our changing world – 1

where we are and how we got there

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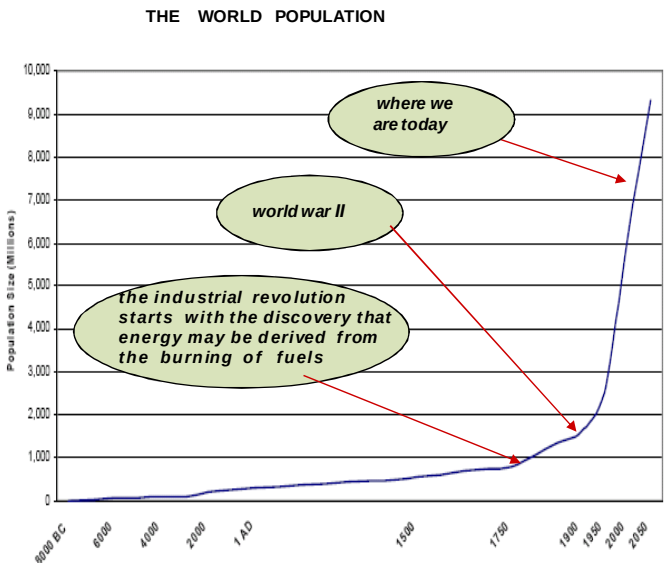
Introduction

That our world is changing has become evident. The media and governmental commentaries may well tell us that wars, migrations, even climate changes have existed in past times and that all will be as before when what they call the current "crisis" will be over, but that is not the case. What we live is not a "crisis", it is different from all past disasters recorded in human history. We are in a new era that started with the 18th century industrial revolution, James Watt's steam engine, leading to a new class of problems that began manifesting themselves in the late 20th century. Then, as of late, an increase in the severity of those problems, a fact abundantly documented in books, journal articles and the like. But what is talked about applies pretty much to selected issues, to the short term and limited moreover to the developed countries of the world (about ten percent of its population) . As for the long term, what the industrial revolution has brought is not all that good, with pretty much ubiquitous trouble at present to somber predictions for the future mitigating that positive view. Malthus had predicted food shortage that may indeed be a problem in some parts of the world, but there are other important problems of an entirely different, more general nature that include environmental damage as well as problems related to the societal side of life on earth. What the media shows us as "news" is replete with images of violence, wars, suffering and masses of migrants in search of a more hospitable place to live.

What we are suffering of is the consequences of an excessive rise in the world's population and industry, an excessive demand on the Earth's resources. We hear of governments and NGOs addressing the situation, responding to each visible problem as a separate issue (like the Paris 2015 accords addressing global warming). But our globalized world has come to function as a whole, a system of interacting components,

and addressing those components separately does not really contribute to solving the global problem, does in fact in a number of cases the opposite.

The only way to save the situation would be in a cooperation, a collaboration between nations, between disciplines, between all parties involved toward a well thought of and agreed upon goal - that would inevitably include hardship and an imposition of reductions to growth. But while formulating such rules of cooperation toward a common global goal is potentially feasible, having all concerned on Earth implement what principles and actions have been agreed upon has shown to be well beyond what humanity can accomplish.



It is not that today's situation was not predicted. A set of studies were conducted in the 1970's to that effect at the MIT and other US universities, the University of Sussex in the UK, to a lesser degree in Japan and known collectively as the "*Club of Rome*" . This had been triggered by new technologies that had come after the war, allowing for the measurement and worldwide communication of data and information, then computers sufficiently powerful to deal with that data. Computers had been used to study by way of simulation not only the dynamics of engineering systems, but also that of certain social, societal systems. This was then applied to looking into the material, societal consequences of the increase in the world's population and industry that had become significant. What they did show was that new material contributions that were claimed to be a positive gift to humanity were also leading to a somber future for life on Earth, and to begin reasonably soon. This was widely reported at the time, generating a lot of public concern. I found myself involved in these developments as member of a project at Princeton University funded by the World Bank that had become concerned and wanted to have an independent evaluation of these new findings. We confirmed at the time the essence of those *Club of Rome* predictions, predictions that came to hold essentially true decades later, today in fact.

That these studies came up with predictive powers that governments, the media, the traditional academic disciplines did not have is not just because new technology and computers had been brought in, but because using them demanded that problems under consideration be analyzed differently, that they be described with numbers, with mathematical models consisting of equations attached to quantifiable variables.

The variables of the Club of Rome models describing the world were essentially *population size, natural resources, industry, agriculture and pollution* - plus the expression of their interactions derived from observations of the real world. Members of a variety of disciplines had to be brought in, formulating images of the world , away from politics and to a degree economics, quite different from those held by governments and the general public, that were pretty much those formulated by the media.

Significantly, this was the first time men were given the ability to look quantitatively at the entire world as a dynamical system of many interacting components, something Malthus and others could not have done since all they had were theories, perhaps educated ones but theories only. It is going to quantitative models (made possible with the appearance of sufficiently powerful computers) that has been the *Club of Rome's* main contribution. Though its initial developments are to be attributed to Jay Forrester[1], most representative of the outcome of the work at MIT was the book by Dennis Meadows [2] appropriately entitled "*Limits to Growth*". They presented in fact a new paradigm to describe the world, quite different from that of what may be called the *official world*, referred to by the media, found in the heads of state and governmental declarations and pretty much limited to the short term. By contrast, the Club of Rome paradigm dealt with the long term, giving some prediction of what would happen to the material side of the world in decades to come. Those predictions were reasonably pessimistic, *asking for a halt, a reduction in the size of the world's population and industry as the only solution*, or else ! This warning was formulated in the early 1970's when the world's population was 3.8 billion., in spite of which the 2019 world population was more than double that at 7.7 more billion.

Very little did take place in response to those warnings, warnings that were in fact asking for significant changes to human society's behavior. But changing society's behavior is easier said than done, and little was seen other than for a number of separate projects whose global effect did not amount to much. So, not seeing change after a few years the media, then the public at large lost interest in the matter. It was not "news" any more. But it has become news again in the late 20st, early 21st centuries with, as predicted, the appearance of visible trouble including environmental change, global warming, then overpopulation bringing unrest and wars in many places on Earth, bringing masses of migrants, refugees fleeing unbearable living conditions and violence, leaving their homeland that could not support their numbers anymore.

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[1] J Forrester *"World Dynamics"* (1971) Wright Allen Press.

[2] D. Meadows et al. *"Limits to Growth"* (1972) - Potomac Associates.

Having been with these developments the 1950's, participating in the Club of Rome studies in the 1970's in the 1980's with UNESCO-Paris, having been part of the international science – technology community that had emerged and organized itself after the war, I thought I would write the story of this remarkable period of time during which technology and material matters did take over politics in their importance to influence the global world, something new, still largely not understood by the media, by governments and the general public.

By necessity, what follows includes contributions from more fields, more aspects of the question than is usually the case. It is precisely fact that an understanding of what goes on with today's globalized world cannot be obtained by considering separately the many manifestations of trouble in what has become a multi component global system. What is required is consideration of their interactions and interdependences, something too much absent in too much of today's media understanding of our globalized world,

What follows is consideration of a number of components important in what goes on in today's world.

transportation

It is by bringing mechanical power to the world that the industrial revolution led to major changes to the way society functioned, its logistics. Not sufficiently emphasized is the importance of new means of transportation, including the maritime network that emerged as a leftover of world war II, larger by orders of magnitude than anything that had existed before. Other than cargo ships, equally important are such things as the ubiquitous Toyota and other trucks we see in televised news reports, allowing for the transportation over large and short distances of people as well as all kinds of goods, including food (and unfortunately military hardware… wars we see in the Middle East would otherwise not be !)

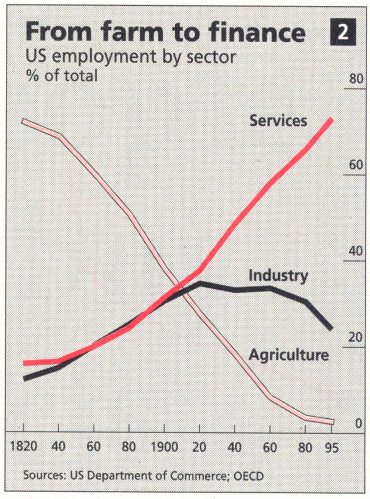
In earlier times, nature had limited the world's population in numbers by the necessity for all to live close to food resources. It is the elimination of this constraint that led to the population explosion we live today.

fig 2a

fig 2b

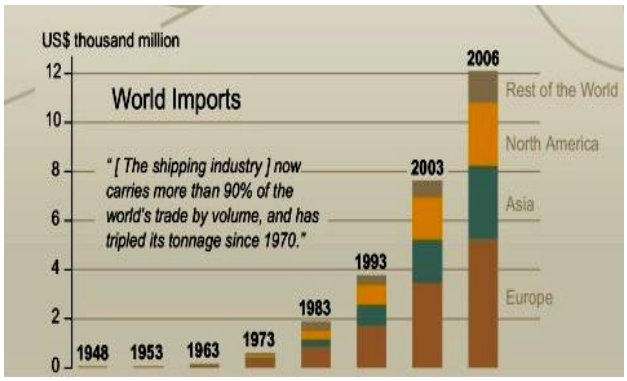
urbanization and employment

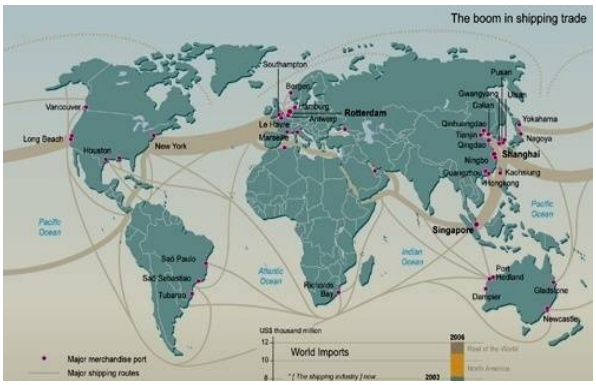
Other than for transportation, steam also brought mechanization to agriculture, resulting in significant societal changes. In the early 1800's, those employed in agriculture and living in rural setting represented over 90 percent of the world's population. It is now down to less than half that much worldwide, down to a few percents in much of the developed world with billions having had to move from rural to urban living, to cities where jobs were created not only to provide for the essential necessities and non essential goods and services, but maybe more importantly to create employment. With unchecked population growth, employment has become an important commodity, more significant in fact than money. The multitude of odd products from China we see in western markets may be there not so much because China needs the money, but perhaps more so to provide employment to a growing population. A situation that reminds me of the retired head of Antwerp Harbor' s Fire Department that I knew in Brussels in the 1950's, telling me that Japanese were selling wrist watches by the bucket off their ships in the 1930's…. which says something about Pearl Harbor that came later.



international trade

International trade had to inevitably be part of it all. Compared with what it is today, its amount had been very small in centuries past. It is after a visit of Nixon to China in 1972 (preceded by some friendly "ping pong" diplomacy) that transpacific relationships were normalized, the US were considered as a foe by China before that. This marked the beginning of the economic relationship between East and West, giving rise to large scale international trade - but the conditions were right and this would have taken place anyway, even without Nixon's visit.





Then came outsourcing, western developed countries taking advantage of cheap labor in other parts of the world. Though not entirely new in a number of ways, large scale outsourcing has become an institution of modern times. That this was also giving to the east the knowledge in technology and manufacturing that had for a couple of centuries made the superiority of the west was not part of the short term concerns of western governments mostly interested in short term economics, nor of manufacturing companies interested in being able to sell cheaper products at home. Which is still the case today , except for the fact that a number of those overseas manufacturing facilities now belong to overseas companies, contributing, in particular, to south east Asia's growing industrial power. This also happens to a lesser degree elsewhere, extending industrialization to many new parts of the world : becoming industrialized is seen by developing countries as the way to better economic conditions, believing so because inhabitants of western industrialized countries are indeed economically better of. But then also that their increasing populations forces developing countries into industrialization for other reasons, just the need for employment and income.

demographics

The world's population is around 7.6 billion, four times what it was in the 1950's. The details of how this has taken place has a number of popular explanations, most of them limiting their considerations to one sector (e.g that we give developing countries medicine to prevent death by disease). But the most influential, the *sine qua non* factor has definitely been the appearance of means of transportation I mentioned earlier, which is essentially what has allowed overpopulation, in particular in what were undeveloped countries. Not only did transportation bring transportation of food inland over larger distances, but it made it possible for those countries to obtain income by selling overseas their natural resources that could now be shipped out to buyers (oil the most heard of). Then outsourcing leading to downright industrialization of some of those countries whose manufactured products could also be shipped out, bringing more income, I income used to buy food, means of subsistence that could shipped in. Remove "shipping" in the above and none of the new world of globalization could have taken place, all of this leading to the population increase we witness

It is in Europe and North America that industrialization had started, and was still pretty much there in the mid-20th century as attested by the establishment in 1961 of the OECD "*to promote policies that will improve the economic and social well-being of people around the world"*. The OECD countries were more or less those that had been the protagonists of the war (minus Russia) , 20 countries that in geography as well as population were far less than the entire world. With some minor changes, the OECD that still exists consists of the same countries, not very different from today's G7 (the darkest parts of fig 6 and 8, respectively).

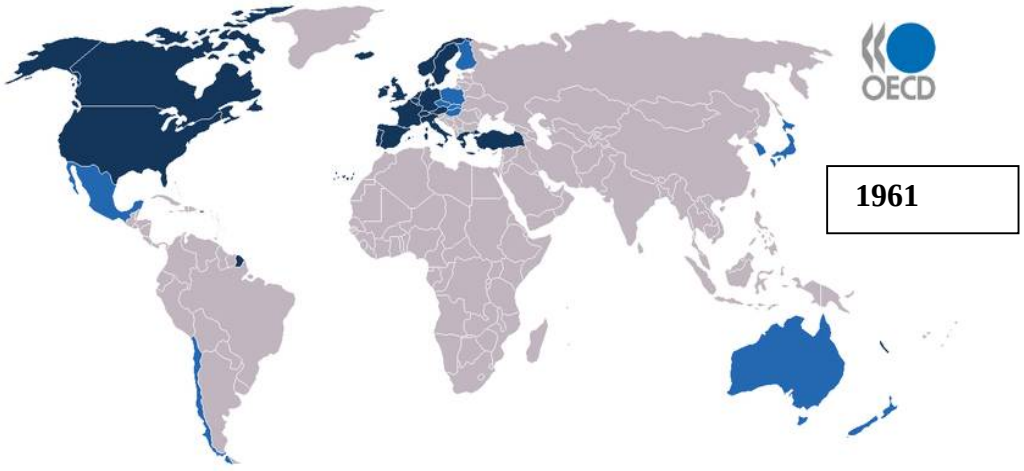


Fig 6

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Significant is the fact that it is not in OECD and other developed countries, but in those that were called undeveloped that post world war II growth has mostly taken place, some of which countries have by now become developed as well. The world's demographics are changing. Troday's global population has a geographic distribution quite different from what it was less than a century ago. Africa's population is over one billon today, six times what it was before the last war. And it is predicted that by 2100 the joint populations of Asia and

Africa will represent over 90 percent of the world's, from about 75 percent today and 65 percent in the 1950's. Which inevitably implies industrialization with Asia and Africa becoming the most important components of the global network of economically, materially advanced countries and continents.

Taking away Asia's current (post world war II) dependence on western management, western know how, science and technology shall presumably not leave the west in any kind of leading position, returning to an economic balance as it had been before the industrial revolution - that was a strictly western affair. The GDP of the eastern world (China, India, Japan….) was more than twice that of the west before 1800 (the start of the industrial revolution), it was down to less than half by 1970 (post-world war II industrial development of the west) but the balance is well on its way to returning to what it was in the 18th century and before.

Population, UN current and projection by continent (millions)

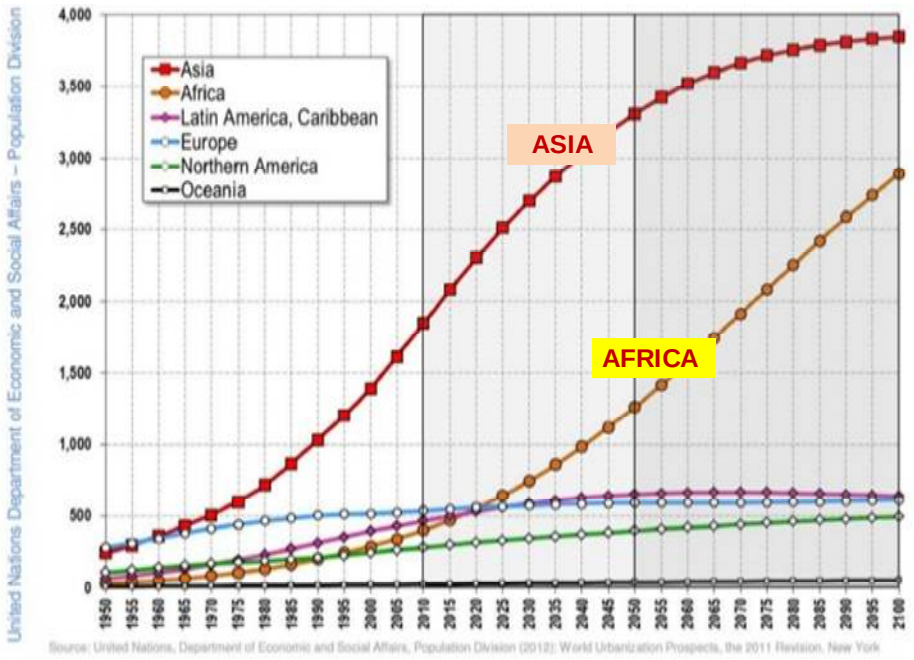

Fig 7

Fig 8

G7 is the Group of Seven (dark area) founded in 1975 as the Group of Six, not much different from the 1961 OECD, pretty much the originators of the industrial revolution. But by 2100, more than 90 percent of the world's population shall be living in Asia and Africa, outside of the OECD- G7 territories . Also inevitably a large portion of the world's industry.

natural resources and the environment

The 1970's Club of Rome predictions did indeed come true, in particular an increased demand for natural resources, including energy. Significant is the fact that eighty percent of that used globally today comes from fossil fuels . I like to quote in that respect from *Charles Galton Darwin*[3] *:*

"…. at the present rate of demand for mechanical power, the estimates are that oil will be all gone in about a century, and coal probably in a good deal less than five. A thing that will assume enormous importance quite soon is the exhaustion of our fuel resources. Coal and oil have been accumulating in the earth for over five hundred million years. For the present purpose it does not matter if these are under-estimates; they could be doubled or trebled and still not affect the argument. Mechanical power comes from our reserves of energy, and we are squandering our reserves, our energy capital quite recklessly"…

……. and that was in 1953! …

Figures 9a and 9b show essentially the size of fossil fuels consumption and CO2 emissions, showing by how much what Darwin calls *"squandering … our energy capital"* has increased with no sign of slowing down : the increase is coming with the increase in

[3] *"The Next Million Years "* (1953). Charles Galton Darwin was the grandson of Charles Darwin of evolution fame.

population, and with its becoming increasingly urbanized, whence consuming more energy per capita. We shall run out of fossil fuels in not much more than a matter of decades and there is no clear picture at this time as to what sources of energy shall come next, other than for the fact that solar shall inevitably be a significant part of it, for the simple reason that solar energy is there, the only problems with it are in developing the technology and the logistics of collection and distribution.

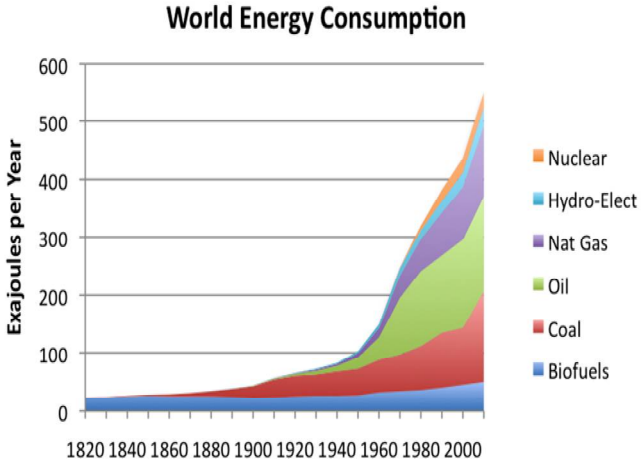

fig 9a

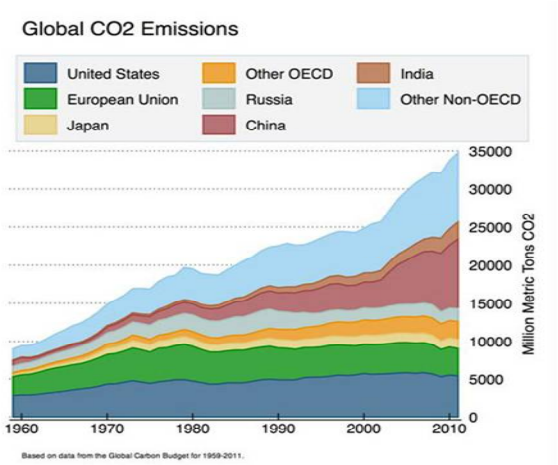

fig 9b

In addition to the depletion of natural resources comes pollution, including atmospheric pollution leading to the much talked about climate change, global warming. A significant factor is carbon dioxide, CO2 whose emission amounts are related to energy usage, itself proportional to the size of population-industry. It is a global problem. The December 2015 Paris COP21 conference on the subject drew some 47,000 participant, including 140 heads of state as was widely reported. But it was only the 21st in a series on Climate and the Environment Conferences organized by the United Nations beginning with Berlin in 1986, with Paris hoping to achieve more than its 20 predecessors with a view, among other measures, to globally reduce greenhouse gas emissions.

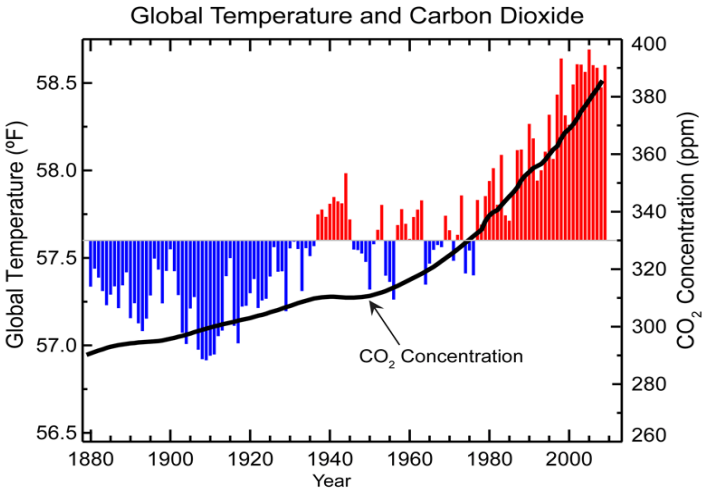

Fig10

What the overall data shows is that the growth in the consumption of fossil fuel and the emission of CO2 are a consequence of the growth in population and industry - that are in the final analysis responsible for global warming. One may well be told of projects to reduce the trend with such things as the recommendations of the Paris 2015 accords - but they would, if agreed upon and implemented by all, at best reduce CO2 emissions by a few percents of what fig 9b predicts.

the societal side

Not sufficiently talked about is the societal side of the story, the human consequences of the material changes for which there is no precedent in history In the 1800's, over 90 percent of the human population was working in agriculture related jobs. As mentioned before, this changed drastically with industrialization displacing masses of workers from agricultural to urban -industrial and services jobs (re fig.3), from rural to urban living, bringing about all kinds of new problems.

**local hardship, unrest and violence*

There are many places on Earth where the population increase has not been accompanied by a parallel increase in means of subsistence, by an increase in employment to keep all occupied. But, hardly brought to the general public's attention, the numbers are so large as to make trouble inevitable.

That these numbers lead to local discontent and violence is not surprising, as was illustrated by the 2011 Arab Spring (that has by now turned into the Arab Fall). It is not that North Africa-Middle East populations turned all of a sudden against too restrictive regimes, they were against poverty and unemployment. In the absence of better information, they assumed that it was the reigning leaders fault, blaming governments for mismanagement. But the real cause is that those countries are no more self sufficient as they used to, as they had to. They have come to depend on the rest the world for subsistence, their population increase having occurred without a consistent increase in goods/food production, without some form of industrialization creating employment opportunities leaving large numbers unemployed, many of them young having nothing better to do than create trouble and topple down governments (or migrate to elsewhere). Toppling governments downs are followed by elections in the naïve belief that this change will solve the subsistence productivity and unemployment problems. Which is not the case, is even not possible given, among other factors, the speed at which change has taken place.

North Africa/Middle East population increase

	1950	2016
Afghanistan	8.1	30.55
Tunisia	3.5	11.13
Morocco	9.34	33.65
Algeria	8.9	40.26
Libya	<1.	6.54
Egypt	21.2	94.66
Syria	3.5	17.50
Iraq	5.2	38.14
Iran	16.4	82.80
Turkey	21.1	80.27
Eritrea	1.4	5.87
Saudi Arabia	3.9	28.16
Total	~104 millions	~470 millions

This also takes place elsewhere.. For example in Africa where the recent violence in Nigeria (where "Boko Haram" means something like "Western, Non Islamic Education is a Sin") is also related to the increase of its population. But again, this is not part of the official world. I saw the Nigerian prime minister in a recent TV interview say that it was climatic change that was responsible for local agriculture not producing enough to feed the populaion, whence famine leading to unrest in parts of the country, saying nothing about the fact that the number of mouths to feed had increased by over 500 percent in his lifetime.

Nigeria	(1950) 29.75	(2016) 187.98	millions

*migrants

Other than for hardship and local unrest, overpopulation has resulted in large scale migration. There may well have been movements of populations in earlier times, but there is no comparison with the scale, the circumstances of what is taking place today. The reason for millions of migrants is all too often attributed to regional wars, but the fundamental cause is that of those wars themselves, regional overpopulation resulting in poverty, malnutrition, violence.

The case of Syria is most reported by the media at this time. Not mentioned is the fact that Syria's population that was some 3.4 million in the 1950's had grown to over 17.5 million in 2015, that of neighboring Iraq from 5.2 to 35 million over the same time span - with inevitably high unemployment rates , poverty, discontent. That Iraq and Syria is where ISIS and other destructive wars have come up was no more than a predictable consequence of millions of unemployed youth. The latest official UN number for world international migrants (those who

have made it to another country) is around 250 million, of which between 2 to 3 million, on the order of one percent of them made it to Europe by 2016 creating all the political turmoil and humanitarian problems we see. The actual number, including those having left their home but not made it to another country may be twice as much worldwide. Where "economic refugees" are coming from is implicitly interpreted as coming from countries with a failing economy, said to be the government's fault, or climate change . But it is in reality due to the out of hand increase in population numbers. Table 1 shows that most of these countries have population numbers that have quadrupled or more in one or two generations!.

In the end, it is a tragedy for migrants from Africa and the Middle East who risk their lives to make it to Europe looking for a better future. Also a tragedy for Europe since the newcomers are not only too many, but they do not integrate well, being mostly Muslims while Europe is mostly Christian, leading to conflicts brought about by the incompatibility of the two cultures, an historical incompatibility illustrated by the Crusades ten centuries ago. Prophetically, a prominent bronze statue erected in Brussels in 1848 is that of an armed horseman with a plaque that says "Godefroid de Bouillon, First King of Jerusalem" 1060-1100. Hopes expressed by some that those incompatibilities can be eliminated with education are pipedreams. One cannot change the culture of populations in a matter of decades, cultures that have roots in religions and have taken centuries, millennia to establish themselves. Today's migrants are coming from places where populations are in economic hardship mostly because of the growth in their numbers, and try to make it to better off places on earth where they are not necessarily welcome. About which there is something too often ignored , namely that governments and the general public's attitude are different, the two having different interests. Those in governments are motivated by politics, economics, the GNP side of their respective countries, the general public more by the "not in my backyard" syndrome**…**

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Then also the recent flare-up of trouble in the United States, has much to do with migrants – refugees not only from the Middle East and Africa, but also from Mexico and other South American countries. For instance, Mexico's population has more than quadrupled since the 1950's, the end of word war II (that of the US has a little more than doubled).

Mexico	(1950) 28.5	(2016) 130.14	millions

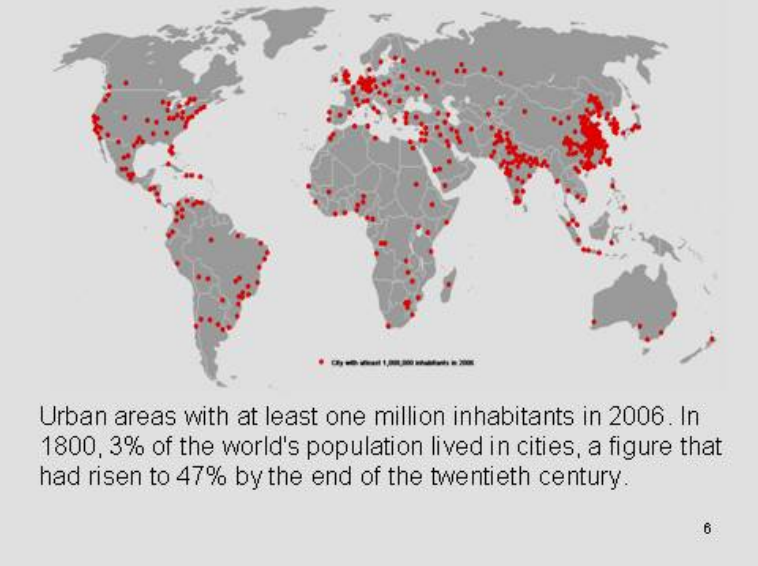
Both the notorious US "ban" and the equally notorious "wall" are direct consequences of global overpopulation leading to migrations.

**lack of habitat*

With mechanization bringing urbanization to what were mostly agrarian populations came insufficient housing, insufficient habitat, much of it with increasing population numbers moving to cities, many ending up unemployed but staying there anyway. Beijing's population

went from 8 million in the 1960's to over 20 million in 2014, that of Seoul from 5 to 25 million over the same time span and Nairobi from 250,000 to 3 million.

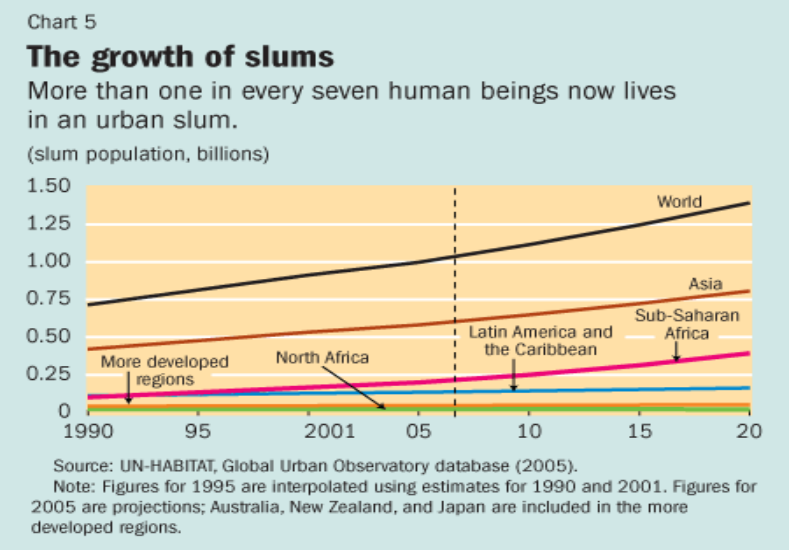
Fig 11



But a four or fivefold increase in a city's population (as is the case in most of the many megacities that have appeared in the post war years) asks for more housing as well as an increase in social infrastructures, municipal administrations, schools, public utilities, health care facilities. Which is simply not feasible in the short time span over which those increases in urban population have been taking place. It is not really a question of money, but developing an appropriately educated labor force takes time, a few decades, which is not fast enough to keep up and resulting in the fact that many of the new comers end up in slums. Figure 12 shows the worldwide number of urban slum dwellers, exceeding one billion to date, most of them in Africa and Asia.

Large numbers of migrants lead to other surprises, such as the unpredicted results of recent elections in most European countries, Brexit and the appearance of nationalist movements (in France, the Netherlands, Austria, Hungary…) all of it affected by the flow of Middle East /African refugees having made their way to Europe in preceding decades, in particular the last. Less talked about than politics, wars or trade, housing (and the education of needed personnel, including school teachers, health care, etc…..) has become a major problem, one that cannot be solved quickly with just money . When the media talks about inadequate housing, they ignore that difficulty and blame local authorities for having failed to plan for habitat ahead of time. But, with the numbers that exist, the problem is materially unsolvable and an increasing percentage of humanity (around 15 percent today) shall find itself living in slums.

Fig 12



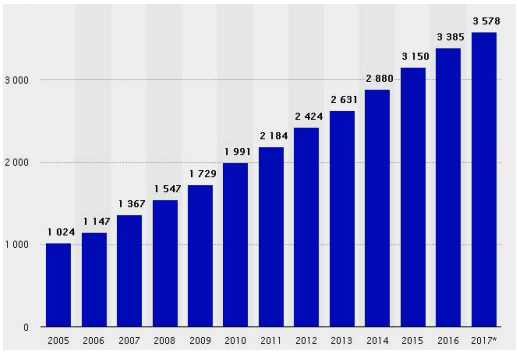
information, communications, knowledge, the information revolution

If it is energy and mechanical power of the 18th - 19th centuries's *industrial revolution* that brought us a material globalization of the world, changes to life on earth that came with information processing technologies that appeared in the 20th century have been arguably as significant, if not more. This included computers, but also means of distance communication made possible by new technologies that had to a large extent seen the light as an aftermath of both 20th century wars , the second more so than the first. One may rightfully talk of an *information revolution* that began in the late 20th century. What it brought about was globalization of knowledge, it brought about communication between people, it made separate communities on earth aware of what others were up to elsewhere, making them want to copy. And making them feel like having a say, having some responsibility for what others were doing, what others were thinking, a different world altogether. That the US today criticizes China for not being a democracy, for not respecting human rights is an entirely new phenomenon on earth. Less than a century ago, each had little idea of what the other was up to, each was mostly concerned with its own, local problems.

Fig13a

2012 's massive information exchange routes that did not exist one century ago.

Fig 13b



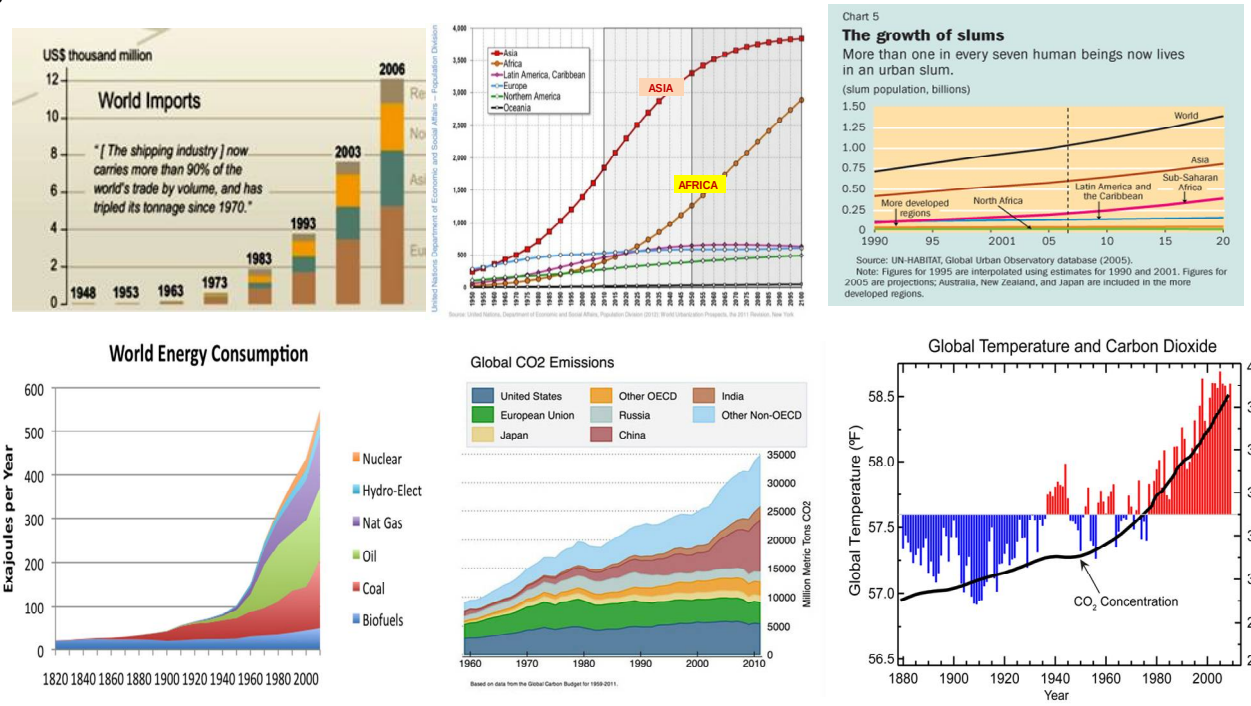
number of internet users, worldwide – millions

With the *information revolution* came the internet in the late 1900's. Significant is the fact that the size of this new development (including the employment, hardware and energy consuming that are parts thereof) keeps growing at a rate even greater than most of the other changes that have come with the energy-to-mechanical- power industrial revolution. Other than for the material side, what internet *et al* have done is change the way people, governments, all kinds of organizations interact, even change the way they think. What is removed is the human side of person-to-person direct contacts, something that has a significant importance in the way communities function. Its gradual disappearance is not a good contribution to the societal side of humanity[4].

[4] See for instance J.L. Locke *" No talking in the corridors of science"* The American Scientist Oct/Nov 1999 or his book "*The De-Voicing of Society – Why We Don't Talk To Each Other Anymore*" Simon and Schuster (1998).

Pulling together the data from the preceding pages shows that the global problems we face are fully consistent with the increase in the world's population, a population that is today over ten times what it was when the industrial revolution began three centuries ago.

Fig 14



What this shows is an inexorable growth in human presence, human activity on earth and some of their ill effects. It is hard to argue against the fact that what an extrapolation of these graphs (actual data) shows shall hold true for at least the next few decades, predicting more growth with disastrous consequences.

Significant is the fact that little if any in the above shows influence of politics, economics, governmental decisions, wars, those things that form the substance of what we may call the *official world*, the world the general public who reads daily newspapers and watches television believes describes most things of importance that take place on Earth, but does not or very little. Hardly does the daily news concerns themselves with long term, material aspects of life on earth like those illustrated in the preceding pages. The *official world* is only about the short term (days, weeks, occasionally a year or so), moreover pretty much limited to attention catching events taking place near reasonably civilized, reasonably accessible places (accessible to the media, that is) and ignoring the rest. It talks for instance a lot about elections, referendums, change in governments without asking for the reasons why those government changes, why those elections take place more frequently and in many more places today than was the case say a century ago. It is that those reasons come from the behavior of those events of the world described in the above, from the *material world*, a different world altogether. Its elements are known by a community of academics and reasonably literate

participants, not much by the general public, even by members of traditional governments whose sources of information are those of the *official world,* with only occasional information about this *material world* coming in the form of "documentaries", not "news".

So, we have come to have come too have two schools of belief, of information , two schools that look differently at the global world, with different paradigms dealing with different data, different classes of problems, two schools that each project a consistent image of some aspect of the inhabited world but do so from entirely different angles, describing different sides of common life on earth. This division bears an interesting similarity with C.P. Snow's notorious observation (1959) of the existence of two cultures in the academic, learned community, that of *the classicists* and *the scientists,* the two talking different languages and unable to communicate with each other, concerned with different disciplines [5] What we have today is more significant since it is not just academic but is about real life for all on Earth, a division between two communities concerning themselves with the same world but looking at it through tinted glasses of an entirely different color.

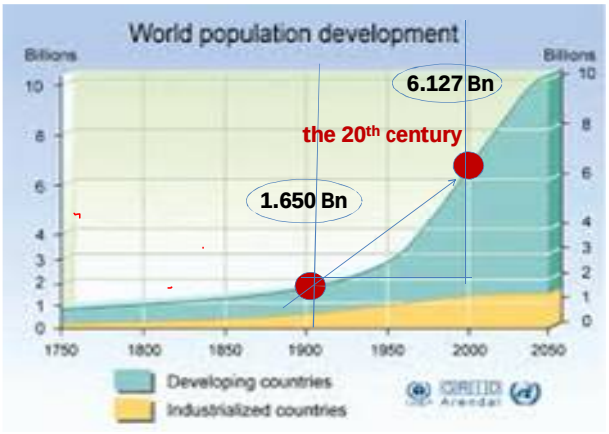
Of the two, what explains our problems and predicts the future are matters that belong to the *material world*. No consistent story comparable with what is shown by fig 14 can be conceived with the variables of interest to the *official world…* in spite of which it is re the case that rbly much of today's world (at least in the west), is pretty much run by communities whose beliefs are those of that world. Which is no more in fact than a continuation of the way humankind has functioned on earth for centuries. This was fine when hard power and boundaries were needed to defend the territorial integrity of countries that depended each on their own resources to survive. But this is not so anymore, globalization has changed the role of physical boundaries, soft power is replacing hard power, something that became a fact sometime in the second half of the 20th century. That China has today a much larger material goods production capacity than the US (soft power) gives it more world power than the US that has a larger military force (hard power), something that was not the case 50 years ago.

And about the reality of the *material world*, there is the interesting fact that without having to think about who is in control of the South China Sea, who won in any one of the many elections taking place worldwide, without having read the latest issue the *New York Times,* the *Wall Street Journal* , *The Economist* or *Le Monde,* looking at what we know of the *material world* (fig 14) tells us, or at least argues convincingly to the effect that the increase in population and industry, the increase in the emission of greenhouse gases and its many consequences shall for at least the next few decades continue inexorably at a rate not much different from what it has been for the past few, an increase of around one percent a year or more for many of them.

[5] C.P. Snow *" The Two Cultures*" first published in 1959, subsequent, enlarged editions published by Cambridge University Press. (1962)

Among other results, this predicts a population of around 10 billion by 2050.

Fig 15



epilogue

Globalization began with developments in science and technology, mostly with the industrial revolution three centuries ago, followed by significant developments in the 20th century. These were meant to bring better living conditions to mankind, but unpredicted consequences have been in an apparently unstoppable increase of the world's population and industry, leading to an increase in the use of natural resources, in all reaching the limits of what the earth can provide. Which has given rise to numbers of material and societal problems with no indication that this trend shall be reversed in the foreseeable future,

Humans had started as hunter gatherers, their numbers limited by nature as to how much food, means of subsistence were available nearby to hunt and gather. They were living in self sufficient, separate groups having limited interaction with each other. There were, in each group, reasonable forms of what may be called governments, not necessarily reasonable by today's principles of morality or political ethics, nor by the principles of other groups, communities at the time but providing some form of stability ensuring survival. All of which changed with transportation and communications transforming the world into a "system" of interacting pieces, interacting groups still geographically, politically separated but no more materially independent, no more materially self sufficient. This means the rise of interdependences that may well not agree with the political relationships between the parties involved. Which interestingly does not prevent business to proceed as this were not the case. The US and China may well largely disagree with each other in politics (in the *official world*) but the volume of material trade between the two, run by multinational corporations that are actually part of the *material world* is among the highest in the world. Why this adapted itself to the new conditions is because its participants have a common material interest, international trade with no possibility to separate the pieces. They do not necessarily like each other … but business is business !

This is not true for the population problem where there is no such deep interdependence, the problem may well be global but it is up to each to participate on their own. The only way to solve that problem would be in a common, official action aiming at a reduction in the population size, a reduction in population growth as well as in energy consumption, in industrial activity on earth and its environmental pollution consequences. This would be a global enterprise requiring the participation, the cooperation of all. But what we see instead are a multitude of research enterprises, projects, some sponsored by governments, some by NGO's. Significantly, each address only one identifiable class of problems[6]. Even the United Nations' response is in the form of separate agencies such as the UN Environment Programme (UNEP), the UN-Habitat, the UN High Commission for Refugees (UNHCR), the World Food Programme (WFP) , the United Nations Children's Fund (UNICEF) each addressing one part of the global problem with little collaboration between them, The UN may well do a valuable job in collecting and distributing information, data concerning the state of the world, but internal politics prevents it from addressing many of the long term, global problems revealed by that data, from suggesting realistic solutions, something I know well, I was in the 1970's- 80's member of one of those committees, on *"bringing the benefits of new technologies to the developing world"* with UNESCO-Paris. Addressing separately different issues does not solve the global problem. It may well be that projects aimed at reducing the emission of greenhouse gases are in the right direction, that of reducing global warming, but those aimed at saving lives by bringing subsistence help to places where excessive poverty is present, bringing medical assistance to overpopulated, underdeveloped regions (and there are a number of these), while being in line with today's principles of morality (those of the *official world*) do only contribute to increasing the global population, the opposite of what solving the overpopulation problem would require.

Why a common cooperative effort is not feasible finds its explanation in our ancestral past. I shall in that respect quote from Christian de Duve :

"For the past hundreds of thousand of years, hominids were distributed in small groups of ten, twenty, thirty individuals, wandering in African forest and savannahs in search of food. Two traits were important for the survival of the individuals in those small groups and for their reproduction - cohesion inside of the group and aggressiveness with respect to other groups – and it is those traits that, giving an advantage to certain groups over others, have privileged them by natural selection[7]".

The essential traits he mentions, cohesion inside of one's group or community and aggressiveness toward the others are still with us, going against what is needed to have

[6] I cannot resist noting that one may ensure visible success in the accomplishment of any project whose quantifiable objectives have been appropriately formulated from the start.

[7] Christian de Duve *"Genetics of the Original Sin : the impact of natural selection"* (2010) Yale University Press. He was a colleague of mine in Belgium, received the Nobel price in 1974

all become a unified community sharing in the earth's resources. We also remain to a large extent under the influence of principles of morality, those of the *official world* where consideration of the limitations imposed by the finite sustaining capacity of the earth are largely ignored, but those limitations did not exist, did not become significant until quite recently, less than a century. It is E.O. Wilson who said something like "*we have stone age emotions, medieval institutions and live with space age technology"*.

So we have come to live in a world of *"more", more* population, *more* industry, *more* use of natural resources - in all having reached the limits of what our finite earth can provide and resulting in the troublesome developments we witness. Which interestingly parallels technology where there is something known as *'Moore's Law' (1965)* predicting the number of transistors that will fit on a computer chip : "*twice as many every 18 months or so…*" a *"law"* that is by now reaching a physical limit (2018). As for we humans on earth, all we may expect is a population of over 10 billion and continuing to grow in size, an average global temperature more than 2^0C over what it was in the pre-industrial days, then continuously *more* unrest, conflicts, local wars and other societal disasters - Which may well be the result of one of our inherited traits mentioned by de Duve : in a world of limited resources, *more* is favorable to survival. But transportation has changed what nature had imposed in the form of (nearby) resources …"*if not here, get them from elsewhere"* and we end up with today's growing world with no real hope that this trend will reverse in the predictable future.

The magnitude of the problem is not realized by leaders in the government community. With industry being a major contributor to atmospheric pollution and global warming, we still hear heads of states boast of the success of their accomplishments by quoting growth in the *GP* of their respective countries, which means more industry, the same heads of state that signed in Paris the proposed agreements to substantially reducing CO2 emissions. And at the closing of the 2018 G7 meeting in Quebec, we heard *Christine* Lagarde, managing director of the International Monetary Fund say something like "*the world's economy is not doing so bad, in spite of difficulties, we may nevertheless expect an increase of a few percents in the global GNP next year.*

Something is not right . Instead of believing that one may solve today's global problem by addressing its components separately (as is too much the case and does not work) what is needed is facing reality as a whole , something we humans seem to be well unable to accomplish. The problem came with the 18th century discovery that the fossil energy present in the earth's underground could be converted to mechanical power, a technology discovery that opened the door to entirely new developments in the way of living of the human society, leading to growth. Population growth is perhaps the most visible but it is not isolated, it could not be without the consistent growth of other components that make it possible, like those illustrated in fig 14.

There is little hope that governmental organizations will leave growth in *GNP* as a measure of success in their respective administrations. Likewise, industry will keep growing in size, and so will the severity of the associated problems. In the final analysis, our lack of ability to solve today's global problem comes from human nature we have inherited from our ancestral past, a human nature that cannot adapt itself to the modern world we have created. We may well have think tanks and elite communities aware of the situation, aware of the danger large amounts of populations and industry represent and informing all who want to hear what problems we are to expect in the future. But that is of no help as there is no hope for human nature to change, no hope for all on earth to agree and cooperate toward a common objective. We were as a species simply not prepared to live as the materially interconnected community that large numbers we have reached are forcing us into. Which (see fig 15) took no more than one century to develop, more or less the 20th century.

(to be continued)