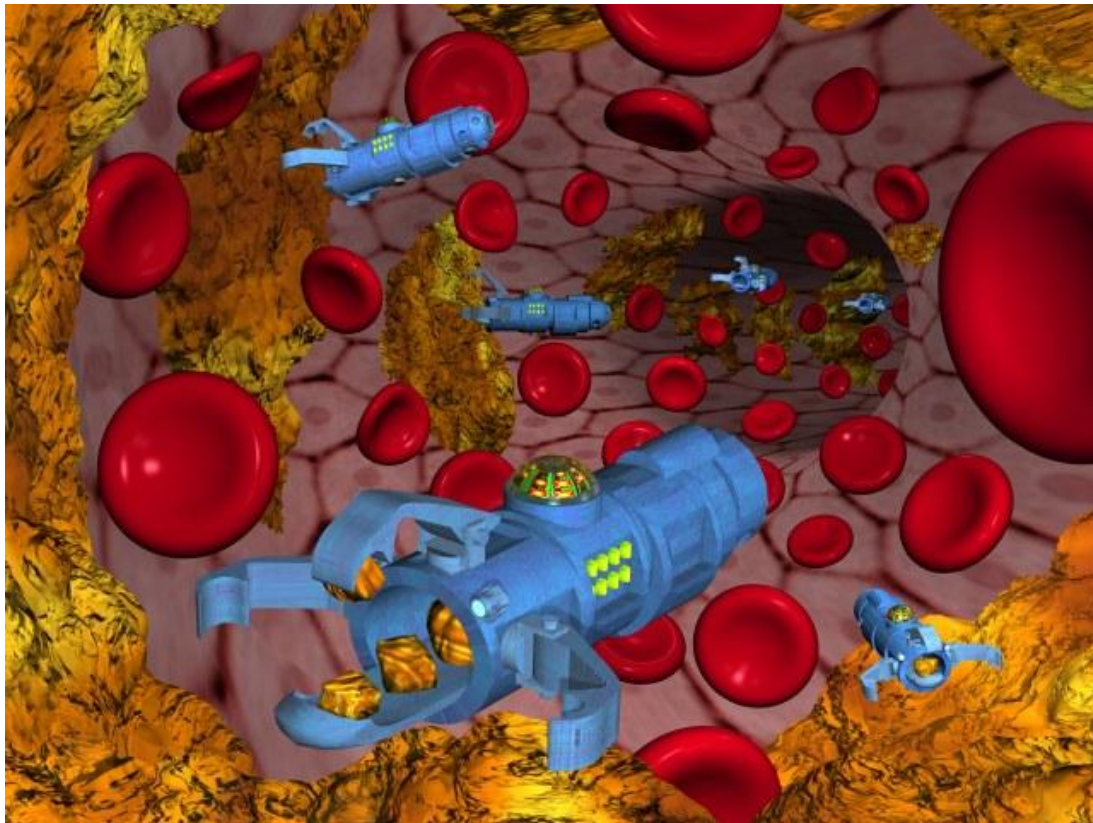


# THE ERA OF NANOMEDICINE

**Where Sci-Fi and Real Science Merge into a  
Transcending Future for Humanity.**

An exciting journey in the future of minimal  
therapeutics, prevention of diseases, enhancement of  
human abilities and longevity



*L.A. Louizos, MD, MSc*

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Home Page for the Era of Nanomedicine Book

<http://www.nanotechgalaxy.com/nanomedicine-book/>

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## *in Nanoscience & Nanotechnology*

*“When talking about atoms language can only be used as a poem. A poem intended not to confer meaning but provide visualizations”*

Niels Bohr

### CHAPTER 1

#### Introduction

#### **1.1 What is Nanotechnology?**

Nanotechnology is the science of the nanometer. “Nano” comes from the greek word “nawo” which means dwarf. But how small a nanometer is?

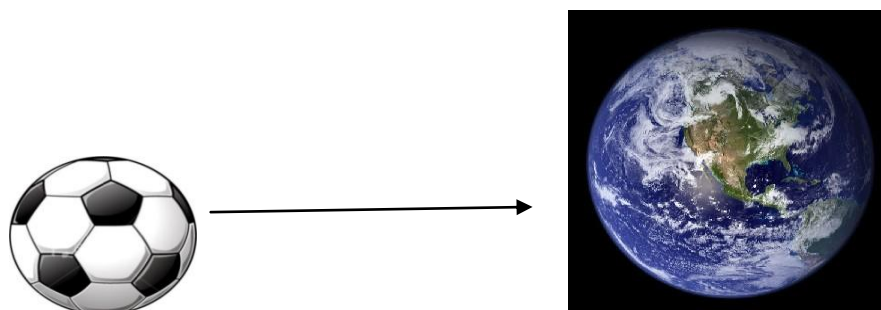
Our brain has not been built to understand notions such as the very big or the very small. Nevertheless, we may surpass this barrier with analogies.

##### **Analogy 1:**

Think of a human hair. Take a look at its diameter, which approximates the limit of human vision capability. Imagine that you cut this hair into 1000 pieces. Then, every piece of this hair would be a nanometer in diameter.

##### **Analogy 2:**

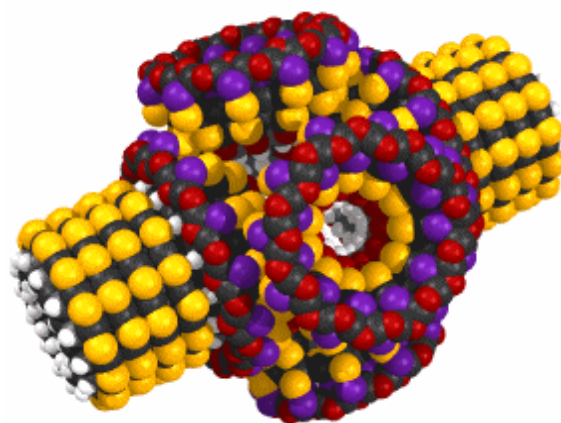
Think of a soccer ball. Compare this soccer ball to earth. This is the analogy in size between meter and nanometer.



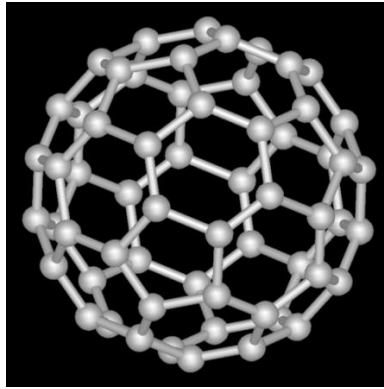
*Figure : What is the size of a ball in comparison with the size of the earth? This is the analogy between meter and nanometer.*

## 1.2 A HISTORICAL PERSPECTIVE

Feynman may be considered as the grandfather of nanotechnology, with his seminal talk in the American Science Academy in 1953 titled “*There is plenty of room at the bottom*”. In this talk Feynman realized the potential of the nanoscale in creation of new material with properties that can catapult our species’ evolution. Many great scientists envisioned the nanoworld reporting excellent work, such as Drexler who proposed the creation of molecular machinery (still not practically achieved), Kroto who discovered the exotic fullerene which is the 3rd form of carbon (along with graphite and diamond) and many others.



*Figure: Image of a proposed molecular machinery design by Eric Drexler, theoretically feasible in the nanoworld. Unfortunately we have not yet (2010) achieved such a molecular assembly capability. Consult [Drexler Engines of Creation: The Coming Era of Nanotechnology \(1986\)](#)*



*Figure: A fullerene molecule of Carbon (C<sub>60</sub>). A beautiful nanoscale structure, discovered by Kroto et al. [Click here for the full paper.](#)*

Nanotechnology is not a new science. It is a new name to a science that surfaced upon our ability as species to manipulate atoms. Chemists have been developing colloids (suspensions of many molecules stuck together) many years before nanotechnology term came into fashion. These colloids were nanoparticles. There are reports of ancient Greeks and Egyptians using methods to produce hair colors that involved the creation and use of nanoparticles. It seems that people used nanotechnology, through chemical routes, many years before the term existed.

Nevertheless, it was the visualization of nanoparticles with powerful microscopes along with the realization of novel properties of materials in the nanoscale, that brought about the term nanotechnology.

### **1.3 HOW WILL NANOTECHNOLOGY AFFECT US?**

Now that you have a grasp of how small a nanometer is, welcome to the world of “nano” which in fact is the world of atoms, a place so strange and intriguing that is promising to change the way we live in a fundamental way.

We are now making our first steps in the nanoworld, but we can discern the huge long-term potential: the technological possibility to control matter, atom by atom.

How we know that controlling matter to the atomic level is possible? The greatest example of all is biological material, such as a plant or a human tissue. Nowadays, we know that Nature is a 4-billion-year-old nanotechnologist. It has manipulated matter in the atomic level and created an army of nanomachines that continuously surprise scientists with what they can achieve.

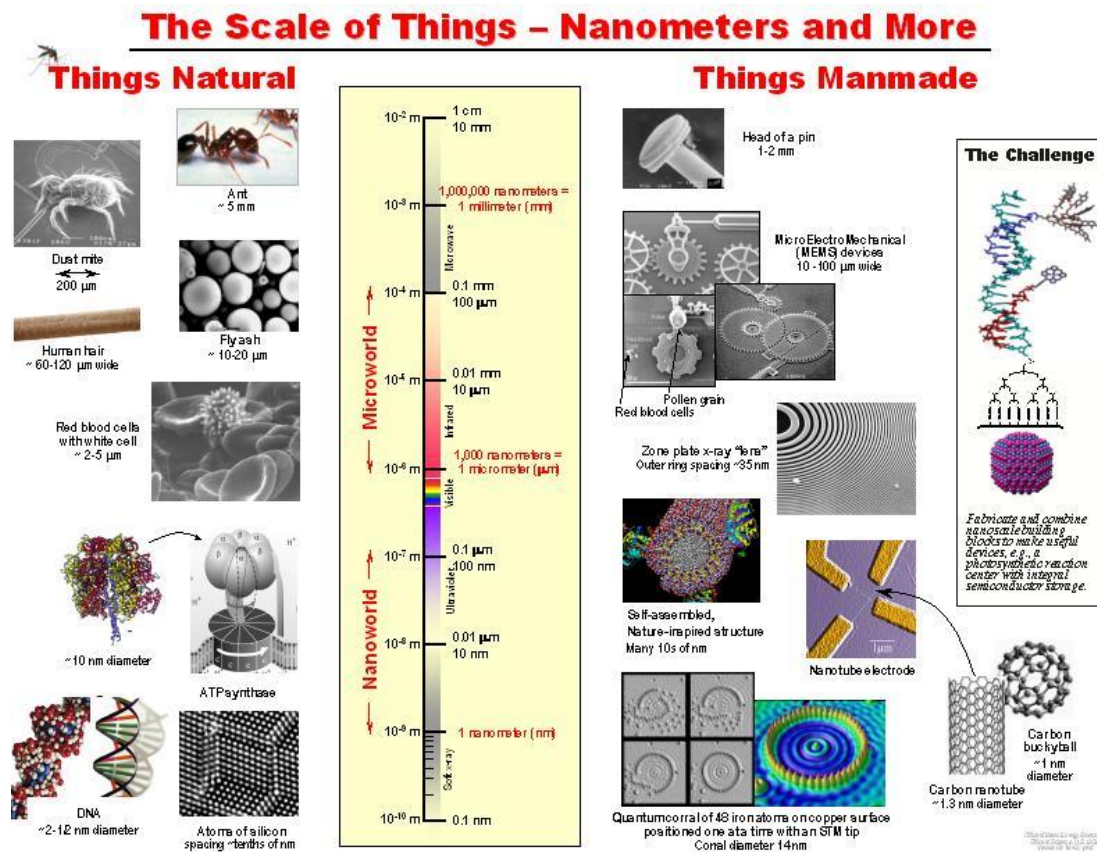
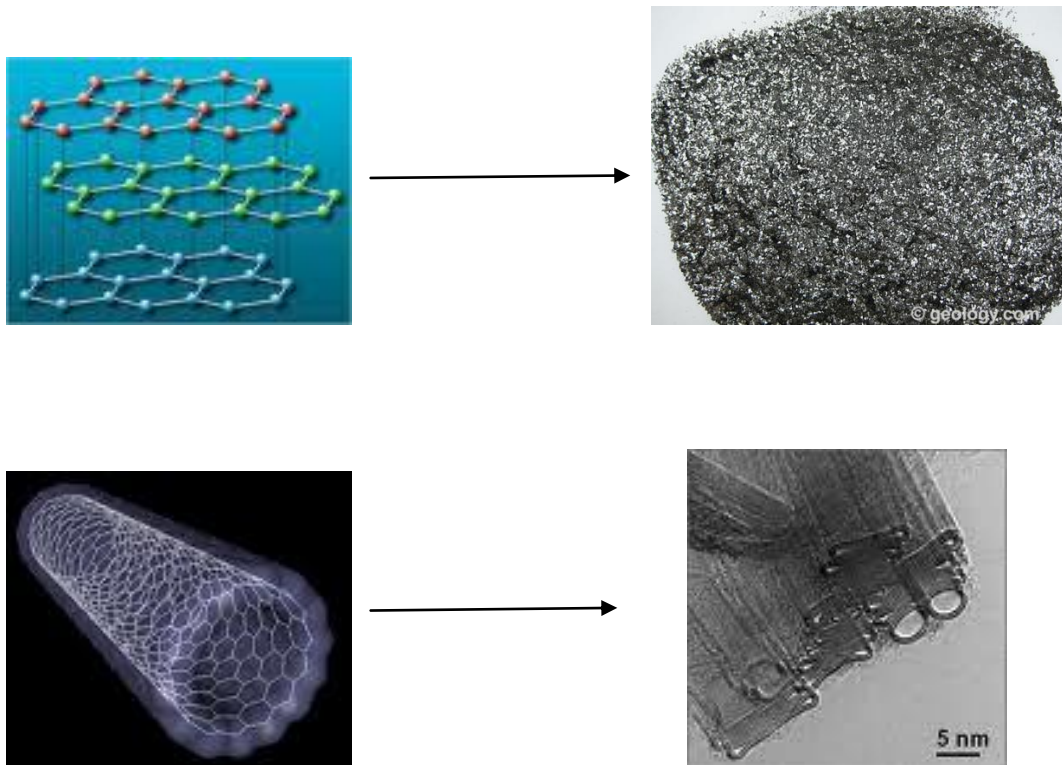


Figure . A sense of scale from macro to nano with natural (left side) and man made micro and nano objects (right side). You may also get a sense of scale by getting the Nanoscale Module which is fact is a game from <http://www.nanomission.org>

Materials in the nanoscale present unique properties that manifest in the macro world. Think about carbon, which in graphite form, such as this in your pencil, is brittle but if you manipulate its atoms to create a cylinder, named “carbon nanotube”, then you acquire the hardest material ever known. In a broader sense, it is the atom to atom assembly properties that gave rise to what we today define as life.



*Figure : The same amount of the same atoms lead to material with very different properties at the macroscale if assembled with different fashion in the nanoscale.*

## **1.4 THE REVOLUTION OF MOLECULES OR THE REVOLUTION OF LIFE**

We live in a universe with 100 billion visible galaxies. Every galaxy contains about 100 billion stars like our sun (is it a coincidence that our brain neurons are about 100 billion?). In the vicinity of such a sun there is a tiny planet, located in the Goldilock zone, neither too close and nor too far from the star, but in the appropriate to keep water liquid.

In this planet there is a “war” going on for billions of years. A war between molecules composed mainly of carbon and environmental influences, which are expressed as thermal energy, radiation and menaces from the vast universe like meteorites. In that point, we are really lucky to have Jupiter attracting meteorites away from earth due to its big gravity field.



Figure: See the small dot in the upper right corner of the figure? It is our Earth from a picture of Cassini from Saturn. Think of how small it is in the cosmos, but simultaneously how beautiful...

Primer molecules made of carbon like ethylene and lipid acids are colliding randomly for billions of years (like the balls of lotto) and many possible combinations and more complex molecules are created in this

primeval soup. Until some of these countless combinations of molecules produces molecular structures that are able to copy themselves acting as scaffolds to create a similar molecule. This is the theory of abiogenesis (in greek it means the creation of life from non-living matter). We do not know exactly how life has been created through random molecular creation but what we do know is that a process called “self-assembly” may have played a significant role in this genesis.

“Self-assembly” term describe processes in which a disordered system of pre-existing components forms an organized structure or pattern as a consequence of specific, local interactions among the components themselves, without external direction. Self-assembly is a powerful process in the nanoscale. Imagine small magnets distributed randomly on a table. Think of a magnetic field affecting them and how these magnets will react. They will be “self-assembled” into a structure aligned to the magnetic lines. In a more complex fashion this is how molecules self-assemble to create supramolecular structures.

The whole point of nanotechnology is the bottom-up building approach. That is how nature exploited the self-assembly process of the molecules which led from supramolecular structures with greater and greater complexity to cells, tissues and animals. The “war” is still going on. The environment presses and carbon supramolecular structures react with all possible combinations until the best fitted to the enviromental pressure survives and copies itself to next generation of molecules. This is the “molecular version” of Darwin’s evolution theory.

## **1.5 BIOLOGY AND THE FLOW OF INFORMATION**

What we also understand today about Nature is the flow of information. Carbon structures and interactions among them are hardcoded in the DNA. Think of DNA like a hard disk keeping all the information concerning creation of life. DNA demonstrates also a self-replicating ability. Living creatures are very complex. Millions of molecules are

orchestrated and react upon each other in order to produce the phenomenon of life.

However, it seems that life has been built abiding by simple, specific and elegant laws.

DNA has the complete information about all these chemical interactions compressed in 4 letters: A, C, G, T. It is like having a software in your PC that has been super compressed.

Imagine this: All our structural information, the beautiful parallel computational abilities of our brain, the most efficient pump in nature (our heart), the most complex chemical laboratory in the world (our liver) etc, are produced from the information of a single cell: zygote (meaning joined in ancient greek). This is how elegantly Nature has compressed all the information about the complexity of life in about 3 billion DNA base pairs (3 billion letters are equivalent to a software sizing about 375 Megabytes, and surely you have PC games larger than this).

Thus the scope of Nanomedicine is to decode how those simple computational rules constitute the phenomenon of life and reproduce them to cure diseases and enhance human abilities.

## **1.6 NANOMEDICINE: A NEW ERA IN MEDICINE**

The fact is that we have made such progress, that we are now able to reverse engineer many of these complex chemical reactions in our body and understand its inner procedures, bit by bit, molecule by molecule.

Nanomedicine today focuses on gathering all the information regarding our living material and reverse engineer the molecular processes of life, intervening with them to provide cures and finally enhance our body to be more efficient against the environment.

Nanotechnology will, at first, allow us to treat successfully many of the contemporary illnesses that seem incurable..

The next step will be to hack our own code and hijack our own evolution as species.

These two effects of nanomedicine, therapy (which, in fact, will become prevention) and enhancement is the theme of this book.

The chapters are organized in a systemic fashion starting with the brain, moving to the heart and circulating system and then referring to diseases such as cancer and viruses. We will also look into longevity due to nanomedicine and then address the dangers and ethics of nanomedicine. Finally, a possible roadmap and some predictions will be made. I will try to explain the effect of nanomedicine on these systems according to latest literature and years of my personal research, and then address a parallel futuristic possibility for enhancement of human abilities and longevity as a result of Nanomedicine evolution.

My effort is to explain these difficult scientific facts in the easiest possible way, in order to make this book an understandable futuristic journey and not just another scientific handbook of nanomedicine.

In case you have any questions or comments, I would be grateful if you emailed me at [alouisos@gmail.com](mailto:alouisos@gmail.com), or visit my site and comment on the book page at <http://www.nanotechgalaxy.com/nanomedicine-book>

In <http://www.nanotechgalaxy.com/> you will also find the latest nanotechnology and nanomedicine news.

Thank you in advance.

Sincerely yours,

L.A. Louizos, MD, MSc.