on a new modern invention which will devastate them in peace without a single bullet fired or moving a single soldier. The good news is that the people in the developing countries are quite capable of developing the very same inventions needed to protect themselves in peace, if they are given the means to start developing nanotechnology projects now. Only those who have nothing to lose go to war. Happy people do not go to war.

5.3 Workshops on nanotechnology

If the above is not completely sufficient to convince all decision makers in the developing countries of the vital importance of the above nano initiative, I propose to hold a very high level workshop on nanotechnology as soon as possible in order to promote the idea. To be sure, such a workshop is essential anyway. What is debatable is only the timing and whether this workshop should be held before or after a decree of establishing a National institute of Nanotechnology and commencing a nanotechnology initiative. Either way I propose that such a workshop, in addition to an exhibition of nano products should be held as soon as possible in very country seeking to join the new scientific, industrial revolution in order that the general public may become fully aware of the nano age.

6. Taking the limit and conclusion

Nobel Laureate in Economics, J. Stiglitz has long uncovered the immense harm and the phenomenal high cost of allowing mass poverty to go on. His two best sellers "Fair Trade for all" [12] and "Globalization" [13] were not exactly eye openers because the author was already long ago a disciple of J. K. Galbraith [16] but it is a must reading for any scientist pondering the fate of our world and why development is freedom not only for the poor but also for the rich of this planet as argued by another Nobel Laureate in Economics Prof. Amartya Sen [14].

It is under all the preceding influences that I came to see the future of economics as simply scientific excellence. In the limit, science will not be a factor or even a very important factor in economical development. Science will be synonymous with economics. It will no more be agricultural or mineral resources as the Physocrats or Marxists have argued which will define economics. It will not be the balance between land and population as argued by Galbraith. It will not be the greater understanding of economics and econometric models. It will be simply science itself.

The human brain is our most valuable tool for survival, economic revival and achieving affluence for all. A glimpse of this future could be seen in countries of very different sizes such as Israel and the People's Republic of China. Other countries are working very hard toward achieving a scientific society with different degrees of successes, such as India, Saudi Arabia and Iran.

In the limit, the future will not belong to those who control vast oil reserves, but those who have the largest number of engineers and scientists with the highest levels of education possible. When there is no oil, they will invent oil and when there is no arid land, they will construct crops in the laboratories [5]. These are no more idle dreams, but real prospects anticipated long ago by R. Feynman and Erik Drexel [5]. One just needs to look at a country which has hardly anything but science and democracy like Israel which is moving with the speed of light towards prosperity and I am not talking here about military might which is in real terms of the limit quite irrelevant. By contrast, we just need to look at the oldest and greatest civilization the world has ever known, Egypt which has everything but a deficient scientific leadership and educational policy and consequently lagging way behind not only Israel but a country as small as Kuwait and Qatar. Egypt used to be one of the most advanced powers in the Mediterranean sea less than two centuries ago in the time of Mohamed Ali Pasha who was the undisputed leader of the Middle East and all Arab countries in the fifties of the last century and is now at a stable relative minimum scientifically speaking and consequently faces its greatest challenge ever after higher education and advanced scientific research have been virtually wiped out except for the few rich. No one could be fooled by the razzmatazz and empty drums talking about science and education nor the unrivaled 6 star hotels of its magnificent beaches. It is a crude reality, no excellence in science, no future for the nation. I am sure it is not only oil that is doing the miracle in young Gulf States. It is the Stanford and Berkeley educated elites who are making the difference.

There are many witty jokes about taking the limit which leads frequently to absurd results. Here however, I truly believe that science and particularly nanotechnology and not the war on terrorism are our salvation. To see that one needs the intellectual elite to be the political leadership. To think there can be real democracy in a country where 85% of its population live under the poverty line is making a mockery of the wonderful ideal. Needless to say this is not happening at the present not even in the most advanced and richest countries on our planet let alone the poor developing world mostly ruled by ignorant dictators. Let us hope Nanotechnology could give us some peaceful ways to manage a coup d'etat to bring these badly needed changes. I for one am betting on nanotechnology.

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[8] in which he has shown how E-Infinity theory could be applied to problems related to nano textile technology. Here we have a theory devised specifically to tackle quantum gravity and then suddenly one finds that it is of great usefulness in turbulence [9] and brain research [8]. Nonetheless, on reflection this is not in the least surprising. Arnold Diffusion, KAM, Sphere Kissing and Neuhaus sinks as well as chaotic dynamics and fractal gravity are all concepts well known to those working in nonlinear dynamics [11]. On the other hand, nonlinear dynamics plays a crucial role at the mesoscopic level of nano structures and that is where E-Infinity theory becomes relevant to nanotechnology. The connection is simply the fact that we can improve quantum mechanics by exploring deterministic and dissipate quantum systems as done by 'tHooft or look at deterministic but chaotic dynamics as an alternative mathematical solution. In E-Infinity we have clearly taken the second avenue and hence the connection to nanotechnology and mesoscopic systems [10, 11].

5. Some applications of nanotechnology

Let us start with one of the largest and fastest growing research areas of nanotechnology which is related to or health. In medicine less is frequently more. The side effects of medicine are more often than not just as harmful as the disease we want to cure. Using nanodevices to deliver the medicine accurately to the damaged tissues and cells will increase the chances of healing tremendously. Instead of shooting blindly with a radioactive machine gun to cure cancer we have a sniper which targets only those cancer cells without killing innocent bystander cells. There is a huge new field called nanobot reminding us of the Hollywood science fiction film "The strange voyage" of 1965. Shrinking the heroine of the film, Raquel Welsh to nanosize is of course science fiction which will remain fiction probably for hundreds of years if not forever. But the idea of sending a miniature apparatus not much larger than 1mm and 1/10mm radius into the bloodstream which could then remove blockages in the arteries may quite soon become a science, not a fiction. In fact, we are almost there with regard to a dialysis machine for kidney patients with is sufficiently small to implant inside the person suffering from kidney failure. Similar technologies may be used for diabetic patients. I have just told a dear friend of mine who studied with me in Germany in the early sixties of the last century and who had a stent placed in one of the main blood paths to his heart a few years ago, that unless this stent is coated with a special nano material, trouble will be pre-programmed. However, a nanostent helps the healing process and prevents clotting of the blood [3-5].

In electronics, we know the pivotal role of silicon. Miniaturization of electronic chips depends totally on silicon. But we are reaching the limit and soon will not be able to make silicon chips any smaller. Luckily nano technology has given us a new material, namely nanotubes which can do all what silicon does and more and could reduce the size considerably. Nanotubes are science fact and applications of this new technology is too numerous to cover in this letter.

There are many more applications of nanotechnology, like nanofridges which kill any smell producing germs and nano and smart clothes, some of which is already on the market. Smart clothes depend of course on sensors, but sensors have many other applications in nanosecurity research. There are two extremes in nanotechnology. On the one hand, we have visionaries like Eric Drexel, the Director of the Foresight Institute in California who dreams of a nanomotor which is a very small engine driven by the Brownian motion in fluids such as water as well as changing sand into meat because both are made of atoms and molecules.[5]

On the other extreme we have nanotubes and new nanomaterials. These are science facts. The majority of research effort in nanotechnology will lie somewhere between these two extremes. Only research will show where fact and where fiction lies in the nanovision of the world [5]. The results of this research will change our world beyond recognition.

5.1 Monetary Considerations

How much will the launching of a nanotechnology initiative cost and where could one start? This is a practical and realistic question. I think for a country like say Egypt, one would need 300 million dollars over say five years. This is not much, not at all considering the enormous gains.

Developing countries should send Ph.D. students abroad to work on nano research. They should bring leading scientists from abroad to work for a few years training their staff. At the same time they should coordinate between the different groups already working on various aspects of nanotechnology, probably in total isolation. In all events the initiative must be independent of any of the well-known and loathed developing world bureaucratic systems or it will fail.

Although funding in say an oil-rich country is presently not a problem in general, funding should be provided up to 50% by the government. The rest of the money should come from enlightened rich personalities. In addition many institutions may want to have the honor of investing in the future of a world without poverty, without war and without terrorism. It is interesting to see that Israel is number 5 worldwide with regards to public funding per capita for nanotechnology just after Switzerland, way before the United Kingdom which is number 13. Israel is a magnificent model for what a serious nanotechnology program should be like in all of the Middle East.

It is also very important that such a new project has the support of the respective government and be put under the auspices of the Head of State. In the USA it is under the auspices of President Clinton and in Israel under Shimon Peres, two well-known and highly visible personalities.

5.2 Nanoinitiative for the Developing World

Following the examples of the USA and Israel, it is easy to see that the function of a nano initiative must be multi verse:

- It will supervise a first class cutting edge research institute working in various disciplines. For instance, a country with an all important oil industry is where much of the effort should go.
- It will supervise the private sector and coordinate between various institutions and universities working in nanotechnology.
- It will raise funding and keep international connections between the country in question and the outside world.
- Encourage public awareness of the importance of science in general and nanotechnology in particular.
- Work towards a regional nano initiative including all regional powers.

5.2 The Clinton initiative and wider aspects of the role of nanotechnology

When President Clinton introduced the nanotechnology initiative in his speech in the year 2000, he borrowed generously from Richard Feynman's famous 1958 lecture "There is plenty of room down there" by noting that one day we could store the library of Congress on a devise the size of a sugar cube.

One can see here that the demarcation line between science fiction and science fact is blurred. Indeed, I feel that if at all possible, someone with the necessary courage should meet the supreme political leadership in every developing country and inform them that he has bad news and good news for them. The bad news is that the rivals are right now working feverishly

I should approach nanotechnology from another viewpoint, namely that of industrial production. So far the majority of our industrial products could be labeled bulk industry or bulk production. To produce a wooden chair, we take a large trunk of a tree and cut it down to smaller sizes and fit these pieces together until we produce a chair. However, nature operates in a very different way. To produce the trunk of a tree, nature grows a tree. It starts with a very small seed. This seed has all the information needed to grow a tree. In nanotechnology, we are trying partially to imitate nature and to build things starting with atoms. So we have moved now from the traditional bulk industry which is wasteful and accompanied by a great deal of pollution to the atomic scale industry which we call nanotechnology [3-5].

In figures 12-17, we attempt to illustrate the concepts of nanotechnology via the physics of the quantum world as well as by analogy to the social behavior.

Now we can move to the next point, namely why nanotechnology is important? In fact we can make a leap and ask why nanotechnology is important for the developing world, particularly for very rich but paradoxically still developing countries.

Of course, I can answer this in the normal logical way, when the circumstances are normal and logical. However, many parts of the developing world are facing incredible situations. The most advanced, most powerful country on our planet, the United States of America has invested billions of dollars in nanotechnology. The Clinton-Nanotechnology Initiative goes back to the end of last century and was officially announced in 2000. Europe has in the meantime an enormously large nanotechnology program; billions of Euros worth and nanotechnology centers are mushrooming everywhere. Both India and of course the miraculous People's Republic of China are investing generously in nanotechnology. China has an excellent nanotechnology textile industry already. Not only that, but Israel is a key player on the international scene, which in many aspects is admirably leading the world in nanotechnology. Unfortunately that is where things nearly end. Poor and rich developing countries are lagging hopelessly behind.

However, this is still not the whole story. The crucial importance of the above comes from the very nature of nanotechnology. This technology requires a relatively small investment and the way from research results to marketing is relatively short. In addition, government expenditure at least in the United States is matched almost dollar by dollar by the private sector. Most companies in the U.S.A. have an R&D department working on nanotechnology. There are also a huge number of small companies in Israel, the U.S., Europe, China and India working on nanotechnology related products.

This alone shows us that the whole scientifically aware and technologically advanced world consider nanotechnology to be the future. Most thinkers and scientists working on nanotechnology predict that nano will change our world in the next 100 years more than all the changes that we have seen in the last half millennium. Countries as large as the United States and as small as Israel think nano is the future. Countries with the highest standard of living, such as Europe and countries with the weakest per capita income like India think that nano is the future and that investing in nano is indispensable. In such circumstances how could it be possible that other developing countries, like say my country, Egypt should be an exception?

The history of technology in general is a history of competition even between friendly neighbors. It is enormously important to see what your neighbors and competitors are doing. They are doing nanotechnology on a large scale. For one to say that we do not care what our neighbors are doing in nano or any other industrial field, is such an ignorant utterance which invites even the mildest of people to get impatient and even angry. No one could possibly be so absent minded or conceited or presumptuous to that that he or she lives in a vacuum, unless this vacuum is the head which produces such arrogance. It is for the writer a truly lamentable situation that many of the countries in the developing world have allowed themselves to slip away in many directions, but missing the nanotechnology age could be their most fatal mistake.

Nanotechnology is important because it is relatively cheap, relatively safe, and relatively clean and the financial rewards are relatively very high. It is a technology and science mélange oriented towards applications [4-6]. For instance, I work with all my brain and heart in high energy physics and quantum gravity. This is very prestigious research. It consumes huge amounts of money for experimentation. However, the financial economical benefits which comes out of CERN for instance or the Fermi Lab is so minute compared to the investment that it can be classified as almost useless for a country like Egypt and of secondary importance for a country as rich as Kuwait for the next 100 years. That does not mean we should not participate in such activity but compared to nanotechnology all this CERN stuff is of secondary importance. Only atomic energy is important for the economy of poor developing countries but atomic energy is not high energy physics. In fact, compared to CERN, this is relatively low energy physics, but atomic energy and reactor research is extremely important and will become much more so in the not too distant future when the price of oil surpasses the 90 US dollar mark. Nevertheless and paradoxically so, developing countries are ignoring peaceful atomic research and the development of modern and safe atomic reactors are extremely slow on nanotechnology. This is clearly irrational or ignorance. Alternatively, it may be a sheer lack of control of destiny and total surrender to erratic political circumstances, more or less like a candle in the wind to put it mildly and melodically.

Nanotechnology touches or will touch every aspect of our lives. For simplicity we divide the field into 3 major activities. Nanomaterial science, nanoelectronics and nanomedicine. Needless to say they all interact. In fact the writer is the editor of an international interdisciplinary journal devoted partially to nanotechnology. Nano is interdisciplinary by its very nature and by definition.

4. Nonlinear Dynamics, E-infinity and Nanotechnology

I came very early as a school boy under the spell of Einstein's General Theory of Relativity and then to make matters worse, just before starting my engineering university education, I discovered the work of Heisenberg and quantum mechanics. It was very hard for me to leave all these fascinating subjects and study bridge design, steel constructions and reinforced concrete tall buildings which I nevertheless did because I had to. I would have given anything to be able to work on the problems of modern physics instead.

Today I feel I am truly privileged to work in physics and grapple with things like quantum gravity and the nature of spacetime [7]. The practical value in the foreseeable future of my research in these areas is quite limited but I must admit I will do it whether it is of limited value or no practical value whatsoever. Nevertheless, we always hope to find something particularly useful for application but I admit that with the exception of calculating the mass spectrum and finding a good theory for low temperature super conductivity, my hopes were less than modest. The more my surprise was when to my indescribable delight I came across a recent paper by the remarkable Chinese scientist, Prof. Ji-Huan He and his team, submitted for publication in Chaos, Solitons & Fractals

with a vision involving science in general and nanotechnology in particular [2].

The writer was taken by the remarkable congruence between Ferguson's conclusions and his own vision of the future. Taken to the limit, this view of reality leads to an equation which could be stated in the following simple form:

Economic revival = Scientific excellence

It is tempting to call the above an identity rather than an equation. Part of the present work will be a meditation on the meaning, implications and ramifications of equating scientific excellence with economics.

Returning to Ferguson's article, of course security using nano innovative equipments could free us from present day indignities and unnerving procedures which we experience constantly in airports, to mention but a minor subject compared to being shot in error for running in an underground station in London which was traditionally one of the most relaxed and safe capitals in the world functioning perfectly without the need for any armed police. However, the real quantum jump which nano technology can bring about is with regard the living standards of the majority of the inhabitants of a planet ravaged by poverty, malnutrition, diseases and even occasional famines as seen in many parts of Africa in recent years.

Compared with classical bulk-based technology, nanotechnology is immensely smart. It is compatible with all kinds of economics and socio-political systems, large or small, industrial based or agricultural oriented. The initial investment required by nanotechnology is relatively low and the reward is relatively high as well as swift compared to traditional technologies.

A Brief History of Economy .2

Long before Rev. Thomas Malthus pessimistic principle of population, David Recardo's Iron wages and Adam Smith's invisible hand of self-interest, there was F. Quesnay and the Physiocrats whose teachings was that only agriculture produces a real surplus and thus gives a real net profit. [15]. We have come a long way since. The author's first real serious encounter was with "Das Kapital". However, by the end of the sixties it was clear that something was truly wrong in the land of communism. So we had to go back, not all the way to Zurich as Lenin would have done if he were to come back to life and see the Soviet non-military economics, but rather back to Keynes. At the end I as many of my generation rediscovered J. Kenneth Galbraith and the idea of mixed economy and American liberal thinkers which translated to English means radical leaders such as Kennedy [15, 16]. Yes correct, I mean J. F. Kennedy; Einstein's relativity theory is also applicable to the passing of ordinary time. The writer admits that to this day, he remained blissfully ignorant of Reaganomics and Thatcher's economics; but in all these revolutions and evolutions, where is the place of science and scientific research?

In figures 1-11, we are giving in the corresponding caption bibliography, a short history of economical thoughts.

In World War I, it was the automatic machine gun which changed almost everything known at that time. Nothing new in the west of Erich Maria Remarque came to an end by technology, not philosophy or economical theories. Similarly, the expropriation of the expropriated fundamental to Marx' thesis of the absolute contradiction inherent in the capitalistic system did not understand the role which science and engineering will play and the incredible demand for large numbers of highly trained engineers coupled to a phenomenal rise in the number of middle-class in the industrial societies.

In fact the effect which satellite television and the internet have had on the Middle East and particularly the Gulf states is more profound than anything which took place in these regions. Al Gezira television in Qatar is more feared in some quarters than certain armies. First, the transistor radio, then the mobile phone, changed the face of rural life in an old and traditional society like Egypt. Finally China and in a lesser measure India and lastly the Islamic Republic of Iran are clear examples showing that technology, rather than the traditional economy, will set the course not only for those countries but for the whole world. In the middle of all that nanotechnology seems to us to be by far the most important technology of the immediate future.

3. What is nanotechnology and why is it important?

The naïve and direct answer to the frequently posed question what exactly is Nanotechnology is to say that it is a technology concerning processes which are relevant to physics, chemistry and biology taking place at a length scale of one divided by 100 million of a meter [3]. Maybe a little bit more enlightening, although equally naïve, is to say that nanotechnology is the art of producing little devises and machines, somewhat at the molecular scale. [4, 5] However, the scientific definition which I admit may be slightly involved for a non-specialized person is to say that nanotechnology is a technology applied in the grey area between classical mechanics and quantum mechanics. Classical mechanics is the mechanics governing the motion of all objects we can see with our naked eye [3, 4]. This is a mechanics which obeys deterministic laws and which we can control to a very far extent. We know when an airplane or a care will arrive at its destination when we know when they started their journey and their speed. The same applies to a stone or a shell fired by a canon. When we know the forces acting on the shell or the stone then we know exactly where it will land. This is what we learned from Galileo and Newton. By contrast, quantum mechanics which is the mechanics controlling the motion of things like the electron, the proton, the neutron and the like is completely probabilistic. We know nothing about the motion of the electron except that there is a probability that the electron may be here or there. Even crazier than this, if we know the exact location of an electron, it is impossible to know its speed, and if we know the exact speed of the electron, it is impossible to know its exact location. Such a relationship is called the Heisenberg uncertainty principle.

The question which poses itself is when does a classical object like a stone change its nature to a quantum object like an electron? Somewhere between these two scales these changes happen, but this does not happen suddenly. There is a grey area between these two scales which neither classical nor quantum. Theoretical physicists call it the mesoscopic system [6]. This is what is called by non-physicists the nanoworld. A nanosystem is therefore something which is sufficiently small that we could not see with our naked eye and not even with an ordinary microscope [6]. However, it is sufficiently larger than an electron so that we control it in principle if we have a very fine tool to manipulate the system. It was a great achievement of a young German, Gerd Bennig to invent a microscope which is so refined that he could see atoms with his eyes for the first time in history. Bennig and Rohrer received the Nobel Prize for Physics for that invention [4].

Further development of this microscope made it possible to use it to move and transport atoms at our own will, thus forming new materials which do not exist naturally in our planet [3]. This may have been the starting point of what we call today Nanotechnology. But Nanotechnology existed also much earlier, although the word was not invented yet. For instance, all genetically manipulated agriculture products are forms of nanotechnology. The way of treating cancer with radiation and chemotherapy is a very primitive form of nanotechnology applied in medicine. We will come to all that later on, but maybe