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"Atomic Explosion Stopped at Millionths of A Second": Media Microtemporalities and Time Synchronisation

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Abstract

From 1945 to the early 1960s, the US government undertook numerous atomic and hydrogen bomb tests. These full-scale explosions were recorded on film from various angles, and at different speeds. Indeed, it soon became required to obtain images of the very first milli-seconds of the expanding phase of the atomic fireball. Ultrahigh-speed cameras able to produce such images were specifically developed for that purpose. This article explores the different "media-temporalities" that intersect in those images. I focus on the "micro-processes happening on a technical level that are very fast," and more specifically the ones that go into the "Rapatronic camera" designed by Harold Edgerton (head of the US national defense contractor company EG&G) to record the atomic fireball early formation. The scientific slow-motion films and high-speed photographic images operate at the junction of the micro-scale temporality of the atomic explosions' early phases, and the macro-scale temporality of the political and ecological implications of these explosions. I argue that these films are the objects and inscriptions of micro-temporalities, macro-history and geological times.

Keywords: High-Speed photography; Media Temporality; Micro-Processes; Synchronization.

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1 Introduction

The date is Monday, March 7, 1955, and the sun is not yet awakened. The temperature is approximately five Celsius degree in the Northern part of the Mojave Desert (United States. Environmental Data Service and United States. Weather Bureau 1955), where since 1951 is established the Nevada Test Site dedicated to the testing of nuclear devices, 130 kilometers northwest of Las Vegas. On the top of a 152 meters high tower, there is a platform with a little house with Plexiglass casements about one foot wide. It is the "bomb cab," inside which a hydrogen bomb type XW-27 of 43 kilotons (or twice the energy of the one dropped on Nagasaki on August 9, 1945) is ready to burst. The code name of the explosion is TURK. It is the fourth test of Operation TEAPOT. Right before the explosion, smoke trails have been drawn in the sky, forming a grid in front of which the bomb will explode. This drawing will serve during the blast to make the shockwave visible: the streaks will appear on the photographs and films to be distorted by the very high air density in the shockwave region, which otherwise remains barely visible. This simple solution will allow the shockwave propagation to be recorded and measured, and its velocity calculated. Dozens of cameras of different kinds and operators ready to record the devastating explosion stand all around the test site in bunkers made of steel and lead to protect them from radiations. Everything is set. The count starts at thirty seconds down to zero. It is now 05:20 am. The electric signal is sent to initiate the burst. The bomb explodes (Figure 1).

Figure 1: Screenshot. Operation Teapot – Turk. 1955. Film n°28141. https://www.youtube.com/watch?v=DeRcOZZxNXs

In a fragment of a second, a gigantic flash lightened the sky, just as the sun would do at noon. Borrowing the words that General Thomas Farrell had after the Trinity Test in June 1945, "the whole country was lighted by a searing light with the intensity many times that of the midday sun" (quoted in Wellerstein 2015). This is not even exaggerated since the flash of TURK crossed three entire states (Nevada, Oregon, and Washington) and was seen up to the town of Bellingham, Washington, located at 1400 kilometers away, close to the Canadian border (only 50 kilometers from Vancouver). The early expanding phase of the fireball occurs at a speed of approximately 8 million kilometers per hour. The 152 meters high tower is vaporized in a fragment of a second.[1] A colossal amount of soil rises into the air, and a gigantic wave of dust surges toward the camera.

1. Oppenheimer provides a very nice description of these first seconds of the explosion: "A little less than a millisecond later, the pressure, which had reached several million tons per square centimeter, returned to normal. A hemispherical fireball several hundred meters in diameter appeared and spread intense white light for a second or two. She touched the ground almost instantly and vitrified

The entire explosion takes a dozen of seconds and forms a mushroom cloud that takes minutes to reach its highest peak at 13624 meters (Light 2003, 28). It will then take couple hours to disappear. It is now 07:30. The morning sun illuminates the land. The sky does not bear the trace of any atomic cloud anymore. What is left is a potentially deadly radioactive zone, where radioactivity was measured at 1000 röntgen per hour. This measurement quantifies the exposition rate to X-rays and Gamma-rays, and is, under normal circumstances, of only one micro-röntgen per hour. In the next three decades at least, the intensity of the radioactivity, in case of extended exposition, might provoke thyroid cancer and other forms of disease. The site will still be contaminated for the next centuries, and to a lesser extent, during the next thousand years.

TURK belongs to the 216 atmospheric and underwater nuclear explosion tests that the US Department of Defense and the Atomic Energy Commission conducted between July 1945 and November 1962. The primary aim of the TURK explosion was the testing of a new kind of nuclear fission primary stage device, which corresponds to the part of the bomb that initiates the chain reaction from fission to fusion. The plutonium fission explosion acts as a detonator for a fusion reaction (this is the basic principle of the hydrogen bomb). The effective power of the nuclear weapon is widely determined at this precise stage of the blast. If not correctly initiated, a large portion of the fissile material might remain unreacted or burn before reaching its critical mass. All these primary stages of the chain reaction occurred in the first micro-seconds of the explosion (one-millionth of a second, or 0.000001-second, noted µs). The long-term impact of the explosion on the living and the environment, the destructive power of the bomb, the contribution of this test within the US military and political program of the nuclear weapons race, all these consequences on the macro-history and geological time already meet within this infinitesimal time-scale that is the µs.

To evaluate the efficiency of different kind of bombs designs and devices, and of different type and quantity of fissile materials, the impacts of the bombs on its surroundings, etc., visual data had to be produced for analysis. At the Los Alamos National Laboratory, nuclear engineering came hand in hand with optical engineering. "Nuclear weapons testing needed, for diagnostic purposes, nuclear weapons photographs, and the cameras that took pictures of nuclear detonations were themselves being 'field-tested' in nuclear tests" (O'Gorman and Hamilton 2016, 184). Among the critical visual data were photographs and slow-motion films of the first micro- and milli-seconds of the explosion.

This article is about these first micro- and milli-seconds made visible and analyzable by high-speed photographic means, that produced images with extremely short exposure times, or films in ultra-slow-motion. I will take a closer look at the micro-processes happening on a technical level that run inside the ultra-high-speed cameras designed to record the fireball formation at a rate up to 10 million frames per second. The scientific high-speed photographic images and films operate at the junction of the micro-temporal scale of both the technical micro-processes of the cameras and the atomic explosions' early phases and the macro-temporal scale of the political and ecological implications of these explosions.In this article, I will investigate this "multitemporal reality where slowness [and macro-temporalities] entangles with the technological micro temporalities" (Parikka 2016, 9), and discuss the necessity of synchronizing them together.

2 Slowing Down Nuclear Explosions

Over the seventeen years of the US atomic test recording, more than ten thousand films and plates were produced.[2] The primary purpose of these images was the production of visual data, measurements and analysis of the triggering, detonation and explosion of the bomb. These data would allow the nuclear physicist to measure the actual power of the detonation and, comparing it with the estimation, to evaluate the effectiveness

it. [...] The fireball continued to widen, until it reached a diameter of about 300 meters. At 2 seconds, it rose like a huge balloon of hot air and, at 3.5 seconds, a column of intensely radioactive dust and smoke appeared, which connected it to the ground" (in Rival 2002, 13; Also cited in Lefebvre 2003, 2–3).

2. After the Limited Nuclear Test Ban Treaty was signed in 1963, explosions tests in the atmosphere stopped and the massive number of photographs and films entered the archives of the Los Alamos National Laboratory (LANL) and the Lawrence Livermore National Laboratory (LLNL) as classified documents. Around 4200 of these films have been partially declassified in 2015, and since are being digitized at the Lawrence Livermore National Lab. A little part of them (around 400) are made accessible on the LLNL YouTube Channel. The TURK test films I am referring to in this article comes from this digital archive.

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of the bomb’s design, its impact, its radiations, etc. More than 50 cameras recorded each of the explosion tests, including TURK, shooting it from various angles, distances, and at different speeds.

Time-lapse photography was only used in order to record phenomena that evolve over particular durations of time. In the case of nuclear explosions, events occur too fast for this technic to be truly useful, except for late cloud formations (the Mushroom cloud) and their dissipation in the atmosphere, which take several hours in total. The formation of the mushroom cloud, quick at first, takes then several minutes to rise and only reaches its peak after more than a dozen of minutes. The atomic cloud remains in the sky for a certain time and dissipates in the atmosphere at the same speed as the other clouds, swept by the more or less quick wind. On the TURK explosion, a time-lapse sequence of the late cloud formation was recorded at less than an image per minute for two hours between 5h30 and 7h30 in the morning. The resulting film is a 126 frames sequence that starts with a distant flash appearing in the dark sky (Figure 2.). On some pictures we can see operators walking around, adjusting the apparatus nearby, while we still can see the mushroom growing. In front of the camera are set up a bunch of measuring and scaling tools. The sequence was shot from a distance that is far enough from the explosion to leave the apparatus and the operators stand outside safely. The late cloud takes not only times but also space to form. To have a full picture of the highest peak of the mushroom cloud, the camera has to be set up at a certain distance from the explosion. Played at 25 frames per second,[3] the 126 images sequence last five seconds, showing extremely quickly distant explosion that, within these conditions of time- and space-scale, does not seems that much harmful.

Figure 2: Screenshots from a time-lapse photography sequence. Operation Teapot – Turk. 1955. Film n°28150. https://www.youtube.com/watch?v=Zg2MHxzmnx8

Cameras from the industry, such as the Fairchild camera and the Mitchell camera were also extensively used but specifically to record real-time events or slightly slowed down events since they could only provide frame rates at 24 up to 100 frames per second because the film is moving and stopping alternatively behind the lens. Quickly, cameras with higher frame rates were required to obtain images of the very first milli- and micro-seconds of the expanding phase of the atomic fireball, allowing to measure the yield of the explosion, the rate of increase of the nuclear fireball, as well as to record high-velocity shock waves. Already in 1943, Berlyn Brixner, photographer and member of the optical engineering group of the Los Alamos Laboratory, wrote that “the most pressing need was for new specialized [high-speed] cameras to record experimental data that would lead to the design, construction and perfection of the atomic bomb” (Brixner 1983, 2). Camera systems with continuously moving film strips were required in order to obtain minimum frame rates at several thousand frames per second. Systems with rotating prisms, rotating drums and rotating mirrors were used.[4] In 1943,

3. 25 frames per second is the speed at which the digitized films of the LLNL are played on their YouTube Channel.

4. Some of these systems were known since the pioneering work of the scientist and cinematographer Lucien Bull, who worked at the Station Physiologique Étienne-Jules Marey on the development of such camera principles around 1904. For further details about Lucien Bull’s contribution to the development of high-speed cameras, refer to: Bull, Lucien, ‘Application de l’étincelle électrique à la chronophotographie des mouvements rapides,’ Comptes rendus des séances à l’Académie des Sciences, 1904; Bull, Lucien, ‘La chronophotographie des mouvements rapides,’ Bulletin de la Societé Philomatique, 1904; Bull, Lucien, ‘Recherches sur le vol de l’insecte,’ Comptes rendus des séances de l’Académie des Sciences, 1909; Bull, Lucien, ‘Les merveilles du ralenti,’ Cinéa, n°80, 1922; Bull, Lucien, ‘Comment on filme les mouvements ultra-rapides,’ Cinéa, n°84, 1923; Bull, Lucien, ‘La technique cinématographique au temps des pionniers’ (1960), Bulletin de l’Institut de cinématographie scientifique, n°2, 1961. See also: Lefebvre, Thierry, and Laurent Mannoni. ‘La Collection Des Films de Lucien Bull (Cinémathèque Française)’. *1895 – Revue de l’Association Française de Recherche Sur l’histoire Du Cinéma*, Images du réel. La non-fiction en France (1890-1930), no. 18 (1995): 144–51.

the two cameras in use with such arrangements were the Fastax Camera (10000 fps) and the Marley Camera (100000 fps) (Brixner 1997, 30).

The Fastax high-speed camera, developed in 1934 by the Wollensak Optical Company, was one of the most widely used on nuclear tests. It made it possible to produce images on 8 mm or 16 mm films at rates of up to 8000 frames/second. The film is continuously moving inside the camera, and image blur is avoided by a rotating prism, an optical system that compensates for the speed of film movement. "It was this device that would give the best results, and it was favored by scientists for several years" (Lefebvre 2003).

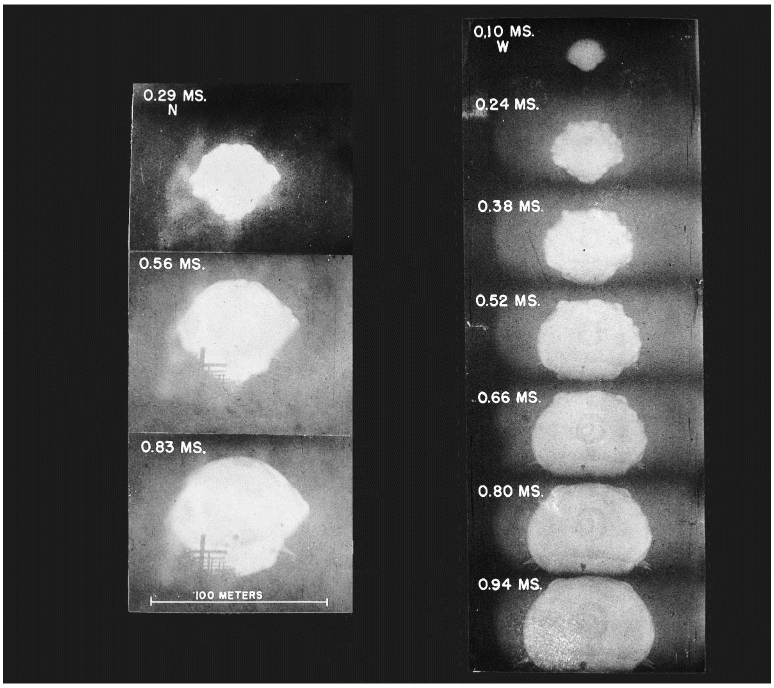


Figure 3: Brixner, Berlyn. Trinity Test 1945.

Figure 3. shows a sequence of the fireball formation phase during the Trinity test, shot with a Fastax Camera at a rate of 7143 frames per second, or one frame every 0.14 milliseconds (Figure 3.)(see also Lefebvre 2003).

Several types of other ultra-high-speed cameras were specifically developed for the need of nuclear test recording. Julian Ellis Mack, head of the Optical Engineering Group at the Los Alamos Laboratory, invented a camera dedicated to the measurement of explosion velocity, which was called the Mack streak camera. It used a three-faced pyramidal rotating mirror, allowing a time resolution of 10^{-7} seconds. The O'Brien drum frame camera had a strip of film on a rotating drum revolving at 200 rounds per second to get a time resolution of 10^{-7} seconds. The Brixner high-speed frame camera, patented in 1954, takes one hundred seventy pictures at a rate of 3.4 million fps, using a rotating mirror spinning at 10 000 rps (Brixner 1955; 1993).

Each of these cameras inscribed the nuclear explosion in a specific time-scale, using different very fast technical micro-processes that combine mechanical movements, electrical motors, and optical systems.

3 The Rapatronic Camera

Contrary to the cameras mentioned above, the Rapatronic Camera (for Rapid Action Electronic camera) has no moving part. It was designed by the American engineer and photographer Harold Edgerton in 1951. The critical element of this camera was a Kerr Cell, a cylinder of glass with a wire wound around it and a polarizing material inside (Fig. 4.). When electric current passed through the wire, the magnetic field rotated the direction of polarization, opening a path for photons. From the moment it is switched on, it increases light transmission in less than one-half of one-millionth of a second (0.5 μs). At the moment of the explosion, a photomultiplier tube registered the light from the blast and triggered the magneto-optic shutter, which opened and closed in the space of a millionth of a second (1 μs). One rapatronic camera was only able to make one single exposure without being reset – batteries of up to twelve cameras were used, each of them taking a picture at a different moment to capture the different phases of the expanding fireball. An electronically adjustable time delay was thus necessary to adjust the timing of the recording. The cameras were attached to twenty centimeters Newtonian telescopes and put on towers at about eleven kilometers from the explosion. The images were recorded using ordinary films. (Edgerton and Wyckoff 1951; Edgerton 1959; See also Elkins 2004). The Rapatronic was distinct from all the cameras previously listed because its millionth-of-a-second speed made it possible to look in detail at the explosion, from 0.0 seconds to around 0.006 seconds, when the fireball was not yet round. While, for the Fastax camera, the time between 0.0 and 0.006 second corresponds to the time between two frames, when the camera is blind. The Rapatronic camera provided thus a considerable improvement in terms of what could be visualized from these firsts μs.

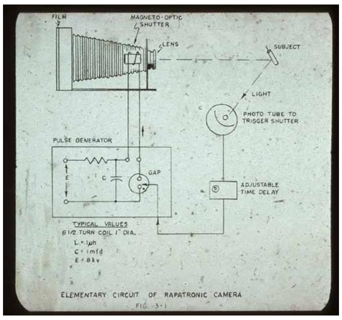
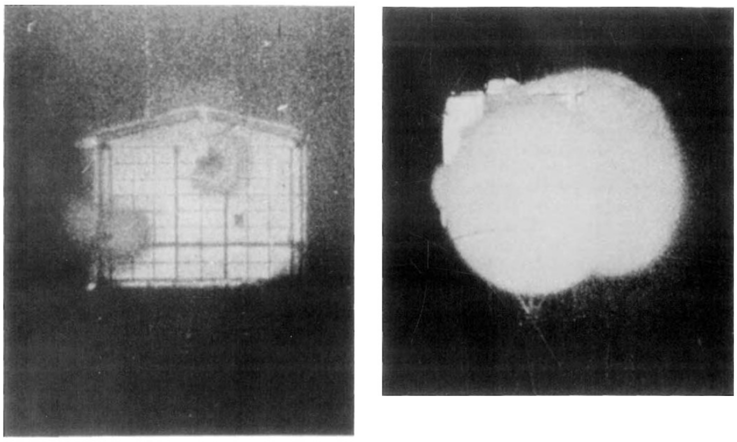


Figure 4: Magneto-optic shutter – 1952. Scheme. HEE-SC-08300. Harold Edgerton Digital Archives (MIT).



1 μs EXPOSURE AT ABOUT 1 μs

Figure 5: Atomic test explosion inside a ‘bomb cab’, 1959. Archives no. 14.244. Harold Edgerton Digital Archives (MIT).

4 Time Synchronization

In the NOVA TV documentary *Moving Still* (1980) about the century and a half long history of photographic experimentations with high-speed photography, time-lapse photography and other forms of photographic time manipulations, the camera designer John Hadland shared his amazement about the fact that “we can nowadays [in the 1980s] take pictures at one trillion pictures per second, and such a camera, if it would be running for a single second, would take enough film to get around the world… twice.” This statement contributes to the complete loss of proportions that such cameras imply in terms of speed and time scale for our level of understanding. At the same time, it clarifies something of their technical reality: they never record for an entire

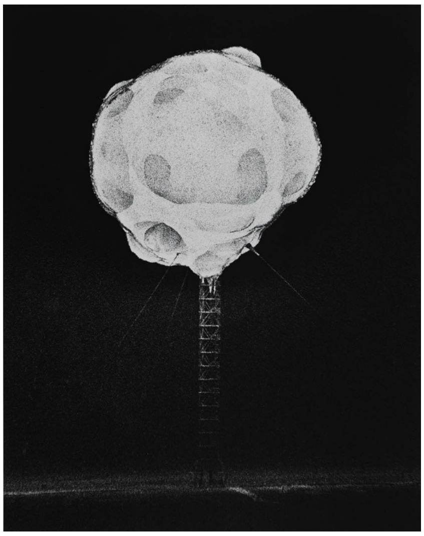


Figure 6: Harold Edgerton. Atomic Bomb Explosion, 1952 (circa), HEE-NC-52004.L.

second. I referred to cameras used during the nuclear bomb testing that take up to one million frames per second and even more. Those cameras are never recording for an entire second, nor do they record one million frames in a shot. At a projection speed of 24 frames per second, this would correspond to a slow-motion film of almost twelve hours. The ultra-high-speed cameras are therefore operated only for an extremely brief moment; and it is impossible to start the recording even a tenth of a second before the event, or in the current case, before the nuclear explosion. The recording must happen at the milli-second or even micro-second before the explosion. Systems of synchronization that align the time of the recording with the precise moment of the nuclear detonation were therefore required. If the recording was not properly synchronized with the explosion, the test, even with a successful blast, was a failure. Bernard J. O’Keefe, an engineer who worked on the design of the Fat-Man bomb, wrote in his Memoir:

> One series of tests [Operation Crossroads] had been conducted by the military in the summer of 1946 [...]. The tests were poorly conceived and inexpertly executed [...]. On the first test, an error in the operation of the radio-controlled timing system prevented crucial instrumentation, such as high-speed cameras, from operating until fifteen seconds after the device had detonated; much valuable data were lost (O’Keefe 1983, 135).

Harold Edgerton, together with Kenneth J. Germeshausen and later with Herbert E. Grier, co-funded EG&G, Inc. in 1947 (which Bernard J. O’Keefe also joined). The MIT group already partnered up before the war, in the 1930s, to work on precisely timed high-power electrical pulses like strobe devices, which Edgerton applied to photography, and in the military context to aerial flash photography at night for reconnaissance purposes. EG&G became during the cold war period, a key US defense national contractor. Part of the company’s work was precisely about synchronizing the instrumentation for the test, especially the optical ones, with the nuclear detonation. They were in charge of developing and managing a network of timing signals and firing system, “with the cameras and detonator wired together through a common underground circuit” (O’Gorman and Hamilton 2016, 198). The button that initiated the detonation was the same that made the high-speed cameras running. If for Paul Virilio, “weapons are tools not just of destruction but also of perception” (Virilio 2009, 8) it can also be said in this case that cameras are tools not just of perception but also of destruction, since initiating the recording implies to detonate the bomb.

The detonator of the bomb itself also had its own synchronizing system. “The detonator worked by means of a sudden infusion of high-voltage electricity through numerous wires, timed to detonate simultaneously” (O’Gorman and Hamilton 2016, 192). If the signals are not synchronized, some parts of the bomb might explode earlier than others and risk to vaporized the plutonium before it even reaches its critical mass, which would significantly reduce the efficiency of the weapon. It was also the task of EG&G to design and implement this circuit within the bomb detonator system. Indeed, the expertise EG&G had in the field of precisely synchronized high-power electrical impulses – since aerial flash photography – has also been a critical technology for nuclear weapon detonators. The capacitors that powered the airborne flash units that EG&G developed in the 1930s and the timing and firing system that detonate atomic weapons some years later are the same. This is precisely this circulation of technologies that drove O'Gorman and Hamilton to develop the concept of "deep media," which, according to them, refers to "the fundamental technical modalities that mediate or 'go on between' artifacts and the physical elements on which they rely" (O'Gorman and Hamilton 2016, 184). A circuit and a signal, initially used in a photographic lightning technic, were transferred into the very core of a nuclear bomb. "From the aerial flashing of enemy troops to the ignition of an atomic bomb, the 'deep media' of timing, firing, and exposing had rendered the technologies of cameras and bombs virtually interchangeable"(O'Gorman and Hamilton 2016, 193). And at the same time, as I explained earlier, the timing of the rapatronic camera was determined by the explosion itself. Once the bomb exploded, the atomic light that was emitted was used as a signal to trigger the rapatronic camera shutter. From photography to bomb to photography again, the circuit is closed. "The same 'deep' processes animated and drove both cameras and bombs" (O'Gorman and Hamilton 2016, 193).

5 Time Synchronization Beyond the Signal

Wolfgang Ernst has shown to what extent electronic synchronization systems are crucial elements within what he calls *time-critical media*, which "are media events in which minimal time processes represent a critical and thus decisive criterion for medial operativity itself" (Ernst 2016, 10). Referring to Ernst's words, "synchronization is an act of (electro)technical force – an act of violence that combines two media processes" (Ernst 2016, 51).

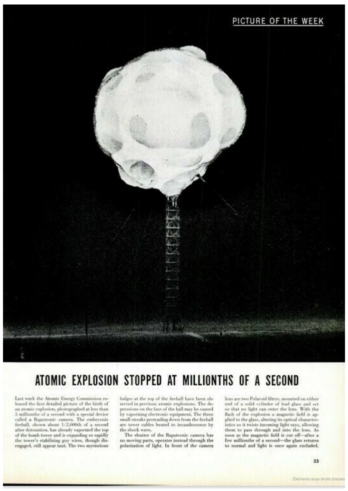
But synchronization not only requires sophisticated technical arrangements. Many examples from the 18th and 19th centuries (including the calculation of longitude, or the development of synchronized electromagnetic clocks for example) could very well show that synchronization is never just about synchronized signals, but about military tactics and political power. The first symptom of conflict, of division, is desynchronization. In 2018, a dispute between Kosovo and the European Union has led to a decline in electricity production that has disrupted the electricity grid in most European countries. This drop in production would have been a voluntary move by Kosovo. The Kosovar government would have to disrupt the European grid as a whole in order to put pressure on Brussels to join the club of states that make up the "European Network of Transmission System Operators for Electricity," a network to which Serbia belongs, even though Serbia produce less electricity than Kosovo. This decrease in production has disrupted the electrical frequency from 50 Hz to 49.996 Hz, slowing down by six minutes the clocks that measure time by this alternating current. On the contrary, in 2018 as well, North Korea, which was living at Pyongyang time, aligned its time zone with that of South Korea and changed its time by half an hour. From signal to sign, synchronization is introduced here as a political gesture whose symbolic meaning is unity, reconciliation.

Sarah Sharma, states in her book *In the meantime: Temporality and Cultural Politics (2014)* that "the temporal is political" (Sharma 2014, 11). She further elaborates and develops the concept of *power-chronography* that seeks to provide "a politicization of time that dispels individualistic accounts of time and allows the social and relational contours of power in its temporal forms to emerge" (Sharma 2014, 14). Jussi Parrika reads this concept as "an attempt to make sense of the multiple speeds that define various techniques, actions, infrastructures, and not least, lived experiences of contemporary [visual] culture" (Parikka 2016, 17). This *power-chronographical* dimension is also very much characteristic of the signal synchronization systems that aligned the technical micro-processes of high-speed cameras with the electrical circuit that detonates the bomb. As O'Gorman and Hamilton have noted about the rapatronic camera:

> If the official purpose of the Rapatronic and other EG&G cameras in nuclear tests was yield measurement, a function of the 'proving and testing' regime, as significant an aspect of these synchronous image machines was rhetorical and representational. They offered 'proof,' glimpses of the unseen to publics that purportedly needed to be convinced less of the mysteries of nature and more the powers of science and engineering in the hands of the national security state. This

rhetorical application of the new slow-motion photography found its way to the public not only through mass-reproduced fireball images, but through the propaganda films of the Federal Civil Defense Administration (O'Gorman and Hamilton 2016, 197)

6 Conclusion



PICTURE OF THE WEEK

ATOMIC EXPLOSION STOPPED AT MILLIONTHS OF A SECOND

Last week the Atomic Energy Commission released the first detailed picture of the birth of an atomic explosion, photographed at less than 5 millionths of a second with a special device called a Rapatronic camera. The embryonic fireball, shown about 1/2,000th of a second after detonation, has already vaporized the top of the bomb tower and is expanding so rapidly the tower's stabilizing guy wires, though disengaged, still appear taut. The two mysterious bulges at the top of the fireball have been observed in previous atomic explosions. The depressions on the face of the ball may be caused by vaporizing electronic equipment. The three small streaks protruding down from the fireball are tower cables heated to incandescence by the shock wave.

The shutter of the Rapatronic camera has no moving parts, operates instead through the polarization of light. In front of the camera lens are two Polaroid filters, mounted on either end of a solid cylinder of lead glass and set so that no light can enter the lens. With the flash of the explosion a magnetic field is applied to the glass, altering its optical characteristics so it twists incoming light rays, allowing them to pass through and into the lens. As soon as the magnetic field is cut off—after a few millionths of a second—the glass returns to normal and light is once again excluded.

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Figure 7: "Atomic Explosion Stopped at Millionths of A Second." *Life*, 9 November 1953, p. 33.

Figure 7 is a photograph with *one micro-second* of exposure time (Figure 7.) that shows the first-*millisecond* phase of an atomic explosion which itself occurs on the *millionth of a second*-level after a chain reaction completed after hundreds of *nanoseconds*. After the bomb exploded, unstable radioactive isotopes contaminate the geographical location of the explosion and beyond for *decades*. The very nocive Strontium-90 has a half-life of *25 years*, and Cesium-137 of *33 years*.[5] The isotopes that initiate the bomb explosion, plutonium-239, has a half-life of *24 110 years*. In between these micro-temporalities and the macro-temporalities of the deep-time, the explosion test took *months* of preparation, while the bomb's design took *years* of experimentation and testing within military and political program of nuclear weapon development. And *in the meantime* (to echo Sarah Sharma's book), the picture also ended up as "Picture of the *Week*" in Life magazine ('Atomic Explosion Stopped at Millionths of A Second' 1953).

This rapatronic photograph, as well as the high-speed cine-photographic images of the early phase of nuclear explosion, using Jussi Parrika's words, embody "situations of multiplicity of times," from ultra-fast micro-events and processes to "slow violence" of the long terms' durations impact on the environment, to take up the terms coined by Rob Nixon (see, Nixon 2013). These films are the objects and inscriptions of what Parikka designates as "a multitemporal reality where slowness entangles with the technological micro temporalities" (Parikka 2016, 9). What interested me was how and on which level this entanglement is technically mediated by the high-speed camera. This entanglement also highlighted the technical role as well as the meaning of time synchronization in high-speed photographic recordings, and more specifically, in the (techno-political) context of nuclear explosion testing.

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5. Half-life designate the time required for a quantity to reduce to half its initial value.

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