

Historical Note

A “Lost Time” Between Science and Literature: the “*Temps Perdu*” from Hermann von Helmholtz to Marcel Proust

MARCO PICCOLINO

From the Dipartimento di Biologia, Università di Ferrara, Via Borsari 4644100, Ferrara, (Italy)

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This article explores the recently suggested possibility that the phrase “*temps perdu*”, present in the title of the masterpiece of Marcel Proust, may have a scientific origin. Exactly the same expression was indeed used in 1851, about fifty years before Proust, by Hermann von Helmholtz, to indicate the latency of the physiological responses in his nerve-muscle experiments, and in particular to designate the time of nervous conduction that he had first succeeded in measuring in 1850. A possible link between Helmholtz and Proust might be Etienne-Jules Marey, the French scientist particularly known for his physiological studies on heart and circulation and for his development of modern methods of graphic and photographic records of physiological events. But the story might have an antecedent, connected to strange errors in astronomical observations, which might, in turn, be related to sensory perception, and particularly to visuo-auditory coordination. *Key words: History of science, nerve physiology, Etienne-Jules Marey, personal equation.*

For about a century Sigmund Freud has been teaching that what we do, think, wish, fear and also what happens to us in the course of our everyday life, sometimes in an apparently unpredictable way, may be connected to distant events of our past life, events that we may not remember in a conscious way, but which have nevertheless left significant traces in the depths of our personality. The connection between these past events and the ongoing course of our life might not be simple and obvious and it might take persistent efforts to reveal it with the help of the “archaeologist” of the human unconscious, the psychoanalyst. Occasionally, what is true for the restricted dominion of individuality, may be also true for the realm of history as a whole. The connection between apparently unrelated events may then be revealed through the work of the historian, who scans the deep traces of past epochs by consulting old books, manuscripts, sometimes unread for centuries, often situated in distant places and difficult to access.

At the beginning of the 20th century, Marcel Proust expressed, with the charm of his poetic prose, the difficulties and, at the same time, the fascination of this search of old documents which might require a long journey to, say, The Netherlands, by horse drawn barges along canals, with a fleeting view at the cathedral of Dordrecht, up to final destination which might be the town of Utrecht and its Amersfoort archives. As in any true search, the results might be unexpected and reveal connections between events that seem, not only unrelated,

but also pertain to different domains of human endeavour (see Proust, 1906).

As this article attempts to show, there may be an ideal connection between events which occurred at Greenwich at the end of the 18th century and the title of the *La recherche du temps perdu* of Marcel Proust (1871–1922), a milestone of the 20th century literature. An intermediary link in this chain is related to neural and sensory physiology, and in part to auditory physiology. It has its main actor one of the greatest scientists of the 19th century, Hermann von Helmholtz (1821–1894). He was a multifaceted genius who, besides contributing to various fields of physics and physiology, played a fundamental role in the emergence of modern science out of the mists of a scientific endeavour still founded on vitalistic and metaphysical doctrines, that was the romantic philosophy of nature (*Naturphilosophie*) which dominated Germany at the end of the 18th century (on Helmholtz see in particular Cahon 1993; and Meulders, 2001).

A VISUO-ACOUSTIC METHOD OF ASTRONOMIC OBSERVATION AND THE ERRORS AT GREENWICH IN 1796

The observation of the transit of a star with a powerful telescope requires an exact and prompt determination of the position of the celestial body moving rapidly across the sky, combined with an accurate measurement of the passage time with a sub-second precision. However, the

chronometers available up to the end of the 18th century (and also for some decades of the next century) were capable of measuring time only to the nearest second. To overcome these difficulties, James Bradley (1693–1762) the third “Astronomer Royal” at Greenwich developed an interpolation method based on an “eye and ear” coordination. The telescopic field being divided by a mesh of parallel wires, the observer had to track the rapidly moving star with respect to a wire of the mesh, and to take into account the time, by counting the beats heard from the clock. In order to make the measure with a greater precision than that allowed by clock, he should note the star at the instant of the clock beat just before it crossed the wire, and at the beat time immediately after the passage, and he should mentally interpolate the time fraction corresponding exactly to the wire crossing.

In spite of the complex sensory and mental tasks involved, Bradley’s method was used up to the mid 19th century. It allowed an expert astronomer to achieve a time precision of about one tenth of a second. Sometimes, however, the observations of the same star passage made by two astronomers might differ by a considerable amount. This turned to be the case at Greenwich for David Kinnebrook (1772–1802), who, in the period 1795–1796, repeatedly estimated a stellar transit with a systematic difference of about 800 milliseconds with respect to his chief Nevil Maskelyne (1732–1811). After having been summoned to use a more correct observation method, Kinnebrook was eventually dismissed by his chief at the end of 1796 (see Mollons and Perkins, 1996; and Finger and Wade 2002).

In 1818 the episode came to the attention of Friedrich Wilhelm Bessel (1784–1846), director of Königsberg observatory. Besides being one of the principal astronomers of his age, Bessel was also a great mathematician, particularly interested in the theory of instrumental errors. By comparing his own observations with those of other respected astronomers of the epoch, he came to the conclusion that, in astronomical observations, the case with Kinnebrook and Maskelyne might be the rule rather than an exception. The problem thus came to centre stage of astronomers’ attention, and it became evident that an irreducible and systematic difference persisted in spite of the greatest care in the observation process. Astronomers were then requested to calculate their own difference with respect to a standard observation (with a true star or with a “simulated” star) and to express it as a “personal equation”, in such a way as to permit a comparison between different observers.

The problem was eventually overcome by the introduction, around 1850, of precise chronographs and by the use of automatic methods for recording star transit. Interest in the matter continued, however, up to about 1870. Bessel and others assumed that the problem might

depend on some property of the physiological mechanism involved in the complex task based on the interplay of visual and auditory sensations. This pointed to the possibility that nervous and mental processes may require a sizeable time, a possibility that contrasted with the view, still dominating the science of the epoch, that processes belonging to the sphere of perception were not amenable to the physical territories of measurement and experiment (see Wolf, 1865; Donders, 1868, Canales, 2001).

HERMANN VON HELMHOLTZ AND THE MEASUREMENT OF NERVE CONDUCTION TIME

In 1849, due to a series of complex academic arrangements involving Ernst Brücke, Karl Ludwig, Emil du Bois-Reymond and Hermann Helmholtz, an impressive quartet of disciples of Johannes Müller, Helmholtz was appointed professor of physiology at Königsberg. Although aged only 28, he had already made fundamental contributions to both physiology and physics, along with a scientific attitude that would dominate all his scientific life. From the academic viewpoint this attitude would culminate in his becoming appointed (in 1870) professor of physics at the University of Berlin, the same where he had graduated in *medicine* in 1842. The interplay between physiology and physics had marked the beginning of Helmholtz’s scientific life. In 1847 he had written his classical memoir on the *Conservation of the force*, (stipulating what would become the first principle of thermodynamics), mainly to provide theoretical grounds for his experiments on muscle physiology. In these experiments he showed that prolonged muscle contraction was associated with detectable chemical changes in muscle tissue, suggesting that the development of mechanical force depended on physico-chemical transformations in muscle (see Helmholtz, 1847).

Before moving to Königsberg, he was studying muscle physiology and, in particular, he tried to graphically record muscle contraction by adapting the smoked drum method originally developed by Ludwig. The first results obtained by Helmholtz with this method seemed to argue against the view, held in particular by Edward Weber (1806–1871), that the contraction induced by an electric stimulus had an instantaneous time course, beginning without any time delay at stimulus onset and terminating abruptly at the end of stimulation (Olesko and Holmes, 1993).

Once he arrived in Königsberg in 1849, Helmholtz rapidly established a friendship with the astronomer August Ludwig Busch (1804–1855), director of the local Observatory and a former assistant of Bessel whom he had succeeded upon his death in 1846. Very likely, through conversations with Busch, Helmholtz became familiar with the problem of the personal equation that still had a

strong impact on the astronomers of the epoch. In the autumn of the same year, he set up an experimental apparatus for recording muscle contraction and started his first experiments on frog nerve-muscle preparations. In these experiments, a short-duration electrical stimulus (produced with an especially designed inductive coil) was applied to a motor nerve, and muscle contraction was recorded graphically.

From the outset it appeared that the contraction lasted much longer than the stimulus and, moreover, the muscle started contracting with a clear delay after the end of a short electric pulse. Furthermore, Helmholtz noticed that the delay between the stimulus and the onset of contraction varied, depending on experimental conditions and, in particular, became longer as the nerve-stimulating electrode was situated at progressively greater distances from muscle body. In the elusive way that characterizes great discoveries, experiments which initially had apparently aimed at investigating the time course of muscle contraction, changed their purpose in a somewhat radical way: they became instead an attempt to measure the time required for nerve conduction.

For various reasons, Helmholtz was able to realize the importance of his experimental observation of the dependence of the contraction delay in the muscle on the distance from the nerve segment stimulated. First he was familiar with the problem of personal equation which had led astronomers to suppose that a sizeable time might be required for nervous function in general and for conduction in particular. Moreover he was acquainted with the work on nerve physiology pursued in that period by his friend du Bois-Reymond. According to du Bois-Reymond, signal progression along nerve fibres was an electric event, but it differed from typical electric conduction along metallic cables (a phenomenon conceivably very fast), because it involved a spatial rearrangement of the “electric molecules” composing the core of excitable fibres (see du Bois-Reymond, 1848–1884). In Helmholtz’s opinion this movement would require a finite time, and thus nerve conduction could not occur at an immeasurably fast speed (as was generally held by the supporters of the earlier physiological doctrines).

Of particular significance in this context was Johannes Müller’s attitude, because it probably helped to stimulate Helmholtz to attempt to measure what his great teacher had considered immeasurable. Müller held the opinion that the “nervous principle” was “an imponderable fluid or a mechanical undulation”, somewhat akin to light, and should, therefore, propagate along nerve fibres at an extremely high speed. Consequently, any attempt to measure the time necessary for the propagation of a nervous signal along a nerve trunk of limited length was, for Müller, doomed to failure (see Müller 1844).

Having realized the importance of his achievement with nerve-muscle preparation, Helmholtz tried to confirm his observations by using a more precise method than that based on graphical recording. The graphical method appeared unsatisfactory in terms of the quality of the tracings (the vertical deflections monitoring muscle contraction were so small as to require a microscope to be observed), as well as the repeatability and reliability of results. Besides, conduction time appeared to be a very small fraction of the total time involved from stimulus onset to the completion of muscle contraction. It was therefore difficult to measure the time difference between the tracings corresponding to the muscle contractions evoked by stimuli applied to different places along the nerve.

Helmholtz thus made recourse to a more precise method developed by the French physicist Claude Pouillet (1790–1868) and already used in artillery for determining the speed of cannon balls (see Pouillet 1837). It was based on the observation that the galvanometer excursion caused by short current pulses was proportional to pulse duration. By synchronizing the onset of the electrical stimulus, it was thus possible to accurately measure very short intervals. Another experimental design derived from Pouillet consisted in arranging the relationship between the animal preparation and the stimulating device in such a way that frog leg contraction automatically interrupted the current passage (and thus terminated the time measurement).

With the new method, Helmholtz obtained sufficiently precise and reliable results in a series of experiments begun at the end of 1849. With the nerve stimulating electrode distance from muscle varying from 50 to 60 mm, the time from the stimulus onset to the start of contraction varied between 1.4 and 2 milliseconds. At the beginning of the next year he had enough data to send a short note to be presented at the meetings of two scientific societies of Berlin (the *Akademie der Wissenschaften*, and the *Physikalische Gesellschaft*, see Helmholtz, 1850a and b).

The rapidity with which Helmholtz published preliminary announcements concerning the presence of a “measurable time” for nerve conduction betrays his conviction of the epochal importance of his achievement. It was the first unequivocal measurement of the time required for the progression of nervous signal, the elusive message that in ancient medicine was supposed to involve mysterious entities indicated as “animal spirits”, the agents mediating the relationship between the immortal soul and the corporeal body in both sensory and motor mechanisms (see Piccolino and Bresadola, 2003).

By showing that nerve conduction involves quantifiable physical phenomena, Helmholtz was concluding a millenary endeavour of humankind toward a scientific

comprehension of nerve function. At the same time he paved the way for a new scientific approach to the experimental study of nervous (and mental) functions. In a sense, Helmholtz's was just one contribution in this direction, which acted together with other important achievements of the epoch such as, for instance, Johannes Müller's formulation of the law of the specificity of nervous action, Carlo Matteucci's (1811–1868) and Emil du Bois-Reymond's demonstration of the role of electricity in the function of excitable tissues and Gustav Theodor Fechner's (1801–1887) first quantitative assessment of sensations. Yet, as was accurately remarked, Helmholtz's measurement of nerve conduction speed was "so dramatic that it did more than any other single bit of research to advertise the fact that mind is not ineffable but a proper subject for experimental control and observation" (Boring, 1957).

A DISCONCERTING DISCOVERY

We are now accustomed to the idea that mental activity involves various physiological processes taking place in specific circuits of our brain and leading to a variety of manifestations, as nervous signals propagate toward the periphery of our body. We also know that time is required for nerve signal conduction and for more elaborate nervous operations, particularly when these involve a multitude of synapses with their complex machinery. We may thus have difficulties in appreciating what Helmholtz's demonstration of a finite (and relative long) nerve conduction time could mean for the mentality of the period, and how hard was to accept the idea of a time lag between a mental act and its bodily expression. In 1850 Helmholtz's father, in congratulating his son for his brilliant achievement, could not refrain from expressing his perplexity on that point of view:

As regards your work, the results at first appeared to me surprising,

since I regard the idea and its bodily expression not as successive, but as simultaneous, a single living act, that only become bodily and mental upon reflection (Königsberger, 1902).

In order to undermine his father's astonishment, Hermann observed that the existence of a delay in nerve conduction did not imply any specific statement on the temporal character of mental process. In the case of hearing, he noted, it was just adding to the time required from stimulus to sensation, an additional "nervous" delay which added to the time already needed for the transmission of sound waves along the middle and inner ear. Elsewhere he remarked that nerve conduction, although slow compared with other communication processes, was fast enough for physiological requirements. Only in the case of very large animals might it involve considerable times: in a whale, for instance, it might take about a second for a sensory signal originating in the tail to reach the brain (see Königsberger, 1902).

To support the idea that nerve processes required time, in his letter Helmholtz alluded to the "personal equation" which, in his view, pointed to the possible variations of time estimation by different sense organs (eye and ear). He also mentioned the difficulty encountered in ascertaining the synchrony of two clock beats perceived by the two different ears, which might in part be accounted for by small conduction differences in the two cochlear nerves (Königsberger, 1902).

In his further experiments on nerve conduction Helmholtz decided to return to graphical recordings of the time course of muscle contraction. Although this method appeared to be less precise, it was more expressive than Pouillet's method as a visual illustration of the results was obtained. By carefully improving his "Myographion", (the ancestor of modern myographs), Helmholtz recorded reliable tracings which he presented in 1852 in his extended paper.

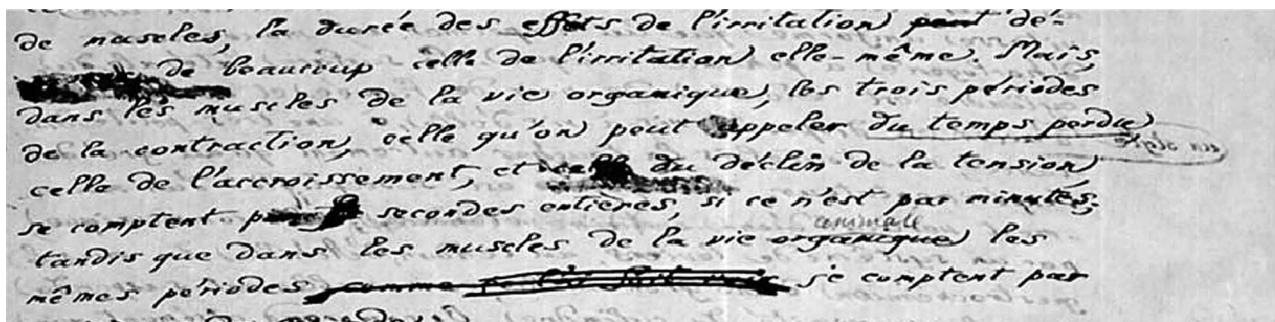


Fig. 1. The passage of the original draft of the communication sent by Helmholtz to the French Académie des Sciences in 1851, where the phrase "temps perdu" appears for the first time to indicate the latency of muscle response to direct electric stimulation. The writing is not Helmholtz's, but of du Bois Reymond, the closest friend of Hermann von Helmholtz, who helped him in translating the text of the communication into French (From the Archive of the Berlin Brandenburgische Akademie der Wissenschaften, NL Helmholtz 526).

THE “TEMPS PERDU”

In order to ensure priority for his discovery at an international level, Helmholtz also sent two communications to the French *Académie des Science* in Paris, one in 1850 (Helmholtz 1850c) and another in 1851. In the second communication (*Deuxième note...*) he first presented the data obtained with Pouillet's method, and estimated the conduction velocity obtained in this way to be about 26 metres per second. He also referred to the graphical method by noting that it was “a more expedite method [...] requiring a smaller number of experiments”. After describing this method in some detail, Helmholtz concluded that the “measurements obtained with the new method are in perfect accordance with those provided by the method of Pouillet” (Helmholtz, 1851).

For the theme of our article, the second communication is of particular interest because it contains the first instance of the phrase “*temps perdu*” that would recur about sixty years later in the title of Marcel Proust's masterpiece (see Fig. 1). Interestingly in Helmholtz's *Deuxième note*, this phrase is first used not to describe the physiological time lost in the nerve conduction process, but only to say that, in the case of an instantaneous electrical stimulus applied directly to muscle, there is a latency between stimulus and response.

Very likely Helmholtz was tracing, in a faithful way, the path that had led him to his discovery. As already discussed, initially he started his experiments in order to ascertain whether the muscle contraction excited by an electrical stimulus was an instantaneous process, closely corresponding to the stimulus time course (see Olesko and Holmes, 1994). It turned out not to be so, and, in particular, the initial mechanical effect was detectable shortly after the stimulus. Helmholtz wrote that a *temps perdu* (italics are Helmholtz's) is thus present in the muscles of animal life (i.e. striated or voluntary muscles, the kind of muscle involved contraction of frog legs); however, in these muscles this “lost time” was much shorter than in the muscles of organic life (i.e. the smooth muscles of viscera), a kind of muscle whose slow time course was well known. Afterwards he presented what is his main achievement, the discovery of the finite time necessary for the nerve conduction process, simply as an augmentation of the *temps perdu* between the application of electric stimulus and contraction onset, an augmentation evident when the stimulus was on a motor nerve further away from its insertion into the muscle. In all, the phrase *temps perdu* recurs three times in Helmholtz's *Deuxième note* (only at the first occurrence it is in italics), and this occurs in the same page (p. 263) of the *Académie Proceedings*.

PROUST *versus* HELMHOLTZ

It might be difficult to imagine two personalities as different as Helmholtz and Proust.

Although not insensible to literature and art, Helmholtz appears to be a typical (although very great) expression of the 19th century German scientist, with his unlimited confidence in science and scientific rationality. An experimentalist with a prodigious productivity in a huge variety of fields, he was also great theoretician and played a very significant role in the emergence of the modern scientific attitude out of a vision of the world dominated by the enchantments of the romanticism with its tendencies to irrationality and metaphysics. Like most 19th century exponents of the intellectual elite of his country, he had a profound knowledge of philosophy. However, he had a negative attitude toward the philosophy of his age, and in particular, towards Hegel and his followers. Kant was his intellectual reference, mainly because the enlightened rationalism of Königsberg philosopher, with his confidence in the causality principle, provided solid grounds for scientific knowledge. In the matter of art and literature, Helmholtz's tastes were, on the whole, rather traditional and academic. He was a great expert on music and devoted much attention to musical theory and to the history of music, culminating in his *Die Lehre von den tonempfindungen*, a masterpiece encompassing both the science and the aesthetics of hearing and music. However, even in the field of music, he seemed to be incapable of accepting the challenge of modernity, and apparently of appreciating German (and European) music after Mozart and Beethoven, a music that did not conform to the classical notions of harmony (see Meulders, 2001).

On the other side Marcel Proust, with his apparently exasperating and almost morbid sensibility, a symbol of the new century, more modern but more fragile, whose reference is not science and rationality, but aesthetics, art, history, the creator of a new and unique way of writing, where words, sentences, periods flow sometimes for whole pages apparently without structure, but with the charm and fascination of musical phrases with mysterious and captivating rhythms. Proust, author of a novel without an evident story, where the subtle thread of memory keeps together events apparently disparate in both place and time, with rapid movements similar to sudden alterations of the heartbeat (*intermittences du cœur*), and where the characters perform in an apparent free way, liberated as they are from the rigid rules of any definite literary plot. Proust's life became dominated by his art so that he spent long years of his existence confined in a sound-proof room, closed to external world, sleeping during the day and working at night, as if the absence of external interference made his interior senses more acute and

allowed him to recall the past moments of his life, and to live them again according to more deep dimensions of literature and art. In so doing, he could rediscover and recover the past and “lost time” of his apparently dissipated life, of which his literary work was a search (*La recherche du temps perdu*). Proust appears to be modern in both his musical tastes (the ‘small phrase of Vinteuil’ which recurs in *La recherche* is a ‘virtual’ composition echoing the music of contemporaneous artists); and is modern also in his philosophical interest (among his references there was Henri Bergson, a philosopher who anticipated some of the intellectual tendencies of the 20th centuries, certainly far beyond the limits of Kant’s rationalism).

A “TRAVELLING LETTER” FROM HELMHOLTZ TO PROUST via MAREY?

Is there any possibility of finding a link, an intersection between such disparate personages as Helmholtz and Proust?

The link could be the phrase “*temps perdu*” of the title of Proust’s masterpiece which seems an echo of Helmholtz’s lost time in the muscle response to electrical stimulation, a time that, as mentioned, is denoted as *temps perdu* in the second communication to the Paris *Académie*. Although the identity of the expressions might be just a coincidence, there are indications, albeit tenuous, to suggest that *temps perdu* (in Helmholtz’s acceptance) might have recurred in Proust’s work through the mediation of the French medico-physiological culture.

Medicine dominated Proust’s scientific dimension for various reasons. Among them was the constant influence that pathological states, of both physical and psychological origin, particularly asthma, exerted in his life. Often he consulted doctors and planned to spend long times in hospitals or clinics both in France or abroad. Moreover, Proust’s father, Achille Adrien Proust (1834–1903) was an eminent medical doctor, Professor at the Faculty of Medicine (from 1885), and member of the *Académie de Médecine* (from 1889), particularly expert on infectious diseases, but also interested to pathological states of neurological relevance (such as aphasia and neurasthenia). Many doctors frequented Proust’s house when his father was alive (and some of them were reflected in some of the characters portrayed in *La recherche*). Medical books were certainly present in the world around Marcel. This was true both at the time of his infancy and also when, in his mature age, he endeavoured to understand the nature of his sickness and paid particular attention to the complex relationship between psyche and body emerging in medicine and philosophy at the end of the 19th century.

In order to trace the path which might lead from the

temps perdu of Helmholtz to that of Proust let us first see how Helmholtz’s phrase arrived in the French scientific literature.

The phrase is present in *La machine animale*, a book published in 1873 (more than twenty years after Helmholtz’s experiments) by Etienne Jules Marey (1830–1904) an important French physiologist, then Professor at the *Collège de France* and member of the *Académie de Médecine* (in 1878 he would also be elected at the *Académie des Sciences*).

From his first experimental studies (and up to the end of his career), Marey had been interested to the graphical recording of a variety of physiological events (muscle contraction, heart and respiratory movements, blood pressure and vascular pulsations, locomotion in humans and quadrupeds, flight in insects and birds). He had a special talent in developing new instruments or improving previous ones, and his initial essays were mainly devoted to improving the graphic methods developed by German scientists, notably by Helmholtz. Later on he developed photographic methods and, in that regard, he is considered to be one of the pioneers of cinematography (on Marey see particularly Braun, 1992).

In order to study the mechanical pulsation of blood vessels, and particularly of arteries, Marey developed one of his many recording instruments, the “sphygmograph” (a much improved version of an instrument invented by Karl Vierordt, 1818–1884). He could thus also investigate various kinds of alterations of cardiac rhythm. Due to his achievements, Marey became the leader of French physiology in the second half of the 19th century. Figures portraying the recording instruments he had invented and illustrating his experiments (particularly in muscle and cardiac physiology, with his myographic and sphygmographic tracings) were almost constantly present in any French textbook of physiology up to the first decades of the 20th century.

In *La machine animale*, Marey makes a detailed reference to Helmholtz’s *temps perdu* in nerve conduction, a reference which is interesting and rich in suggestion mainly because of a metaphorical argument used in order to clarify the problems with Helmholtz’s experiment. For Marey, Helmholtz’s case with nerve conduction studies is formally similar to the measurement of the (average) speed of a mail train which transports a letter, by knowing the exact time of the train departure (from say to Paris), and the time of letter delivery to the addressee (living for example in Marseille), but ignoring the time of train arrival to the final station (Marseille). The difficulty comes from the ignorance of the time needed for the letter to arrive from the station of Marseille to the very final destination (i.e. in the hands of the addressee), a time required for a series of postal operations. Had this time been known, it would be easy

to ascertain the time needed for the train to go from Paris to Marseille, and thus to measure the average train speed.

Having introduced his metaphorical argument, Marey is on safe ground in illustrating Helmholtz's experiments on the muscle contraction evoked by electrical stimulation. He says that Helmholtz had discovered that "not all the time elapsed from the excitation to the contraction is taken by the transportation of the nervous agent; but that the muscle, once it has received the order carried by the nerve, is for one instant at rest before acting". He continues by saying: "It is what Helmholtz has called *temps perdu*", and notes that this time would correspond, in his metaphorical example, to "the duration of the preparatory work made between the arrival of the letters and their delivery".

The phrase is repeated twice more by Marey, always in italics, and always taken to mean the time taken by local processes in muscle after the arrival of the excitation and before the development of any visible contraction. Of course, Marey reports how Helmholtz succeeded in measuring the nerve conduction time by placing the stimulating electrode on the nerve at various distances from muscle. In a further chapter of the *Machine animale* (Ch. 6), in dealing with the discharge of electric fish, Marey comes again to the *temps perdu*. He reports there the results of an experiment (already published in a preliminary form in 1871, see Marey 1871) aimed at measuring the conduction velocity in the nerves of the electric organs of the torpedo.

A description of Helmholtz's experiments, very similar to that in the *Machine animale* (with the recourse to the metaphorical argument of the travelling letter) would appear in later Marey's publications, as for instance in his book *La Méthode graphique*, first published in 1878. In Marey's work, however, the mention of Helmholtz's *temps perdu* precedes the *Machine animale*. It appears for instance in a book published in 1868, a collection of lectures given at the College de France (*Du Mouvement dans le fonctions de la vie*). There is, however, no reference there to the metaphorical argument of the travelling letter. As in many other occasions in his books, in *Du Mouvement* Marey also discusses the problem of conduction speed in sensory nerves (by alluding to further experiments made by Helmholtz and others) and, moreover, he considers the delay in reflex motor responses.

Marey would deal again with Helmholtz's *temps perdu* in other publications. For instance in 1875, in a memoir published in the first volume of the *Travaux*, he noted the existence of a delay in the heart muscle contraction evoked by electric stimulation (see Marey, 1875). Marey commented by saying that this delay corresponds, in heart physiology, to the *temps perdu* discovered by Helmholtz in striated muscles (although, as he noted, in the heart the

temps perdu is much longer than in striated muscles, 1/3 versus 1/100 of a second).

Due to his progressively increasing authority in the scientific world, and also at a more public level (among others, he was invited to give a demonstration of the sphygmograph by Napoleon III), Helmholtz's *temps perdu* spread from Marey's publications to the scientific literature of the time. A reference to it became almost inevitable in French textbooks of physiology in the second half of the 19th century and it appeared with significant frequency also in the first half of the 20th century (and it is still present in some relatively recent textbooks, as for instance in the 3rd edition of the *Precis de physiologie* of Herman and Cier published in 1974).

Very probably Marey's use of the metaphorical argument of the travelling letter, and likely also subtle linguistic reasons (*perdu* referred to *temps* means, at the same time, elapsed, lost, wasted) contributed to this diffusion, and to the consolidation of Helmholtz's *temps perdu* in French scientific literature. Compared to phrases such as *période latente*, *période de l'excitation latente*, (which more faithfully reflect the German phrase "*Zeitraum der latenten Reizung*" used by Helmholtz), also employed to indicate the same phenomenon, but *temps perdu* more likely captured reader's attention and was more easily retained for the richness of the suggestions implied.

In the scrutiny of physiological textbooks and related publications that I have been able to perform, *temps perdu* (in Helmholtz's acceptance) appears with an impressive frequency. Apart from in textbooks, it appears in periodicals (as for instance in the *Comptes rendus* of the French *Académie des Sciences*), and is particularly frequent in the *Travaux* of Marey's laboratory (with the impressive score of 56 recurrences in a long memoir published in 1880 by Maurice Mendelsson). Among the textbooks examined, *temps perdu* may appear even 9–10 times in the same page (as for instance in some editions of Arthus' *Éléments de Physiologie* and of Beaunis' *Éléments de Physiologie humaine*). In Arthus' book, the phrase is also indexed in the "Table of contents". In the case of Beaunis', *temps perdu* rebounds into the Italian edition of the textbook due to Vittorio Aducco (1860–1937), where it appears ten times within a single page as *tempo perduto*. In the Italian version, the phrase also appears in Luciani's physiology textbook, a monumental work which had numerous editions and was translated into various languages including German, English and Spanish.

"INTERMITTENCES DU CŒUR", SPHYGMOGRAPHIC TRACINGS AND WRITING

In Marcel Proust's epoch, *temps perdu*, used to mean the time of nervous conduction and the time lost by

fundamental physiological processes involved in any sensory, motor and psychological action, was present in the French scientific literature, mainly through the mediation of Marey who had introduced Helmholtz's experiments to the French scientific audience in an expressive and easily understandable way. Proust might thus know *temps perdu* in Helmholtz's sense, and this possibility is made more likely by the fact that Proust's father, Achille Adrien, was acquainted with Marey (both were members of the *Académie de médecine*) and on some occasions they had even collaborated. Adrien Proust was one of the main French experts of cholera, a subject to which Marey had devoted a study in 1865. In 1885 Marey was the *rapporteur* of a Committee of the *Académie de Médecine* charged to prepare a report on the cholera epidemic of 1884 and Adrien Proust was one of the Committee members (see Schestag 2003).

We have not been able to trace any positive evidence in Proust's correspondence (and in the other papers consulted), that Proust referred to Helmholtz's *temps perdu* when, in the period 1911–1912, he finally chose the general title for the book he was writing and beginning to publish. However, there are some suggestions of a possible “resonance” of Helmholtz's phrase (through Marey's mediation) in the title of *La recherche du temps perdu*.

Before arriving to the final decision, Proust had already in mind “*temps perdu*” for the title of his work. It was when he was contriving to concentrate the material that he was accumulating in the long nights of creative self-reclusion in his sound-proof room in only two volumes. Initially, *Temps perdu* would be the title of the first volume and *Temps retrouvé* the title of the second. Interestingly, at this stage, the general title would be *Les intermittences du cœur*, a title that, in the published edition, would remain to designate only one episode of *Sodome et Gomorrhe*. Here it is used to indicate, as already mentioned, the psychological (and literary) process whereby the past and forgotten time may suddenly come again to the conscience, thus revealing the deeper aspects of reality that were not initially apparent. As Proust explicitly recognizes, *intermittences du cœur*, is of medical derivation.

In the physiological and clinical terminology of the epoch, *intermittences du cœur* was used to designate a variety of troubles of the cardiac rhythm, notably those characterized by a sudden cessation of the beat and by a subsequent reappearance of the pulsations, generally of a particularly strong intensity (i.e. the extrasystolic conditions according to modern terminology). Together with other alterations of cardiac rhythm, the *intermittences* had been intensively studied from the second half of the 19th centuries, thanks mainly to the recording apparatus invented by Marey. In particular, sphygmographic

tracings had become popular as a way for characterizing and documenting heart diseases (see for instance Ozanam, 1886).

In this context, it is interesting to note that, in 1905, a reference to sphygmographic tracings appears in a work of Proust, which marks a fundamental phase of the path that would eventually lead him toward *La recherche*. This occurs in a long footnote added by Proust to his French translation of a conference of John Ruskin (1819–1900) on the importance of reading (*Sesame and lilies*). The footnote appears in relation with a passage in which Ruskin comments on the importance of choosing accurately the words in translating a text.

Proust writes:

Ruskin, who has so well and so often shown that the artist, in what he writes or in what he paints, infallibly reveals his failings, his affectations, his defaults (and as for the hidden rhythm of our soul – much more vital than that we perceive it ourselves – is not indeed the work of art similar to those sphygmographic tracings where the pulsations of our blood inscribe themselves in an automatic way?), Ruskin should have seen that if the writer obeys in its choices to a concern for erudition [...] it would happen that it is this concern for erudition – interesting as it could be, but never more than interesting – which would be reflected, which would inscribe itself in his book.

Afterwards Proust briefly discussed the attention devoted by different authors to the choice of words, with results which may be very diverse. In some of them the recourse to a term particularly refined or of an ancient taste may simply be the expression of “second order” talent. In others, as for instance Victor Hugo, the attention to the wording would result in literary effects of great moment. However, Proust says, echoing Schelling's romantic theory of artistic creation (see Séailles 1883; and Henry 1981), before starting his work, the good writer knows his dictionary and the texts of the great writers from whom he draws his linguistic inspiration well,

In the act of writing he does not think of them anymore, but he cares of what he wishes to express, and chooses the words that express that at the best, with the greatest force, colour, harmony. He chooses them from an excellent dictionary, because it is the dictionary which, in his memory, is available for him, since his studies have established the propriety of each word. But he does think of them [i.e. the great writers] when he writes.

There might be other arguments to suggest that, besides a simple verbal correspondence, there is some more deep analogy between Helmholtz's and Proust's *temp perdu*. The protagonist of Proust's *Recherche* is able to give a real meaning to the events of his life, not in the actuality of their presence, but only when he is able to recall them and live them again through the filter of his memory. Thus he can confer a deep reality to these events only when they have gone away, and are thus lost in the ordinary sense of the irreversible flow of time.

Helmholtz's discovery that an elusive time is taken by fundamental physiological processes, and particularly by

nervous conduction, and that, by consequence, things come to consciousness after a definite (although short) time, points to the existence, even in the psychophysiological aspects of our nervous and mental activity, of a reality non-perceptible at the very moment of its presence. It opens a first window to the existence, even in the physicality of our body, of hidden processes, a window through which men would eventually penetrate the existence of a variety of processes happening below the conscious level which are, nonetheless, capable of shaping their life, their way of thinking and behaving, both at a private and at a social and historical level.

One could propose this, and other resonances, between the *temps perdu* of Helmholtz and of Proust, a writer interested in medicine and psychology, and particularly in the mechanism of memory, and puzzled by the existence of memories which we can never be able to recollect in a conscious way.

However, in the absence of compelling and documented evidence of a link between Proust and Helmholtz-Marey, we prefer just to say that it is likely, in putting *temps perdu* in the final title of his *Recherche*, Proust was thinking neither of Helmholtz nor of Marey, but he was choosing a phrase from his dictionary, a rich dictionary to which surely his medical culture had contributed, because, as already noted, when a writer chooses his words:

He chooses them from an excellent dictionary, because it is the dictionary which, in his memory, is available for him, having his studies established the propriety of each word...

but he does think of the excellent writers who might have contributed to his dictionary.

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This article is inspired by a recently-published, stimulating essay of Thomas Schestag (see Schestag 2003) whose elaborations, however, I am only partially inclined to follow. In order to make my paper more readable, I have not indicated in the text most of the bibliography on Proust that I have consulted. Besides the correspondence (mainly in the edition of Kolb, 1970–1993), of classic biographies, as for instance that of Painter (1959–1965) and of Tadié (1996), and of specific essays, I have profited mainly of the works of Mariolina Bongiovanni Bertini, Anne Henry, Anna Maria Contini and Giovanni Macchia (some of which are listed among the references). In order not to make the reference list excessively long, I have also decided not to include the textbooks of physiology that I have searched for the occurrence of “*temps perdu*”. I wish to thank the many colleagues and friends that have read previous versions of this manuscript and have encouraged this work, somewhat outside my specific field of interest. Among them Giacomo Magrini, Alessandro Martini, Dafydd Stephens, Paolo Mazzarello, Jacques Neyton, Ottorino Belluzzi, Germana Pareti, and particularly, Dora, Ana, Abel and Hersch Gerschenfeld.

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Address for correspondence:

Marco Piccolino
 Dipartimento di Biologia
 Università di Ferrara
 Via Borsari 46
 44100 Ferrara
 (Italy)
 Tel: +39 328 4909380
 Fax: +39 178 276 6560
 E-mail: marco.piccolino@unife.it