

Economy, Pollution, Energy, Environment, Climate: From the Past to the Future

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ABSTRACT

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We do not pretend to be exhaustive on the investigated subject, not even one volume would be enough. In this paper we want to present some reflections on the energy, environmental and climatic problems of our time (in particular those less studied), starting from the knowledge of the past. The contribution provided by non-renewable energy sources to the development of our civilization is analyzed, underlining that their replacement is not feasible in a short time in order not to cause a drastic shortage of the resources necessary for a still growing world population. The difference between environmental and climatic problems and the need to deepen knowledge of the latter ones is emphasized, in order to better understand their causes, predict future developments and take preventive actions to reduce their impact on our environment and our lives. Finally, mention is made of the need to establish priorities in addressing the great problems of our time, in a global vision of human society.

1. INTRODUCTION

The history of man on Earth has developed according to the environment in which he lived and to the resources available in different places and thanks to the knowledge of the moment. The environment, in turn, was strongly influenced by the climate, which has undergone great changes over the centuries. The climate, determined mainly by the events of the solar system and by other internal causes of the planet (volcanoes, earthquakes, etc.), was the master of lands, waters, pastures, forests and crops: therefore, it conditioned people life, the areas in which they settled, their migrations, the wars for the conquest of more favorable places; in the absence of other explanations, the climate was considered a sign of the benevolence or anger of the gods.

Of course, man was not simply watching, but tried to modify the environment to make it more suited to his needs, cutting down trees, tilling land, regulating the water regime, building roads, villages and then cities. Until man wasn't able to use fossil fuels to have energy on a large scale, population has grown very slowly, because of self-regulation due to the lack of resources. If at the time of the Roman Empire there were 200-300 million individuals, only in 1850 there were just over a billion people; then there was the demographic explosion, which made us reach 7.3 billion in 2016, a number that continues to grow (today we are 8 billion).

This exponential increase was made possible by the large availability of energy: in fact, the population trend is similar to the energy consumption one, which in the last two centuries has been supported by all sources that can be used with the available technology: fossil fuels, uranium, energy, hydroelectricity, biomass. Solar energy in its various forms has always made a fundamental contribution to the

maintenance of natural cycles (water, carbon, etc.) and forests, and also to the development of agriculture and pastures; and today it provides a further contribution, smaller but growing, through new forms of exploitation (solar, photovoltaic, wind). Nevertheless, fossil fuels still cover approximately 80%-85% of world needs. However, our land is a finite environment: the enormous number of humans and animals existing today and the fervour of activity of current civilizations cause not only a rapid consumption of these resources, but also an unprecedented environmental impact.

The current generation has to face some epochal problems: how to cope with the slow (although still far away) depletion of non-renewable sources. How quickly can these sources be replaced in an appreciable way, thus contributing to the alleviation of environmental problems, without depriving the population of the necessary resources and without upsetting the economy and way of life, which would cause serious conflicts? How will lifestyles and ways of using sources change in the medium-long term?

Another aspect has recently attracted general attention: the issue of climate change. Talking about climate change is apparently a banality: the climate has always changed and will continue to do so. But the problem that is being debated today is the following: what are the main causes of the current climatic trends? In other words: the responsibility is of anthropogenic activities, which have never been so intense in the past, or does the climate continue to change independently of these, according to the rhythms imposed by the causes that have determined the events of the planet over the millennia? If the climate today is mainly determined by human activities, it makes sense to try to counteract its trends, in the event that these are considered harmful; if, on the other hand, the climate depends, as always in the past, on natural causes, rather than

trying to counteract its changes, it is preferable to face its effects with the means at our disposal.

2. ENERGY, POPULATION, ENVIRONMENT

The ability to intensively exploit energy sources has produced the development of our civilization, with its positive and negative effects. Our society today largely depends on non-renewable sources, that is mainly on fossil fuels, which cover 80-85% of the total needs. These sources have made it possible to modify our life, generally for the better. Thanks to them, there has been the development of science and technology, which have made available a large amount of food, have favored the spread of education and knowledge, have lengthened life expectancy due to the fundamental contribution of medicine and hygiene, have introduced us to distant worlds thanks to the increase in mobility and communication systems, have improved the comfort of our daily life. All this has been possible thanks to the great availability of energy: therefore, it is quite ungenerous to demonize the fossil sources that have allowed it and without which we would not be what we are.

But the planet has finite dimensions; therefore, exponential development cannot continue indefinitely, both because non-renewable sources, while still abundant, do not have unlimited availability, and because the terrestrial environment is unable to dispose of and recycle materials and energy beyond certain quantities. This also places limits on population growth. Ultimately, energy, environment and population are interdependent and conflicting aspects and require the search for a right compromise, which happens for the first time in human history. In addressing these problems, one has to be realistic and leave no space for utopias and ideologies, which often, perhaps in good faith, distance the solution of problems. It is obvious that the use of fossil fuels will have to be progressively reduced; but to think of their massive replacement in a short time with renewable sources, that is with solar energy, is illusory. A lot of time is required to achieve this target, both because of the intrinsic characteristics of solar energy both because of the deep socio-economic transformations that follow; and we know that such transformations cannot be too fast, in order not to cause upsets in the economy of the people with the consequent tensions, which would cause social conflicts.

Furthermore, renewable sources are unlikely to support an energy-intensive society. In fact, they have some negative characteristics that make their exploitation generally expensive and problematic:

- low power density, which requires large capture surfaces and therefore large-scale installations, with occupation of space and material requirements;
- non-continuous and unpredictable availability, which reduces the utilization factor and forces the installation of additional generation and storage systems;
- availability linked to the place of installation (latitude, altitude, windiness, etc.), which does not always coincide with that of use.

Taking these considerations into account, it makes sense to direct research, which is the engine of innovation, towards the improvement of the exploitation systems not only of renewable sources, but also of the sources that are currently the majority, with the aim of using them with higher performance than current ones; in addition, a very important

and quantitatively significant role will be played by a more efficient organization of energy systems, both for generation and for energy use (higher performance according to the Second principle by developing the exergetic and emergent treatments). Political strategies may lead to a different type of society from the current one, but very gradually. The role of energy education will be fundamental to obtain sharing in making even unpopular decisions; and the role of communication will be equally important: we must not disclose distorted information or keep silent part of the truth to guide public opinion, but we must be transparent.

An example of not entirely correct communication is given by the news with which the Italian public is informed about environmental pollution. We know that the Po Valley is a critical area due to its geographical position: it is a closed area between the mountains, in which air circulates with difficulty. It is also very populated and is the site of intense economic activities. Therefore, the concentration of pollutants fails to drop below certain levels, as it is instead possible in many other European areas. In fact, the limits established at European level are frequently exceeded, no matter how many initiatives are taken; and the media are constantly reminding this aspect, pointing out the health risks. The impression that the population draws from this matter is that the pollution is worsening, the health of citizens is subject to ever greater risks and the number of diseases and deaths from pollution is growing. This causes alarm and pushes administrations to take emergency measures, which are not very useful, but just undertaken to not give the impression of not acting. But what does the information not say?

First of all, that pollution in Europe and Italy was higher a few decades ago, when the efficiency of vehicles, boilers and power plants were lower and systems for reducing pollutants were lacking; all things to which little importance was given. Subsequently, the growing awareness of these problems led to improve the efficiency of energy systems and to set limits on the admissible concentrations for the major pollutants. Consequently, pollution in the Po Valley has decreased. It is evident, however, that it will not be possible to drop significantly further with the concentration of polluting products, except on rainy and windy days. Modest further improvements can be obtained by gradually changing lifestyle, which will take a long time.

Very different considerations can be made for other areas of the world with a high rate of development (China, India, etc.): in these countries one should try not to retrace the paths followed by the most industrialized countries in the past, given that it is now possible to act in a more rational way without renouncing development.

Secondly, the average lifespan of the population in the world, and especially in more developed countries, has increased in recent decades. In Italy, for example, the average life expectancy was equal to 69 years in 1960, almost 85 years in 2015: we are second in the world after Japan. This means that general health has also improved, thanks to medicine, hygiene standards, increased awareness of healthier lifestyles. If the number of certain types of diseases increases (respiratory diseases, tumors, etc.), this is due to the advanced age of a significant part of the population: once a certain age is reached, it is easier to contract the aforementioned diseases, that previously you did not have time to take: you have to die of something!

From the previous considerations it is deduced that it is not ethically correct to disseminate incomplete information,

hiding a part of the truth, to support one's thesis: pollution must be fought, but without causing unjustified alarms. Alarms that media tend to spread in many fields, because negative and tragic news attract more than positive ones.

The world energy situation is evolving: the more developed countries tend to limit energy consumption through rationalization policies that make it possible to reduce waste and improve efficiency, while emerging countries rapidly increase their consumption, exerting considerable pressure on resources and the environment, also due to their very high number of inhabitants. It is true that the rate of population growth is destined to decrease, but this phenomenon and above all its effects will take a long time. In this context, a continuous increase in world energy consumption is foreseeable for many years to come, during which it will not be possible to give up the contribution of non-renewable sources, but one must try to use them more and more efficiently.

3. CLIMATE CHANGE

As mentioned, the climate has always changed on our planet. By way of example, and limiting our attention to the period and geographic area for which we have greater documentation, let's see briefly how the climate varied over the last two millennia. In general, the relatively warm periods ("interglacial") have been more favorable than the cold ones ("glacial") to the development of civilizations: civilizations are daughters of the interglacial periods; however, the climatic conditions that favored certain areas were adverse for others. In Europe and in the Mediterranean area, the following climatic periods took place:

- a "Roman warm period" (3rd century BC-4th century AD), in which the development and maximum splendor of Roman civilization took place;

- a subsequent "small early medieval ice age" (5th-9th century), during which the inclement climatic situation contributed to causing a relative regression and caused displacements of populations (barbarian invasions, religious upsets), with the consequent fall of the Western Roman Empire;

- a "medieval warm period" (10th-14th century), which led to the splendor of the Renaissance in Italy;

- a "little ice age" (15th-half of 19th century), in which the climate, even though with various fluctuations, was on average cold and there were climatic and historical upsets of various kinds;

- the "current interglacial period" (starting from the half of nineteenth century), during which the temperature has been increasing on average, but with significant variations (decrease from 1945 to 1980; relative stability from 2000 to today); in this period the great development of the population and the intense exploitation of energy resources have had a deep impact on the environmental situation.

Within these periods there have been many anomalies (peaks of cold and heat, drought, famine, floods, etc.), some of which due to intense volcanic phenomena; for example, in 1816 there was the eruption of the Tambora volcano in Indonesia, which had a devastating impact on a large part of the planet and caused the following "summer-free year" in Europe and North America (temperatures dropped to zero degrees in August in some areas). The aforementioned periods have mainly characterized the northern hemisphere and especially Europe and the Mediterranean area.

Which were the causes of all these climatic events? And what can we say about the current changes? Which predictions can we make for the future? To make reliable assessments of the causes of current climate change it is necessary to start from the past, trying to recognize the factors that have caused changes in the climate over the millennia.

To this end, it is necessary to use and integrate the information that can be given to us by the various research sectors, because climate science is typically interdisciplinary. Reliable instrumental data relating to climatic parameters (temperature, humidity, etc.) have recently been available: the last 100-150 years. It may therefore be tempting to build interpretation and forecasting models based above all on the aforementioned data. But to think that the last 150 years of the history of climate, environment and human activities contain all the data to understand why the current climatic-environmental variation is taking place is unscientific. It is equivalent to believing that the last 150 years have no past and believe yourself omnipotent, thinking that only human activities are responsible for global changes we are experiencing. The environmental pollution of the last century is certainly due to anthropic activities; but the climatic-environmental change of the same period is quite another thing and must be correctly framed in the previous millennial history.

There is therefore a need for synergy between nature scholars, who know how to correctly examine and interpret natural archives relating to the last millennia (climatically controlled sediments, archaeological finds, historical archives, documents, artistic creations, etc.) and scholars of the instrumental data of the last 100-150 years, in order to orient oneself, to correctly interpret the past and to draw elements from it to foresee the next changes in the climate and the environment and to provide adequate solutions in time to prepare the anthropized environment for future environmental conditions.

Today the different scientific disciplines help us to begin to understand; but climate science is young: there are still many uncertainties. One thing, however, seems clear enough: the variations in the activity of the sun, also signaled by sunspots, have had and still have a significant influence on the earth's climate; as well as many astronomical events (variations in the mutual positions of the sun and the planets, in particular of Jupiter and Saturn, changes in the eccentricity and precession of the Earth's orbit, the inclination of the Earth's axis, etc.). It is very suggestive, among other things, to observe that in the course of history the climate, in its long-term evolution, has been modulated by periodic oscillations, having different periods (maybe attributable to astronomical causes?): 9.1 years, 10-12 years, 15 years, 20 years, 30 years, 60 years and longer periods.

A better knowledge of these causes external to the planet, combined with internal causes (volcanoes, earthquakes, etc.) and with the actions of man, may be fundamental to fully understand climate change: it takes humility to recognize that there is still a lot of work to do. Today we do not have true certainties that allow us to make reliable predictions; and it is illusory to think that the forecasts advanced through the models developed by many scholars and endorsed by the IPCC, which attribute the causes of climatic variations almost entirely to man, can tell us how much we can change the trends through energy policy actions. It is hardly credible that natural causes, which have been the engine of the climate throughout the history of the planet, have become irrelevant since human actions are quantitatively relevant.

4. WHICH ARE THE MOST SERIOUS PROBLEMS TO FACE?

In a world with a growing population, limited resources and many problems to solve, it is not possible to face all problems at the same time, but it is necessary to establish priorities, in order not to waste resources and aggravate the situation. Climate is probably not the most important problem for the future of humanity: there are other more serious priorities, such as malnutrition in poor countries, lack of education in many areas of the world, tribal and interreligious conflicts, some diseases (malaria, tuberculosis, aids, cruel evils), the unavailability of vaccines, and others. Immigration flows deserve a separate discussion. If they are uncontrolled, they go to act on countries that risk collapse, they dramatically increase delinquency and violence, they can destroy civilizations that have given so much to the cultural development of the world to unduly enrich “non-profit” and political and religious associations that have the purpose of destruction.

Among the important problems of our time we must mention the use of the land by man, also linked to climate trends. Under the push of demographic pressure and individual interest a lot of constructions have been built, profoundly modifying the environment, but often with little awareness of the risks and dangers. We have built buildings in inadvisable areas, we have taken little account of seismic risks, we have done little maintenance of the territory, we have proceeded with wild deforestation in some areas, while in other places we have abandoned previously cultivated areas, which have suffered degradation and have been progressively invaded from the forests (beware of the demagogy of trees).

In the face of not very sensible behaviour, nature does not forgive and forces us to intervene with emergency measures after disasters have occurred, while it would be more sensible to act preventively. We must remember that the climate changes, that natural events can be sudden and violent and that therefore we must not be caught unprepared, but act with adequate prevention measures. And we must fight air, soil and water pollution through a rational use of resources. Among these, fossil fuels, which today provide a major and fundamental contribution, cannot be abandoned too soon, because this would cause a catastrophic lack of resources to

support the world population; however, it is necessary to continue to improve its use from an energy and environmental point of view.

These are epochal problems, requiring wisdom, honesty, long-term vision and decision-making skills. Will we be able to act accordingly or will we continue with small cabotage policies?

5. CONCLUSIONS

Our world faces very complex and interconnected epochal problems. Interreligious conflicts would seem distinct aspects from the others that we have mentioned and that we will illustrate again, but this is not the case. Just think of the interference of religious leaders on the political choices of the various national governments and on the economic choices of great importance, the lack of education in many areas (one of the worst evils of humanity) for which masses of individuals become masses of manoeuvre for political, economic, religious groups, etc. Inequalities and cultural levels represent real barriers to the conversation. The demographic and pollution problems are really big, strongly interconnected with each other and with energy aspects and, it seems almost secondarily, but if we think about it significantly, also with the climate. Thus ends the first part of this note which contains the concrete and real problems of the world, without falsehoods and political demagogy.

REFERENCES

Very numerous newspaper articles (in particular *Sole 24 ore*, *Financial Times*, etc.) and scientific articles have been read; they have been synthesized, summarized and interpreted, we do not mention them as they are too many, often well known, but above all none preponderant. A reference to a single text “The man on his way to the future” (publishing house Clueb) with articles by Zichichi, Sermonetti, E. Lorenzini, B. Sorge SJ. Furthermore, this note is prepared for the round table of the Congress on Energy, in which the predominant report, of big interest and current content, was that of the National President of ENEA, Gilberto Dialuce.