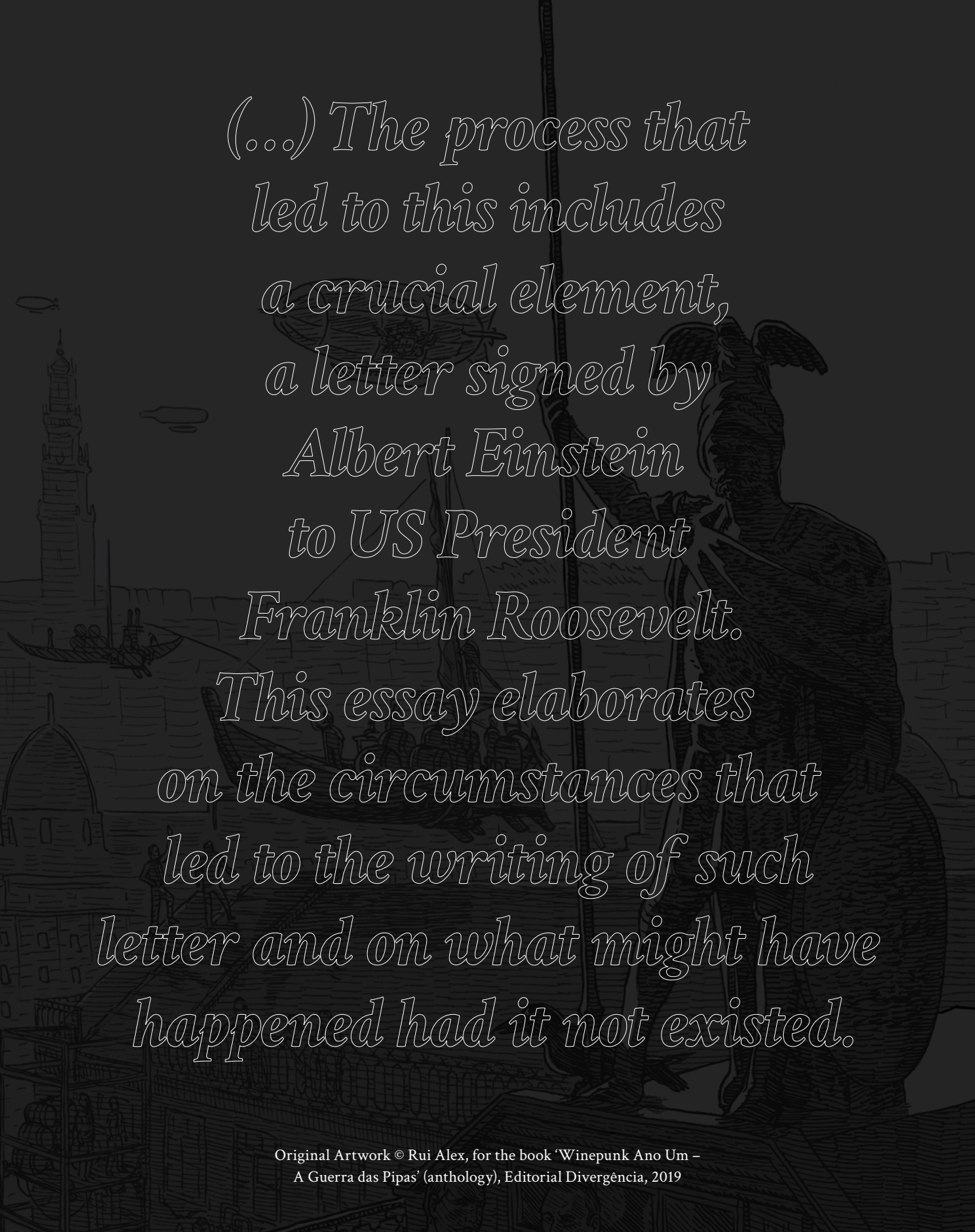

(...) The process that led to this includes a crucial element, a letter signed by Albert Einstein to US President Franklin Roosevelt. This essay elaborates on the circumstances that led to the writing of such letter and on what might have happened had it not existed.

What if Einstein had not sent the letter to Roosevelt?

José Luís Santos [1, a]

[1] | Department of Physics and Astronomy, Faculty of Sciences, University of Porto, Portugal

[a] | Author to whom any correspondence should be addressed: josantos@fc.up.pt

Submitted:17 March 2023
Revised: 30 July 2023
Accepted: 13 November 2023
Published: 14 November 2023

DOI: https://doi.org/10.34626/2184-9978/2023_vol3_n1_787

Abstract. The 20th century was unique in known human history for a number of reasons. It holds a brutal human suffering with two planetary wars with unparalleled levels of destruction and genocides of a dramatic scale. It was the century of the explosion of science and its expression in technologies inconceivable in previous times, moving Humanity to new frontiers, well illustrated by the walk of human beings on the Moon. It was the time of the emergence of disruptive social and cultural movements, the time when we found the finitude of the planet that shelters it. Just as was the time of Humanity to acquire the ability of self-destruction through the atomic bomb release of the energy stored in the depths of the atom. The process that led to this includes a crucial element, a letter signed by Albert Einstein to US President Franklin Roosevelt. This essay elaborates on the circumstances that led to the writing of such letter and on what might have happened had it not existed.

Keywords: Alternative history; twentieth century; revolution in science; world wars; atom; Einstein; Roosevelt; Manhattan Project; atomic bomb; civilization.

Introduction

The twentieth century emerged as an epoch characterized by an almost euphoric feeling regarding man's ability to dominate Nature and control everything, grounded in the fascination induced by the remarkable developments of science in the previous century. Indeed, it was admitted by many that there was little more science to explore, with the focus shifting to converting this knowledge into technology in order to definitively achieve our planetary supremacy [1]. This perspective was well established at the 1900's *Universal Exhibition* in Paris, which had the motto "*Celebrate the achievements of the last century and accelerate development for the next*" [22].

Europe was the center of the world, with its colonial empires distributed across the globe in what seemed to be the natural order of things, displaying its dazzling capitals with cultural trends that could not be less than a planetary reference, the same with the science that emerged from their universities. The new century was born framed by this almost deterministic atmosphere about man and Europe's role in defining the future of human civilization.

However, the smoothness on the surface of that period concealed a seething that was no longer larval, but with a dynamic pointing to violent eruptions in various domains. It was the case within the social *status quo* full of violations of the human dignity, as in the political instability of European nations dragged down by colonial interests, as well as in the world of arts with signs of disruptive features, remarkably in science and in the assumption that its building had solid foundations and was essentially complete [3 – 5].

These dynamics, which could be felt in certain circles more aware of the breadth of the times and of the human nature, originated developments with an absolutely unexpected amplitude, a symptom that the underlying dysfunctions were deep and inductive of enormous instability. The consequence was a twentieth century totally atypical in the known history of Humanity, with events that looked hindsight are astounding for their unpredictability and magnitude [6, 7].

Examples of this are: the two world wars with all their horrors on an unthinkable scale; the planning and carrying out of genocides on a range that illustrates well what the dark side of man is capable of; the implementation of a new global geopolitical order; the understanding of the planet finitude, not only from a conceptual perspective but also in its impact related to the scarcity of resources/waste sinks; the awareness of the impossibility of the planet to absorb and regenerate in periods compatible with the human life; the increasing levels of pollution and degradation of ecosystems resulting from the exponential application of the economic model installed after the industrial revolution.

In contrast to these points, it can be mentioned the affirmation of the democratic system as the political model that provides society with adequate degrees of freedom, permitting the sharing of human ideas in a dialectics that works towards the common good. Also, what may be considered the most remarkable development of the twentieth century, the meteoric evolution of science and technology.

The arrival of man on Moon in July 1969 was the most impressive event resulting from this scientific/technological endeavour, but not in terms of dramatism and structural relevance for the Human Community. Here, the control of the atom energy and the demonstration of its power in the atomic explosions of 1945 stands on a unique level. In fact, for the first time in the known history, our species got the knowledge to provoke its self-destruction on a planetary scale.

It is recognized that this process and the time scale in which it developed was greatly conditioned by a letter signed by Albert Einstein and addressed

to the President of the United States, Franklin Roosevelt. Within this framework, it is relevant to point out the reasons that led to this event and, in an alternative history approach [8–12], conjectured about what could have happened if this letter had not existed. Notwithstanding, the focus will be in the "what could happen", rather than "exploring how it could happen", subject for a different essay.

This is the objective of this essay organized as follows. It starts delivering some notes of the status of science at the beginning of the twenty century, then introduces the rise of Nazism in Germany and the danger of the regime's mastery of the atomic power, proceeds by detailing the context around the delivery of Einstein's signed letter to Roosevelt, the development of the Manhattan's Project, and the decision to drop the atomic bomb, and finishes with some thoughts of alternative history.

2. Science at the Beginning of the Twentieth Century

At the end of the 19th century, mathematicians and physicists proclaimed with pride and self-confidence that there was little more to discover in their scientific fields. For example, the eminent mathematician David Hilbert at the International Congress of Mathematicians in Paris in 1900, presented a famous set of 23 problems of mathematics still unsolved, ending up transmitting the message that with their resolution the edifice of this science would be essentially complete [13]. In turn, in the field of physics, the notable success of Newtonian mechanics, of the electromagnetic theory resulting from the unification of the laws of electricity and magnetism carried out by Maxwell, also of the thermodynamics that made possible to master thermal machines, induced a state of euphoria in the physics community. It developed to the point of building up the conviction that almost everything had already been discovered, well expressed in the words of Albert Michelson, author of very precise experiments regarding the speed of light, who in 1894 stated the following at the inauguration of the Ryerson Physical Laboratory at the University of Chicago: "…although it is never safe to assert that the future of Physical Science does not have even more startling wonders in store than those of the past, it seems likely that most of the great underlying principles are already firmly established" [14]. On the same line, the statement attributed to Lord Kelvin (unconfirmed) is also famous "…the future truths of physical science must be sought in the sixth decimal place…", to whom is also associated the discouragement of young students to do PhD's in physics because essentially everything was already discovered.

Looking back, by the end of the 19th century there were essentially three "minor" anomalies between the physical theories and the experimental results [15]. One of them was linked to the speed of light, with the puzzle that its measurement always gave the same result regardless of the relative speed of the light source and the observer. Another had to do with the so-called photoelectric effect, the emission of electrons from a metallic surface when light falls on it, being observed that when light has a frequency below a certain value the emission of electrons ceased to exist (while from the theory did not result any threshold for the emission of photoelectrons). The third anomaly was related to the radiation emission profile of heated bodies, with the experimental results indicating an emission frequency for which the emitted radiation had maximum power, while the established theory did not imply the existence of such maximum. Certainly, they were annoying discrepancies but not too compromising, therefore reduced relevance were attributed to them.

In 1900, by the time of the Universal Exhibition in Paris, Max Planck in Berlin sought to theoretically reproduce the experimental results related to the emission of radiation by heated bodies.

After many failed efforts, he admitted the "bizarre" hypothesis that energy was not continuously emitted but, instead, appeared in discrete packets of energy. To his surprise, it was found that in this way the obtained equation for the emission of energy was in agreement with what was observed. The concept of "quanta" emerged, establishing the beginning of the quantum theory. Few years later, Einstein published his special theory of relativity that settled the equivalence between mass (m) and energy (E), introducing the famous equation $E=mc^2$, where c is the speed of light. These two developments allowed the construction of the theoretical framework that enabled the understanding of the energy associated with the atom [4].

Both Planck and Einstein were Germans, exponents of the European scientific landscape of the late 19th, early 20th centuries. The concentration of the scientific elite in Germany and in the Austro-Hungarian Empire was another manifestation of the centrality of Europe in that period, situation that changed substantially after the Second World War.

3. The Rise of Nazism in Germany

After the defeat of Germany in the First World War, the situation in the country deteriorated substantially, opening space for ultra-nationalist tendencies. They settled and grow to the point of leading the Nazi party to win the 1932's elections, resulting in the appointment of Hitler as Chancellor in 1933. One of his priorities was to rearm Germany with a military power anchored in the edge technologies of that period.

By the time, nuclear physics was a rather hot topic in the quest to understand the structure and dynamics of the atomic nucleus. Initially, Germany was the country where most progress was being made as a result of the value of its scientific institutions and researchers. Many of them had Jewish ancestry and ended up being targeted by the Nazi persecution. Consequently, a large number decided to leave Germany, as was the case with Einstein, who emigrated to the United States in 1933. This process led to a slowdown of the German research program in nuclear physics, which nevertheless proceeded with increasingly more secret contours.

At the beginning of the Second World War, Germany established as military region the uranium mines of the former Czechoslovakia, today the Czech Republic, one of the places in the planet where uranium is found in most favourable mining and purification conditions. For some scientists this was a sign of alert since they knew the level of energy "condensed" in the atomic nucleus and the risk associated with its use for destructive purposes [16].

4. The Letter of Albert Einstein to Franklin Roosevelt

One of the scientists that left German was Leo Szilard, a Hungarian nuclear physicist who worked at the University of Berlin and to whom important contributions are due in this field, one of them the chain reaction process, central in a nuclear explosion. He moved to England and later to the United States where obtained a teaching position at Columbia University. Even so, he kept maintaining contacts with colleagues at the University of Berlin, which permitted him to be aware of German progresses in the field.

At a given point he realized the need to alert the President of the United States, Franklin Roosevelt, about the German nuclear program. Evaluating the best way to do so, he came to the conclusion of the importance of associating to the process Albert Einstein, the most famous scientist at the time, also his personal friend from the period where both were teaching at the University of Berlin.

Einstein quickly understood what was at stake and agreed to sign a letter addressed to Roosevelt sharing these concerns, which he did on

August 2, 1939, resulting in one of the most important documents of the 20th century.

The letter begins with the following three paragraphs [17]:

> *"Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and if necessary, quick action on the part of the Administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendations.*
>
> *In the course of the last four months it has been made probable through the work of Joliot in France as well as Fermi and Szilard in America, that it may be possible to set up a nuclear chain reaction in a large mass of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.*
>
> *This new phenomenon would also lead to the construction of bombs, and it is conceivable – though much less certain – that extremely powerful bombs of this type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove too heavy for transportation by air"*

After an intermediate text where suggestions are presented for a USA program aiming to master the atomic chain reaction process, the letter ends with a paragraph where a connection is made to what was happening in Germany:

> *"I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsacker, is attached to the Kaiser-Wilhelm Institute in Berlin, where some of the American work on uranium is now being repeated"*

Leo Szilard considered essential the letter be hand-delivered to the President, so he asked for the collaboration of a mutual friend, Alexander Sachs, an economist, also Roosevelt's adviser. From such action resulted a meeting scheduled to October 11, 1939. In that day Roosevelt took the letter in hands and, some hours later, wrote a letter addressed to Einstein in which states:

> *"I found this data of such import that I have convened a board consisting of the head of the Bureau of Standards and a chosen representative of the Army and Navy to thoroughly investigate the possibilities of your suggestion regarding the element of uranium... "*

These words can be considered the beginning of one of the greatest projects in history, the Manhattan Project [18].

5. Manhattan Project

This project, which formally began on the day Franklin Roosevelt became aware of Einstein's letter, developed to the point where, in its peak, directly involved over 130 000 people, also with the engagement of many universities and business institutions. It had the international collaboration of United Kingdom and Canada. Geographically, it was located in four regions: Oak Ridge, Chicago, Hanford and, fundamentally, in Los Alamos, a remote area in New Mexico where, literally, a new city was built to host the people with the most varied professional skills to work on the project.

Despite its dimension, the final objective of the project, the construction of the atomic bomb, was known only to a very limited group of people.

To the community in general it was transmitted the message that the project aimed the security of the United States, therefore justifying the absolute requirement of discretion in relation to the activities that were being carried out. To emphasize this orientation, it could be find many posters in Los Alamos with indications such as "What you see here, what you do here, what you hear here, when you leave here let it stay here" [19]. The project had as general director General Leslie Groves (later also involved in the construction of the Pentagon) and, as scientific director, Professor Robert Oppenheimer of University of Berkeley. It was formally closed on August 15, 1947.

On April 12th, 1945, Franklin Roosevelt died so his Vice-President, Harry Truman, took office as President of the United States, at the time unaware of the objectives of this project. This is surprising, but an extreme indication of the secrecy about what was on-going. On July 16 in the area of Alamogordo in New Mexico exploded the prototype of the atomic bomb, named *Trinity*. It is said that when Oppenheimer saw the magnitude of the explosion he uttered the following words from a Hindu scripture: "*Now I am become Death, the destroyer of worlds*".

6. The Decision to Use the Atomic Bomb

The Manhattan Project led to the production of three atomic bombs, the test one (Trinity) and two others that were improved in relation to the prototype by the indications resulting from the test. They were named Little Boy and Fat Man.

By the time Trinity exploded, the war in Europe was over, continuing in the Pacific. What was on table was the invasion of Japan by the US Army, with the awareness of the enormous number of casualties such action would entail.

Harry Truman had the responsibility to decide whether the two remaining bombs should be used or not. His decision was to proceed with the bombing. The first was dropped at 8:15 am on August 6th 1945 over the Japanese city of Hiroshima, while the second was dropped at 11:00 am on August 9th over Nagasaki. The consequences for the populations were terrible, with the immediate death of hundreds of thousands of people and the delayed death of many others due to the radiation. In those days, Humanity entered a new era, one in which it came to dominate the means to bring about its self-destruction.

In retrospective, one might wonder whether it was really necessary to use atomic bombs. Wouldn't it have been enough for the Japanese authorities to observe the destructive power of these bombs so that, in view of their being used in Japan, they simply decided to end the war?

This is already an element of alternative history given that in public Truman always defended the bombings and their necessity, justifying their use by the horrendous casualties that United States would suffer if Japan decided not to surrender. In private, however, he makes reservations. In the words of his grandson, Clifton Daniel, "*He made the decision to end the war and save American lives, save Japanese lives, but he always regretted the loss of life in Hiroshima and Nagasaki and he carried the weight of his decision to drop the bomb throughout his life*" [20].

7. What if Einstein had not sent the letter to Roosevelt?

Everything that was previously expressed concerns a factual reality, which now drifts to what can be considered an alternative scenario that could result from the non-existence of Einstein's letter. In light of what happened later, some traits of this reality will be obvious, others not, many others beyond our ability to make conjectures since, in one way or another, they are inevitably supported in what we already know.

So, in a linear approach, what can be assumed to have happened if such letter had not existed? It

can be pointed out:

- Certainly the US nuclear program would not have been accelerated;
- Surely the atomic bomb would have appeared much later, probably in the United States since at the end of the war it was already the world great technological nation, while Germany was in a deep worn out state of material and human resources to carry out a project of such scale;
- The disasters of Hiroshima and Nagasaki would not have happened;
- The Second World War in the Pacific would lasts much longer with the US invasion of Japan, possibly with the participation of Soviet Union, which intended to intervene in this conflict to extend its geopolitical influence;
- The Cold War would still exist, possibly with other contours;
- After World War II, with high probability a new war in Europe would not have last 73 years to happen;
- Possibly, would not have had the same magnitude the disruptive artistic and cultural developments that had their origin in the dramatic reality of Hiroshima and Nagasaki which made irreversible a Humanity new era, one in which was possible to provoke its self-destruction.

This alternative history scenario can be amplified to new contours if one assumes that Einstein's letter arrived too late in the sense that Germany was already substantially more advanced in the process of producing the atomic bomb, ending up being the first country to dispose of this weapon. What would have happened?

- Instead of the cities of Hiroshima and Nagasaki being victims of the atomic bomb, this would happen to London and Moscow;
- Europe from the Atlantic to the Urals would come under Nazi rule which would establish a regime of global repression including components of genocide with unprecedented magnitude;
- The United States would not be the hegemonic power that it has become, with its region of influence essentially confined to the American continent and parts of the Pacific;
- The political, social and economic organization on the Planet would be very different from what they are today;
- This Hypothesis Historia Periodical initiative would certainly not exist;
- This state of affairs would probably only change according to one of two possibilities, a positive one associated with a revolution that removed the Nazi regim*e from power, a negative one related to a nuclear conflict involving Germany and the United States with unpredictable consequences.*

8. Conclusion

The 20th century was much more than a time period of 100 years, it was disruptive along multiple dimensions, with scientific, technological, social, economic, political and cultural developments of such magnitude and consequences that they ended up translating into qualitative changes of the Human Civilization. In particular, by mastering the energy of the atom, it establishes the temporal border between before and after the establishment of the human capacity to provoke self-destruction. In this process a letter from Albert Einstein addressed to the President of the United States Franklin Roosevelt is of dramatic importance. This text contextualizes this event and elaborates on what could have happened if such letter had not existed, also about the consequences that could arise if the Nazi regime had been the first to have access to the atomic bomb.

References

[1] Badash, L. (1972). The Completeness of Nineteenth-Century Science, ISIS, Vol. 63, pp 48–58.

[2] Ageorges, S. (2022). Sur les traces des expositions universelles, Parigramme Eds.

[3] Wesseling, H. L. (2004). The European Colonial Empires: 1815–1919, Routledge.

[4] Krige, J. (*Editor*) (2014).. Science in the Twentieth Century, Routledge.

[5] Xin, Q. (2019). A Brief History of Human Culture in the 20th Century, Springer.

[6] Cantrell, J., Smith, N., Smith, P. (2019). Complete 20th Century History, Oxford University Press.

[7] Runciman, D. (2015). The Confidence Trap: A History of Democracy in Crisis from World War I to the Present, Princeton University Press.

[8] Rodwell, G. (2013). Alternate Histories in the Classroom Whose History? Engaging History Students through Historical Fiction (University of Adelaide Press) 99-116.

[9] Hellekson, K. (2001). The alternate history:Refiguring historical time. (Kent State University Press).

[10] Bunzl, M. (2004). Counterfactual history: a user's guide. The American Historical Review, 109 (3), 845 – 858.

[11] Montaudon Tomas, C M, Amsler, A. 2021. The value of alternative histories in scenario planning. *Hyp. Hist. Period.*, 1, 109-127. DOI: 10.34626 / 2184- 9978_2021_1_008. https://www.up.pt/casacomum/wp-content/uploads/sites/520/2022/07/08.pdf

[12] Montaudon Tomas, C M, PInto López, I N, Amsler, A. 2021. Using alternative stories to promote . organizational change. *Hyp. Hist. Period.*, 1, 46 - 59. DOI: 10.34626 / 2184- 9978_2021_1_004. https://www.up.pt/casacomum/wp-content/uploads/sites/520/2022/07/04.pdf

[13] Yandell, B. (2001). The Honors Class: Hilbert's Problems and Their Solvers, CRS Press.

[14] Livingston, D. M. (1973). The Master of Light: A Biography of Albert A. Michelson, Scribner.

15] Purrington, R. (1997). Physics in the Nineteenth Century, Rutgers University Press.

[16] Rose, P. L. (2001). Heisenberg and the Nazi Atomic Bomb Project, 1939-1945: A Study in German Culture, University of California Press.

[17] Dukas, H., Hoffmann, B. (1979). Albert Einstein, The Human Side: Glimpses from His Archives, Princeton University Press.

[18] Kelly, C. C. (2020). The Manhattan Project: The Birth of the Atomic Bomb in the Words of Its Creators, Eyewitnesses, and Historians, Black Dog & Leventhal.

[19] Making Public What Was Once Secret: Los Alamos and The Manhattan Project. Making Public What Was Once Secret: Los Alamos and The Manhattan Project. (2022) The National WWII Museum.

[20] Anslover, N. L. (2013). Harry S. Truman: The Coming of the Cold, Taylor&Francis.