le travail de dactylographie", *op.cit.*, p. 47.

65 Jean-Marie Lahy, "Les conditions psychophysiologiques de l'aptitude au travail dactylographique", *Journal de physiologie et de pathologie générale*, 5 July 1913.

66 Jean-Marie Lahy, "Les bases scientifiques du travail des dactylographes" (2nd article), op.cit., p. 827. Later J-M. Lahy worked with the MAP. See Aimée Moutet, *La rationalisation industrielle dans l'économie française au Xxe siècle*, *op.cit.*, p.406; *Mon Bureau*, May 1927, p. 299.

68 The principle of the French keyboard was based on the idea that one should situate the letters used infrequently in French at the extremities of the keyboard.

69 Jean-Marie Lahy, "Les bases scientifiques du travail des dacytylographes", (3rd article), *op.cit.*, p. 936.

70 Charles Dellion, *Tu seras dactylographe, apprentissage rapide de la dactylographie, exercices pratiques* (Paris: Association Graphical) (Editor), p.128.

71 "Experiences dactylographiques scientifiques", *Revue du Bureau*, March 1925, pp. 129-136.

72 *Mon Bureau*, October 1923, p. 872.

73 "Quelle est la meilleur méthode de doigté en dactylographie: la française ou l'américaine?", *Revue du Bureau*, N.155, October 1923, p. 467; "La meilleur méthode de doigté en dactylographie", *Revue du Bureau*, N. 152, October 1923, p. 467.

74 J. Waldsburger, "La recherche des aptitudes professionnelles", *Revue du Bureau*, December 1921, pp. 561-563.