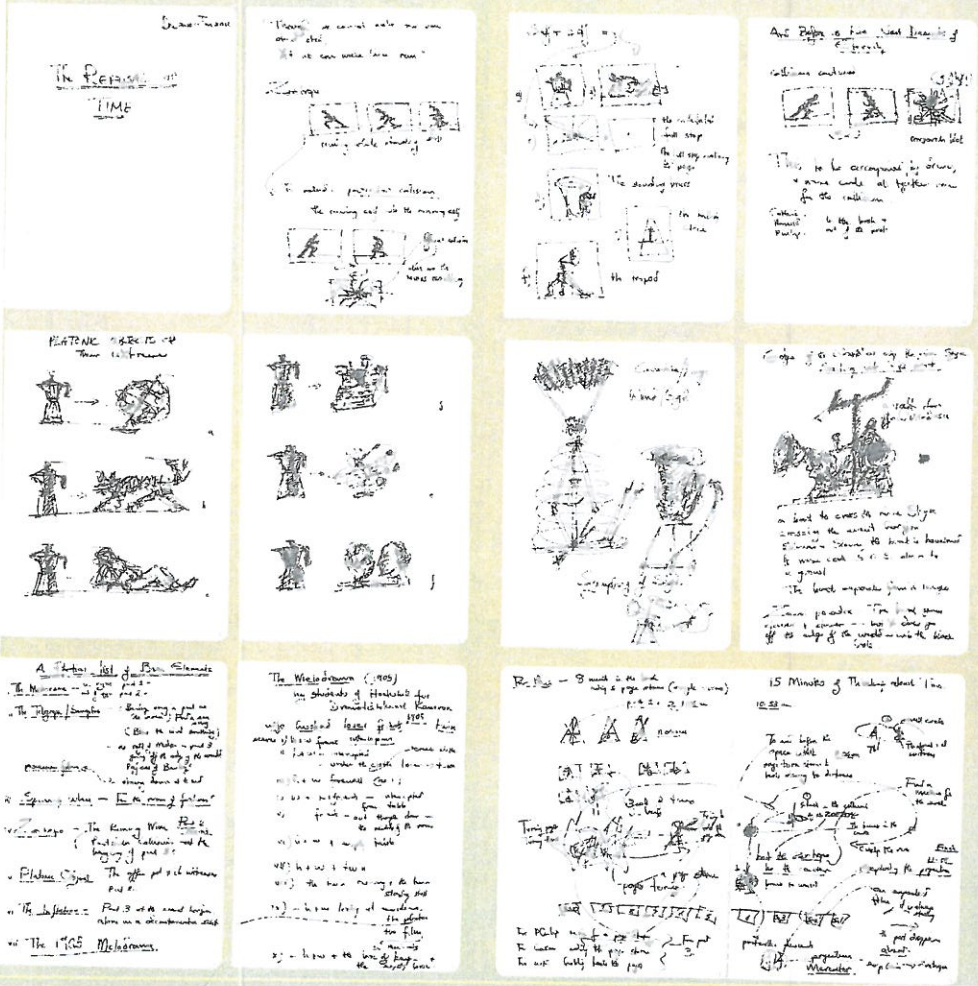
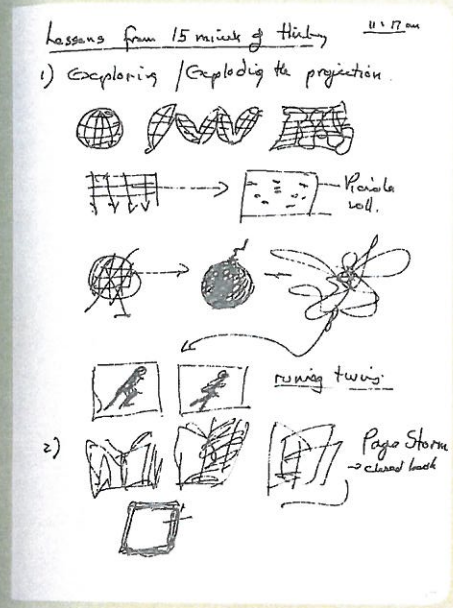
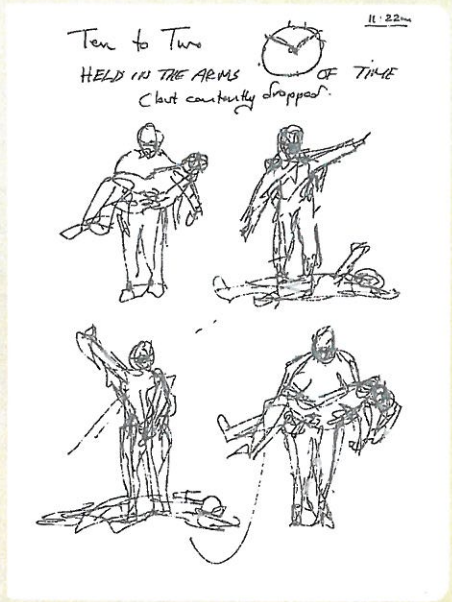
№009

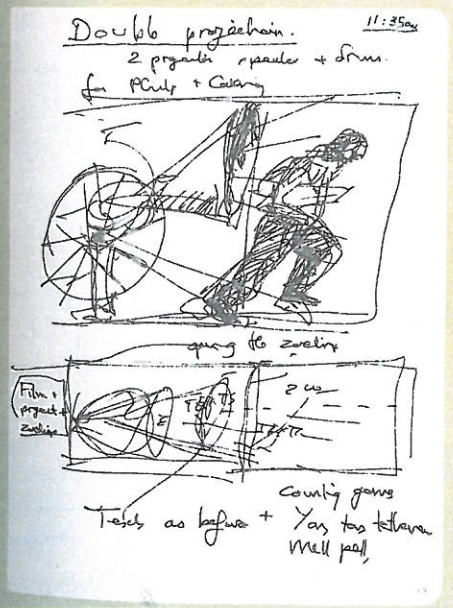
William Kentridge & Peter L. Galison

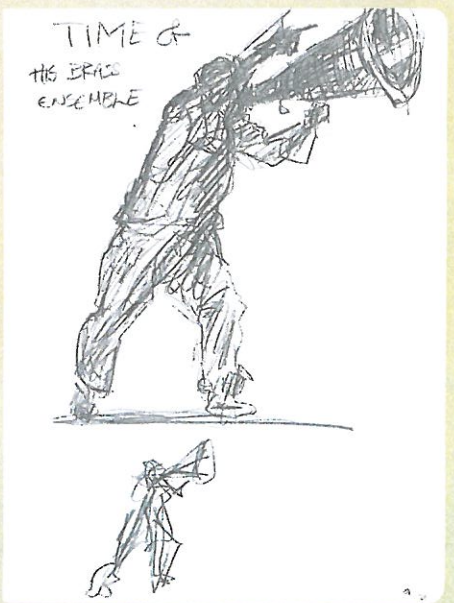
The Refusal of Time











ime + Cis concertina.

YET WE CAN MAKE HIM RUN

Start with

TIME in his overalls · with his oil-can guitar + concertina.

Time fallen on hard days

Start with

Time alone with his guitar · calling the metaverses to being to order

joined by he who is late · she who is early

later to become the putti on the border of the black hole.

End with

Time as pied-piper as judas goat-

Time as Black Hole Barker

" Come on in ..
All sins forgiven
All nightmares forgotten
Leave your coats at the door
Ladies this side
Gents this side.
You to the left.
Yes, sir, to the right.
Step this way.

Who walks against the stream.

BLACK HOLE TARANTELLA

TIME AT THE END OF HIS TETHER.

Time + Cis concertina

Procession of the Damned.

t Book without God 12 minutes of counting

...ology — 6 separate lectures
each found on a page,
lost, refound
at times – 2 different lectures
on the same page

Multiply the volumes – a cacophony
of information.

Some lectures stuck, always relaying.

The Elements

1) Talking Clock – wire, ball, drumstick
reading out real time
(every 10 seconds)

2) Twins – Einsteinian Time
The mirror clock

WTI Demanbate = mirror –
Illustrate on Book.

12 MINUTES & COUNTING

③ Platonic Objects + their
Witnesses
K, M, + their refutation.
(in some volumes the coffee pot
rotates, lecture continues on other
pages)

④ Getting rid of Old Books,
Throwing the encyclopaedia into the
Black Hole
Getting rid of the evidence
Guilty crimes can be covered up

Blowing up the Meridian.
Keeping Once own Sun.
Time as Grief refusing the ~~passage~~.

Pneumatic time,
The City filled with sighs.
Gasps of amazement sent from
astonishment to astonishment

Ladies + Gentlemen,
'Man is a talking clock'

MAN AS TALKING CLOCK.

Silence against Time

Further Tests for Projection

① HOLDING YOUR BREATH

② THE PAUSE

BEFORE

THE FINAL

NOTE

③ DANCING WITH THE FAT MAN.

– HOLD YOUR BREATH
– SAY SOMETHING
– THE MOON IS LIKE A BLOODY BLADE.

④ FORENSIC SYLLOGISM.

Captain for the Melodrama

- Fact –
- Surmise –
- Suspicion –

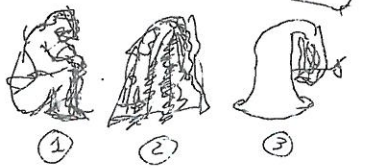
- Evidence

Syllogism. –

- Revenge
- Remorse

- Beyond the Event Horizon
(Dancing with the Fat Man)

Syllogism against Nature

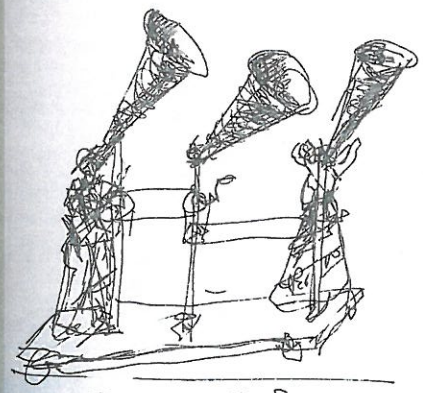


BREATHE
BERATE

INSPIRE – Holding your breath
EXPIRE – against time.

INHALATION
EXHALATION
ANNIHILATION

Music – the gap between notes – the
pause before the
final note.



Background Radiation
Chorus of Matter Code.

THE FULL STOP
THAT
UNMAKES
THE SENTENCE.

Peter L. Galison
The Refusal of Time

Part I: A River of Absolute Time

On Saturday, September 28, 1889, representatives of eighteen countries gathered in Sèvres, outside Paris. They were there to bring the world under the measure of a single meter known as **M** and a single kilogram, **K**—to bless a particular ruler and a particular weight. The conference arbitrarily chose one meter stick and one sample weight from thirty nearly identical copies, declaring: "This prototype of the meter will from now forward represent, at the temperature of melting ice, the metric unit of length. . . . This prototype [of the kilogram] will be considered from now on the unit of mass."[1] Each delegate strode solemnly to receive his country's copy of the iridium-platinum X-shaped bar, his nation's exemplary weight.

Until the sanctioning ceremony, **M** and **K** had been but two of many—carefully—measured standards. No one among them was yet crowned as the one perfect length or weight. All were certified to be within two ten-thousandths of a meter of all their siblings; this bar might be 1.0001 meters long compared with another, that one 0.9998 meters. But at 1:30 pm that afternoon, the officials loaded the chosen ones—**M** and **K**—into a triple-locked vault, **M** in a sealed, felt-lined brass cylinder and **K** in a triple bell jar. Standard-bearers then took **K** for burial, with **K** always surrounded by its six *témoins*. These copies of the kilogram were witnesses in the truest sense, chosen to bear witness with their very bodies should anything untoward befall the standard.

The director of the International Bureau of Weights and Measures locked the case with two keys, secured the inner basement door with a third key, and bolted the exterior door with a fourth and a fifth key. The president of the conference then handed keys in sealed envelopes to the director of the International Bureau, to the general guard of the National Archives, and to the President of the International Committee for Weights and Measures.

At that moment, **M** and **K**, two of the most precisely forged and measured objects in history, the most individually specified human-made things, became, in burial, the most universal. What had been measured now defined the meter: **M** was One Meter, no more, no less. Every other length in the world took its measure from it. **K** was One Kilogram—every atom and asteroid, every galaxy and giraffe, would be given in terms of those two metal objects deep below-ground at the Pavillon de Breteuil in Sèvres.

Here was a way to populate Plato's heaven: the single buried object became a guiding universal. Governments wanted conventions to govern train tracks and temperature, electrical power, gears, and steam engines. Most of all, they wanted to standardize time. From a master clock controlled by the Paris observatory itself, the Control Room, rue du Télégraphe, pipes carried pulses of air—that is, pulses of time—under the streets to reset clocks. Citizens gathered around the public clocks in their *arrondissement* to admire the coordinated time. Soon they began to demand even greater precision—adjustments that would make their clock display noon corrected for the seconds it took the pulse to traverse the city.

Others balked. In August 1880, a Parisian poet, M. Porto-Riche, living above the central workshop for the pneumatic distribution of time, heard the driving pulses, absorbing the beats without variation or limit. Here was the rhythm of everything modern, correct time pulsed to all Parisians. Porto-Riche sued the company, successfully, protesting that the pressure blasts of airtime were destroying the very foundations of his muse, in his, the most creative of all jobs.

Meanwhile, French administrators looked with anxiety and admiration at the American system of electrical time networks and the British array of undersea cables to link clocks around the nation's vast empire. When a cable reached the shores of Recife in Brazil, Emperor Pedro II came down to the beach to witness the arrival of European time, time synchronized to the globe's zero point, the Royal Observatory in Greenwich.

Others watched from the shadows. On Thursday, February 15, 1894, a young French anarchist, Martial Bourdin, bought a ticket from Westminster Bridge to Greenwich. Two lab assistants in the computing room heard a huge explosion. One recorded: "I immediately remarked to Mr. Hollis, 'That is dynamite! Spot the time.'" 4:51 went into the books, observed with the precision for which the assistants were trained. Anarchists fingered a police setup; the police smelled an anarchist conspiracy.[2] Joseph Conrad imagined a secret agent caught in the crossfire of dupes, manipulators, and careerists. His conniving First Secretary of a foreign power told his fellow conspirators that there was better terrorism than murder or destruction of art—best would be an assault on science, ideally a bomb into the heart of pure mathematics; short of that "the attack must have all the shocking senselessness of gratuitous blasphemy." It must kill the heart of material prosperity. "The blowing up of the first meridian [time zero] is bound to raise a howl of execration."[3]

But the never-ending expansion of the time-unification zone continued. Cables snaked under the sea down the West Coast of Africa, making landfall at the colonial capitals, like Dakar. It crossed the seas and headed up into the Andes, wound down into Haiphong Harbor . . . everywhere telegraph lines could reach, the time signals did, too. Time, weight, length began to cover the globe: a planetary machine that would bring the world under one ticking clock.

And yet, standards change. It seems that **K** has lost fifty millionths of a gram over the past 120 years—relative to the witnesses buried with it. No one can explain this loss. But at this rate, in 2.4 billion years, the entire weight will be gone. Then the standard weight will be the guide to the masses of every weight in the universe and yet there will be nothing in the bell jar at all. This suggests an intriguing program. An empty bell jar could contain the ideal (vanished) cat, another the ideal (departed) typewriter, a third the

ideal (disappeared) phonograph . . . an entire universe populated by the nonexistent, failed objects that are, for their lack of reality, the most real of all.

Part II: A Peculiar Consequence

Albert Einstein, the iconic physicist of the long twentieth century, was born in 1879. So was his friend the terrorist physicist Friedrich Adler. The two took classes together in Zurich; both married Slavic women, both couples had children about the same age, both families lived in the same house at 12 Moussonstrasse. Here, Adler reported to his father, were parallel lives. Einstein and Adler retreated to the attic to think physics: "The more I talk to Einstein," Adler related, "the more I realize that my favorable opinion was justified. . . . We find ourselves in agreement on questions which the majority of other physicists would not even understand."[4] Both followed the physicist-philosopher Ernst Mach, both despised old ideas of absolute time that made no contact with tangible things. When Einstein left for Prague, he wrote, ". . . I wish that Adler would become my successor."[5] In 1908, both applied for the same job—but Adler cautioned the authorities, "If it is possible to obtain . . . Einstein . . . it would be absurd to appoint me."[6] Einstein was chosen; Adler abandoned physics for politics.

Einstein pointed to the peculiarity of light: unlike a bus or even sound, we can never begin to catch up to light, not even by a fraction. Einstein's time and simultaneity were nothing but measures and signals, no universal duration, no sheltering River of Absolute Time. He imagined a clock of pure light, a flash bouncing back and forth between a mirror at your feet and one above your head. One bounce, one click. Fly by another person and he sees your light as traveling on a slant. A slant track from one mirror to the other is longer than a perpendicular one—but light always travels at the same speed so it takes longer on the slant. As night follows day, the still person watching you says your moving light clock is running slow.

Einstein: "This yields the following peculiar consequence."[7] Every person in motion carries a private time. One twin flies out and back, returning to find his double, his twin, already dead for a thousand years. Einstein refused to accept what he called the "universally audible tick-tock"[8] of classical physics. "Newton, forgive me,"[9] he wrote.

Now a physicist without physics, Adler headed back to Socialist headquarters in Vienna where he saw Trotsky, directed the journal *Der Kampf*, served as Party Secretary; Einstein plunged ever deeper into space and time. World War I and its chauvinistic slaughter revolted both twins. Einstein allied himself with pacifists around Europe and, in 1915–16, canceled the picture of space as an empty volume, and instead made space and time into a curved, all-pervading field. No physics, petitions, or proclamations for Adler. On October 21, 1916, he picked up a Browning pistol, walked over to the prime minister of Austria as he ate lunch, and put three bullets in his head. Condemned to die by hanging, a sentence later commuted, Adler sat in a cell and began corresponding with Einstein—about the paradox of twins and their clocks.

Einstein spoke out for Adler, gave interviews about Adler's work in physics, protested to those who would listen that Adler was one of the purest souls he had ever encountered. Einstein: "My compassion for him has grown so strong that I really would like to do something for him." To the emperor: "His Majesty! . . . The political murder, of which Fritz Adler is guilty, shook the well-being of every rightly sensitive person in the deepest way. With not a single word will I prettify this gruesome act . . . however, it seems to me to have to do with a tragic accident rather than a crime. Few can have known Herrn Adler so well as me." "Purest character." "Unparalleled selflessness." "Unqualifiedly reliable and honest." "I herewith submit to your majesty, from the bottom of my heart, a plea for you to invoke the law of clemency, in the event that Adler is sentenced to death."[10]

Einstein to the condemned Adler himself: "How much I would like to discuss the relativity problem with you!"[11] Adler: "I awoke Saturday with the solution to a small [physics] problem."[12] "I have found a decisive criterion in relativity theory that rules against . . . Einstein."[13]

Adler: I refuse Einstein's times. It cannot be that time passes slower for one twin than the other; how could they be different? How could one age and the other not? Wouldn't the first twin's view of the second just be exactly like the second twin's view of the first? Nonsense, Einstein replies, "We imagine my standard clocks as having been produced identically . . . by a clockmaker who enjoys a world monopoly."[14] These timepieces are transported everywhere. One is sent out and then returns—the traveling one that turns around is measurably accelerated, the other is not. No symmetry. Then Adler invented a thought machine—with a meter and battery—that he hoped would bring down relativity. Bang: Einstein's theory would die. This time, the target shot back: Einstein, September 1918: "Your bias for absolute time . . . is exposing itself."[15]

Einstein proposed using their exchange as part of a kind of play, a pair of opponents joined in opposition, "Dialogue about Objections to the Theory of Relativity."[16] *Kritikus*: "I want to tell you right away: today I have come to you personally in order to make it impossible for you to shirk [responding] as has happened before. . . . I assure you, I will not yield until you have answered all my questions." Of course, the literary twins enter the dialogue right away, each with his clock. *Relativist* responds—with a dialogue within the dialogue: one from the point of view of stay-at-home Twin-1 and the other from the point of view of the traveler Twin-2. Lo and behold! Though they describe the situation differently, the twins agree: the traveling twin ends up younger. "This clarifies completely the paradox you referred to," says *Relativist*. *Kritikus*: "Your argument leaves me more convicted than really convinced"—sitting in prison, condemned for assassination, on the warpath against Empire and Einstein, Adler was indeed surely more convicted than any other of relativity's critics. Two weeks later, the Austro-Hungarian Empire collapsed. Adler walked out of prison free, a revolutionary hero. The next year, starlight was captured bending around the sun—and Einstein became a saving symbol of a bloody new century.

Orbiting twins, flying twins, accelerating twins—always separating and reuniting. Or separating. And returning to a home long gone, a casualty of time.

Part III: Society for the Destruction of Information

The most important message: "Here is the time at the Paris Observatory." Poincaré telegraphed that dispatch from the Paris Observatory to London, Washington, Dakar—to make a world map around Paris. Einstein imagined his time message sent along the Swiss railway by a flash of light: Bern to Muri, reflected back to Bern: "Bern, train arriving here, 7 pm." By redefining time into time coordinating procedure (send a light signal, take into account the signaling time), physicists had cracked the absoluteness of simultaneity and entangled time with space. "Gentlemen," Hermann Minkowski told his 1908 audience, "Space by itself and time by itself are doomed to fade away into mere shadows. Only a union of the two will retain an independent reality."[17] Spacetime, the three space dimensions plus time, had become a vast, open theater stage on which all the actions of the world would perform.

In the frantic twentieth-century shadow world of illusory time by itself: messages. Everywhere messages saturating newspapers, post, telegraph lines, airwaves. With information came a counterworld of information destruction. Censors plastered white spaces over newspaper articles. Postal workers blacked out letters from the battlefront; radio jammers pumped interference into the ether to block news. Noise against information.

Information must be destroyed. Yes, we live in the Information Society, and we have become familiar with counting it: a 14-K e-mail message, a 2.4-MB picture, a 100-K compressed song. But we also live in the Society for the Destruction of Information. Facilities stand ready to crush your hard drive, pulp your reports, undo your phone records, pulverize your disks. You can pay for documents to be shredded—the tinier the pieces, the pricier the dicing.

Precious data requires more destruction. Confidential material, governments say, should be sliced into 2mm strips. Commercially sensitive paper should be cut into 2-by-15mm particles. Top-secret documents just a few years ago could be snipped into 0.8-by-11.1mm bits. But who knows what information snoops might reconstruct? Remember the Iranian carpet weavers hired in Tehran to sew back together the fragments left in the so-called Den of Spies? Now the National Security Agency wants information blasted down to 1 by 5mm.

But if you really need information destroyed, you want to see it happen before your eyes. You can have a vehicle pull up, and then you can watch through a peephole as the pages are sliced, cut, and burned. You can have them carted to a secure facility where they are shredded, air-blown into randomness, compressed into truckable cubes, bound up with powerful bands, dumped in acid, and re-formed into toilet paper. Other companies turn your documents into animal bedding, playground surfaces, and briquettes.

The Code of Ethics for information destroyers urges its followers not to ever, ever confuse recycling with destruction. Reconstruction looms, ever more sophisticated—so build disintegrators and granulators that slice paper until it will pass through a fine mesh, hammermills that pound bits through mesh, piercing, tearing, grinding.

But somewhere, deep in the background, lie the laws of physics that say that information is never lost. Information always remains, somewhere, and in principle somehow, some way, could be recovered. A quantum demon, an imaginary computer . . .?

Not long ago, the most famous scientist of the late twentieth century, Stephen Hawking, argued that there was a way that information could be destroyed—a method far beyond the dreams of hammering, smashing, grinding wreckers. No, this was a method that would remove the information forever and completely, in principle and absolutely without the possibility of recovery: drop an encyclopedia into a black hole and it would never return. Not even an imaginary demon could ever recover those words.

From the surface of Earth, if you want something to escape from our planet's gravity, you have to shoot it up at about 10 km/second. If Earth weighed more in the same volume, you would need greater speed . . . and if that escape velocity exceeded the speed of light—300,000 km/second—then nothing, not even light, could escape its gravitational trap. That's what happens in a black hole.

According to some key general relativists, an encyclopedia could fall in—but no messages, not the slightest message, can escape. Imagine volumes A–Z falling smoothly into a black hole, sailing past the point of no return, gone forever. John Wheeler (who coined the name "black hole") says, "Every black hole brings an end to time and space and the laws of physics . . . as surely as the Big Crunch will bring an end to the Universe as a whole."[18]

Black-hole absolutists said information could be annihilated in principle, without hope of recovery. Against that view, opposing physicists wanted physics to provide a way out, so the fundamental laws of physics could survive. Memory must not vanish. Entropy and information, they insisted, could not be sucked out of the universe. Some thought the information would leak out like ash bits floating up from a fire. Others hoped that the words of the encyclopedia would be locked in a tiny remnant at the center of the black hole—a lock box secure even if the black hole evaporated to nothing but random light. Yet others began to describe vibrating strings stuck on the horizon, the trace of all in-falling things. Strings would preserve the encyclopedia long after it had crossed into darkness.

According to many leading quantum (string) theorists, all the information of the world encyclopedia stays there, forever, scrambled, like sparkling ashes from a fire, but still there, still inscribed on the surface of a bubble. Every article on aardvarks and arithmetic, the last notes on Zanzibar and zygotes. All there. A holographic trace persisting, inscribing all of our work and imagination . . . the long trail of words wound around the final splintering of spacetime.

The battle pitted two countervailing desires against each other. On one side, the black hole as an absolute end—like the big crunch, bookending our craving for a clean beginning. On the other side, a black hole, indeed the universe, as a kind of hologram, information that falls into the black hole remaining in some sense, always surviving on the outside, carved, as it were, on the event horizon.

The saving hope for the anti-absolutists was string theory. Strings—tiny loops and lines of vibrating matter—would save the information from ultimate destruction. But taking strings seriously

had other consequences for time. For string theorists in the opening years of the twenty-first century, time itself seemed to fail. A century ago, Minkowski had pronounced that space and time separately were doomed to fade into mere shadows. Now, a leading string theorist says, "Space and time are doomed." Another insists that it is "almost certain" that "space and time are illusions." A third adds, "Spacetime . . . we're going to have to give [it] up."[19]

The end of time. This time not because our mortal clock runs down, not even because time depends on motion, or because motion itself is a shadow of frozen spacetime. No, here physics refuses time much more completely: time becomes an illusion, like our sense that water is smooth because our hands are too coarse to sense the atoms that make it up. Time refused: time as nothing but the crude approximation of an obsolete science.

Notes

1 | *Conférence générale des poids et mesures. Rapport sur la construction, les comparaisons et les autres opérations ayant servi à déterminer les équations des nouveaux prototypes métriques. Présenté par le Comité International des Poids et Mesures* (Paris: Gauthier-Villars et Fils, 1889), cited in Peter L. Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W. W. Norton & Company, 2003), p. 88.

2 | Cf. Galison, *Einstein's Clocks, Poincaré's Maps* (see note 1), p. 159.

3 | Joseph Conrad, *The Secret Agent* (Stuttgart: Tauchnitz, 1953), pp. 28–29.

4 | Friedrich Adler to Viktor Adler, Zurich, October 28, 1909, cited in Rudolf Ardelt, *Friedrich Adler. Probleme einer Persönlichkeitsentwicklung um die Jahrhundertwende* (Vienna: Österreichischer Bundesverlag, 1984), p. 166.

5 | Einstein to Alfred Stern, Zurich, December 6, 1910, in *The Collected Papers of Albert Einstein*, vol. 5, *The Swiss Years: Correspondence, 1902–1914*, ed. Martin J. Klein et al., English translation supplement, trans. Anna Beck (Princeton: Princeton University Press, 1993), doc. 236, p. 168.

6 | Friedrich Adler to the Board of Education of the Canton of Zurich, 1908, cited in Ronald Florence, *Fritz: The Story of a Political Assassin* (New York: Dial, 1971), pp. 44–45.

7 | *The Collected Papers of Albert Einstein*, vol. 2, *The Swiss Years: Writings, 1900–1909*, ed. John Stachel et al., English translation supplement, trans. Anna Beck (Princeton: Princeton University Press, 1989), doc. 23, "On the Electrodynamics of Moving Bodies," p. 153.

8 | *The Collected Papers of Albert Einstein*, vol. 7, *The Berlin Years: Writings, 1918–1921*, ed. Michel Janssen et al., English translation of selected texts, trans. Alfred Engel (Princeton: Princeton University Press, 2002), vol. 6, doc. 44a, "The Principal Ideas of the Theory of Relativity," p. 5.

9 | Paul Arthur Schilpp, ed., *Albert Einstein, Philosopher–Scientist*, 2 vols. (La Salle, Ill.: Open Court, 1970), vol. 1, p. 31.

10 | *The Collected Papers of Albert Einstein*, vol. 10, *The Berlin Years: Correspondence, May–December 1920, and Supplementary Correspondence, 1909–1920*, ed. Diana Kormos Buchwald et al. (Princeton: Princeton University Press, 2006), pp. 73–74.

11 | Einstein to Friedrich Adler, April 13, 1917, in *The Collected Papers of Albert Einstein*, vol. 8, *The Berlin Years: Correspondence, 1914–1918*, ed. Robert Schulmann et al., English translation supplement, trans. Ann M. Hentschel (Princeton: Princeton University Press, 1998), doc. 324, p. 615.

12 | Friedrich Adler to Katja Adler, mid-February 1917, in *Rudolf Neck, Arbeiterschaft und Staat im Ersten Weltkrieg 1914–1919*, 2 vols. (Vienna: Europa-Verlag, 1968), vol. 1, doc. 140, p. 235

13 | Friedrich Adler to Viktor Adler, in *Neck, Arbeiterschaft und Staat im Ersten Weltkrieg 1914–1919* (see note 12), vol. 1, doc. 147, p. 244.

14 | Einstein to Friedrich Adler, August 4, 1918, in *The Collected Papers of Albert Einstein*, vol. 8 (see note 11), doc. 594, p. 618.

15 | Einstein to Friedrich Adler, September 29, 1918, in *The Collected Papers of Albert Einstein*, vol. 8 (see note 11), doc. 628, p. 660.

16 | *The Collected Papers of Albert Einstein*, vol. 7 (see note 8), doc. 13, pp. 66ff.

17 | Hermann Minkowski, *Raum und Zeit, Jahresberichte der Deutschen Mathematiker-Vereinigung* (Leipzig: B. G. Teubner, 1909), p. 1.

18 | John Archibald Wheeler and Kenneth Ford, *Geons, Black Holes, and Quantum Foam: A Life in Physics* (New York: W. W. Norton & Company, 1998), p. 350.

19 | Cf. David Gross, "Einstein and the Quest for a Unified Theory," in *Einstein for the 21st Century*, ed. Peter L. Galison, Gerald Holton, and Silvan S. Schweber (Princeton: Princeton University Press, 2008), p. 296.