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I THE NATURE OF TIME

In the preface to a collection of essays on the history of ideas, the cultural historian Arthur O. Lovejoy complained that many studies overunified the views of an author in order to present his thinking "all-of-a-piece." In his own essays he sought to correct that weakness and present the "inner tensions—the fluctuations or hesitations between opposing ideas or moods, or the simple and more or less unconscious embracing of both sides of an antithesis."¹ Lovejoy was referring to an individual's thinking, but the warning applies even

more to the thought of an age. The great variety of views in any particular age do not all line up on one side of the issues. I present the critical concepts dramaturgically in accord with the theory that knowledge is essentially dialectical, that ideas are generated in opposition to other ideas and have a basic polemical nature. The development of a body of thought involves a selection from, and an occasional resolution of, contrasting views. The ideas of this period on the nature of time will be organized around three pairs of opposing views: whether time was homogeneous or heterogeneous, atomistic or a flux, reversible or irreversible.



As every child quickly learns, there is only one time. It flows uniformly and may be divided into equal parts anywhere along the line. This is the time Isaac Newton defined in 1687: "Absolute, true, and mathematical time, of itself, and from its own nature, flows equally without relation to anything external." In *The Critique of Pure Reason* (1781) Immanuel Kant rejected the Newtonian theory of absolute, objective time (because it could not possibly be experienced) and maintained that time was a subjective form or foundation of all experience. But even though it was subjective, it was also universal—the same for everybody. No doubt Newton and Kant experienced different paces of private time, but before the late nineteenth century no one (with the possible exception of Laurence Sterne, who explored private time in *Tristram Shandy*) systematically questioned the homogeneity of time. The evidence for it was written on the faces of the millions of clocks and watches manufactured every year.

The most momentous development in the history of uniform, public time since the invention of the mechanical clock in the fourteenth century was the introduction of standard time at the end of the nineteenth century. A pioneer in promoting uniform time was the Canadian engineer Sanford Fleming, who in 1886 outlined some reasons for its adoption. The use of the telegraph "subjects the whole surface of the globe to the observation of civilized communities and leaves no interval of time between widely separated places proportionate to their distances apart." This system mixes up day and night as "noon, midnight, sunrise, sunset, are all observed at the same moment," and "Sunday actually commences in the middle of

Saturday and lasts until the middle of Monday."² A single event may take place in two different months or even in two different years. It was important to be able to determine local times and to know precisely when laws go into effect and insurance policies begin. The present system, he concluded, would lead to countless political, economic, scientific, and legal problems that only the adoption of a coordinated world network could prevent.

The most famous supporter of standard time, Count Helmuth von Moltke, in 1891 appealed to the German Parliament for its adoption. He pointed out that Germany had five different time zones, which would impede the coordination of military planning; in addition there were other time zones, he protested, that "we dread to meet at the French and Russian boundaries."³ When Fleming sent Moltke's speech to the editor of *The Empire* for publication, he did not dream that in 1914 the world would go to war according to mobilization timetables facilitated by standard time, which he thought would rather engender cooperation and peace.

Despite all the good scientific and military arguments for world time, it was the railroad companies and not the governments that were the first to institute it. Around 1870, if a traveler from Washington to San Francisco set his watch in every town he passed through, he would set it over two hundred times. The railroads attempted to deal with this problem by using a separate time for each region. Thus cities along the Pennsylvania Railroad were put on Philadelphia time, which ran five minutes behind New York time. However, in 1870 there were still about 80 different railroad times in the United States alone.⁴ The day the railroads imposed a uniform time, November 18, 1883, was called "the day of two noons," because at mid-day clocks had to be set back in the eastern part of each zone—one last necessary disruption to enable the railroads to end the confusion that had so complicated their functioning and cut into their profits. In 1884 representatives of twenty-five countries that convened at the Prime Meridian Conference in Washington proposed to establish Greenwich as the zero meridian, determined the exact length of the day, divided the earth into twenty-four time zones one hour apart, and fixed a precise beginning of the universal day. But the world was slow to adopt the system, for all its obvious practicality.

Japan coordinated railroads and telegraphic services nine hours ahead of Greenwich in 1888. Belgium and Holland followed in 1892; Germany, Austria-Hungary, and Italy in 1893; but in 1899, when

John Milne surveyed how countries throughout the world determined their time and its relation to Greenwich, there was still a great deal of confusion. Telegraph companies in China used a time that was approximately the same as in Shanghai; foreigners in coastal ports used their own local time taken from solar readings; and all other Chinese used sundials. In Russia there were odd local times such as that of St. Petersburg—two hours, one minute, and 18.7 seconds ahead of Greenwich. In India hundreds of local times were announced in towns by gongs, guns, and bells.⁵

Among the countries in Western Europe, France had the most chaotic situation, with some regions having four different times, none of which had a simple conversion to Greenwich time. Each city had a local time taken from solar readings. About four minutes behind each local time was astronomical time taken from fixed stars. The railroads used Paris time, which was nine minutes and twenty-one seconds ahead of Greenwich. A law of 1891 made it the legal time of France, but the railroads actually ran five minutes behind it in order to give passengers extra time to board; thus the clocks inside railway stations were five minutes ahead of those on the tracks.⁶ In 1913 a French journalist, L. Houllévigüe, explained this "retrograde practice" as a function of a national pride, expressed in the wording of a law of 1911 promoting the system that other countries of Europe had adopted twenty years earlier. The French law declared that "the legal time in France and Algeria is the mean Paris time slowed nine minutes and twenty-one seconds." Houllévigüe pointed out the Anglophobic intent of the wording: "By a pardonable reticence, the law abstained from saying that the time so defined is that of Greenwich, and our self-respect can pretend that we have adopted the time of Argentan, which happens to lie almost exactly on the same meridian as the English observatory."⁷ In spite of their previous isolation the French finally took the lead in the movement for unified world time based on the guidelines of 1884. If the zero meridian was to be on English soil, at least the institution of world time would take place in France. So President Raymond Poincaré had Paris host the International Conference on Time in 1912, which provided for a uniform method of determining and maintaining accurate time signals and transmitting them around the world.

The wireless telegraph made it all possible. As early as 1905 the United States Navy had sent time signals by wireless from Washington. The Eiffel Tower transmitted Paris time in 1910 even before it was legally declared the time of France. By 1912 the system was ex-

panded with installations in Nancy, Charleville, and Langres so that the entire country could receive the same signals simultaneously. Houllévigüe boasted that Paris, "supplanted by Greenwich as the origin of the meridians, was proclaimed the initial time center, the watch of the universe."⁸ The observatory at Paris would take astronomical readings and send them to the Eiffel Tower, which would relay them to eight stations spaced over the globe. At 10 o'clock on the morning of July 1, 1913, the Eiffel Tower sent the first time signal transmitted around the world. The independence of local times began to collapse once the framework of a global electronic network was established. Whatever charm local time might have once had, the world was fated to wake up with buzzers and bells triggered by impulses that traveled around the world with the speed of light.

Around the time of the International Conference on Time various proposals for calendar reform were made. Nothing concrete came of them, but they reveal a parallel effort to rationalize public time. In 1912 an American reformer noted that while the year, month, and day have a basis in nature, the week and the hour are entirely artificial. The "stupid" arrangement of the calendar, he argued, should be simplified by dividing the year into four equal seasons of 91 days each and leaving out New Year's day and one day every four years.⁹ In an introduction to a proposal of 1913 by Paul Delaporte for calendar reform, the French scientific writer Camille Flammarion applauded the achievements of the International Conference on Time, observed that the unequal divisions of the year should be modified, and endorsed Delaporte's proposal to shorten every month to twenty-eight days, with an intercalary period added in the middle of the year so that workers could be paid every four weeks and rent would be due and interest computed for the same length of time every month. The year would always begin on the same day, thus obviating the reprinting of calendars.¹⁰ In 1914 an Englishman emphasized difficulties in scheduling for business and government and recommended a calendar in which each quarter would be composed of two thirty-day months and one thirty-one day month, with leap year not counted at all.¹¹ A German reformer proposed a "hundred-hour day" composed of units approximately equivalent to a quarter-hour. Just as the introduction of the decimal system in spatial measurements had enabled the German people to make rapid economic development, he contended, so might the introduction of a temporal decimal system liberate resources for other pursuits.¹²

A science-fiction novel of 1893 about life on Mars incorporated

some of the developments in standard time made in the previous decade. In Henry Olerich's *A Cityless and Countryless World*, every dwelling and working place was furnished with clocks that were astronomically regulated and electronically synchronized. The standard for money was time: "In business, when you say I want so many dollars, cents and mills for an article, we say I want so many days, hours, minutes and seconds for it."¹³ Martian currency consisted of paper bills stamped with units of time. This time money was perhaps inspired by the introduction of time-recording machines for workers. The same year that Olerich's book was published, an article in *Scientific American* described a machine, in service since 1890, that stamped an employee's card with the time he entered and left.¹⁴ Though he was paid in dollars, the time-stamped tape determined the amount. Olerich had only to make the slightest alteration to create a utopian world where time is money.

Punctuality and the recording of work time did not originate in this period, but never before had the temporal precision been as exact or as pervasive as in the age of electricity.¹⁵ From the outset there were critics. Some pathological effects were noted in that catalog of medical alarmism, George Beard's *American Nervousness*. He blamed the perfection of clocks and the invention of watches for causing nervousness wherein "a delay of a few moments might destroy the hopes of a lifetime."¹⁶ Every glance at the watch for these nervous types affects the pulse and puts a strain on the nerves. There were many other alarmists who reacted adversely to the introduction of standard time, but the modern age embraced universal time and punctuality because these served its larger needs. That prerevolutionary, pastoral image in Arthur Koestler's *Darkness at Noon*, of Russian peasants coming to the railroad station at dawn to wait for a train that might not arrive until the late afternoon, suggested a life style more frustrating and wasteful than it was idyllic.

The proponents of world time were few, and none of them (aside from Moltke) were well known beyond the narrow circle of fellow reformers. Nevertheless the concept of public time was widely accepted as a proper marker of duration and succession. There were no elaborate arguments on its behalf because there seemed to be no need. The passion in the debate about homogeneous versus heterogeneous time was generated rather by those novelists, psychologists, physicists, and sociologists who examined the way individuals create as many different times as there are life styles, reference systems, and social forms.

Of all the assaults on the authority of uniform public time that appeared in the imaginative literature of this period, the most direct was the one assigned to the Russian anarchist in Joseph Conrad's *The Secret Agent* (1907). His task as an *agent provocateur* in England was to blow up the Greenwich Observatory. Conrad could not have picked a more appropriate anarchist objective, a more graphic symbol of centralized political authority.

The heterogeneity of private time and its conflict with public time was explored in a number of literary works. In 1890 Oscar Wilde imagined a sinister discordance between body time and public time for his *Dorian Gray*, whose portrait aged in his place while he stayed young. When Dorian kills the portraitist, the magic ends and the two times race back to their proper positions: the portrait changes back to innocent youth, and Dorian's face registers the corruption that the portrait had concealed.

Marcel Proust's *Remembrance of Things Past* takes place in a clearly identifiable public time from the Dreyfus affair to World War I. But the private time of its narrator, Marcel, moves at an irregular pace that is repeatedly out of phase with that of the other characters and defies reckoning by any standard system. Marcel reflected that his body kept its own time while he slept, "not on a dial superficially marked but by the steadily growing weight of all my replenished forces which, like a powerful clockwork, it had allowed, notch by notch, to descend from my brain into the rest of my body."¹⁷ In the search for lost time, mechanical timepieces will be utterly useless as Proust learns to listen for the faint stirrings of memories implanted in his body long ago and destined to recur to him in unpredictable and enchanting ways.

The dials that superficially mark time for Proust are virtual enemies in the troubled lives of Franz Kafka's heroes. When Gregor Samsa awakens in *The Metamorphosis* and discovers himself to be a great insect, his distress is intensified by the discovery that he is going to miss his train. This first break with the routine of public time is symbolic of the complete breakdown of his relationship with the world. In *The Trial* (1914-15) Josef K. tells his employer about the summons to his first hearing: "I have been rung up and asked to go somewhere, but they forgot to tell me when." He assumes he should arrive at nine but oversleeps and arrives over an hour late. A few minutes later the Examining Magistrate reproaches him: "You should have been here an hour and five minutes ago."¹⁸ The next

week when he returns he is on time but no one shows up. This confusion mirrors his larger problems with the world. He eventually loses the ability to differentiate inner and outer sources of guilt just as he was unable to determine who was responsible for his missed appointments. In a diary entry of 1922 Kafka commented on the maddening discordance between public and private time. "It's impossible to sleep, impossible to wake, impossible to bear life or, more precisely, the successiveness of life. The clocks don't agree. The inner one rushes along in a devilish or demonic—in any case, inhuman—way while the outer one goes, falteringly, its accustomed pace."¹⁹ His heroes feel absurd when they arrive too early and guilty when late.

The public time that Proust found superficial and Kafka terrifying, Joyce found to be arbitrary and ill-suited to order the diverse temporal experiences of life. In *Ulysses* he modified traditional treatment of time by compressing Odysseus's twenty years of travel into sixteen hours in the life of Leopold Bloom as he meandered about the shops and pubs of downtown Dublin. During that day we are given a microscopic account of everything Bloom does, thinks, and feels, but within the limited duration of the story Joyce widens the temporal range with interior monologues and authorial comments about Bloom's unique experience of time and its relation to the infinite expanses of cosmic time.

The heterogeneity of time is presented formally by means of the specific rhythm of the prose of each chapter.²⁰ In the "Aeolus" episode the rhythm varies like the unpredictable winds which blew Odysseus off course and which in *Ulysses* blow like the windbag newspapermen whose views are chopped up into newspaper-length articles. In "Lestrygonians" Bloom goes for lunch and the rhythm is the peristaltic motion of digestion. Bloom looks into the river and reflects on the way everything flows: food through the alimentary canal, the foetus through the birth canal, the traffic of Dublin, his bowels, thought, language, history, and time itself. The prose in "Oxen of the Sun" approximates the long cadences of a woman in labor. In "Ithaca" Joyce describes the journey home of Stephen and Bloom as a catechism in which their thoughts, like their footsteps, alternate in a series of questions and answers. And in the final episode the rhythm is that of the flow of Molly's stream of consciousness.

In the midst of telling how Bloom flopped over the back fence to get into his home, Joyce suddenly breaks into the narrative with a list

of possible ways of describing when Bloom last weighed himself. It was "the twelfth day of May of the bissextile year one thousand nine hundred and four of the christian era (jewish era five thousand six hundred and sixty-four, mohammedan era one thousand three hundred and twenty-two), golden number 5, epact 13, solar cycle 9, dominical letters C B, Roman indication 2, Julian period 6617, MXMIV."²¹ We are told that Bloom walked around Dublin precisely on June 16, 1904, only Joyce leaves us wondering exactly when that is.

Joyce's reminder that time is relative to the system by which it is measured also points to Einstein's theory that all temporal coordinates are relative to a specific reference system. In a textbook of 1883 Ernst Mach raised some questions about classical physics that anticipated one of the greatest scientific revolutions ever. Mach rejected Newton's views of absolute space and absolute motion and dismissed his absolute time as an "idle metaphysical conception."²² This passing shot at classical mechanics triggered a series of modifications that eventually culminated in the bold dismantling of it by Einstein. The next blow to absolute time came from an experiment intended to show the existence of a luminiferous ether through which light was propagated. According to classical mechanics the speed of light perpendicular to the ether flow generated by the passage of the earth through it ought to have been faster than the speed of light in line with it, but the famous experiment of Michelson and Morley of 1888 showed no detectable difference. This troublesome result led to several hypotheses about a slowing down of time from its movement through ether.

In 1895 Hendrick Lorentz speculated that perhaps time was dilated by motion through the ether just enough to account for the observed equality of the two speeds of light.²³ This position was midway between classical physics and relativity theory. It looked forward to relativity by suggesting that time measurements are modified by motion, that there is a plurality of "local times," each dependent on the relative motion of the clock and observer. But it adhered to the traditional concept of absolute time by insisting that the change actually took place *in the object* as a result of motion through the ether, similar to the way other elastic bodies contract in the direction of their motion through a gas or fluid. Lorentz believed that the dilation of time was real, and he thus retained the concept of absolute time. Einstein would argue that the dilation of time was only a perspectival effect created by relative motion between an observer and the thing observed. It was not some concrete change

inherent in an object but merely a consequence of the act of measuring. Such an interpretation rejected absolute time, because time only existed when a measurement was being made, and those measurements varied according to the relative motion of the two objects involved.

With the special theory of relativity of 1905 Einstein calculated how time in one reference system moving away at a constant velocity appears to slow down when viewed from another system at rest relative to it, and in his general theory of relativity of 1916 he extended the theory to that of the time change of accelerated bodies. Since every bit of matter in the universe generates a gravitational force and since gravity is equivalent to acceleration, he concluded that "every reference body has its own particular time."²⁴ In a subsequent popularization of his theory he contrasted the older mechanics, which used only one clock, with his theory which requires that we imagine "as many clocks as we like."²⁵ The general theory of relativity had the effect, figuratively, of placing a clock in every gravitational field in the universe, each moving at a rate determined by both the intensity of the gravitational field at that point and the relative motion of the object observed. Einstein, who could not afford to have a clock on the wall of his room when he was working in the patent office in Berne, had filled the universe with clocks each telling a different correct time.

Although several investigations of the social origin of time were made in the late nineteenth century,²⁶ the prodigious work of Emile Durkheim constitutes the first one of major significance. The sociology and anthropology of that age was full of information about primitive societies with their celebration of the periodic processes of life and the movement of heavenly bodies, their vital dependence on seasonal change and the rhythmic activity of plants and animals, their exotic commemorations of ancestral experience, and their cyclic and apocalyptic visions of history. It is no wonder that Durkheim came to believe in the social relativity of time.

In *Primitive Classification* (1903) Durkheim mentioned in passing that time is closely connected with social organization, and in *The Elementary Forms of the Religious Life* (1912) he explored the subject in detail. There he distinguished between private time and "time in general," which has a social origin: "the foundation of the category of time is the rhythm of social life." More concretely, "the divisions into days, weeks, months, and years, etc., correspond to the periodical recurrence of rites, feasts, and public ceremonies." Societies organize their lives in time and establish rhythms that then come to be

uniformly imposed as a framework for all temporal activities. Thus "a calendar expresses the rhythm of the collective activities, while at the same time its function is to assure their regularity."²⁷

Arguments for a relativity of time were also made by psychiatrists and philosophers. Karl Jaspers's work in phenomenological psychiatry outlined different modes of perceiving time and space that can occur in mental illness.²⁸ In a history of the idea of memory and time Pierre Janet recounted the contributions of "a whole generation" of experimental psychologists and clinicians in the late nineteenth century who investigated subjective time. Citing his own account of a distorted sense of time among the mentally ill in *Névroses et idées fixes* (1898), he then characterized Jean Guyau's essay of 1890 as opening "a new era in the psychology of time."²⁹ Janet also discussed Charles Blondel's *La Conscience morbide* of 1914, which examined the diverse temporal worlds of the mentally ill. One patient lived "from day to day, like an animal, in a kind of retreat from the past and the future," with time appearing interminable. A few days in the past seemed like years, and all events in time were mixed in nightmarish confusion. For another patient, "Gabrielle," time contracted and dreaded future events were transposed into the past and generated anxiety as if they had already occurred and would remain forever present. It was as if her mind constantly surveyed the entire temporal range to collect and condense all morbid thoughts into a present and inescapable experience of anxiety.³⁰



The argument on behalf of the atomistic nature of time had a variety of sources. Perhaps most influential was Newton's calculus, which conceived of time as a sum of infinitesimally small but discrete units. Clocks produced audible reminders of the atomistic nature of time with each tick and visible representations of it with their calibrations. The modern electric clock with the sweeping fluid movement of its second hand was invented in 1916. Until then clocks could offer no model for time as a flux.³¹ Experimental psychologists attempted to determine the precise intervals of human responses and the shortest duration one can detect. In the laboratories of Gustav Fechner and Wilhelm Wundt metronomes and watches were used to study human life as a construction of measurable bits of time.

In the late 1870s two pioneers of the cinema studied atomized movement by means of a series of still photographs. Eadweard Muybridge recorded the motion of a galloping horse by setting up some cameras in line along the course with a thin wire strung across the track that triggered the shutter as the horse ran by. He went on to make sequential photographic studies of human and animal movements. In 1882 the French physician E. J. Marey began to study movement with a technique he called chronophotography—literally, the photography of time: “a method which analyzes motions by means of a series of instantaneous photographs taken at very short and equal intervals of time.”³² Marey was particularly interested in the aerodynamics of flight and developed an apparatus for photographing birds simultaneously from three different points of view. He believed that the best way to understand motion was to break it up into parts and then reassemble them into a composite picture or plastic model.

When the cinema was improved to permit the first public showing in 1896, it also broke up motion into discrete parts. The Futurist photographer Anton Bragaglia proposed a technique he called photodynamism, which involved leaving the shutter open long enough to record the blurred image of an object in motion.³³ This, he believed, offered the only true art of motion in contrast to both chronophotography and cinematography, which broke up the action and missed its “intermovemental fractions.” Bragaglia’s photographs look more like the errors of a beginner than an artistic solution of the problem of motion, and they offer a vivid, if somewhat ludicrous, illustration of the difficulty that all the visual arts had in capturing the fluid nature of movement or time.

The difficulty painters have rendering the movement of an object in time has always been a frustrating limitation of the genre. That limitation, formalized in the eighteenth century with Gotthold Lessing’s division of the arts as temporal and spatial, came to haunt painters of the late nineteenth century.³⁴ Artists had often attempted to imply a past and future by painting a moment that pointed beyond the present. The Impressionists attempted to render time more directly with a sequence of paintings of the same motif at different times of the day, seasons, and climatic conditions, as in Claude Monet’s haystacks and his series depicting the Rouen Cathedral. Monet himself explained, “One does not paint a landscape, a seascape, a figure. One paints an impression of an hour of the day.”³⁵ The Impressionists also tried to portray their impression of motion,

but no matter how well they suggested the luminous shifting caused by a passing cloud or the ripple of the wind on water, everything was fixed in a single moment.

The Cubists attempted to go beyond the instant with multiple perspectives, at least so a group of early commentators argued. In 1910 Leon Werth wrote that Picasso's Cubist forms show "the sensations and reflections which we experience with the passage of time." In the same year the Cubist painter Jean Metzinger suggested that in Braque's paintings "the total image radiates in time." In 1911 Metzinger explained how he thought the multiple perspective of the Cubists added the temporal dimension. "They have allowed themselves to move round the object, in order to give a concrete representation of it, made up of several successive aspects. Formerly a picture took possession of space, now it reigns also in time." In 1910 Roger Allard noted that a Metzinger painting was a "synthesis situated in the passage of time."³⁶ These arguments are all overstated. The multiple and successive perspective that the Cubists did integrate into a single painting does not justify the conclusion that they radiate in time. No matter how many successive views of an object are combined, the canvas is experienced in a single instant (aside from the time necessary for the eye to scan the surface). The Cubists toyed with the limitations of their genre, perhaps even with some intended mockery. Their inventions presented time in art in a new way, but that did not constitute the experience of time as it passes.

In 1899 the Dutch critic Ernst Te Peerdt observed in *The Problem of the Representation of Instants of Time in Painting and Drawing* that our visual field is not composed of a series of timeless unities. Each instant of perception synthesizes a sequence of numerous perceptions. "It is precisely those moments that are put together as a simultaneity, a *Nebeneinander*, which constitute a sequence, a *Nacheinander*, in the seeing of an object."³⁷ Unlike a still photograph the eye is able to integrate a succession of observations. The task of the painter is to integrate temporal sequence with forms in space. Despite Te Peerdt's argument that good visual art can suggest a sequence, it nevertheless cannot portray the movement of an object or the passage of time.

No motif gives as graphic a reminder of the atomized nature of time as a clock, and there are few clocks in the art of this period. Around 1870 Paul Cézanne painted a still life dominated by a massive black clock without hands—symbol of the timelessness he sought to create in his painting. I have not been able to find clocks again in any major work of Western art until 1912 with *The Watch* by

Juan Gris. Here time is out of joint in several respects. The watch is rotated ninety degrees, making a first quick reading of it difficult. It is broken into four quadrants, only two of which are visible. The other two are obscured and the minute hand is missing, making an exact reading impossible even after some contemplation. On this Cubist watch, time is fragmented, discontinuous, and ambiguous, but fixed forever by the hand that points to XI on the visible quarter-face. In 1913 Albert Gleizes put a clock in a Cubist portrait and effaced half the numbers.³⁸ The time is precisely 2:35, but the clock is useless for readings on the effaced portion. Gleizes broke up time as easily as he fragmented objects and space.

In *Enigma of the Hour* of 1912 Giorgio de Chirico painted a clock with plainly visible time towering over a small figure that looks up at its imposing grandeur. De Chirico included prominent clocks looming like Van Gogh's suns in a number of paintings: *The Delights of the Poet* (1913), *The Soothsayer's Recompense* (1913), *The Philosopher's Conquest* (1914), and *Gare Montparnasse (The Melancholy of Departure)* (1914). In all but the first of these a railroad train chugs by, which suggests that he may have deliberately connected the railroads and the standard time that began to be imposed on a global scale precisely in 1912. Although the titles of the paintings suggest transcendence in space and time, the clocks fix the action in a single and immutable moment. There is a rigid, static quality to them that no train journey or soothsayer's vision could undo. Unlike Cézanne, Gris, and Gleizes, de Chirico chose to concede that the plastic arts are condemned to a single moment, and he celebrated the dominating power of clock time by making its universal symbol so prominent.

As if that concession to round and wholly visible clocks were too much to endure, some years later Salvador Dali painted three melting watches in *The Persistence of Memory* (1931). One is hanging from a tree in a reminder that the duration of an event may be stretched in memory. Another with a fly on it suggests that the object of memory is some kind of carrion that decays as well as melts. The third deformed watch curls over a hybrid embryonic form—symbol of the way life distorts the geometrical shape and mathematical exactness of mechanical time. The one unmelted watch is covered with ants that seem to be devouring it as it devours the time of our lives.

Aside from de Chirico, who placed readable clocks clearly in view, all the other painters deformed, obscured, or defaced these reminders that their genre is incapable of representing time. Lessing's

iron law was challenged but never surmounted. The argument on behalf of the flux of time would be carried through more effectively by the philosophers and novelists who could give it an extended formulation.

The theory that time is a flux and not a sum of discrete units is linked with the theory that human consciousness is a stream and not a conglomeration of separate faculties or ideas. The first reference to the mind as a "stream of thought" appears in an essay by William James in 1884, which criticized David Hume's view of the mind as an "agglutination in various shapes of separate entities called ideas" and Johann Herbart's representation of it as the result of "mutual repugnancies of separate entities called *Vorstellungen*."³⁹ His descriptions of this "vicious mode of mangling thought's stream," this "illegitimate" and "pernicious" treatment of atoms of feeling, anticipate Bergson's characterizations of the spatial representation of time as a "vice." James distinguishes between the separate "substantive parts" and the fluid "transitive parts" which have been neglected by sensationist psychologists. Utilizing his favorite metaphor for the activity of the mind, James ridicules associationist psychology as saying that the river is composed of "pailfuls" of water. Rather "every image in the mind is steeped and dyed in the free water that surrounds it." Each mental event is linked with those before and after, near and remote, which act like a surrounding "halo" or "fringe." There is no single pace for our mental life, which, "like a bird's life, seems to be made of an alternation of flights and perchings." The whole of it surges and slows, and different parts move along at different rates, touching upon one another like the eddies of a turbulent current.

In 1890 James repeated these arguments in a popular textbook of psychology and added a formulation that subsequently became famous. "Consciousness does not appear to itself chopped up in bits. Such words as 'chain' or 'train' do not describe it fitly . . . It is nothing jointed; it flows. A 'river' or a 'stream' are the metaphors by which it is most naturally described. In talking of it hereafter, let us call it the stream of thought, of consciousness."⁴⁰ Although James and Bergson tended to use somewhat different metaphors to characterize thought, they agreed that it was not composed of discrete parts, that any moment of consciousness was a synthesis of an ever changing past and future, and that it flowed.

In *An Introduction to Metaphysics* (1903) Henri Bergson approached

the subject of the fluid nature of time by distinguishing two ways of knowing: relative and absolute. The former, impoverished kind is achieved by moving around an object or by coming to know it through symbols or words that fail to render its true nature. Absolute knowledge is achieved by experiencing something as it is from within. This absolute knowledge can only be given by intuition, which he defined as "the kind of intellectual sympathy by which one places oneself within an object in order to coincide with what is unique in it and consequently inexpressible." Here we encounter a major difficulty. If absolute knowledge, the goal of his philosophy, is inexpressible, how can we write about it usefully? Bergson strives to communicate this kind of knowing, and the existence that comes from it, by a series of analogies and metaphors, all of which, he is quick to admit, can never fully express it, but the metaphors succeed in part because we all share one experience of intuition: "our own personality in its flowing through time—our self which endures." When he contemplated his inner self he found "a continuous flux, a succession of states, each of which announces that which follows and contains that which precedes it." This inner life is like the unfolding of a coil or a continual rolling of a thread on a ball. But as soon as he suggested these similes he conceded that they were misleading, because they referred to something spatial, whereas mental life is precisely that which is not extended in space but in time. In a final effort to provide an approximate analogy Bergson directed the reader to imagine "an infinitely elastic body [which cannot be imagined], contracted, if it were possible [which it is not] to a mathematical point." Imagine a line drawn out of that point, and then focus not on the line but on the action by which it is traced. Then "let us free ourselves from the space which underlies the movement in order to consider only the movement itself, the act of tension or extension, in short pure mobility. We shall have this time a more faithful image of the development of our self in duration."⁴¹ Bergson thus asks us to imagine something which is unimaginable, conceive of an action of that unimaginable image which is inconceivable, and then effect a limitation of our attention to an aspect of that action which is impossible. The effect of this trying analogy is to underline the difficulty of expressing in words the true nature of our existence in time, which he called "duration" (*durée*).

Bergson became incensed at the way contemporary thought, especially science, tended to distort the real experience of *durée* and

represent it spatially, as on a clock. A quarter of an hour *becomes* the 90-degree arc of the circle that is traversed by the minute hand. In another argument against the translation of time into space he refuted Zeno's "proofs" that motion or change is impossible. Zeno concluded that if an arrow in flight passes through the various points on its trajectory, it must be at rest when at them and therefore can never move at all. Bergson countered that the mistake was in assuming that the arrow can be *at* a point. "The arrow never is in any point of its course. The most we can say is that it might be there, that it passes there and might stop there."⁴² Movement, like time, is an indivisible flux. Zeno founders on the assumption that such a division is possible and that "what is true of the line which traces the path followed is true of the movement." The line may be divided but the movement may not. And so with time: we cannot consider movement as a sum of stoppages nor time as a sum of temporal atoms without distorting their essentially fluid nature.

Bergson's theory of duration generated a broad and varied cultural response ranging from passionate support to frantic condemnation. In the 1890s Georges Sorel developed a blueprint for socialist revolution that was intended to create an "intuition" of socialism for the workers by having them participate in a general strike. In Bergsonian language Sorel argued that the scientific analysis of revolutionary socialism is static and misses the essential nature of historical change, which must be intuited in its durational flux. He found the European working class stopped in its revolutionary course like Zeno's arrow was stopped in flight—artificially frozen by analyses that obscured the essential indivisibility of change and movement.⁴³ Charles Péguy used Bergson's philosophy to attack the Cartesian tradition that he believed locked French thought in unproductive rigidity.⁴⁴ Péguy explained the spiritual death of modern Christianity by its mindless repetition of fixed ideas: layers of habit stifle the dynamic energies of true faith.

In the concluding paragraph of *Creative Evolution* Bergson outlined the proper aim of the philosopher who dispenses with all fixed symbols. "He will see the material world melt back into a single flux, a continuity of flowing, a becoming." This vision horrified some of Bergson's critics. Perhaps the most colorful of his detractors, and certainly the most hysterical, was the English artist Wyndham Lewis, who in 1927 concluded that Bergson's romance with flux was the start of a most unfortunate development in the modern world which cooked up all the articulate distinctions of clear analysis into a murky durational stew. Lewis accused Bergson of putting the hy-

phen between space and time, and he registered his passionate disapproval:

As much as he enjoys the sight of things 'penetrating' and 'merging' do we enjoy the opposite picture of them standing apart—the wind blowing between them, and the air circulating freely in and out of them: much as he enjoys the 'indistinct,' the 'qualitative,' the misty, sensational and ecstatic, very much more do we value the distinct, the geometric, the universal, non-qualified—the clear light, the unsensational. To the trance of music, with its obsession of *Time*, with its emotional urgency and visceral agitation, we prefer what Bergson calls 'obsession of Space.'

Lewis viewed Bergson's philosophy and Einstein's physics as well as a good deal of literature of the period as "one vast orthodoxy" that conspired to remove clean lines from art and separate faculties from human perception. He found another example of Bergsonian fluidity in the "softness, flabbiness, and vagueness" of James Joyce's *Ulysses*.⁴⁵

Joyce's treatment of the stream of consciousness is the culmination of a literary development first explored by Sterne and revived in 1888 by Edouard Dujardin in a novel in which the protagonist's thoughts about past and future are presented along with his current perceptions. This technique has been identified as the direct interior monologue, because the inner workings of the mind are given directly without authorial clarifications such as "he thought" or explanations of what is happening.⁴⁶ Many writers before Dujardin had attempted to *analyze* the thoughts of a character, and occasionally they had narrated as if through a character's consciousness, but none had made prespeech levels of consciousness the subject of an entire novel. Although the technique is intended to recreate the entirety of consciousness, it is especially well suited to deal with its temporal fluidity, as the following passage reveals:

The hour is striking, six, the hour I waited for. Here is the house I have to enter, where I shall meet someone; the house; the hall; let's go in. Evening has come; good the air is new; something cheerful in the air. The stairs; the first steps. Supposing he has left early; he sometimes does; but I have got to tell him the story of my day. The first landing; wide, bright staircase; windows. He's a fine fellow, friend of mine; I have told him all about my love affair. Another pleasant evening coming on. Anyway he can't make fun of me after this. I'm going to have a splendid time.⁴⁷

Although the narrative time of the segment lasts only a few seconds, the private time extends over a large duration and shifts erratically in it. Dujardin's direct interior monologue expressed the inner workings of the mind with its brief span of attention, its mixture of thought and perception, and its unpredictable jumps in space and time.

The term "stream of consciousness" came into literary use after 1890, following William James's famous definition. Although *Ulysses* was no mere application of either Dujardin's direct interior monologue or James's stream of consciousness, it provides a superb embodiment of a generation of developments in literature and philosophy on the nature of human consciousness and its life in time. Sections of direct interior monologue are scattered throughout the novel, with a final uninterrupted flow of it as Molly Bloom fades into sleep at the end. The different verb tenses in one passage reveal her widely ranging leaps about the temporal spectrum.

... my belly is a bit too big Ill have to knock off the stout at dinner or am I getting too fond of it the last they sent from ORourke's was as flat as a pancake he makes his money easy Larry they call him the old mangy parcel he sent at Xmas a cottage cake and a bottle of hogwash he tried to palm off as claret that he couldnt get anyone to drink God spare his spit for fear hed die of the drouth or I must do a few breathing exercises I wonder is that antifat any good might overdo it thin ones are not so much the fashion now garters that much I have the violet pair I wore today thats all he bought me out of the cheque he got on the first ...⁴⁸

The metaphor of "stream" is not entirely appropriate to describe this mental activity, because it suggests a steady flow in a fixed course, while Molly's mind revolves about her universe in defiance of conventional calculations of its pace or direction. In this final episode Joyce achieves the fullest expansion of the time of Molly's world as it is experienced in her consciousness. It is the only episode to which Joyce assigned no particular hour of the day and its symbol is that of eternity and infinity—"∞."⁴⁹ The rigid dimensions of conventional time with its sharp dividers are useless to plot the action of her mind. It is as irrelevant to ask when Molly is having these thoughts as it is silly to ask where. They are an endless rewriting of the story of her life that change with every passing reflection and every flickering of sexuality. Her memory is not a faculty for bringing fixed ideas out of

the past; it is one that enables her to transform them repeatedly in the endless creativity of her present consciousness, where all is fluid without separate thoughts or isolated moments of time.



The structure of history, the uninterrupted forward movement of clocks, the procession of days, seasons, and years, and simple common sense tell us that time is irreversible and moves forward at a steady rate. Yet these features of traditional time were also challenged as artists and intellectuals envisioned times that reversed themselves, moved at irregular rhythms, and even came to a dead stop. In the *fin de siècle*, time's arrow did not always fly straight and true.

This challenge had a basis in two technological developments: the electric light and the cinema. The first commercially practical incandescent lamp was invented by Thomas Alva Edison in 1879, and three years later he opened the first public electric supply system at the Pearl Street district of New York that made possible the widespread use of the electric light. The eminent historian of architecture Rayner Banham has called electrification "the greatest environmental revolution in human history since the domestication of fire." One of the many consequences of this versatile, cheap, and reliable form of illumination was a blurring of the division of day and night. Of course candles and gas lamps could light the darkness, but they had not been able to achieve the enormous power of the incandescent light bulb and suggest that the routine alternation of day and night was subject to modification. One of many such observations occurs in a novel of 1898, where a Broadway street scene at dusk is illuminated by a flood of "radiant electricity" which gave the effect of an "immortal transformation" of night into day.⁵⁰

From another perspective, the cinema portrayed a variety of temporal phenomena that played with the uniformity and the irreversibility of time. A pioneer of the cinema in France, Georges Méliès, recalled an incident that inspired a series of tricks of motion picture photography. One day in 1896 he was filming a street scene at the Place de l'Opéra and his camera jammed. After a few moments he got it going and continued filming, and when he projected the entire sequence it created the illusion that an omnibus had suddenly changed into a hearse.⁵¹ This suggested to Méliès several other ef-

fects he could achieve by stopping the camera and changing the scene. He used this technique in *The Vanishing Lady* (1896) where a skeleton suddenly becomes a living woman, implying both a jump in time and its reversal.

Méliès stopped the camera to effect these tricks. The American film maker Edwin S. Porter discovered that time could be compressed, expanded, or reversed in a more versatile way by editing the film. Intervals of time could be literally cut out of a sequence and temporal order could be modified at will. He applied those techniques in *The Life of an American Fireman* (1902), where we see first someone setting off a fire alarm and then the sleeping firemen just before the alarm sounds. David Griffith developed the technique of parallel editing to expand time by showing simultaneous action in response to a single event. In *A Corner on Wheat* (1909) Griffith first used the freeze-frame technique by having his actors hold still to create the illusion of stopping time.⁵² In 1916 Hugo Münsterberg noted that several contemporary playwrights attempted to imitate the cinema and use time reversals on stage as in Charlotte Chorpenning's *Between the Lines*, where "the second, third, and fourth acts lead up to the three different homes from which the letters came and the action in the three places not only precedes the writing of the letters, but goes on at the same time."⁵³

An even more striking representation of time reversal was produced by running film backwards through the projector, first tried by Louis Lumière in *Charcuterie mécanique* (1895). One cinema critic described these amazing effects: boys fly out of water feet first and land on the diving board, firemen carry their victims back into a burning building, and eggs unscramble themselves. His account of a mass of broken glass ascending through space and reforming on a table into the perfect original suggests a Cubist decomposition in reverse.⁵⁴

Several prominent novelists commented on the problems they faced in presenting the passage of time; some found solutions unmistakably parallel to, if not directly inspired by, the innovative temporal manipulations of the cinema. Conrad's method was to isolate a particular moment and hold it up for extended scrutiny as if suspended in time.⁵⁵ Ford Madox Ford summarized a view that he and Conrad shared.

It became very early evident to us that what was the matter with the Novel, and the British Novel in particular, was that it

went straight forward, whereas in your gradual making acquaintanceship with your fellows you never do go straight forward . . . To get . . . a man in function you could not begin at his beginning and work his life chronologically to the end. You must first get him with a strong impression, and then work backwards and forwards over his past.

Life does not say to you: in 1914 my next door neighbor, Mr. Slack, erected a greenhouse and painted it with Cox's green aluminum paint . . . If you think about the matter you will remember in various unordered pictures, how one day Mr. Slack appeared in his garden and contemplated the wall to his house.⁵⁶

In *Ulysses* Joyce created a dramatic interruption in the forward movement of narrative time. As Bloom approaches a brothel he steps back to avoid a street cleaner and resumes his course forty pages and a few seconds later. In those few seconds of his time the reader is led through a long digression that involves dozens of characters and covers a period of time far exceeding the few seconds that elapsed public time would have allowed. Virginia Woolf believed that it was the writer's obligation to go beyond "the formal railway line of a sentence." "This appalling narrative business of the realist: getting on from lunch to dinner, it is false, unreal, merely conventional." She also recorded Thomas Hardy's observation about the new way of rendering time in literature: "They've changed everything now. We used to think there was a beginning and a middle and an end. We believed in the Aristotelian theory."⁵⁷

Psychologists and sociologists observed modifications of the continuity and irreversibility of time in dreams and psychoses and in religion and magic. In a letter of 1897 Freud commented on the temporal distortions he observed in dreams and fantasies. There occurs a distortion of memory that comes from "a process of fragmentation in which chronological relations in particular are neglected."⁵⁸ In *The Interpretation of Dreams* Freud surveyed how the sequence of experiences in the course of our conscious life is rearranged to suit the needs of the dreaming mind. The psychic forum of our instinctual life, primary process, entirely disregards the demands of logic and space as well as time. In 1920 he summarized his theory that unconscious mental processes are "timeless," for the passage of time does not change them in any way and "the idea of time cannot be applied to them."⁵⁹

"Summary Study of the Representation of Time in Religion and

Magic" (1909), by Henri Hubert and Marcel Mauss, argued that time in religion and magic serves a social function and provides a framework for the qualitative rather than the quantitative experience of succession. They viewed time as heterogeneous, discontinuous, expandable, and partially reversible. With Durkheim they contended that the social origin of time insures its heterogeneity. In contrast to most views of the calendar as quantitative, they proposed that it is qualitative, composed of special days and seasons. Sacred time is also discontinuous, for such events as the appearance of a deity interrupt ordinary continuity. Periods separated in chronology can be linked in their sacred function to give time a "spasmodic character." Some special moments may "contaminate" the entire interval that follows, and instants may be united if they have the same religious significance. Time can also be expanded, as "heroes can live years of magical life in an hour of ordinary human existence." Their observation that rites of entry and exit may be united over time implies a partial reversibility as end is joined with beginning.

Following Bergson, Hubert and Mauss believed that time is dynamic, and they endorsed his substitution for time-images of position and succession the concept of time as an "active tension by which consciousness realizes the harmony of independent durations and different rhythms." But they differed from Bergson in the extent to which they were willing to allow public time to be part of the inner consciousness of time. They maintained that public time is one pole of the "scale of tensions of consciousness." "The play of notions, which distinguishes the psychological reality of successive images, consists in the adjustment of two series of representations. The one is constant and periodic: it is the calendar . . . The other constructs itself perpetually by the action of generating new representations. The mind works constantly to associate in a single tension certain elements of these two series." The time of magic and religion is a compromise among interpsychic tensions set up by our private experience of a uniform and homogeneous time. The celebration of an anniversary, especially one associated with magical and sacred happenings, is an integration of our own unique rhythm of living with the uniform rhythm observed by a social community.⁶⁰

Their argument that the divisions of time "brutally interrupt the matter that they frame" parallels a revolutionary theory of Einstein's about the interaction of time and matter that further challenged the classical theory of the irreversibility of time. Newton believed that no occurrence in the material world could affect the flow of time, but

Einstein argued that the relative motion between an observer and an object makes the passage of time of the object appear to go more slowly than if it were observed from a point at rest with respect to it. Therefore it is possible for event A to be observed from one point and seen as occurring before event B, and after it when observed from another point, if relative motion is involved. However, the succession of events that occur at the same place and the succession of causally related events are not reversible from any conceivable conditions of observation, and thus remain absolute in relativity theory.⁶¹

We all learn to tell time with ease, but to tell what it is remains as baffling as it was to Saint Augustine over fifteen hundred years ago. "What, then, is time?" he asked. "If no one asks me, I know what it is. If I wish to explain it to him who asks me, I do not know." In the period we are looking at, the question was taken up repeatedly and with a determination to break through the impasse that had stopped Augustine. There was a sharp rise in the quantity of literature about time, and contemporary observers thought that this was of historical significance. Already in 1890 the British philosopher Samuel Alexander hailed Bergson as the "first philosopher to take time seriously." A French critic saw Proust as the first to discover "that our body knows how to measure time," and Wyndham Lewis bemoaned the preoccupation with time by so many of that generation.⁶²

Contrasting views about the number, texture, and direction of time were complicated by the fact that generally two kinds of time were being considered: public and private. The traditional view of a uniform public time as the one and only was not challenged, but many thinkers argued for a plurality of private times, and some, like Bergson, came to question whether the fixed and spatially represented public time was really time at all or some metaphysical interloper from the realm of space. The introduction of World Standard Time created greater uniformity of shared public time and in so doing triggered theorizing about a multiplicity of private times that may vary from moment to moment in the individual, from one individual to another according to personality, and among different groups as a function of social organization. Similarly, thinkers about the texture of time were divided between those who focused on its public or its private manifestations. The popular idea that time is made up of discrete parts as sharply separated as the boxed days on

a calendar continued to dominate popular thinking about public time, whereas the most innovative speculation was that private time was the real time and that its texture was fluid. The argument about time going in one direction also separated along the lines of public and private time. Only Einstein challenged the irreversibility of public time, and even then for a special kind of event series that occurs in different sequences when viewed from different moving reference systems. All others left public time to flow irreversibly forward but insisted that the direction of private time was as capricious as a dreamer's fancy. The temporal reversals of novelists, psychiatrists, and sociologists further undermined the traditional idea that private time runs obediently alongside the forward path of public time.

The thrust of the age was to affirm the reality of private time against that of a single public time and to define its nature as heterogeneous, fluid, and reversible. That affirmation also reflected some major economic, social, and political changes of this period. As the economy in every country centralized, people clustered in cities, and political bureaucracies and governmental power grew, the wireless, telephone, and railroad timetables necessitated a universal time system to coordinate life in the modern world. And as the railroads destroyed some of the quaintness and isolation of rural areas, so did the imposition of universal public time intrude upon the uniqueness of private experience in private time. It was a subtle intrusion, one that appears sharper in historical perspective than it did around the turn of the century. Conrad dramatized the tension between authoritarian world time and the freedom of the individual by having the anarchist leader ask Mr. Verloc to prove himself by "blowing up the meridian." Most spokesmen for private time, however, did not identify the connection between the new world time and urban clustering, monopoly, bureaucracy, or big government, though it seems likely that their statements were energized in part by a reaction to the intrusion of a variety of collectivizing forces in this period, including World Standard Time.

The technology of communication and transportation and the expansion of literacy made it possible for more people to read about new distant places in the newspaper, see them in movies, and travel more widely. As human consciousness expanded across space people could not help noticing that in different places there were vastly different customs, even different ways of keeping time. Durkheim's insistence on the social relativity of time challenged the tem-

poral ethnocentrism of Western Europe, in the same way as the literary explorations of private time challenged the authoritarian and overbearing tendencies of world time.

All across the cultural record we have identified polarities: three divisions about the nature of time—its number, texture, and direction—as well as a basic polarity about the reality of private as opposed to public time. The sense of time throughout this period emerged from tensions and debates in physical science, social science, art, philosophy, novels, plays, and concrete technological change. In tracing its various modes of past, present, and future we will see other polarities over different issues, structuring the culture through conflict.