



TINY TAKES OVER! – NANO-FUTURE REVISITED

STEPHEN A. STEINER III, BRIAN L. WARDLE (text) GUNNAR LINN (illustration)

In our last Transfer issue, you could read about carbon nanotubes and related Saab activities. Now, we will take things a bit further into the future. Nanoo, nanoo, here we come.

Imagine yourself traversing the barren landscape of a sweltering alien world – a land thirty times hotter than the hottest summer day you have ever felt; a land drowning in a hazy atmosphere of hydrogen and helium gas. Looking about, you notice what appear to be countless soccer-ball-sized meteorites dotting the landscape in every direction. Carefully traipsing across the landscape, you begin to feel a gentle breeze blow upon your face when suddenly **POW!** **POW!** All around you black pillars explosively burst forth from the meteorites like giant beanstalks, rocketing into the sky at nearly 200 kilometres per hour. After several minutes the unbearably loud explosions slow to a halt leaving you imprisoned in a forest so tall its canopy touches the edge of space.



The scenario above is the world one would experience if we were able to scale carbon nanotube growth to human proportions. Carbon nanotubes (CNTs) are heralded as one of the most promising materials ever discovered – cylindrical, hollow, perfect strands of crystalline carbon only 10 to 100's of atoms in diameter, and several centimetres in length (and soon hopefully longer). Unknown until the early 1990s, CNTs boast numerous "best" properties (such as the highest tensile strength of any known material) while still being flexible like a fibre, and ballistic (high-efficiency) electron conduction.

Researchers around the world are developing new science and technology to har-

ness the amazing nanoscale properties of CNTs and other nanostructures for hosts of applications at both microscopic and macroscopic length scales. At times, it seems difficult to find a single area that nanotechnologies could not potentially significantly improve. Nanostructures such as CNTs seem to possess "magical" properties – even the growth of CNTs dramatized above suggests magic. Although a nanotube the diameter of a drinking straw would be almost 25 km long, researchers working with CNTs today would certainly like to cast a spell, like the students at Hogwart's School of Witchcraft and Wizardry, to grow infinitely long CNTs – carbo infinisynth!

So how might these remark-

able materials impact on our lives in the short term? Within the next few years, a new generation of the nano-engineered composites that we and others are developing (see Transfer #3, 2007) will make their ways into a number of applications. As with carbon fibres, it is likely that the first application will be for components in aerospace vehicles. Shortly thereafter, we could see the same materials in energy-efficient subway cars 10 times lighter than the steel cars of today and even ultraefficient (and safer!) automobiles approaching fuel efficiency of 40 km/l (90 mpg). Over the next decade we may also see the evolution of these composites, boasting electrical and thermal conductivities higher than copper per unit weight, replace the kilometres

of wiring required to power aircraft and rockets. The consequence of this? Affordable air travel and cheaper access to space – great for those aspiring space tourists among us!

AND WHAT ABOUT the long-term? Undoubtedly, real advances in scientific and engineering capabilities. Speculatively, this could mean a twenty-first century with affordable point-to-point suborbital travel around the globe, airline travel as cheap as taking a bus, and reduction of automotive and airplane CO2 emissions by 300%. How about water-friendly bullet-proof vests three times more likely to save a life at half the weight? Or perhaps the development of materials so strong that the steel cables of the Golden Gate

LETTERS

This is Transfer's brand-new letters column. Feel free to pour your heart out here. I will do my best to answer your questions, and to comment on your opinions.

Gunnar Linn, editor



Women and men

When I received Transfer #3, 2007, I was very glad to see that the special feature was "Saab and universities" It is a very interesting and important topic. But when I thumbed my way through the magazine, I got a feeling that things were not quite right. I checked again, and found out that when it comes to gender equality, this issue was a disaster. Where are the women? And how are they displayed? Some statistics:

- Men pictured, identified: 26
- Men pictured, unidentified: 17
- Men mentioned, unpictured: 0
- Women pictured, identified: 3
- Women pictured: unidentified: 2
- Women mentioned, unpictured: 1

The most appalling thing is the way that the women are illustrated. One of them reveals only a naked leg, dressing or undressing. The man behind the female leg is dressed, but without socks and shoes. Another woman is a virtual computer game avatar, with protrusive breasts under a see-through blouse.

I understand the presence of a majority of men in Transfer – Saab is dominated numerically by men. But earlier issues have displayed a much better balance of men and women. For the sake of the company, we have to provide a good example for women. Transfer is a key component in that work. And the last issue really went out of line.

Gunnar, seize the editor's responsibility and do something about this. If we wish to attract female academics, please hide the last issue of Transfer.

Karin Wistedt
Publication Engineer
Saab Aerotech

Our response #1:

I am the first to agree with you – we have to get more women into Transfer. But: the question

is extensive. Let me use the illustrated women as examples. The woman's leg is a re-drawing of the very well known poster for the movie *The Graduate*, from the Sixties. Maybe I was wrong to choose it as an illustration, but it does constitute a part of our surrounding world, whether we want it to or not. And the point was not the leg; it was the movie subject of plastics. Publish or not? The avatar from *Second Life*? It is out there in cyberspace, a part of our environment. Publish or not? Where do we draw the line? Any way around, I will do my best to ensure that women and men are treated equally in Transfer. I will start by handing the pen over to Björn Stafstedt at Corporate Communications.

Gunnar Linn
Editor

Our response #2:

I really wish this subject were discussed in other contexts at Saab as well. As Gunnar says, there are acceptable reasons for the movie poster and the avatar. But this question is larger than that. To become a very good magazine, Transfer needs more female authors, more female gurus, and more women visible in images and words. Transfer's task is to find you and let you take your places. We are constantly working on this, but we need help. We must constantly discuss this matter, we must always select a woman before a man if possible, and we must always encourage women to be active. Unfortunately, there is a downside to this; women must not only be good at their work, they must also be "visible". I have met women who decline to be part of our magazine for this reason – "I do not want to be the one filling your quota". One way to identify the women within Saab is to ask our TTGs to visualise them in the respective technology area. Let us all help the best we can.

Björn Stafstedt
Corporate Communications
and Public Affairs



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Internationality?

Thanks for another interesting magazine. However, there is very poor knowledge of the TTG groups here in South Africa. ILS is the exception as always, with Jenny Eld having South African people at her recent workshop – although they did not know it was connected to TTG. I have recently managed to get the South African Microwave people on the circulation list of TTG Microwave announcements, unfortunately too late for this year's seminar. Our test, software, digital, system engineering, design office, optics and IT groups were all unaware of TTG and its activities. I intend to promote the TTG activities here, and I would appreciate it if someone in Sweden could also take action to see that the heads of these groups in South Africa are on the circulation lists.

Dave Howie
Engineering Manager
SAAB Avitronics, South Africa

Our response:

I am responsible for the corporate contacts with the TTG-groups. I would be glad to send contact information for your "heads of groups" to the correct TTG leaders, so that information can be transferred. You can also find more information on the TTG groups on saabnet.saabgroup.com/SaabCorporate/Operations/Groupoperations/Technology/ttg/ttg_en.htm If you have any more questions please contact me.

Annika Forslund
Director of Technology Strategy
Saab AB

Bridge are one day replaced with nano-engineered composites the diameter of knitting yarn? And then of course there are the possibilities for fantastic, exotic new movements in architecture. Maybe even an orbiting space hotel featuring rotating habitation modules with adjustable artificial gravity.

And even though these engineering applications are tantalizing and exciting in their own right, perhaps the most significant consequence of nano-engineering will be the scientific lessons learned from discovering how to control materials at that nanoscale. Over the next century, this understanding could translate into a global revolution in manufacturing, where machines such as automobiles are no longer formed in parts and assembled, but rather "grown", molecule by molecule.

TWENTY YEARS AGO, the possibilities of the above being real seemed like complete science fiction. Our hope is these ideas are now not a matter of "what if", but simply a matter of "when".



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More on the subject? Please see the shortcut about Taiwanese nano on page 07.