IS SCIENCE HARMED BY BELIEFS AND LOBBYING ?

Reflections about two recent books dealing with that subject

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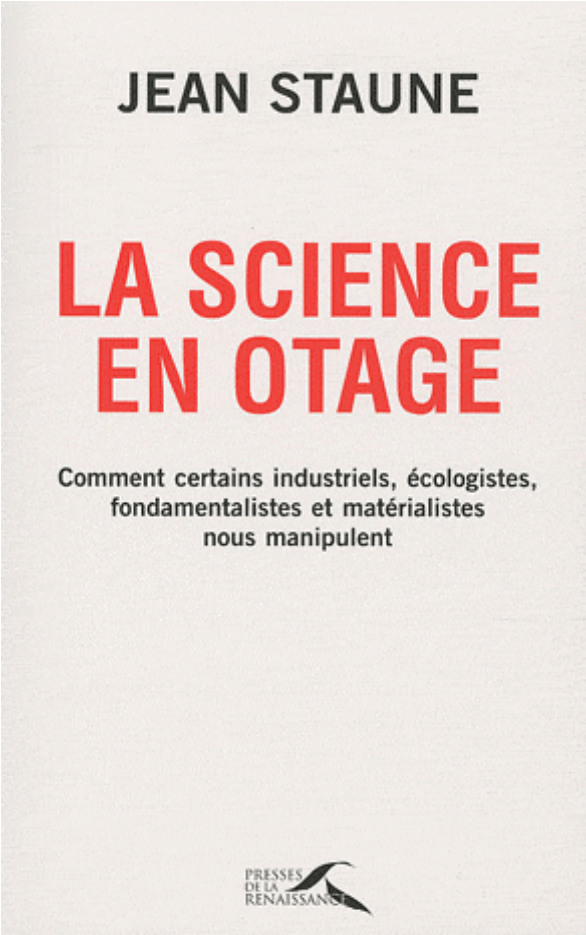

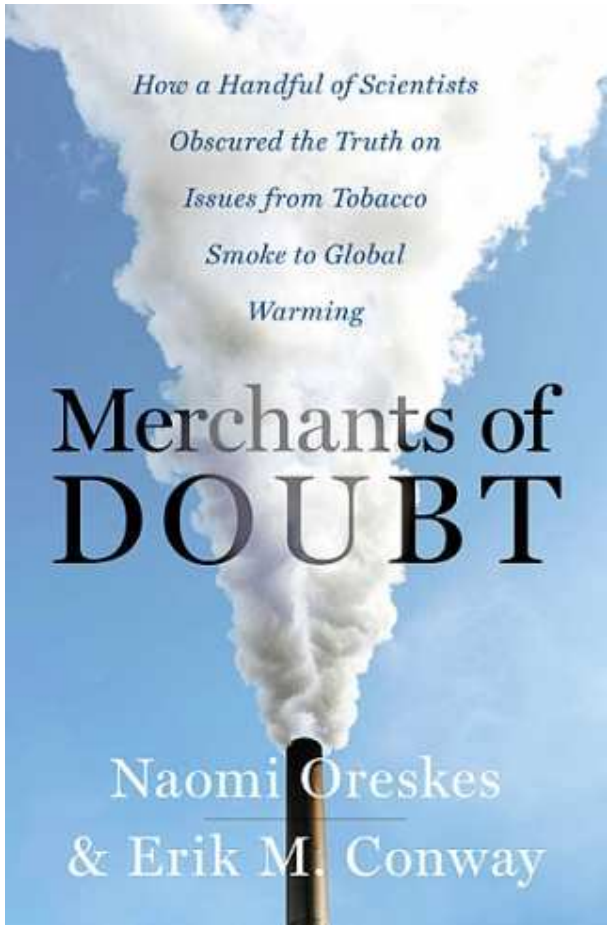

Introduction

Holding a degree in palaeontology, mathematics, management, economics and political sciences, philosopher of sciences, founder and secretary general of the « Université interdisciplinaire de Paris », Jean STAUNE is the author of many books, among which *« La science en otage »* (Science taken hostage), published in 2010, and the best-seller « *Notre existence a-t-elle un sens* » (Has our existence a meaning), published in 2007, which is the result of nearly twenty years of research and encounters, in many countries, with dozens of personalities representing all the main fields of sciences.

Holding a degree in geophysics of the globe, Naomi ORESKES is presently Professor of Earth Sciences at the University of California in San Diego. She has published some books about plate tectonics and continental drift and eagerly champions the thesis of anthropogenic global warming.

Erik CONWAY is a science historian, working in the Jet Propulsion Observatory of the NASA, within the California Institute of Technology in Pasadena. He has written many books, essentially dealing with the link between science and politics in the USA.

The choice of these two books as bases for my reflections – besides being recent – comes from the fact that they deal with a number of common subjects, as global warming for instance, while denouncing the many manipulations that aim at distorting both the public opinion and, above all, the decisions at political level.

But I will show that, beneath that apparent convergence of objectives, there lies a deep divergence about the method that has been used and, *ipso facto*, about a number of conclusions they are drawing from it and about the almost subliminal message they are delivering.

Both authors' approach

Jean STAUNE's approach

In his book, Jean STAUNE assumes an essentially scientific approach, presenting the results of a number of studies and researches that have been led in all transparency and meticulously listed and which, by crosschecking and reciprocal strengthening, prove the absurdity, and even the aberration, of some propositions that a variable, but growing number of industrialists, ecologists and fundamentalists present as « scientifically proved », with obscurantism proliferating as a result.

Beginning with a field that he knows very well through his degree in palaeontology – the evolution of species – he extends his reasoning to the present climate argument, incidentally having a dig at Fred SINGER and the deniers' club, then to the depletion of the fossil energy resources – essentially oil – and to the use of nuclear energy, and finally, more succinctly, to some health problems, as the supposed epidemic of the H1N1 flu and the development of GMOs (Genetically Modified Organisms).

It is only in his last chapter – the tenth – that he indulges in more « philosophical » considerations, before concluding with some personal recipes so that the human adventure could go on.

Naomi ORESKES' approach

In her book, Naomi ORESKES adopts a reverse approach to Jean STAUNE's : she starts from a principle – well summed up by the title of her first chapter : « *Doubt is our product* » – and she tries to prove it through the arguments that raged, particularly in the United States, about various themes – smoking, both active and passive, acid rains and the hole in the ozone layer –, principle that she then makes use of in support of the thesis of anthropogenic global warming.

Naomi ORESKES is clearly not a scientist, as shown by her statement that beryllium is a heavy metal, or by her simplistic explanation according to which « *warming up of the earth is caused by greenhouse gases, because these gases are for the most part trapped in the lower layers of the atmosphere, the result of it being that the troposphere is warming up while the stratosphere is cooling down ; moreover, this proves that the sun cannot be at the origin of this warming* » (follow the guide !). Actually, CO_2 and the other greenhouse gases spread in the whole atmosphere and the evolution of atmosphere temperatures with altitude is much more complex than Naomi ORESKES insinuates.

This one is much more a polemicist than a historian, since she starts from her belief and afterwards gathers and present only the facts that tend to confirm it (while pretending by the way that there are no facts that belie it).

The main subjects that are tackled

Tobacco, acid rains and ozone layer

Even if Jean STAUNE does not speak about acid rains and only slightly touches the noxiousness of smoking, both active and passive, for health, and the important role played by CFC (chlorofluorocarbons) in forming the holes in the ozone layer above both poles, it seems to me that we can come to the conclusion that both authors agree, as much about these facts themselves and their harmful effects as about the negative role that industrial lobbies played against their taking into account.

I would like to underline the fact that, when a problem has been acknowledged, it does not imply *ipso facto* that it has been resolved. Even if smoking is tending to decrease in our western countries, it is not the same everywhere else, notably in Asia and particularly in China. Acid rains go on falling, more because of nitrogen oxides than of sulphur oxides. And the holes in the ozone layer are holding, growing slightly larger indeed, because the use of CFC has been prohibited in 2010 only and that these gases degrade themselves only very slowly in the atmosphere.

Global warming

Contrariwise, both authors do not agree at all between each other about the global warming, namely about the importance of such a warming, about its causes – particularly the role of human activities – and about its effects in a more or less foreseeable future. Of course, I shall not here go over all the details of their respective arguments (those who would know more about it can read the books), but it seems to me that a critical synthesis of these arguments should be useful, imperative indeed, given the importance of the subject.

For Naomi ORESKES, according to her own words, « *keeping an open mind in that matter is totally inappropriate and there is no room for any doubt* ». There is on the one side the community of the "true" scientists – as those working for the IPCC (Intergovernmental Panel on Climate Change) – in whose name she pretends to speak, and there is on the other side a very limited number of scientists, with Fred SINGER in the lead, who are, either stemming from the ultra-liberal movement and linked with the industrial lobbies, or quite old and running after a new media renown.

What she was saying about Claude ALLÈGRE and Vincent COURTILLOT (Director of the « Institut de physique du

Globe de Paris ») in an interview published in the magazine "*La Recherche"* (nr 425 of December 2008) is symptomatic of that. It is a chance that we have Naomi ORESKES to boost the level of those ageing or ignorant scientists !

How much I prefer Jean STAUNE's attitude, who analyzes the facts with as little subjectivity as possible and draws from it the conclusions that seem to be called for, even if, as one would expect, we might not always agree with them : but at least do we have therefore at our disposal precise bases for arguing. Like him, I think that Fred SINGER is an ambiguous – to say the least – character and that Claude ALLÈGRE, in his book entitled "***The climate imposture***", went some times a bit too far.

If I try to take into account the arguments, on the one side of Jean STAUNE and of the other "IPCC-sceptics", and on the other side of those who unconditionally support the conclusions of IPCC, as the 255 members of the American " ***National Academy of Sciences*** " – among whom 11 Nobel prizes – who signed an open letter that was published in the 7th May 2010 edition of *Science* magazine, here are some rather "moderate" conclusions I think I may draw :

- ☞ It is true that the earth temperature has been significantly increasing for the last 350 years, but this increase is in keeping with the more important increase linked with the going-out of the last ice age and has been made more noticeable by the fact that we have just gone through what is called a « little ice age » (from 1400 to 1900) ; furthermore, the present temperature – which has practically not increased anymore for the last ten years – is lower than the earth temperature during the Middle Ages (when the Vikings were farming the South of Greenland) and much lower than the earth temperatures in earlier times.
- ☞ It is true that the CO_2 ratio in the atmosphere is increasing – about 370 ppm at the present time – but the earth experienced much higher ratios in the past (some 760 ppm 38 million years ago, when the earth climate became colder and the Antarctic ice cap began to form) and there is no clear correlation with the increase of temperature ; furthermore, the study of the core samples that have been taken in ice shows that the temperature increase has always occurred before – and not after – the increase of the CO_2 ratio in the atmosphere.
- ☞ The main greenhouse gas is not CO_2, but water vapour, which has a greenhouse power 10 times stronger and the ratio of which in the atmosphere is 100 times higher, which means a global effect 1000 times more important than the effect of CO_2 ; but the experts of the IPCC did not take it into account, because the concentration of water vapour, not only presents very rapid fluctuations, but also increases with temperature.
- ☞ The models that have been used by the climatologists of the IPCC do not seem very reliable, not only because they are too simplistic in comparison with the extreme complexity of the subject and do not take into account all the conceivable parameters, but also because the "proxies" (indirect evaluation methods of climate data that relate to the past) and the further "corrective" treatment of these data do not inspire confidence.
- ☞ A drastic increase of the sea level cannot be caused, either by the melting of the Arctic Ocean (when an ice cube is melting in a glass of water, the water level in the glass does not rise), or by the melting of the mountain glaciers (too weak contribution : 1.2 mm/year at the present rate), but only by two relatively slow phenomena : the melting of the ice caps of Greenland and above all of Antarctic, and a significant increase of the temperature of oceans (by thermal expansion : about 30 cm per °C).

In any case, if one may not deny that human activities have an influence on the earth climate, it seems that such an influence is still too weak, not only to be measured with sufficient precision, but also and above all to be pointed as the major cause of the warming that has been observed for the last three centuries. It remains that a natural warming, as it occurred many times in a remote past, might occur once more and that we must therefore pay attention to that.

Other problems, among which the energy question

In a world confronted with serious problems as poverty, diseases, dictatorships, terrorism, nuclear proliferation, lacks in the education of many young girls, and that is not all, a world where one billion people lack of drinking water and of electricity, climate change is probably not the most urgent problem.

Naomi ORESKES does not speak of those other problems : her only objective is to show that there is no doubt about the global warming and that human activities, in spite of the denials of « ignorant or untruthful » people, are responsible for it.

The most serious problem we shall be faced with, if we want to ensure a sustainable and harmonious development, is in all probability the problem of energy. During the last 12,000 years – since the time just before the apparition of agriculture and breeding – the mean energy that has been used per inhabitant of the earth has been multiplied by nearly 80 (namely, in round figures, from 1 GJ/year in 10,000 BC to 80 GJ/year in 2000) ; during the same period, the world population has been multiplied by 1,500 (more or less from 4 million to 6 billion individuals), and therefore the total yearly consumption has passed from 4.10^{15} to 480.10^{18} J/year, that is a multiplicative factor of 120,000 ! In terms of power, our present capacity corresponds to 13 TW : as comparison, the total geothermal power of the Earth is of 16 TW and the power of the tides due to the moon and the Sun is of 3.5 TW.

During the industrial era, it was first coal, and then, since the last world war, oil and gas that contributed to that expansion. But, neither their production nor their consumption are homogeneously distributed and that heterogeneity is at the origin of most political tensions (Iraq, Afghanistan, Libya, Sudan, Venezuela, …). Furthermore, those fossil sources of energy are not inexhaustible and there will come a moment when their production will reach a maximum – what is called the "peak" – and then decrease quite rapidly. But everybody does not agree about when that peak will occur : already foretold for oil, and then constantly postponed, some experts foretell it now for some time between 2015 and 2025, the peaks of gas and coal coming slightly later.

This opinion is not shared by Samuele FURFARI, Professor of the Geopolitics of Energy at the Free University of Brussels (ULB) and High-ranking Official at the European Commission for Energy and Sustainable Development, for whom the oil peak is due to come much later, as new oilfields are regularly discovered and more difficult exploitation sites become cost-effective thanks to the growing price of the barrel. Moreover, in his opinion, if that peak was expected so early, oil producers would have been investing in another sector for a long time. And, for gas, there is the development of non-conventional sources, that is the gas that has been trapped in the mother rock where it was formed (or in the coal that was formed in the same time).

Be that as it may, one can expect those peaks to occur before the end of this century, and the resulting decrease will be all the faster since the peak occurs later. As Jean STAUNE emphasizes it, it will have a beneficial effect, since the use of those fossil fuels contributes significantly to the increase of the CO_2 content of the atmosphere.

But we shall have to find substitutes for the fossil fuels which, in 2010, were producing about 85 % of the world energy ; the rest consisted of about 7 % for nuclear energy and about 8 % for renewable energies (hydraulic, solar, wind, biomass and geothermal). Jean STAUNE (just as Samuele FURFARI, from a different perspective) throws some light on the mistakes that have been made by the main protagonists.

The ecologists' views are utopian because, on the basis of the technologies that we master at the present time or that we know today we shall be able to master within a few decades, it is unlikely that renewable energies could satisfy more than 25 % of our needs (dependence from water, wind and sunshine, practical impossibility to stock or to transport it on long distances, biomass using grounds that would be more useful for agriculture, …).

As for nuclear energy such as we produce it today, it is difficult to imagine, with the more or less justified fears that the accident of Fukushima has aroused, that it could satisfy more than 10 to 15 % of our needs. This is, explains Jean STAUNE, the disastrous choice made by electricity production industry : the first nuclear reactors had been developed for submarines, for which compactness is an essential criterion (PWR reactors) and, when it came to building nuclear reactors for electricity production, it appeared more cost-effective to make use of an already known and amortized technology, even if it was to the detriment of direct or indirect security (which was not very much in the news 40 years ago).

But, says Jean STAUNE, there exist much more secure nuclear reactors, which are already working for other applications or in the form of prototypes ; he mentions for instance the HTGR (high temperature helium cooled reactors), 1000 times more secure than the usual PWR (pressurized water cooled reactors), and the Rubbiatron ; he could have also mentioned the molten salts reactors, which use thorium instead of uranium. Subject to the necessary investments, they could be developed for electricity production, but the big, very big problem is that, in the present situation, one can hardly consider getting involved in any long and costly technological development !

So, what could we do in order to produce the remaining 65 % of our energy needs ? There is nuclear fusion, of course, says Jean STAUNE, as the tokamaks (which are facing some problems with the 14 MeV neutrons they produce) or the Z-machine, but is it conceivable that such a technology could be ready in due time ? Particularly since anything that is categorized as « nuclear » is nowadays considered as diabolic.

There are other problems also that should catch our attention and for which some choices seem to be questionable in Jean STAUNE's opinion : the H1N1-flu vaccine (whom does the crime benefit to) and the GMOs (for which what is not said is more important than what is said). The list of such problems could be made much longer, but this is not my intention.

Analysis of the explanations

Naomi ORESKES' explanations

Naomi ORESKES emphasizes that « *all the "versions" of the facts are not right or true* » – what seems obvious to me, even if the notion of "truth" is not obvious – and that « *some of those versions represent, either a disinformation that has been deliberately spread by quite organized and financed particular interests, or an ideologically oriented denial of the facts* ».

« *With the lightning development of mass media*, she says, *we are confronted with a cacophony of contradictory information, where it is difficult to make allowances, a fact that is particularly disarming when it goes about scientific subjects, because science rests on proof and all the positions are not taking root in it the same way* ».

For Naomi ORESKES, the public enemy number one is cornucopianisme (from the Latin " *cornu copiæ* ", which means " horn of plenty ") ; it refers to the belief in unlimited resources and in the possibility of a continuous innovation allowing us to always solve the problems that we could meet. Conceptually, cornucopianisme is opposed to Malthusianism and, in political economy, it is consubstantial with ultra-liberalism. Such a belief is deeply rooted in us : our forefathers the mammoth hunters, already, were slaughtering their preys in a rash way, by pushing whole herds towards precipices at the bottom of which they were crashing, not imagining that one day mammoths would run short. In the year 474 AD – two years before the last Roman Emperor's destitution – Sidonius APOLLINARIS, Gallo-Roman writer, bishop and politician, wrote that he hoped his son would become consul of Rome, also unable to imagine that the Roman Empire could disappear one day, even though all the signs of its impending disappearance were available.

This is why Naomi ORESKES stigmatizes the merchants of doubt, « *those irresponsible cornucopians who, with the help of "astray" scientists* – for the previously mentioned

reasons –, *are raising doubts about the risks that their policy of absolute laisser-faire poses to mankind* ». I can do nothing but subscribe to the principle of such an objective, but even so the recommended remedy ought not to be more harmful than the evil it is supposed to fight. That bad remedy could be our belief, also deeply rooted in us, in the occurrence of an apocalyptic end that would be caused by the irrepressible need of men « to play with fire », belief that could end up by totally paralysing the development of those technologies that precisely could allow mankind to go on its way.

Living in the anguish deriving from doubt is a very difficult situation, which leads to the temptation to make a purely subjective choice. A quote from the French mathematician Henri POINCARÉ comes back to my mind : « *Doubting everything and believing everything are two equally convenient solutions, as both spare us having to think* ». Nevertheless, there are some cases when even reflection cannot lift the veil and one has to make a decision (so as not to do as Buridan's donkey, who died because he could not decide whether to eat or to drink first).

But, as often said about questions of science, should not we have certitudes only ? This is very probably true for the so-called "exact" sciences, for which a theory can – in principle – be validated or invalidated by experiment. It is rather true with sciences that are dealing with the past, as palaeontology or geology, for which crosschecking and explaining some present facts make it possible to say that a theory is either very probably correct or certainly false. However, when it comes to foreseeing the future – as it is the case with the evolution of the climate – science can provide us with a number of data, but the choice of these data, the development of an extrapolation model and the inclusion of the chosen data in the model are much more subjective, whatever the number of experts involved (the moment that subjectivity comes into play, " birds of a feather flock together ").

I do not agree with the opinion that Naomi ORESKES gives on science in her book as a whole : it is nothing else than the speech of an assistant public prosecutor trying to convince the jury than those who deny the role of men in the global warming are guilty of " lese-science ". It is an ode to the single thought, the one of the IPCC of course.

Let us now see the explanations provided by Jean STAUNE.

Jean STAUNE's explanations

Jean STAUNE explains that the main objective of his book consists in stigmatizing both forms of scientific obscurantism : the first one, which prevails in the media, is ready to resort to manipulation and disinformation in order to hold the gained position, and the second one, marginal but extremely violent, bring some arguments to the first one by its immoderate and little credible turn.

One of the key points of his argument is the notion de paradigm, which has been introduced by the American philosopher and historian of sciences Thomas Samuel KUHN ; it can be defined as a representation of the world, a way of seeing things, a coherent model resting on a well-defined basis (disciplinary matrix, theoretical model or way of thinking).

I think there is some affinity between that notion of paradigm and the notion of "habitus", introduced by the French sociologist Pierre BOURDIEU, who said : « *Obscurantism has come back, but this time we are dealing with people who use reason as a reference. Faced with that, one cannot keep silent* ». The French philosopher Michel ONFRAY, for instance in his " Traité d'Athéologie ", is a striking example of one of those "people".

All the examples that have been analyzed more or less in detail by Jean STAUNE aim at bringing out that scientific obscurantism and at trying to dismantle its mechanisms. One of these mechanisms is what he calls " the Gell-Mann effect " – by the name of that Nobel prize who had criticized the conclusions of the experiment that led to the EPR paradox – which more generally consists, faced with an experiment that leads to the conclusion A, in interpreting it as a conclusion B and in claiming to criticize A while, actually, one criticizes B (which can be very different from A, even its exact opposite).

In continuation, he wonders about the end of progress – following the example of the French historian and essayist Jean GIMPEL who, in 1992, wrote a book with a provocative title : « *The end of the future : technology and the decline of the West* » and who, I mention it, could have been influenced by the British historian Arnold TOYNBEE, who developed a similar thesis in his book « *A Study of History* », published in 1972 – and finally about the end of science.

To that effect, he mentions another essential contribution of Thomas KUHN, namely the distinction between « *normal science* », which develops within a given paradigm, and « *revolutionary science* », which infringes the established paradigm and makes it possible to develop radically novel ideas. But, he ads, scientists who are capable of developing normal science and scientists who are capable of developing revolutionary science do not have the same characteristics at all and, unfortunately, on the one hand our educational system only teaches the development of normal sciences and, on the other hand our economic system makes the life of those who have the competency and the will to develop revolutionary science particularly difficult and hazardous. I can but applaud such an approach, which has been mine for many years.

Then, Jean STAUNE refers to the work of the American physicist Lee SMOLIN, who describes seven characteristics of the scientific community that supports the string theory (which he particularly criticizes) ; he thinks that they can also be applied to those who defend Darwinism as the only driving force of evolution, to those who present the PWR reactors as the only possible source of nuclear fission energy, to those who defend the positions of the IPCC as the only conceivable explanation of the present evolution of climate, and still to other cases ; these seven characteristics are :

1. A huge self-confidence, which gives the feeling to belong to an elite.
2. An unusually monolithic community, which shows a strong meaning of the consensus, whether this one relies on proofs or not.
3. In some cases, a feeling of belonging to the group that is similar to one's identification with a religious belief or a political party.
4. A strong feeling of the border between the initiates' group and the other experts.
5. Some contempt and a lack of interest for the ideas, the opinions and the work of scientists who do not belong to the group.
6. Being inclined to interpret indications in an optimistic way, to believe the exaggerate interpretations of results and to neglect the possibility that the theory could be false.
7. A lack of estimation in measuring the risk that has to be involved in the research programme.

Let us broaden the perspective

About the reality of knowledge

In 1936 already, the Polish-born American engineer Alfred KORZYBSKI, who had specialized in human sciences and has been considered as the father of general semantics, pointed out that « *The map is not the territory* ». In other words, we are not directly geared to the external world, but only through the intermediary of our five senses, the electrochemical information of which is decoded by our brain, with the peculiarity that we were also given the code itself, extremely complex, by the intermediary of our five senses, through a process called learning. Therefore, all what we know – or think we know – rests only, without any possible exception, on what the first men knew or thought they knew.

This reminds me of what the Indian-born philosopher Jiddu KRISHNAMURTI was maintaining, namely that the human brain is seriously ill. Actually, though it contains a certain amount of knowledge, it also contains a certain amount of ignorance and mistakes, and we are strictly unable to distinguish between both sides.

On the other hand, this seems to belie the refutability principle, which was stated by the Austrian science philosopher Karl POPPER, according to which a scientific statement can be distinguished from a pseudo-scientific statement because the first one, unlike the second one, can be refuted by observation or experimentation : indeed, both a statement and its refutation are based on the same presuppositions, which have been amassed since the dawn of mankind.

Does it mean that we must agree with the « *anarchistic theory of knowledge* » that was developed by the Austrian-born American philosopher Paul FEYERABEND, who stated that the scientific approach does not follow a particular methodology and that science is only one form of thought among other ones ? According to him, the various conflicting or successive scientific theories that were born in the course of history – and Jean STAUNE gave some examples of them – cannot be compared with each other, because they have each their own, essentially subjective, validity criterion. And myths should deserve as much interest as scientific theories, astrology as much as astronomy, magic as much as physics and – to Jean STAUNE's displeasure – creationism as much as evolutionism ! Finally, he stated that, just as much as State was separated from the Church, one should separate State from Science, because this one is « *the most recent, the most aggressive and the most dogmatic religious institution* ».

About beliefs

This brings us to the question of beliefs. The human being has a practically irrepressible need of certitudes, which form as many answers to the existential fears that gnaw at him, particularly those that are linked with his destiny. However, in order to be effective, those certitudes have to be preserved, codified into belief systems and, above all, not at risk of being doubted (that doubt condemned by Naomi ORESKES). A belief system is an authority and it states its own validity, while getting rid of any objective approach. One can find belief systems at two intersecting levels : on the one hand in the relationship of the individual with the sacred and the divine, and on the other hand in connection with some hypotheses that are regarded as being true, though partially or totally unverified, and that relates to some aspects of everyday life and to the development of our « modern » society.

Besides cornucopianisme, already mentioned, a belief that is deeply rooted in our Judaeo-Christian subconscious – Cain and Abel, the death penalty imposed to Jesus Christ (« *his blood be on us and our children* »), « *if God is just, our suffering can only be a punishment* », the Apocalypse (from the Greek αποκαλυψις that means "unveiling") attributed to St John of Patmos the Evangelist) – is the growing fascination for the "catastrophist" theories of the end of the world : « *The Earth is ill, men are guilty for having devastated it, they must pay for it* », such is the vulgate that is spread nowadays in the world, particularly in the West. Hate of science and progress, cultivation of fear, praise of frugality : isn't there a form of despotism behind all that ? I cannot refrain myself of quoting the Irish writer Clive Staples LEWIS, an atheist who converted to Christianity, author of the famous « *Chronicles of Narnia* », and who, in a less known work – *The Screwtape Letters* – imagined the following letter of Satan to his nephew : « *My dear nephew : as you know, one of my preferred stratagems consists in confusing the issues, in seeing to it that people confess to what they are not guilty of and apologize for having what they are entitled to have. In short, it consists in jumbling up everything. This is why our epoch is sinking in a sticky guilt and a black despair. I looove despair, it's my hellish joker !* ».

The external expression of such a belief, which appears in the background of both analyzed books, particularly as regards the global warming (but also with the problem of nuclear energy and of GMOs in Jean STAUNE's), is ecology : not ecology as the science of environment – which is eminently respectable – but as a doctrine that is

laid down as an indisputable *a priori* by the ecologist parties and NGOs. I want to mention one of Samuele FURFARI's books : « *Dieu, l'Homme et la Nature – L'écologie, nouvel opium du peuple ?* » (*God, Man and Nature – Ecology, the new opium of the people ?*) and to state that I agree with what he says about that (even if, concerning religion, we are not exactly on the same wavelength : my favourite expression is : « *I believe in God, but not in what men have made of him* »). The worst is that such a belief does not affect only people who know nothing whatever about science, but also scientists who hold important positions and who, during debates in front of students, present their fanciful interpretations as scientifically proved facts.

There are many other beliefs that play a role in the development of our western civilization, as the belief that technological development is the mainspring of happiness, or than science is neutral and should be able to explain everything, or else that free market is a perfect example of self-regulation, etc. … Raghu GARUD et Michael RAPPA have developed a socio-cognitive model of technological evolution that shows by what process beliefs influence such an evolution (Organization Science, vol. 5, n° 3, August 1994, pp 344-362).

About revolutionary science

The distinction, made by Thomas KUHN and quoted by Jean STAUNE, between normal science and revolutionary science seems essential to me. In his aforementioned book, Arnold TOYNBEE made the following observation :

- In history, the first element of an army was the "hoplite", armoured warrior fighting more or less independently.
- Around 640 BC., he yielded to the Spartan phalanx, which replaced the uncoordinated mob by a well-ordered unit.
- Some 250 years later, it yielded to the Theban column which, to discipline, added an element of surprise.
- But, shortly afterwards, this one was in turn driven away by the Macedonian phalanx, where skirmishers and phalangists, totally differentiated, were skilfully integrated, with a heavy cavalry, into a single fighting force.
- Two hundred years later, the Macedonian phalanx was defeated in Pydna by the Roman legion, which had improved the Macedonian integration technique through bringing to it much more flexibility.
- But, in 378 AC, the Roman legion was driven away by the heavy cavalry of the Goths cataphractes, and the Romans integrated them into their legions.
- Progressively, the cataphracte had degenerated into an amour-plated parody of himself, uneasy to manoeuvre, who lost his single combat against the mounted Mongolian archer, mobile and lightly armed.
- However, the success of this one did not last long, as he had soon to yield to the Egyptians Mamelukes and to their counterparts, the Ottoman janissaries, who reigned supreme over the Middle East during 500 years.
- But, in 1798, the French army of Napoleon put an end to their supremacy by making use of firearms.

One could go on such an analysis with the wars of modern times, but what Arnold TOYNBEE points out is that, in that domain, two successive innovations have never been brought within the same « society » : the next innovation always came from another place. He blames this phenomenon to the experience effect : the military chiefs, who have been trained to a given technique and master it to the highest degree – as proves their hierarchical position – are more or les unconsciously opposed to any essential novelty, in the framework of which their experience would not be an advantage anymore. A Chinese saying, attributed to Confucius, tells that : « *Experience is like a lantern that one carries on one's back : it sheds light only on the covered way but none on the way one should have to choose* ». I think that this experience effect explains why, as Jean STAUNE points out, many scientists who owe their status, and even their renown, to the development of a given theory, refuse to acknowledge that a new theory could supersede « theirs ».

So, that phenomenon is not new but, as I shall try to show, it does not always present the same intensity.

About the end of progress

The end of progress, the end of future, the end of science, the end of our civilization, the end of the world, … Never has the word " end " been in fashion than nowadays !

« *The end of progress ?* » wonders Jean STAUNE. Now, I have some difficulty in following him, because one should first define what progress is, and this is quite a profound philosophical point. « *The end of science ?* », he also wonders. A temporary end of revolutionary science, as explained above, yes, it could be. An end of normal science, I do not think so, because stakes are much too important. « *The end of the world ?* », no, certainly not : I do not believe in those apocalyptic visions.

Then : « *The end of our civilization ?* », yes, it could probably happen. In his work, Arnold TOYNBEE – he again – studied 23 civilizations, among which 22 died by suicide. The 23rd is our Western civilization : why should it be an exception to the rule ? Last May the 17th, on the occasion of the World Conference on Continuing Engineering Education, organized in Valencia (Spain) by IACEE (International Association for Continuing Engineering Education), I made a presentation where I tried to show that the cognitive process presents some fractal properties, in the sense that the typical individual process recurs, by successive stages, with just some slight modifications, to the various human organizations, with civilization at the top of the ladder. If such an approach is correct – it makes me think of structuralism, a theory of evolution defended by Jean STAUNE – some phenomena that are characteristic of individuals, as ageing, could also be found in their organizations. As one gets old, one loses the suppleness one had when younger, one begins regretting « the good old days » and cursing « those young people who don't respect our values ». For civilizations, such an ageing could be the progressive transition from the Promethean vision of its founders – as expressed by Arnold TOYNBEE – to the congenital blindness of its last representatives : when blind, the only thing you can still see is the practically holographic projection of your fantasies !

Of course, the 22 civilizations that disappeared were only occupying a limited area of our planet, while we have the impression that our Western civilization is covering the whole world ; but it is only an illusion, which is kept alive by the world-wide recourse to the same technologies and to the same market techniques. But a civilization is the group of people who have in their head more or less the same « map of the world » ; and neither the Chinese nor the Muslims have the same vision of the world as ours.

If I were to make a forecast, I wonder if the next civilization could not be the one of the Muslim world. Of course, when seeing what presently happens in our relationship with Muslims, one could think that I am « wide of the mark ». But we must not forget that, before the Renaissance and the Age of the Enlightenment, Europe went through a long period of intolerance and obscurantism during the Middle Ages : it could be that a civilization also has to go through an awkward age.

Conclusion

In this article I wanted, through the analysis of two books dealing partly with the same subject, throw some light on two approaches that greatly contrast with each other :

- One, of Jean STAUNE, is inclusive, open both in space and time, insofar as he tries to include various disciplines and to reconcile some theories that seem contradictory, and as he proposes some solutions for the future.
- The other one, of Naomi ORESKES, is exclusive, closed both in space – as those various drawers in which she shuts up some people – and in time, as she calls out " you have been warned " but does not offer any innovating solution.

In that perspective, I showed, following on Jean STAUNE, that the global warming is indeed a problem to which we must turn our attention, but that it is not the only one and that other problems, as the question of energy, could be much more serious in a near future. And that the shouting and warning from the ecologist parties and organizations, and the measures they propose, most of them contradictory and unrealistic, could grow a thick tree for which we could not see the wood ; their homilies are like those of the high priests of the mother-goddess Gaïa !

This is why, after that analysis, I took the liberty to indulge in some more general – even more philosophical indeed – reflections on the reality of our knowledge, on the important role played by beliefs, and on the future of science and of our civilization science. Because I am one of those who think that, the farther we are looking in space and time, the more chance we have to steer our vessel " Humanity " safe and sound.

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