

CONSIDERATIONS ON FUTURE CIVILIZATIONS

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Abstract. *This communication aims to be an insight into how mankind has developed over time until this day, pointing out that over 300 years ago the industrial revolution first occurred, followed by the energy revolution, which led to a considerable increase of production and consumption of energy, responsible for the prosperity and well-being of all mankind. Starting from here considerations are made about future energy civilizations as they are foreseen by the scientific community today, showing the current position of humanity. It is shown that the first future civilization of Type I, the Planetary Civilization could be achieved by 2100, given an average growth rate of the world economy of 1%, while the other two, the Stellar and Galactic Civilizations would be achieved in two stages separated by two and a half millennia. Considerations are made about the significance in terms of energy consumption for each civilization, as it appears in the literature and the new criteria for classification, information and entropy, are discussed. It is shown that the course for achieving Planetary Civilization is very critical due to the risks borne, and the fact that it is a unique moment, a so called singularity. Attention is drawn to the role of the young generation in achieving this objective and a picture regarding the benefits of this first civilization is taken. Finally, attention is drawn to science and technology viewed as the driving force for the humankind development.*

Keywords: future civilizations, energy classification criteria, informational classification criteria, entropy classification criteria, science and technology development engine

1. Introduction

Today we are witnessing of a sustained development of science and technology in some parts of the world such as the EU and the USA, that have determined in the last few hundred years a considerable mutation in general wealth on the planet.

Thus, around 1500 CE the main superpowers that dominated the world were the Imperial China and the Ottoman Empire. It seemed that they will have been established themselves definitively among the most developed nations. But it was not to be so! Imperial China, for instance, even before 1500 was regarded as the greatest power of the time holding secrets such as: compass, paper, printing press, gunpowder, etc. Chinese scientists were the most reputed, the state was unified and strengthened and peace reigned in the country. In full swing of development, in 1405, Chinese Emperor Yongle ordered the construction of a huge naval armada consisting of seven ships, each being able to accommodate all the three ships of Columbus, designed to explore the world. They start exploring west coast

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navigating around Southeast Asia and East Africa, apparently reaching even up to Madagascar and maybe beyond, from where they returned with a rich plunder. However, the endeavor was considered by the Chinese leadership insignificant in relation to investment. The lack of powerful civilizations on this route made to disappear any interest to resume exploration. China has entered a long period of complacency considering itself the center of the developed world, and gradually entering a long period of isolation that inevitably led to stagnation and rebound, making it to lose its front lead it once had.

The Ottoman Empire, which then embedded the entire Arab world, on the other hand, invented algebra, made great advances in optical physics and astronomy giving names to the stars. At the time of maximum development, science and art flourished unstoppable. Imperial capital, Istanbul, was one of the most advanced science centers in the world. The Turkish Army excelled in high-caliber guns and warships with paddles and sails, and military science as well, making it the first power of the era. This meant that Turkey would not be faced with a significant military opposition. Little had missed for the Ottoman Empire to be the conqueror of the whole Europe. Again it came in a situation of self-sufficiency, which led to the promotion of religious fundamentalism and exacerbated bigotry, renouncing to the scientific knowledge considered un-Islamic, which inevitably led to centuries of stagnation and setback, losing the important place once held.

Instead, Europe at that time consisted of a series of powerful states grinded in religious fundamentalism of the most odious expression, such as the Inquisition and the witch hunt, which have determined a Dark Age steep decline for more than a millennium after the fall of the Roman Empire. At that time Europe was in fact an absolute importer of technology and somehow represented a black hole not emitting anything technologically. But this state of things was soon to change dramatically. There is a known historical view on this, but to scientists like physicists in the present case, it is dear another explanation on Europe's becoming the most developed region of the world in the second half of the second millennium. Europe flourished beginning with the dawn of a great awakening known as the Great Renaissance. It began with Gutenberg's printing allowing far more rapid accession to new information regarding sea navigation, detailed mapping of the explored coasts, and new ideas in trade which brought certain prosperity rather quickly. There was one thing that was decisive, namely the monarchs of the countries at the time, countries that were almost equal, promoted science and military technology in order to achieve their military ambitions. In this way the promoted science and technology become factors for making a new wealth, all these happening while the church was diminishing its dominant power.

In short, the great leap of Europe who managed to comfortably overtake China and the Ottoman Empire was due to the science and technology that flourished

more than ever, becoming engines of new prosperity. Deepening this assertion, one can say that we owe everything we have today to understanding the four fundamental forces that govern the universe [1].

Indeed, the first force is gravity, ubiquitous on earth and in space, to which we owe our anchor on earth and the existence of our solar system. The second force is the electromagnetic force, of which we benefit greatly by illuminating our cities and powering all electrical devices which embellish our life. The third and fourth are weak and strong nuclear forces that are responsible for the existence of nuclei and atoms which constitute us and everything around us and govern the fusion reactions in the sun without life could not be possible.

What is crucial to this discussion is that whenever one of these forces was discovered and studied the consequence was that appearance of a great scientific and technological momentum. All four forces have been discovered in Europe, a fact that contributed to its amazing development. [2].

Let's start with Isaac Newton who discovered gravity when he was only 23 years old. In 1687 he published his book Principia, arguably the most important scientific work of all time in terms of impact it had in its epoch. This resulted in Newtonian mechanics that consequently promoted mechanization era and led to the establishment of the Industrial Revolution in Europe, the main factor ensuring the new prosperity.

The next major event was the discovery and study of electromagnetic force by Faraday and Maxwell, leading to the second energy revolution that allowed further illumination of the entire planet. Today electricity is as vital for the industry as it is the blood for the human body.

Weak and strong nuclear forces were discovered also by European scientists. They did understand fission energy in the early 40's of last century, and detour that from the aim of mass destruction by the US atomic bomb to the construction of nuclear power plants which is today's highest and well controlled technology in terms of energy production. At the same time it was understood the principle of fusion reaction that keeps our sun ignited and led to the formation of the entire galaxies of the universe. Here too, it all began with the fusion bomb detonation and again the reason won and the scientific and technological industrial community is working in favor of nuclear fusion plants commissioning, which, although a much more difficult objective to achieve than anticipated, it will eventually be carried out. This is imperative due to the fact that fusion is far superior to fission regarding the aspects of energy output, yield and waste products.

The numerous scientific and technological achievements that were made so far and those achievable in the next hundred years until 2100 are arguably signs that

humanity is gradually building a planetary civilization [3]. The leap from what exists now to what will be in year 2100 is grandiose [4]. In the purely scientific field, Europe will continue to lead the way by the research taking place in Geneva, Switzerland at the Large Hadron Collider facility (LHC), the largest particle accelerator in the world for studying the Standard Model. Additionally to this, there is under construction the European Extreme Light Infrastructure (ELI-NP) at IFIN-HH, Măgurele, Romania, built with European funds, for advanced nuclear physics research using the highest power laser in the world [5]. Under construction or planning are also other large research infrastructures such as: The Experimental Fusion Reactor (ITER) at Cadarache, France, followed by the first European fusion reactor prototype (DEMO) in 2035, European Centre for Brain Research, in Switzerland, The European Extremely Large Telescope (E-ELT) which is a ground-based extremely large telescope for the optical/near-infrared range in Cerro Amazonas, Chile, the Facility for Antiproton and Ion Research (FAIR) which is an international accelerator facility under construction which will use antiprotons and ions to perform research in the fields of: nuclear, hadrons and particle physics, atomic and anti-matter physics, high density plasma physics, and applications in condensed matter physics, biology and the biomedical science, in Darmstadt in Germany, etc.

A line of research that will be pursued with perseverance is the unification of all four known forces, overcoming the current deadlock concerning the non-integration of gravity force among the other three forces. The research will continue on developing of an universal theory, a theory of everything, whose best candidate is superstring theory, which once successful, will allow us to understand how the whole Universe evolved [6]. At that time we will be in the position to finally address the issue of why the Universe exists as such, rather than not existing at all. This is due to the fact that once the science has solved a problem; it creates another arising from it immediately.

Among the new developments of our civilization, one can expressly retain attention: the advent of computers and the Internet. In that matter the forecast points towards the silicon computers being gradually replaced by optical and quantum computers. The Internet has a development potential of about 100 years before running out completely, as the steam engine did [4]. The artificial intelligence will experience a fabulous development leading to an era of omnipotent robots. Medicine, that is so important for preserving the human race, will reach unimaginable heights today simply by developing nanotechnology.

Energy requirements will increase and diversify leading to significantly energy consumption of our sun. Nuclear fusion power will be achievable, fission power plants technology will be revived once the problem of neutralizing their

radioactive waste is solved [7]. Around the year 2100 mankind will reach the stage where travel to the stars is feasible.

All these grand achievements must have a price, which is the energy consumption required for sustaining them. In the next section we will deal with the concept of energy civilizations of the year 2100 and of the following centuries or millennia.

2. Concept of energy civilization

The transition to the first planetary energy civilization that seems to be reached by the year 2100 is dictated by all the current scientific and technological achievements and especially future achievements [8]. This transition seems to be the most important in the mankind evolution. It is generally accepted that in the last hundred thousand years after mankind has appeared in Africa, there have been about 5000 generations on Earth. Of these the most outstanding role lies in generation that is born in these years since the new civilization will be built on her shoulders. It depends on this generation if the planetary civilization is installed or not. Reasons for possible failure that could occur are primarily a huge mistake in addressing development or unpredictable natural disaster that could completely destroy life on Earth. Therefore it is never enough to show that this generation is by far the most important of all so far! If everything goes well, energy consumption analysis seems to show that there is no doubt that this first planetary energy civilization will be reached around the year 2100.

Historians, when analyzing an extinct or emerging civilization, they usually resort to invoking the emergence of social movements, conflicts generated by productive forces and means of production, the new revolutionary ideas or mistakes made by the ruling classes.

Physicists have a completely distinct approach and civilizations are viewed through the prism of energy consumption, for that the more energy a civilization generates, the more evolved it is! From this point of view if we look back into the mists of time we find that for millennia our energy was limited to 1/5 horsepower per person, the arms power of each representative of the human species. During this time people have lived a hard life, short and brutal, with the first focusing on survival. Life expectancy at that time was no more than 18-20 years and from birth to death, tortured by hunger.

But at a certain point in time, about 10,000 years ago, the Ice Age ended for reasons that even today we do not fully understand. [10] This quickly led to the emergence of agriculture which transformed the people of hunters and gatherers in product makers. Simultaneously people domesticated animals, which has increased the available power at about 1 horse power. Suddenly life became more comfortable by the fact that endemic hunger could be eliminated. In suitable areas, stable villages and towns appeared where people could live safer. Writing,

math knowledge and knowledge about good times for sowing and harvesting occurred as well as accountants for wealth inventory, scribes to assess wealth in order to impose taxes. Gradually it came to states increasingly larger, accompanied by increasingly powerful armies, slavery and all the known empires. Things have moved on in small steps until about 300 years ago when it appeared the Industrial Revolution, which led to sudden exponential increase by moving from one horsepower work to the work of steam of hundred and thousands of horsepower. There were great transformations in the societies of that time, because peasants migrating to the city where they became laborers. Life did not become immediately better than the harsh life of peasants, but in time, with the regulation of working time in factories, things took a really good turn. Energy Revolution that followed in the late 19th century boosted this process, when the lighting of homes and other facilities related to electricity started to become current. As a consequence, in the early 20th century the average life expectancy in some more developed countries reached 50 years and the population began to grow more and more since then.

At the moment we are in front of the third wave, the information wave that due to the computers systems is travelling at breakneck speed all over the world. Science, technology, culture, entertainment, travels at the speed of light through fiber optics and satellites arriving into each of our homes. This is likely to create added value at a rate unimaginable in the past that ensures an increase in wealth never matched before.

In the mid sixth decade of the last century, Russian astrophysicist Kardasev [2] reflecting the possible existence of extraterrestrial civilizations, concluded that they can vary substantially by the energy they consume. The more energy consumed is higher; the level of science and technology, and the overall development is higher. Therefore he proposed the existence of three possible planetary civilizations which differ by the energy consumption (nominal power).

Therefore, a Type I Energy Civilization is by definition a civilization that consumes on its planet the entire received solar flux, which is about 10^{17} W, or 100 million GW, being a Planetary Civilization because it consumes the resource at planetary scale.

A Type II Energy Civilization is defined as a civilization which consumes all the energy emitted by the star of the solar system in which resides the technological society that is about 10^{27} W, making it a Stellar Civilization.

Finally, a Type III Energy Civilization is consuming a power of 10^{37} W. It is therefore a Galactic Civilization.

It is interesting to note that civilizations are separated by a factor of 10^{10} which is the average number of stars in our galaxy. A Galactic Power Civilization

consumes 10^{10} times more energy than a Stellar Power Civilization, which in turn consume as many times more energy than a Planetary Civilization. This classification has the advantage of introducing a criterion that enables the real quantification of civilizations, instead of making vague considerations about their development level. It must be said that this classification can be extended to the intergalactic level by introducing a type IV energy civilization, apart from the type III by the same factor of 10^{10} , but it is not included in the discussion here.

It is extremely interesting to see where we stand, as a civilization on Terra, at the moment.

The fact is that the power currently consumed on Earth is only 0.7×10^{10} W that is seven tenths of Planetary Civilization of Type I. In other words we can not qualify for Type I, although we are, indeed beyond its half. Another interesting issue is to establish timeframes for achieving these three types of civilizations [2]. Based on an annual growth rate of world Gross Domestic Product (GDP) of 1%, a reasonable average for the last few centuries, we may conclude that it takes 2,500 years to install a civilization of some kind. It is of course obvious that in case of doubling of the global annual development rate, the time horizon would fall to only 1,250 years. This figure is reasonable, as is expected that in the future as the planetary society is more evolved, this growth rate would be more likely.

But more than that, we can assess the time the current Earth Civilization could reach the level of Type I Energy Planetary Civilization. Well, at an average annual rate of 1%, the calculation shows that around the year 2100, we can reach Type I, despite all the economic crises that will occur and will distort the development. Therefore, the generation that is born now will live this extraordinary moment and it is required to achieve it. In the next section we will deal with the transition from a Type 0 Civilization to the Type I and its characteristics.

2.1. Transition from a Type 0 Civilization to a Type I Civilization

Generalized Internet is the main feature of Civilization born in this century [8]. It is a world communication system that allows contacting people on different continents and can exchange information on a very large scale. The process is evolving and seems unstoppable. Real-time information on world events is beneficial for the fate of events that can be influenced as they progressing.

The use of Internet has imposed, as the language of communication, the English language that is primarily used in a proportion of 29%. A second language is Chinese accessed by 22%, followed by Spanish with 8%, Japanese with 6%, and French with 5%. At present, English is the first language spoken in science, technology, business, finance and entertainment. There is no doubt that this is likely to lead to accelerated overall development with a corresponding increase in the standard of life and wellbeing.

Germs can be seen in a planetary civilization that emerged continental economies like the EU and NAFTA example (North American Free Trade Agreement) and in the moment that we write these lines, BRICS the cooperation agreement between Brazil, Russia, India, China and Africa South and the Euro-Asiatic Community, formed by Russia, Kazastan and Belarus. They are progressively expanding, and following this model economic union are expected to occur on other continents, as countries will understand that alone can not be competitive.

A huge middle class is about to occur in countries with huge demographic potential such as China and India. What is now happening represents without doubt one of the biggest social changes in history. For these people the traditional values are changing. They are now interested only in political and social stability, prosperity and well being (health).

No weapons, but economic development is now the target for nations on Earth because it was understood that only economic force can count on maintaining economic competitiveness. Nuclear weapons simply can not be used because they are too risky for everyone.

We are witnessing to the inexorable birth of a culture planetary culture based on the most spoken language manifested through music and films, international retail chains, luxury fashion meant for general consumption, international sports world championships and Olympics, etc.

Environmental threats are now much more aware of by a large mass of people who can intervene in the debates and cause changes in the corrective actions that are taken.

Tourism is booming everywhere on Earth. Requiring more modest amounts of money, travels are becoming more numerous. In this way, a much better understanding of other people is possible generating a positive impact on mutual understanding. Tensions between nations will be smaller because they naturally know each other better.

The concept of war is in decline now that the populations are more interested in increasing wealth unperturbed. A powerful and war hostile media, can make war extremely unlikely.

Although for a while there will be wars on Earth, they will become less and less common as the disparities between countries are reduced.

An argument can be invoked in favor of reducing the frequency of wars, namely: the number of children per family in the past was high – 7-10 on average - and many were taken to the army. Today, with 1.5 children per family, the number of those interested in the military is much smaller. States will not have the demographic potential to compile numerous armies!

The individual strength will diminish as regional and then global unions will occur. Route to a Type I civilization will change the essence of capitalism whose economic power is shifting from individual countries to continental economic unions and trading blocks.

But as noted above in the Introduction, the greatest development will belong to the fundamental science, applied sciences and technology, optical / quantum / type computing, robotics, medicine and nanotechnology, etc.

2.2. The Type II Civilization

A Type I Civilization once achieved around 2100, it will be naturally and gradually strengthened, and then by methodical increasing of energy generations and consumption beyond the Type I, the human society will reach the Type II Energy Civilization stage, a Stellar Civilization, in the range of 1,250-2,500 years, that earliest around 3350 CE but no later than the year 4600 CE.

If a Stellar Civilization managed to develop on Terra, it then becomes indestructible. This statement has coverage in the fact that anything known to science can no longer destroy humanity. For example, since the climate will be well controlled, the greenhouse effect will be annihilated in time and ice ages will be completely avoided. Moreover, even if in a huge time horizon, the sun is about to become a red dwarf, mankind will have the means to change the Earth's orbit moving it away from the sun, or simply leave it for another convenient destination.

The best known way in which a Stellar Civilization can be achieved is by building a Dyson sphere [8], which means building a giant sphere around the solar system star, so that all the energy of the star to be used for the benefit of humanity.

As noted above, a Type II Civilization could install at the earliest in 3350 CE and no later than the year 4600 CE. This is a time horizon long enough for a Type I Civilization to be able to smooth all asperities which are inherently present in its structure. This makes us to believe that a Stellar Civilization will profoundly quiet and deeply at peace with itself [8], which is to say that social tensions will be reduced substantially due accession to a high standard of living. As it is already known, the space travel will remain extremely expensive, it is expected that the mankind will to adopt the strategy of remains on Earth long after the installing of Stellar Civilization, which imperatively requires a lasting social equilibrium.

2.3. Type III Civilization

When a Type II Civilization reaches a Type III civilization, which might happen in the next 1,250-2,500 years after the installation of Type II Civilization, i.e. between 4600-7100, a Civilization of Type III will be able to colonize the first solar systems in the galaxy, outside of our solar system, systems that will have been already explored since the time of Type II civilization edification.

The most economical way to do this is to send auto-replicator robotic probes throughout the galaxy [2]. These are called von Neumann probes after the name of the scientist who imagined the concept, and they have the quality of reproducing themselves in an unlimited number of copies. In this way, starting from only a von Neumann probe, sent to another planet in one given solar system of the Galaxy, the whole galaxy can be gradually mapped. Once this goal is achieved, the effective colonization of the galaxy solar systems can be initiated.

In this mapping process we may encounter any other civilizations older or newer than ours. Indeed, since the universe is 13.7 billion years old, and life and our solar system appeared 4.5 billion years ago, it is perfectly plausible to have planets older than our Earth. The oldest such planet could have at least 8 billion years, when the universe would have been cooled enough to allow aggregation of solar systems.

In such a long time, given conditions similar to those on Earth, a civilization incomparable more advanced than ours could have developed. If we still do not feel its presence now, it's because either it self-destroyed, or it does not want to make its presence known to us. If it is the latter situation, we will know when encounter this extraterrestrial Civilization.

Therefore as long as our civilization has not reached a high level, it is preferable refrain from emitting signals revealing our presence to outer space, because in any potential confrontation with a civilization more advanced than ours, we have absolutely no chance of prevailing. But it could just as well be that such a civilization has been destroyed long ago.

One such possibility is the most likely transition from a Type 0 civilization to a Type I Civilization because only then it is still completely preserved the religious fundamentalism, the savageness, and the racism of caveman (human consciousness has not changed much since caveman came into Type 0 Civilization Cities). Therefore it is likely to find in other solar systems of the galaxy, the evidence of Civilizations extinctions, such as an atmosphere too hot or very radioactive or toxic that made the continuation of life improper.

The Type III Civilization already has the resources for probing the "Plank Energy" of 10^{19} MeV, a level of energy at which space-time itself becomes unstable [8]. This is a tremendous energy compared to that of the Geneva LHC Installation, namely of 10^{15} more (a million of billions more). At this level of energy, the fabric of space-time from Einstein's relativity theory collapses leading to portals which can connect to other universes or other space-time points. Then it would be possible to create shortcuts through space-time, either by compressing time, either through wormholes, which would result in dramatic shortening of the time to conquer the entire galaxy [11].

3. New approaches in classification

The classification introduced by Kardasev was made in the 60^s of last century when physicists attention was focused on producing energy effectively because of the effervescence caused by nuclear energy triumphant debut. It was not long after the advent of computers and the importance of information was acknowledged because of the added value in the grand scheme.

3.1. Hierarchy according to the information

Carl Sagan was the first to release a new classification based on information processing [8]. He had the idea to use the Latin alphabet to quantify the amount of information processed. According to this classification, a Civilization of Type A corresponds to a volume of information of 10^6 (a million) units of information (bits). This would correspond to a civilization that has only one language spoken, not written. A Civilization of Type B corresponds to a society that possesses a written and spoken language and has a 10^9 (a billion) bits. By scaling up this classification we can see that our current Civilization of Type O processes an information volume corresponding to level H, i.e. 10^{27} bits. So our civilization is a Type 0.7H Civilization. In 2100 CE our Civilization will probably be a Type IK Civilization.

Nevertheless, in the last years, we have seen that not only the production of energy and information processing are important. We have realized that any energy source and even any information processing is generating pollution as well. [2].

We understood quite quickly that a Type IK civilization may produces so much pollution that it can simply collapse. For this it is enough to think of the many power plants on Earth that in 2100 CE will release to the atmosphere half the generated heat, which will create a big problem for life on Earth. It is not difficult to understand that a civilization which loses control of its pollution can kill itself very easily. Energy and information are not sufficient to ensure the survival of a Civilization while climbing on this scale.

Therefore we need to establish a new scale that takes into account the efficiency, the residual heat and the pollution. In order to do this, we have to introduce a new concept namely the entropy.

3.2. Hierarchization. Depending on Entropy

A civilization of some kind needs to ensure a continuous increase in energy output and information processing, but limiting the increase in planet's temperature or in the end decreasing the amount of the generated waste. It is somehow a constraints maximization problem. To deal with that, we need to resort to the laws of thermodynamics. There are only two laws of thermodynamics. The first states that

you cannot get something from nothing, i.e. “there is no such thing as a free lunch” [6]. This is because the amount of mass and energy from nature is constant. But as Stephen Hawking says, the second law of thermodynamics is more interesting because it is directly involved in the fate of a civilization of one type or another. According to the second law of thermodynamics, the entropy, which is defined as the ratio of heat and the temperature, rises continuously. Entropy is a measure of disorder or chaos, and what it tells us is that orderly states always converge to the disorderly states. This occurs simply because the former are less numerous than the other.

The transition from order to disorder is to say that all things that are ultimately ordered states degrade while entering a more pronounced disorder, which is to say they will rust, rot, decompose, grow old and crumble. Only an increase in entropy it is possible, as if it were otherwise - that if the entropy would decrease - we would see the impossible, such as omelets in the pan coming back in the eggs from it was made, or old organism gradually regained youth. After all, the fact that we human beings get older is evidence of increasing entropy for the state of youth is the orderly condition tending to the less ordered, so disorderly, associated with the old age.

Therefore, any Type I-II-III Civilization that produces more energy and thus increases the heat the planet’s temperature to a level that makes it impossible to survive. Even so, every civilization that process more and more information, continuously cutting forests, is producing a mountains of waste paper and will end up drowning in their own waste.

In view of these facts, it is useful to introduce a hierarchy of civilizations with two types of entropy [8].

The first would be a Civilization with limited entropy, i.e. a civilization that somehow conserves its entropy by using all means available to control temperature rise and waste generation. For global entropy can not be stopped, there is only one way of doing it, that is by limiting entropy growth into a subsystem of interest and allowing faster growth in the rest of the system in compensation. In this respect, it may be discussed the fission energy, the most advanced and efficient electricity generation industry. However the development of nuclear energy fission is blocked on one hand by the three major accidents occurred in the past, but mostly because of the radioactive waste [9] resulting from their operation, which is a growth factor for the system entropy. There are two possible ways to counter the increasing entropy. The first would be to send radioactive waste in the solar system, depositing them in a convenient satellite of any planet. This would be in consonance with the above statement that entropy decreases on Earth and increases in the rest of the solar system. Cosmic

expeditions are costly and for the moment the option is not feasible. A second way is related to a top research concerning highly radioactive material transmutation and very long half-lives into the stable products by using gamma-neutron reactions with the help of very powerful lasers [12]. This possibility will be a research subject even at IFA-Măgurele in Romania at the European Extreme Light Infrastructure - Nuclear Physics (ELI-NP), now under construction with EU funding. In this way we could obtain a considerable reduction of entropy of the nuclear systems, which will have the effect of reviving nuclear fission on a planetary scale. Moreover, we can do better than that, i.e. in the subsystem of interest Terra for instance, entropy can be forcedly reduced (but still only locally) using nanotechnology and renewable forms of energy for eliminating wastes and increasing energy inefficiency.

The second would be a Civilization in which the entropy is allowed to rise freely, in other words there is an interest specifically to the production of energy regardless of the consequences. In this case, when life on the native Earth becomes improper, the Civilization may decide to leave for another planet, because they are having enough energy and this goal becomes feasible. But as we have shown here, space colonization costs remain prohibitive for a long time from now on, which limits the expansion. If the entropy increases faster than the expansion capacity of a Civilization on another planet, this Civilization would undoubtedly perish. Therefore, we can note that the future Civilizations on Earth will be at the current level of knowledge, Civilizations determined by energy, information and entropy.

4. Final considerations

If we follow back the position of humanity from antiquity to the present day, we can easily see that in the beginning people were passive observers of nature, and after a while, since the industrial and energy revolutions, they gradually become choreographers of nature, managing to adjust here and there the forces of nature. However, whether, by year 2100 we shall become a Type I civilization, things will change dramatically [11, 13]. We would become masters of nature, for instance moving objects with the power of the mind, thanks to the widespread computerization, we could control life, postponing death and we could turn to the colonization of our solar system, then aiming to the stars. But if we become masters of Nature, it would be unrealistic not to be her protectors as well, namely to preserve Nature values. We saw that if entropy is left free, it will inevitably lead to compromise of life on Earth. The Next Civilization, the Type II civilization to which we are heading, consumes as much energy our sun produces, which would cause the Earth surface temperature to reach incandescence, if entropy is not limited. Fortunately there are always ways to do this.

One method is related to the continuous reduction of energy consumption of household appliances. However unlikely it may be at first glance, it is well covered by the facts, given the huge number of electrical devices. The power efficiency of this kind will be achieved by implementing future nanotechnologies. This will dramatically reduce the power requirements and especially those heavily polluting plants such as coal powered plants.

Another method is the fact that the development of superconductors at room temperature will revolutionize the way our energy is produced and transported. A zero resistance to electric current flow will mean a dramatic reduction of the cost of electricity whose production centers will be located near the cities, thus avoiding risks. Today up to 30% of energy produced is lost in the transport cables, even if the voltage was highly increased. Eliminating this loss is considerable and absolutely beneficial in order to reduce the energy production while preserving the same living standard. But any reduction in energy production decreases entropy, which is exactly what we need.

Superconductors at room temperature will allow scientists to create giant magnetic fields applied to enormous scale. One of the obvious applications of this would be to create trains and automobiles using magnetic levitation with the help of soil embedded superconductors, instead of roads. The absence of friction would make these vehicles extraordinarily effective. This is one of the many reasons for which XXI century will be the century of magnetism without doubt.

The transition from a 0.7H Civilization to an IK Civilization, which is well underway according to the general scientific community general opinion, is the most important evolution in human history. This situation is very special because the fact that proximity to a IK type Civilization is a critical state. We are closing to a tipping point, also known as singularity, when the robots could become clever than we are, from which we can prosper and flourish, or on the contrary, we can fail and our Civilization succumb due to our imprudence and stupidity. The latter scenario can be explained by the fact that we the people of this XXI century we have changed very little over the last hundred thousand years since we were living in caves. The character features imprinted in the conscience of caveman were governed by the scarcity of subsistence means, and although there were mutations, they are not significant for radically alter us in the last one hundred thousand years. Consequently, the people of this period about to reach a type IK Civilization might not be wise enough to overcome the challenges that arise from that course.

According to Immanuel Kant, "Science is organized knowledge, while wisdom is organized life" Developing the concept, we might say that wisdom is the ability to identify the crucial issues of our times, to analyze them from different angles and

perspectives and to choose the optimal strategy for achieving the objective. It is from this point of view a field of operational research and decision theory with one or more objective functions subject to restrictions, or a game theory with one or more objective functions for conflictual situations, an approach which has long proven its usefulness. [14].

Unfortunately it is not always easy to find the wisdom to act correctly. The biggest problem is that just as Isaac Asimov once said: "Science gathers knowledge faster than the contemporary societies can obtain wisdom" That is happening because as Albert Einstein showed: "Science can only determine what there is, not what there will be, and beyond this limit, value judgments become indispensable" This field is the one belonging to wisdom!

Well, but how can we become wiser? First, through a range of serious education of young people, challenged to enroll in science and technology fields. But not only them, but elderly scientists have to be drawn into the stream of continuous education, despite the difficulties brought about by age, for wisdom is largely related to the experience of life; an educated older is better positioned than a young person in what wisdom is concerned! Removal of the elderly from the process of wisdom acts is a disaster by no means excusable.

But what it is an act of wisdom anyway? It is a rational and informed debate between opposite sides, reminiscent of game theory [14], without emotional involvement, on topics crucial to society [15]. For instance, happiness defined as a goal with two components, income and health, is of close interest for mankind. Given the fact that income increases with age but health decreases with the age, the question is when a man realizes the highest happiness? In youth, when the man has a low income but a high health status or in old age when income is high, but his health is minimal? As shown in [15], this dilemma consist of a non-zero sum game with two partners of which the solution is somewhere in the middle of life when income is not the largest, nor the minimal health! Although this kind of debate is usually loud and drowned in smoke and fog from the beginning, it has the merit that ultimately leads to the best solution for everyone. In today's world this debate is undertaken successfully in all democratic societies. However, for such an approach to be successful it is necessary for the parties involved in it to have a solid knowledge base and, thus, we get back to a good education.

Nowadays, the means for ensuring the framework of this debate is most certainly the Internet, despite its shortcomings and excesses. We observe today the themes, debated behind closed doors before, are now analyzed within many discussion forums on Internet. One consequence is the fact that the dictatorial regimes can not make irrational decisions as easily as they did in the past and this process is just beginning!

Briefly speaking, the future that we are building lies solely in our hands. It depends on our wisdom, whether we will enter the era of IK Type Civilization or we will annihilate ourselves through nuclear war or catastrophic and irrational environmental policies. If we do that, we should understand that there is no second chance for humanity to make a new beginning as shown by John Gribbin [10].

This study is intended as a plea in favor of science and technology whose role is not emphasized enough in the current society [7]. This paper wants to draw attention to the fact that the true strength of science lies in the fact it is offering us the strength to go forward in terms of prosperity and welfare, continuously stimulating mankind creative and innovative spirit [8]. I also want to point out that the year 2100 is a singularity moment, a threshold we will reach for the first time in human history, a Type IK Civilization level. Afterwards, beyond the Type II Civilization the human development and expansion in the Universe would be unstoppable.

In conclusion, we can observe that mankind needed about 100,000 years to reach the threshold of a Planetary Civilization and it will probably require only another 5,000 years to successfully achieve the next two stages, the Stellar and Galactic Civilizations, but only if the Planetary Civilization is reached.

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