

"Innovation for the efforts against the climate change: an opportunity for a different social organization"

Antonio Ruiz de Elvira

The message: If, after huge efforts using a method, things don't improve, we must change the axioms on which that method is based

or

For persistent problems, change the axioms or the postulates.

Example: Tycho Brahe vs. Kepler/Galileo/Newton

Therefore, when confronted with long standing problems and/or repetitive crises we cannot insist on old methods, we must search innovative thinking

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We are in the middle of, at least, three crises: One, real, the very fast increase in the concentration of greenhouse gases in the atmosphere, produced by the combustion of fossil fuels. Other, very real for the people, no so much for some business: The maladjustment of the financial system, and the very deficient management of many firms. The last one, concerning governance, is caused by the last gasps of the tribal system of organizing society, as confronted with a free system.

Confronted with crises humanity answers today with paralysis.

A recent book and film over the Neapolitan Camorra has produced, and will produce, no relevant action, save some demonstrations and many declarations of intent.

In Spain we have the small problem of ETA. After every killing there are declarations, but unappreciable activity.

All around the world, car traffic causes early, evitable, deaths. No action.

In Spain, after the plane crash in August, there was much talk, but no assumptions of responsibility.

Coming back to climate change and financial crisis, Al Gore has been making world tours preaching against it, to no avail. I am giving an average of a lecture a week on climate change, all around Spain. I see no change of the minds, much less of the attitudes of spanish people regarding climate change. There is worry, but no new ways. As with the today's perfectly evitable financial crisis, the attitude is passive, it is an attitude of resignation, of submissiveness.

50 years hence the world was vibrant. Science was to conquer the planets, to solve many problems.

We have now much better science than then, but many in society are despairing to be able to solve the problems that surround us. To confront the financial crisis the only answer until now has been to spend the stored wealth and to insist in the old tired ways of building more houses, more cars, to throw away efforts and wealth, simply to “live another day” instead of looking for a full long life. We sense no new attitude to face new problems.

In the same way, the problem of confronting climate change is met with piecemeal measures, with doubts and hesitation, with cowardice. Instead of squarely facing the problem, and starting, with all promptness, to renew all our energy system, we do not more than to run in circles, beating the bush but not proceeding with a decided step towards the clear solution ahead.

The difference in thinking between the present and 50 years since is a new conscience of the gigantic size of the globe brought home by the easiness of travel and communication: The conscience of the huge number of people we need to move to change things brings despair to the people, that then choose between religion (a better life after life) or the old “be merry today, you don't know about tomorrow”. But mere size is never a problem. We have the solution in our hands and we can implement it.

Which is the cause of these two crises?

The evolution of natural, unconstrained systems produces a change of their boundary conditions: The motion of a jet of air changes the velocity of the air parcels surrounding it. In old Spain, the discovery of huge amounts of silver in the mines of Bolivia and Mexico changed the boundary conditions in an empire that, however, kept with the administrative ways of a poor country based on the export of wool. Spain had a new World to build upon, but instead of new ideas she chose to carry on with the old ones. We are seeing today the effect of these old ideas in the 21st century there.

As evolution changes boundary conditions, the system inside them must change its equations, the model on which the society bases its thinking and actions. A Spain full of silver could not use the economic models that brought it to an enormous prosperity based in the export of wool.

A world almost saturated with CO₂ cannot continue using fossil carbon for its energy source.

One of the objectives of the present seminar is to look for messages that can convince people although the problem is big, we have solutions in our hands.

Energy

At the end of any possible reflection on our human nature we, humans, are still animals, very deep in our brains. Life is defined by the search for energy. The animal world has control mechanisms that limit the growth of any species, in the form of other animals as competitors, and viruses, bacteria and parasites as predators.

But as human beings we have eliminated many of these predators; wars have never been able to control the increase in population, and, as we have discovered how to obtain more than enough energy, we can keep illness at bay. In the last two centuries we have been able to increase our direct wealth by some orders of magnitude, but at the same time the number of individuals of our species has increased almost without limit, so the wealth per capita, although it has grown, has done it very slowly.

As we have increased our material possessions we have drastically reduced our real wealth by destroying a part of our habitat, our house, and by mortgaging our future. In the same way that the present financial crisis derives from mortgaging our possessions to have money now, the actual and coming climate crisis derives from mortgaging our future obtaining energy by injection of CO₂ into the atmosphere.

The solution based on carbon to the energy problem, that was the adequate one in the 19th, is not longer the correct one in the 21st. The idea of –defending- the catholic faith against the moors that allowed Castile to dominate a part of the Iberian Peninsula, was no longer adequate in a World that the same Castile had changed by open the doors to America. Exactly in the same way that the roman ways to conquer were producing the necessary wealth to sustain the empire up to 180 C.E., the keeping of these ways on a world with changed boundaries produced its collapse between 200 and 470 C.E.

A solution fine for a certain system with a set of boundary conditions is almost surely wrong for that system with changed ones.

Today there is a real danger of producing, in a short period of time, a collapse of the global civilization. Contrary to many other climate crises of the past times (the collapse of the Mayan empire comes to mind), the present one is global in extension and long lasting in time. Our colleague David Wasdell will give later on more details about that danger.

The danger is real; the message is not apocalyptic because we have in our hands the tools to stop it. But we are not using them and we are insisting in the old ways that mean an acceleration of the change.

How can it be that acknowledging the danger and having the tools we do not eliminate it?

There is only one answer: Our **ingrained thinking and behavioural habits** in a similar way as in the cases of the former society collapses. Spain could not think of using the new wealth in other ways distinct than to fight the protestant Low Countries, as today many parts of the world keep dreaming old dreams, or kill to try maintaining a very old tribal society.

There is a powerful image from the animal kingdom: A bird will fight to defend its eggs as long as they are inside the nest. As soon as they are outside it, the bird stops recognizing them as eggs. We are plodding our way along some known and used rails. We see the danger ahead. We see nearby rails that will turn us away from the danger. We have trying to brake the train and we have seen that we cannot do it. The solution is to change tracks but we are not doing it. As the bird, we are using the ingrained ways and we fail to recognize the nearby tracks as new rails.

It is this changing of tracks what is very difficult for us, and it is this change of tracks what I want to discuss here today.

The problem of the boundary conditions for systems controlled by differential equations

How has this problem arisen? In some systems, mainly in those of machines, built for that purpose, conditions of motion do not change for very long multiples of their characteristic time scales. Think of your car: The conditions surrounding the motor keep the same for some 2 billion turns of its gears.

But think also of the Mississippi river, flowing along a sandy or limestone course. The walls of the river change constantly. It is the flowing of the river what modifies the boundaries, and these new boundaries change the water velocity in an endless system of coupled positive feedbacks.

In the language of mathematics, the water flow is controlled by equations like

$$\frac{\partial^2 \psi}{\partial x^2} = F(x)$$

or, very schematically

$$\psi(x) = (\psi(a) + \psi(b) - (\Delta x)^2 F(x))/2$$

To determine the values of the function inside a domain we need the values in the boundaries:

$$\psi(a); \psi(b)$$

If they change we have no evolution equation for them that does not involve other boundary conditions that change again.

So we have a complex system formed by at least two systems in interaction where each one modifies the other in feedback processes that go on and on endlessly.

Real, as different from, artificial systems, evolve continuously, never really reaching equilibrium. Moreover, in real systems, interactions are never linear, that is, it never happens that doubling causes produces doubled effects. Two very interesting complex systems that never approach equilibrium are the climate and human society.

The tools to analyze both systems cannot come from traditional physics, including into this physics also the assumed “modern” quantum mechanics, which is based in the hypothesis of non-interacting linear and simple systems.

Which tools can we use for these real, complex, non-linear systems? I don't want to do propaganda of climate science, but in the climate models the question of the variable boundary conditions was solved some years ago. When we started buildings models of the atmosphere we discovered that the lower boundary condition, the surface of the ocean, kept changing steadily as a consequence of the motion of the atmosphere, and this as a consequence of the changing ocean. We had to extend the boundaries further and further so now the climate models are a true representation of non-linear complex systems. In a similar way it is urgent to extend the mathematical economic models of our society to include into them all the countries and population, to make endogenous almost all of the –exogenous– variables, and to include into them explicitly the time variability.

The social organization until now derives directly from our descent from our hunter and gatherer

ancestors of the african savannas, and is still very similar (changing the scales) to that of our genetic cousins the savannah primates. **It is based on concentration, or in other terms, hierarchy.**

Hierarchy has, evidently, a lot of advantages. But it has, at the same time, a lot of problems. I don't want to propose here new utopian systems, like those of Plato, More, Marx or Thoreau. We still don't know enough of our human society to attempt to solve that problem. But I would like to point ways, to indicate possible **nearby trails** that could be taken.

What is clear, on the other hand, is that with the new boundary conditions the system has acquired during its evolution, we cannot continue with an organization adjusted to other situations, like the spanish empire using castillian administration designed for a territory of 200000 sq.km for situation of several millions of them.

A consequence of the idea of hierarchy, and a consequence of the multiagent modelling and of the models like the one of the Game of Life (Conway), is the concentration of the sources of available energy into a very small number of them, and the systemic concentration of population into very few centers, NOT as an improvement on the conditions of life, but simply as a result of the non linearity of the game. In the Game of Life the economic situation of all the population, save one individuum, is of extreme misery, with all the wealth concentrated into only that person. This situation happens again and in the history of society, and with energy it has happened again and again. In the London of the beginnings of the 19th century there were a considerable number of business supplying gas to the population. At the end of the century, or by 1950 there was only one.

Exactly the same situation happens with cities: Mexico city has grown not because the growth was positive, but simply by the same non-linear/positive feedback mechanism that produces only three automakers in the USA, and only three banks and three electrical utilities in Spain.

Can we detect any clear advantage in a city like Mexico, Shanghai, Sao Paulo or Istanbul? Can we, human beings, use our knowledge of these laws like the Sugarscape or these of the non-linear systems, to improve upon some situations, and in particular upon the today's energy and climate change problems?

One point have we learned from the climate change problem: We can devise **no static** solutions, no quinquenal plans, no electoral programs. All solutions have to include an element of adaptation, of continuous evolution. We need actual and mental models that include, **explicitly, the time derivative**. Our science cannot continue concentration into asking questions about what **are** the things, but should concentrate into how things **evolve**.

We cannot aim today for the same objectives than were proposed hundred years ago simply because it has taken a long time to be able to reach them. If they were interesting then, are they still necessary today under changed boundary conditions?

In this sense, economic theory, which is one of the main forces driving our society, seems today somewhat outdated. The present form, in all of its flavours, neo-keynesian neo-liberal, neo-..., derives from the d'Alembert static problem of finding the optimum distribution of charges in a beam. Economics is using the methods of statics to learn about the optimum distribution of scarce resources in society. As this traditional economy is based on statics, linear methods, and fixed (or infinite) resources, and on the concept of endogenous/exogenous variables, it cannot adapt to a non-equilibrium changing global society. To take into account the recurrence of crisis periods, this static

theory introduces the idea of cycles, but as it does not explicitly include the time variable into it, it cannot study them, nor try to model them, if they exist as cycles instead as catastrophes (catastrophes in the very technical approach of Rene Thom).

ENERGY

The use of concentrated sources of energy in the form of fossil fuels, starting in 1800 in northern England with coal, and followed until today in some places of the USA and in the very small fields of oil and natural gas in pockets around the world, has extended the above idea of concentration and hierarchy, refuelling the natural primate tendencies of concentrated power and wealth surrounded by slaves/poor beings.

Between the first energetic (agricultural) revolution around 8000 years ago and the second one (fossil carbon) 200 years from now, human beings used the sun as the only source of energy via photosynthesis, and as a source of work via human beings and burden animals. After the second energy revolution we have substituted the extended sources by concentrated ones, based on carbon. We need now to change again to extension, as we must again extract our energy from the sun. But in contradistinction from our former sources, now we can use the entire Earth surface to obtain this energy, as we need neither water nor fertile soil to get the energy. The wars for land to grow human beings and burden beasts as units of work can end, as well as the wars to control small patches of soil to obtain the energy from fossil carbon.

As soon as we switch to the solar energy we will have to, **-have to-**, change our social organization. Acknowledging this, some sectors of society insist in a desperate struggle to convince the rest of it of the non-existence of climate change, and of the convenience of nuclear energy. This reflects the very deep need in our genes of keeping with the idea of bosses (either individuals or firms) controlling fertile land and/or concentrated sources of energy.

On the other hand, as solar energy can be installed in any piece of Earth surface between 60°N and 60°S, any individual can be able to satisfy her/his energetic needs. The only way to organize such a society will be by cooperation instead of by dominion.

CITIES

Cities, whose pattern has been hierarchical since their first inception in Mesopotamia long, long ago, will have to adapt to a new system of extension, either horizontal or vertical, in full contradiction with the long lasting tendency of concentrated cities organized around the seats of power, be this power a state or a town one.

In the other occasions mankind has faced collapse or partial collapse we didn't know about this situation. Romans were surprised that Eneas eternal Rome could not last over 476 A.D., Spain, the defender of catholic faith, was mightily surprised of the economic collapse of its american empire in 1665, Germany was surprised when the "unending" empire of Hitler lasted for such a small amount of years. Today we have tools to try analyzing these collapses. Some of them will be expounded during this seminar. Others will be developed, perhaps by some of you, in the next times.

We need innovative solutions. Governments and opposition parties all over the world, when

confronted with today's financial crisis are still following old, very old recipes, like those of Keynes, adapted to old boundary conditions. We see this daily in the media.

We must be afraid that the same governments, when confronted with the climate change crisis, will not be able to devise any of the needed innovative solutions.

INSTEAD OF A NEW DEAL BASED ON OBSOLETE IDEAS AND TECHNIQUES WE NEED A NEW CONTRACT BASED ON THE IDEAS OF THE 21ST CENTURY: GLOBAL, WIN/WIN, DISTRIBUTED ENERGY.

Which tools do we have?

Some of them will be discussed during this seminar. I don't want to say now more than will be said by all the speakers here. The only thing I want to mention is that these approaches are all of them -innovative-, that they are looking for new ways to confront the new boundary conditions of the human – Earth system that we have created by our evolving under the old ones.

Enjoy the presentations and profit of the debates in the World Café.

- 1) New economic models based on a dynamical optimization problem, including explicitly the time derivative into them, non-linear, multiagent, with as many endogenous variables as possible.
- 2) Multiagent modelling for social evolution and governance
- 3) New cities as a possible solution of old problems
- 4) Bayesian analysis (introducing what we already know, past experiences into mathematical modelling)
- 5) Innovation and sustainability models
- 6) A new language