

Designing the new engineer and scientist

J. De Wachter^{*}, J. Wauters^{**}

^{*} IMEC, Leuven, Belgium, jo.dewachter@imec.be

^{**} Flanders Nano Bio Alliance, Larchmont, NY, USA, jan.wauters@flandersnanobio.org

ABSTRACT

Nano-bio science and technology is reaching a high level of technical expertise and knowledge. It opens up completely new ways of design, production and manufacturing. The deep understanding of materials and living matter evolves into the design and creation of totally new products and industries. Nano-bio know-how requires expertise in biology, chemistry, physics, engineering, medicine, agriculture ... in other words an interdisciplinary expertise. In the USA and Europe the first interdisciplinary labs pop-up. But not only do we need more interaction between people with various backgrounds in the labs, we also need more interaction between labs and industries, the creative art scenes, the humanities, the society... There is lots of expertise showing great potential, but we have got to share our knowledge over the borders of our expertise fields. And then try to integrate all these different ideas into what we are doing.

Keywords: nanotechnology, biotechnology, nanobiotechnology, scientist, engineer, outreach

1 INTRODUCTION

A research & development lab involved in nano-bio research does not only need to set up interdisciplinary lab teams of chemists, biologists, engineers, physicists,... It must also actively involve people from the social sciences and other interested communities from outside the 'academic world'. Because the science and research is not only on materials but also on living matter. In the current nano-bio lab, we are not only talking about a new memory cell for an i-pod, but also about human cells connected with electronics. And there is more. At the nanoscale there is no difference between the building blocks of living or dead matter. It's the same thing we are dealing with: atoms and molecules.

So we have the opportunity with all this nano-bio knowledge to build great new things, but we can also mess it up terribly, because it's about the building blocks of everything around us, like DNA and even smaller molecules, ... So from the start of this kind of research we must involve people with various intellectual views. Not only tech experts, also interested people with totally different backgrounds.

2 INTERDISCIPLINARY RESEARCH

That is new to IMEC, the nanoelectronics and nanotechnology center of Leuven, Belgium. Now, most of the people at IMEC are experts working in pilot lines and electronics labs. And that is very much OK, because IMEC has been able to transfer lots of knowledge to the market and will continue to do so for many years to come. But for the nano-bio research we need a broader approach. That's why IMEC launched the Ad!dictLab-IMEC nano research projects [1]. How do Ad!dictLab members, i.e. artists, designers, architects, ... think about nano and how do they imagine future opportunities? What is important to them, even if they don't know a lot of the scientific expertise behind nano-bio? Or maybe they do? Then, we want to confront these inspirations, these ideas, with IMEC researchers and with the rest of the world. A real confrontation. Discussions, dialogs, confrontations between engineers, scientists, artists, designers, interested public,... about nano.

We have got to understand that with all this nano-bio expertise piling up, we really have the chance to do it right, right a way. But that is not easy, it is not like following the ongoing consumer markets. The drivers of the nano-bio research & development shouldn't be consumerism and militarism. And this interdisciplinary approach is also absolutely not about lowering standards and norms, on the contrary. We can and we want to build great new things. But we will have to do it in an interdisciplinary way. Why is that important? Because we have the chance now to invent things that can completely change the way we manufacture products. As was stated recently in a New York Times article about Olin College [2]: "Engineering has traditionally been focused on doing it right, but not on what's the right thing to do. That means designing products that are environmentally friendly and that respond to the needs of the people using them and not just what the purchasing department wants." That's the spirit, that's the vision we need.

3 TRUE EXPLORERS

So on the one hand, we want to do research on things that are going to be of a lot of value to the society, i.e. applied science. But also here we have got to do it in a long term vision. This means we cannot rush into the production of nano-bio consumer goods that are not designed properly.

On the other hand: there always must remain focus on deep level science, basic science.

So it is not all about useful knowledge or useful science or science=technology. We also want to make a point here that investing in science-for-the-sake-of science is also a must do. We know some great scientists and they are active in what they call basic science. We don't see products coming out of their research the coming decades. But the overall knowledge gained is so fantastic (about nature, the universe), it's priceless, that it is worth to invest in that. These great scientists are also the ones that do care about other views and visions in other fields than their own. And they go into discussions, not to impose their world view but to learn from others. They are using those dialogs to confront themselves and their own ideas. They question themselves constantly. And then magic happens. Great new knowledge originates. What these scientists are doing is an association exercise with other worlds and the result is great. They are not just deducting in a linear way. They are what we call the true, genuine explorers. Ask a true explorer to explain what she/he is doing to a kid, and he/she will manage. Because true explorers have that greater world view, that universal picture in their head, these association patterns with other elements and other ideas. And it is true that when we look at great scientists and their work, the difference between basic science, applied science and technology disappears. Because we can all appreciate the enormous value they create. We would like to make a reference here to what L.M. Branscomb and G. Holton describe as Jeffersonian science [3,4]. That's indeed the new science mode that has to be supported.

4 DEEP-LEVEL COAL MINING

So, interdisciplinary research is not at all about lowering science standards and norms. On the contrary, it will bring back more intellectuals to the labs. It's like deep level-coal mining. The deepest shafts are interconnected with other shafts. Because of the fact that they are interconnected they can dig deeper, because fresh air comes in through other shafts and new knowledge can find its way up more easily. Also, they don't have to surface all the time in order to share their views. The shafts that are not interconnected stop at a low depth.

So why is all this important? Because when we start to produce things, to make and sell products, we must realize that mankind is here to stay on this earth for a very, very long time. So we better do it right, right a way.

Also we have to remember that in the course of history of life on earth, extinction is the rule and survival is the exception [5].

And now, finally, with all this nano-bio knowledge and expertise piling up, we really have the chance to do it right. Let's do it. Let's sit down together, build deep knowledge and make great things.

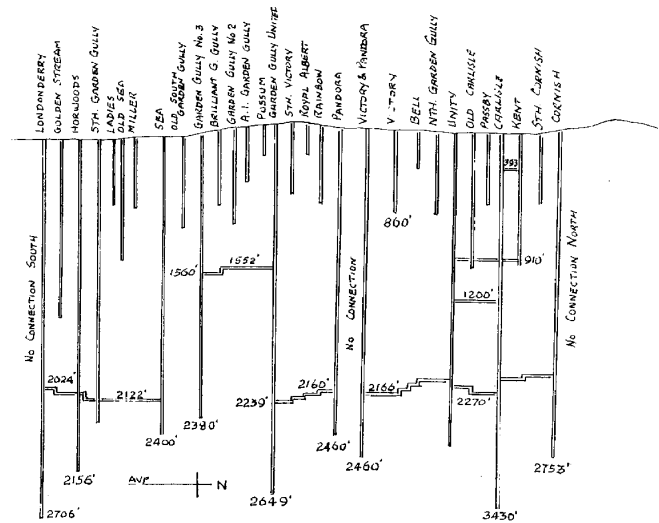


Fig. 1 : example of mine: deep shafts and horizontal connections illustrate interdisciplinary research (source: The Carlisle Gold Mine, History and family tree of John Jewell, www.jewel.asn.au).

5 CONCLUSION

Successful Nano-bio Outreach builds on 3 foundations:

5.1 Bring science and technology inspiration and passion in education through kids, teachers and parents

Regarding IMEC, IMEC EXPO's classroom [6] and demonstrations currently serve as a location base for this. The IMEC EXPO project is a joint initiative of IMEC and RVO-Society [7]. RVO-Society wants to stimulate youngsters for technology and science by means of original educational kits and social projects.

IMEC EXPO has to be rebuilt to carry a more universal viewpoint : saving man and earth through knowledge, i.e. nano-bioscience. To establish this, we have to bring in new fresh ideas from outside imec. A first step is the AddictLab project.

A new project, "Youngsters' lab 16-18y" integrated in a new science gallery building, must be set up to complete this inspiring bring-science-to-(kids, teachers, parents)-life experience.

The underlying vision of this educational outreach effort is the belief in science and knowledge gaining as the key to human survival on earth and in the universe. Especially with the current growing beliefs among people in creationism and religious fundamentalism, it must be set clear that the only way forward is to continue to gain more knowledge and understanding. The quest for 'veritas' must continue. We have to advance science and technology. But we have to realize that if we produce something it has to

benefit the world and the universe in a big way, not only economically. Three pitfalls have to be avoided: Violence (aggressive power over people, non-democratic hierarchy, religious fundamentalism), Money (take the money and run attitude) and Ego (being vain, striving to become famous) Success is important, but not by means of power, money and ego. Success as a measure for bringing real value to humans and the world [8].

5.2 Interdisciplinary nano-bio research needs wide-angle interested researchers

This means bringing back the genuine, true explorer/scientist spirit and inspiration to current research institutes and universities (Jeffersonian science).

Ideas and visions by other community groups like art and design can be used as a trigger to start up discussions with nanotech researchers about their work. It also serves the need to look at nano science and technology from another angle or from a more universal viewpoint. The first goal of true research must not be to make money, or to become famous, but to gain knowledge, to go for truth, to build value and to strive for preservation of the human species on a healthy earth. And nanoscience and technology holds this potential. Nanoscience can give us the knowledge to create 100% eco-efficient industries.

If this switch in mindset succeeds among researchers, then existing research labs can restart into new groundbreaking research projects with revived human spirits.

5.3 Build strong business community relations, diverse networking

Building strong and intimate relations with industries that are reaching out to nano-bio science but have no clear current connection with it. These industries are e.g. the chemical, the biomedical, and the pharmaceutical industries. All of them are looking for new ideas and new markets, expecting a lot from nano-bio R&D. A new eco-efficient industry is the ultimate goal of nano-bio production and manufacturing. It will enlighten the current industrial production from the burdens of waste, energy spills, EH&S (environment, health and safety risks), overconsumption,...

REFERENCES

- [1] www.addictlab.com
- [2] J. Schwartz, "Re-engineering Engineering", , The New York Times Magazine, September 30, pp. 94-97, 2007
- [3] www.branscomb.org
- [4] G. Holton, "What kinds of science are worth supporting? A new look, and a new mode" in The Great Ideas Today (Chicago, Ill.: Encyclopedia Britannica), 106-136, 1998.

- [5] C. Sagan, A. Druyan, "The varieties of Scientific Experience", Penguin Press, 2006
- [6] www.imecexpo.be
- [7] www.rvo-society.be
- [8] R. St John, "8 to be great: the 8 traits that lead to great success", Train of Thought Arts Inc, 2005