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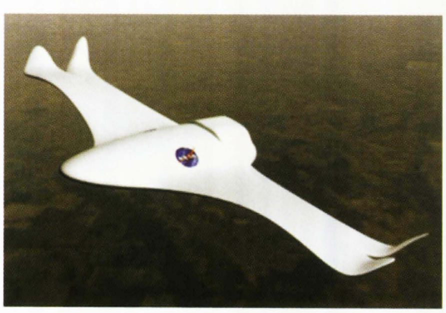

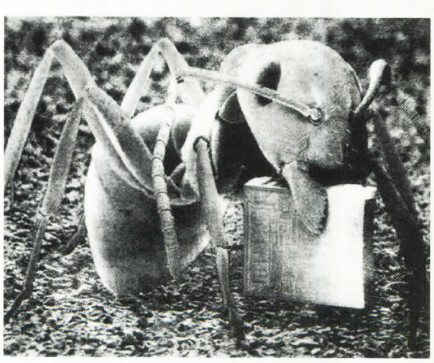

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Engineers' Forum is Virginia Tech's student-run engineering magazine. Engineers' Forum is published four times during the academic year. The editorial and business office is located at:

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From The Editor

Welcome to the February 2006 issue of the Engineers' Forum. Recently, I browsed through some of the older issues. By old, I mean issues published since the 1930s. Back then, one page of jokes was included per issue. Many of them are offensive by today's American standards; however, most remain timelessly funny. Be sure to read some of them reprinted in this issue's 'email bag'.

Also included in this issue is a brief overview of the history of aviation, leading up to comparisons between the Boeing 787 Dreamliner and the Airbus 380. The future of aviation, likely beginning with military aircraft, will include jets with morphing wing capabilities, discussed in an article about materials aspects for this class of aircraft. Many of the engineering freshmen may find interest in an article concerning sustainable design as it pertains to this year's Engineering Fundamentals class project. Furthermore, global warming is the topic of this issue's photospread, where you can get a glimpse of our talented layout editor. Lastly, I rant about the addictive use of the prefix 'nano'. Enjoy.

Respectfully,

Editor-in-Chief
Engineers' Forum Magazine

A brief look into the history of commercial aviation

-Divakar Mehta

Humankind has always dreamt of flying. Many of us, as kids, wanted to fly away into the open sky to get as far away from our problems as possible. Personally, the blue sky has always been an enigmatic presence in my life. Since the early days, many people have tried wacky ways to get themselves airborne, without much real success until the 20th century. Socrates had made a remarkable statement about aviation during his golden years, as he said, “Man must rise above the Earth—to the top of the atmosphere and beyond—for only thus will he fully understand the world in which he lives.” It is remarkably eerie how much knowledge and wisdom scholars held, the bold visions that they had, all centuries before man was ever able to conquer the skies.

The Early Years

During the 16th century, Leonardo Da Vinci, in one of his many speculations, came up with a rough sketch of a man made bird with remarkable similarities to the modern helicopter. As one can imagine, it was not a single man or country that led to the development of aviation. People from all over the world and all walks of life contributed to this revolution in travel and war. In the 1800s, many inventors attempted various methods to travel the skies. The American astronomer Samuel Pierpont Langley was the most successful as he was able fly his steam powered monoplane as high as 4000 ft.

Like all dangerous research, aviation saw the death of some of its early entrepreneurs with people like Vincent DeGroof from Belgium crashing to his death while trying to conquer the skies.

On a cold December day, after making some minor repairs, the Wright brothers were able to fly a heavier-than-air craft for about 12 seconds for a distance of 120 feet. That day, December 17, 1903, marked the beginning of a new era in aviation - an era that changed the way the world interacted and traveled. Wilbur Wright was quoted saying, “More than anything else the sensation is one of perfect peace mingled with an excitement that strains every nerve to the utmost, if you can conceive of such a combination.” This was his description of flying which would soon become a hobby, a career or a mode of transportation for millions of people around the world.

As one can expect, the militaries of the world were the first to make widespread use of this new technology. During the First World War, both sides had some form of flying machines that played the role of warplanes. The year 1911 demonstrated a few firsts for the aviation industry, including the first time that aircraft were used to carry mail. The United States Post Office Department, on September 23, 1911, through pilot Earle Ovington was able to send mail a distance of 5 miles in an airplane. The pilot carried a mailbag on his knees and after reaching his destination, dropped the bag from the sky for the local post office to pick up and distribute. This service only lasted for about a week. Next, Calbraith P. Rodgers made the first transcontinental flight, when he flew from New York to Long Beach, California in a Wright machine. It took him a total of 84 days to get to California; however, his actual flight time was only 3 days, 10 hours and 14 minutes.

Airborne At Last!

The two World Wars had a significant impact on the development of commercial aviation as all the participating nations searched for novel ways to transport their troops. The first commercial flights began as early as January 1914 between Saint Petersburg, Russia and Tampa, Florida. The next few years saw substantial improvements in the design and instrumentation of planes until 1933 when Boeing launched the first truly modern airliner, Model 247. This craft featured an all-metal body with a retractable landing gear and an insulated cabin with space for 10 passengers. United Air Lines saw a lot of potential in this development and ordered 60 Model 247s from the Boeing Company. As Boeing was busy trying to fulfill the order for United, Trans World Airlines (TWA) decided to approach Donald Douglas to build them an alternative to the Boeing Model 247. Douglas designed the DC-1, DC-2, and DC-3, out of which the DC-3 became the most successful propeller aircraft in the history of aviation up to that time. With a seating capacity of 21, this 1000 horsepower bird could take its passengers across the country in less than 24 hours, but of course with plenty of refueling stops along the way.

Determined not to fall behind, Boeing later released the Model 307 Stratoliner, which featured a pressurized cabin allowing airlines to fly their customers at heights as high as 20,000 feet, above the atmospheric turbulence of low-level clouds. As World War II progressed, new technologies such as jet engine propulsion were introduced by the aviation industry. Britain's DeHavilland Comet was the first commercial airplane to feature jet engines capable of carrying a plane up to 550 mph. However, two fatal crashes led to the grounding of the fleet, giving Boeing and Douglas time to launch their versions of the jet engine aircraft. Boeing released the 707 and Douglas the DC-8. Within just a few hours of release, the world of travel was

Left: Airbus A380, Right: Boeing Dreamliner

revolutionized as civilians traveled from New York to London in less than 8 hours. Propeller technology was clearly no match for the new jet engine technology and both major manufacturers entered the age of jumbo jets. Boeing released its 747, Douglas came out with the DC-10 and Lockheed Martin engineered the L-1011 Tristar. Boeing and Douglas saw some success with their jet engine airplanes, however, Lockheed Martin was not very successful and eventually bowed out of commercial aviation.

Where Now?

As with any other technology, the aviation industry is far from fully developed. In the 1970s Douglas and Boeing saw another competitor from across the ocean known as Airbus. In 1997 however, Boeing successfully acquired long time business rival McDonnell Douglas, thus leaving only two major players in the field of commercial aviation. Interestingly, both Airbus and Boeing have decided to go different routes with the development of new technology. While Airbus feels that getting more people on a plane is what the airlines are looking for, Boeing feels that smaller yet speedier planes are more attractive to the contemporary market. Airbus is currently working on the A380, which will seat 555 people in a double-decker environment running the length of the aircraft. Meanwhile, Boeing recently released the smaller, yet faster 787 Dreamliner which seats somewhere between 200 and 300 people. The two new designs have led to a bitter rivalry between the two firms as they both accuse each other of illegal governmental aid.

To date, Boeing has a total 241 orders from various airlines around the world while Airbus has 132 orders. Both firms obviously claim that their way is the best, however, only time will separate the contender. Alan Mulally, president and CEO of Boeing Commercial Airplanes was recently quoted as saying, "The 787 is a game-changer for airline profitability and for passenger comfort." Similarly, a recent Airbus press release boasts, "The A380 is a significant evolutionary step in the history of commercial aviation that promises to ease congestion at major airports by transporting more people more efficiently than ever on the world's major air routes." Like a parent is always proud of what their children accomplish, Airbus and Boeing are like two competitive mothers trying their best to make sure that the world looks upon their child as the star while viewing the other as merely average. Both companies have invested a lot of money into their new programs and the next few years will be interesting no matter who wins this war of commercial aviation, because it will certainly shape the future of world-wide commercial aviation.

A New Look At Engineering for the 21st Century: Sustainable Design and Green Engineering Creates a New Direction for Engineers Around the World

-Kari Adkins

Engineering is a constantly evolving field, providing endless opportunities for students, faculty, and professionals to learn new concepts and additions to the traditional engineering curriculum. One of the newest additions to the curriculum at Virginia Tech, especially in the freshman Engineering Education Department, is a study of sustainable design.

Sustainable design, according to the World Commission on Environment and Development, is "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainability is by no means a new concept, but it has gained increasing attention as people from around the world realize that natural resources are limited, and use of them with no regard for the future will result in consequences for our present actions. Many speculations of the future global climate have been made, most of which paint a grim picture for the planet and its inhabitants. Here's another way to look at it – it would take the resources of four Earths for the world's population to live as the average American does.

To better educate Tech engineers, the freshman engineering classes participated in the Sustainable Design project, as required by their professors in ENGE 1024. The goal of the project was to help a community in a third world country by designing a device or piece of machinery that could be built from the resources that the villagers already had available to them. Each team of four or five students was given a plastic Ziploc™ bag with bamboo sticks, two bandanas, modeling clay, one aluminum can, a one liter bottle, and rope of two different sizes and lengths, all of which is supposed to represent the supplies and resources villagers have readily available to them. Using these materials, the teams then focused on one of four areas as a framework for the device that they created: education, energy, nutrition, and agriculture.

In November 2005, the project deadline ended for the approximately 1000 Tech engineering students. Class members voted on one design team from their respective workshop class, of which there were over thirty individual sections, and the selected teams then competed in a Sustainable Design Fair. This fair also served as a chance for students to see what other teams accomplished, further broadening concepts of sustainability for students.

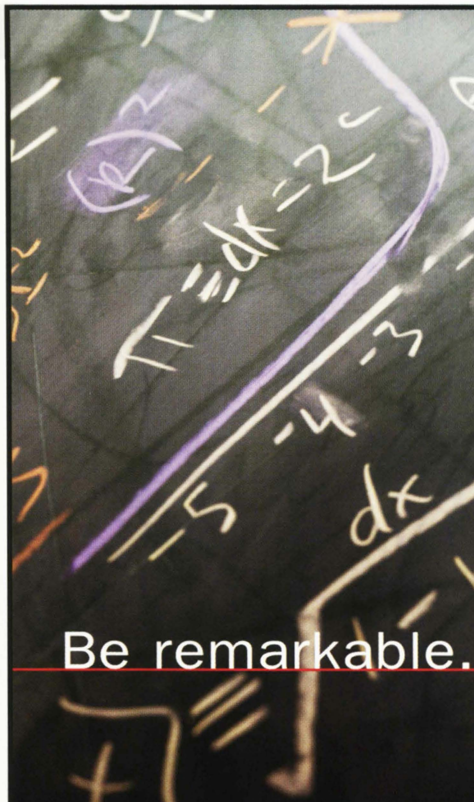
In December 2005, the Engineering Education department at Tech hosted a Sustainable Design lecture, during which students were described how sustainability is applied in the real world and how students and faculty members alike can best make environmentally-conscious decisions in the future. Also discussed at the lecture was the increased popularity of hybrid vehicles and whether or not they are more environmentally-friendly than their gas-engine counterparts. Entertained at the lecture was the possibility that hybrid vehicles are actually just pains because they cost much more than a plain gas-powered car. Moreover, after approximately 100,000 miles the battery of a hybrid car may die, requiring the owner to replace it. It is quite possible that, in some cases, the resources and work needed to pay the extra costs of a hybrid vehicle outweighs the benefits of the vehicle altogether. Also outlined were several alternatives and how to make the best decisions when evaluating sustainable design. A key point of the lecture was to inform students that all claims about environmental issues are not equal and that engineers especially should be careful when evaluating and judging the claims about environmentally friendly products.

Virginia Tech also has a Green Engineering Program. "Green Engineering can be defined as environmentally conscious attitudes, values, and principles, combined with science, technology, and engineering practice, all directed toward improving local and global environmental quality", as stated on Tech's Engineering website.

This program was primarily created to help inform and educate engineering students of the need for Green Engineers, and illustrate to them how to best apply their engineering background to Green Engineering and Sustainable Design after graduation.

Engineering students with a significant interest in sustainability and environmental issues are offered the opportunity to pursue a concentration in Green Engineering. The concentration is compromised of eighteen credit hours, of which two Green Engineering courses, two are courses within your specific Engineering major that relate to the environment and your specific major, and two are electives outside the College of Engineering that relate to social, political, environmental, and economic issues.

It is projected that in the coming years the Green Engineering concentration might evolve into a minor for engineering students. However, as an engineering student, there are many opportunities to become involved in the Green Engineering and Sustainable Design revolution. Freshmen in the Engineering Education program at Tech have already gotten a head start by participating in the Sustainable Design Freshman Engineering project, but students of all years as well as faculty members, graduate students, and professionals will find benefit from learning about sustainable design and Green Engineering. Going into the 21st century, with the limited resources and growing population that faces the next generation, implementation of Green Engineering and Sustainable Design concepts will reduce the negative impacts the world currently faces.



>email bag

The jokes below were taken from very old issues of the Engineers' Forum (then known as The Virginia Tech Engineer), between 1946 and 1950. These jokes are among the less offensive ones . . .

Road signs are frequently prophetic. For example:
"Soft Shoulders"
"Dangerous Curves"
"Men at Work"
"Danger"
"Look out for Children"

Teacher: *"Now children, every morning you must take a cold shower and you will feel rosy all over. Are there any questions?"*
Johnny: *"Never mind about the shower but tell us more about this Rosie."*

"What's the hurry?"
"I just bought a text-book and I'm trying to get to class before the next edition."

She: *"My dad is an engineer. He takes things apart to see why they won't go."*
He: *"So what?"*
She: *"You'd better go."*

Instructor: "Did you go through Calculus?"
Student: "Not that I know of, unless I came through there on my way here. You see, I'm from West Virginia."

"What makes Junior so happy?" asked papa rabbit.
"He had a wonderful time in school today. He learned how to multiply."

Prof.: "This exam will be conducted on the honor system. Please take seats three seats apart and in alternate rows."

Angry Prof.: "How dare you swear before me?"
Freshman: "How did I know you wanted to swear first?"

King Arthur: "I hear you have been misbehaving."
Knight of the round table: "In what manor, sir?"

An electron is a dot of electricity that speeds very fast backwards from the direction that electricity actually goes.

Jane: "Why doesn't John ever take you to the movies anymore?"
Joan: "One evening it rained and we stayed at home."

Ed: "Have you got a picture of yourself?"
Roommate: "Yeh"
Ed: "Then let me use the mirror. I gotta shave."

She: "It's easy to write a play. First Act, boy meets girl; Second Act, they hold hands; Third Act, they kiss."
He: "That's how I got arrested."
She: "What do you mean?"
He: "I wrote a five act play."

"Now, gentlemen," said the president of the Honey Chile baby bottle Company, "We have 50,000 of these feeding bottles in stock and it's up to you salesmen to go out and create a demand for them."

Morphing Wings

-Dan Cirulnick

Man has grappled with material properties and limitations for millennia. Many years ago, cavemen sharpened rocks to serve as tools. As time passed, the melting and shaping of metals became integral to the progression of humanity. More recently, plastics were created, changing the way people create products and processes forever. Today, the advance of polymers and carbon fibers takes the forefront in materials science research. Man has arrived to a point in time where, with the power of computing and the advancement of education, it is possible to create designs for devices and machines of great complexity requiring advanced materials that perhaps do not yet exist. Examples include an elevator to space, self-replicating nanomachines, and of course, a morphing aircraft wing.

The design of a morphing aircraft wing (MAW) was inspired by nature itself. The gentle gliding of a seagull as it descends on sand, or the precise use of a falcon's wings as it swoops upon its prey are just two examples of why nature employs morphing wings. A seagull changes the shapes of its wings during landing to increase lift and decrease speed. The falcon slightly retracts is wings during an attacking descent to increase its speed, and subsequently, its terminal velocity. Not only will a dove flying 500 feet above the ground not see its death approaching at 240 mph, but the force of the falcon's talons on the dove will end its life immediately. Dinner will be swooped up before the prey hits the ground. Various studies have shown that the seemingly elegant acts of these animals in nature (flying birds or fish, specifically) exhibit aerodynamic properties far greater than most, if not all, flying machines. Thus, a current thrust in the aircraft industry is to develop planes that can mimic these creatures. Alas, this type of design problem requires the use of advanced materials and engineering processes. Unfortunately, the materials today are not entirely up to the task of enabling the creation of a morphing wing - multiple limitations restrict operational performance.

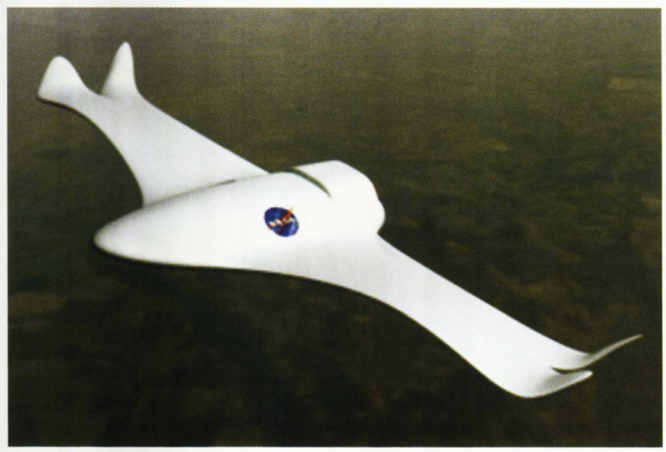
Top: "Sliding skins" concept by NextGen, Bottom: Lockheed Martin folding wings

The first type of materials that should be discussed are known as Shape-Memory Alloys (SMAs). After a temperature-dependent deformation, these metals are able to revert back to their original shape. This is true for most materials under an extremely small amount of strain, but some SMAs are capable of attaining 5% strain without exceeding their elastic limit. It was discovered that structural changes at the atomic level were responsible for this unique capability. Also, these materials are capable of solid-state phase changes. The more deformable, lower temperature phase is known as martensite, while the higher and stronger phase is known as austenite; these phase changes involve the rearrangement of the position of the particles within the crystal structure of the solid. Thus, these materials can be stretched to a much greater degree than most of today's metals, and seem fitting for this type of application. However, this material has certain drawbacks and limitations. As one would expect, SMAs are expensive to manufacture compared to more traditional materials. Also, SMA's have poor fatigue properties. This is an especially troubling property for aircraft applications. Planes fly thousands of sorties during their lifespan, and experience large amounts of vibration each time they fly. In order for a SMA to be effectively used, this limitation must be addressed, else the lifespan of a plane with SMAs could be quite limited. A plane employing SMAs with a desired long life span may require a greater amount of maintenance than today's traditional planes. This would create an extra expense to keep morphing wing aircraft in the air, possibly negating their benefits altogether.

Another class of materials with a similar name is Shape-Memory Polymers. These materials are composed of two different components with varying thermal properties: a hard component and a switching segment. These materials can be stretched to 4 times their original length, and when heated, they will return to their normal size. These types of materials can also be twisted and bent into various shapes. With the application of heat, the polymer will return to its original shape. Shape-Memory Polymers have been suggested for use in the Morphing Wing project, albeit it remains to be determined how such a temperature change might be made while flying, perhaps other means of control can be found. Unfortunately, these polymers also have a host of limitations. Obviously, the strain these materials can endure is breathtaking, but their load carrying capability is extremely limited.

Another material important to Morphing Wing Aircraft is Compact Hybrid Actuators (or piezoelectric actuators). These devices would be used to actuate the movement of the morphing wing itself. Utilization of these devices necessitates improved properties such as extremely high power density and specific power in order for them to be reasonable. The smaller the device can be made, the lighter it will be, thus making for an overall decrease in airplane mass. To make such a leap in terms of specific power, smart materials with very high energy density are necessary. Unfortunately, such materials would be extremely expensive, as well as temperature sensitive. Also, these materials may only be capable of small movements, given how small these actuators are to be. If a MAW is to be actuated by one of these devices, it will require a large range of motion.

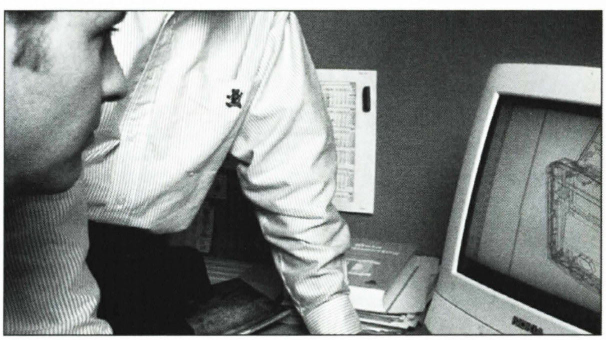
A consideration for the aircraft's outer surface (or skin) must also be made when designing a Morphing Aircraft Wing. When the inner structure of a morphing wing is manipulated to change shape, the skin of the aircraft must move with it. It is evident that one cannot have a series of linkages moving, because this will not create lift or pressure variations. The outer layer must be smooth to reduce drag, and also to provide a surface for the pressure differences to act. In the case of a morphing wing, it becomes very difficult to create an outer surface that can expand, retract, and bend while remaining smooth and rigid. A retractable plating might be suitable for expansion or retraction of the wing, but bending movements would be inhibited by such a design. A suitable material that can stretch as well as remain rigid under extreme aerodynamic loads is not immediately evident. There are a number of compromises, such as the one mentioned above, but none with the versatility and strength to deal with such a problem. A material in the same vane as human skin is highly sought after for this application because it is both flexible and resistant to deformation under aerodynamic load.



Courtesy: NASA

Finally, considerations must be made for the aircraft as a whole. In this case, the Defense Advanced Research Projects Agency (DARPA) and the Air Force are major partners in the Morphing Wing project. Thus, it is reasonable to assume that such an aircraft will be put into harms way. If a large amount of moving parts and linkages are within the wing, there are much fewer areas that are safe to be hit with enemy fire. Granted, any amount of damage on a traditional airplane is critical, the large number of moving parts could make this type of aircraft more sensitive and prone to failure. This also brings up the possibility of malfunction during flight. Failures occur at seemingly random moments; a structure that can morph, and then fail while it is transforming, could create a situation where the airplane is uncontrollable. Also, if the outer skin of the aircraft is flexible, and similar to human skin, surely it will not provide protection against missile fire, nor even small arms fire from the ground.

Before an aircraft such as the "Morphing Wing" can be deployed in anger, or even in a commercial flight, there are many problems that must be solved. Materials limitations are among the chief concerns of creating such an aircraft. Be it Shape Memory Alloys, actuators, the skin, or the overall survivability of the plane, there is still a long way to go before such a plane is seen transforming in the skies.



GLOBAL WARMING

"Global warming seems to be a problem that will increase throughout my lifetime, so I'd be all for starting some preventative measures in order to halt it's increase." Ryan Gimmy

"I don't think it's a big deal, in itself. It's way too long-term of a problem for me to worry about it, but I do consider the pollution that causes it a threat because of acid rain and stuff like that killing wildlife."
Ian Good, Sophomore, Computer Science

"I think global warming is definitely something we should keep our eye on, but I don't think it's our biggest problem now."
Nick Moore, Freshman, Mechanical

"I think that the media is making global warming a bigger issue than it really is!" Shannon Bell

G - HOT OR NOT?

"America needs to get on board with the Kyoto Protocol. Being the leader in innovation and research, we have the oppurtunity to take the lead in policies concerning global warming."
Ellen Anderson
Graduate Student
City Planner (visiting from Georgia Tech)

"The developed world needs to recognize the consequences it can have on our future generations, and invest more in reducing factors contributing to this inevitable disaster. And in a way, we can thank third world nations for keeping our globe alive today."
Anshul Sazena
Senior
Industrial & Systems Engineering

"There is a lot of research that shows that our Earth is having its record high temperatures in the recent years, but, no one has done anything substantial to address this because it is too big a problem that will take a few decades to solve. Haagen Dazs might have soaring profits until then."
Naren Sundaravaradan
Undergraduate - Computer Science

"It's something that requires not just national attention, but something that needs to be addressed and dealt with immediately on the global scale."
Justin Shanks
Graduate Student
Urban and Regional Planning

-Enoch Dames

Nanotechnology will allow you to take an elevator to the six millionth floor. It will allow you to cryogenically freeze yourself for the next millennia so you can finally meet a cute one-eyed woman with purple hair. It will allow you to plant a tree in your front yard that grows apples, pears, and dollar bills. And yes, small nanomachines will carry a beer from your fridge to your hand in an assembly which will make the beer seem like it's floating. But there's a catch – you just have to wait a little while.

Nano - it's a prefix, and that's it. The nano craze isn't yet over. As a matter of fact, it technically never started. The quick rise of nanotechnology as a primary thrust for research in both government institutions and universities is simply the result of an outcry for attention to a nebulous field of science. Stating that you want to study nanotechnology is a bit like saying you want to know everything. It's as silly as saying that you want to study microtechnology, or macrotechnology. A professor of nanotechnology? Forget it – there will never be such a faculty position.

However, we can attach the prefix to just about anything. Maybe you've heard someone use these terms before: Nanomaterial, Nanoparticle, Nanotube, Nanobiology, Nanobioengineering, Nanoscience, and yes, even Nano- iPod™. All this nano-terminology is eventually going to desensitize the public, and it could possibly drive me crazy.

The nanotrain took off from quantumville several decades ago, originally popularized by Richard Feynman and quoted most frequently from his "there's plenty of room at the bottom" speech. However, only several years ago did the majority of first-world citizens hear nanotechnology used on an almost daily basis.

Then came the media-induced scares about self-replicating nanomachines that would prey on human flesh and take over the universe. You can thank a man named Eric Drexler for this, who claims to be a molecular nanotechnologist (he received his degree from the Department of Redundancy Department at the Sam Houston Institute of Technology). Although a genius in his own right, many do not consider this 'father of nanotechnology' realistic. The engineering designs and ideas he envisions will not come to fruition for a long, long time, if at all. Some of those ideas are mentioned in the first paragraph.

Richard Smalley, 1996 Nobel laureate in Chemistry for the discovery of fullerenes, also did not believe Eric Drexler's visions to be realistic. Although Dr. Smalley recently, and unfortunately, passed away, he is remembered as a true scientist and the closest thing to an expert of nanotechnology. In reality though, Dr. Smalley was a chemist just trying to make very small carbon soccer balls.

Chemistry is nanotechnology. Genetic engineering and the concept of DNA computing is nanotechnology. Tissue engineering is nanotechnology. Materials science is nanotechnology. Rather than confuse the rest of the world, scientists and engineers should simply state what it is they're actually doing, and admit that the progression of science as a whole necessitates the use of multidisciplinary tools (i.e., physics, chemistry, engineering, and biology) to control matter at an ever smaller scale.

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