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chain reaction

The national magazine of Friends of the Earth Australia

SIZE DOES MATTER

Nanotechnology: Small Science – Big Questions!

A Friends of the Earth project

Wild Spaces Film Festival

environmental and social justice national film festival 2006

All filmmakers are invited to submit their work to the Wild Spaces Film Festival 2006

The festival will be screening around Australia and seeks to showcase the most exciting, progressive,inspirational, experimental and thought provoking work from the world's film community, focused on environmental and social justice issues.

Entries close: 2nd June

www.wildspaces.foe.org.au

for entry forms and more information

An initiative of Friends of the Earth

Reverse Garbage Co-op Ltd

Reverse Garbage Co-op Ltd is a non-profit re-use centre that diverts high quality industrial discards from landfill to make them available at low cost to the community.

- low cost materials for creative and practical projects
- creative workshops for schools and communities
- materials sent to rural and regional areas Australia-wide
- gift shop showcasing works made from salvaged materials by local artists and designers
- free collection of materials from Brisbane-based businesses & industry
- helping to support Friends of the Earth - Brisbane

Reverse Garbage

296 Montague Road,
West End, Brisbane, Qld, 4101
Phone: 07 3844 9744
Email: info@reversegarbage.com.au
Web: www.reversegarbage.com.au
Open: 9am to 5pm,
Monday to Saturday

Radioactive Exposure Tour 2006

July 22 – August 4

The Radioactive Exposure Tour is on again. Join Friends of the Earth for a journey to remote northern South Australia where we will visit the Olympic Dam uranium mine at Roxby Downs, the beautiful Lake Eyre and Mound Springs environments and meet with indigenous peoples campaigning against the nuclear industry.

This year the tour will take in Alice Springs in the Northern Territory with visits to potential radioactive dump sites and nearby communites.

The tour offers a unique opportunity to go out on to country and witness the impacts of the nuclear industry on people and the environment. Indigenous people across the world suffer most directly from the impacts of the nuclear industry, this 'radioactive racism' is a major focus of the tour.

Get on the bus, get out under the stars and get ready to listen! Friends of the Earth have organised many of these life-changing tours in the past.Total cost of the tour will include travel, accommodation and organic vegetarian food plus paying the rent to aboriginal communities. The final dates and itinerary for the trip may vary subject to availability of people/ communities etc.

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Adelaide: Joel Catchlove,
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Students of Sustainability Conference

9th - 15th July, University of Queensland, Brisbane, Australia.

"Students of Sustainability" is a large-scale, community-oriented conference that has been run by volunteers for 15 years and has its roots in student environmental activism. Our ethos is to bring together people from all over Australia to share knowledge and skills, and to network, inspire, celebrate, empower, and motivate us all into action towards creating a genuinely sustainable world. Passion, information, education and commitment are the tools with which we accomplish this. All participants share their knowledge and learn from each other, bringing their own opinions, voices and ideas. This diversity makes SoS what it is. To register or find out more please visit:

www.exploresustainability.org

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Chain Reaction is produced in Melbourne and Katoomba. We acknowledge the traditional owners of these lands and the fact that Indigenous land has never been ceded.

Friends of the Earth

EARTH NEWS

Climate Change - Online Map Of Impacts

Scientists and environmental organisations have produced an online map - <www.climatehotmap.org> - which details the impacts of climate change around the world.

Events indicated on the map are divided into two categories:

• Fingerprints - events which are direct manifestations of a widespread and long-term trend toward warmer global temperatures. These include heat waves, ocean warming, sea-level rise and coastal flooding, glaciers melting, Arctic and Antarctic warming.

• Harbingers - impacts likely to become more frequent and widespread with continued warming although evidence for a direct link to climate change cannot be confirmed at this time. These include: spreading disease, earlier spring arrival, plant and animal range shifts and population changes, coral reef bleaching, downpours, heavy snowfalls, flooding, droughts and fires.

www.climatehotmap.org

Wind Energy Demand Booming In The USA

Last year, climbing natural gas prices made conventional electricity more expensive than wind power in several US states, a milestone in the shift to renewable energy.

Electricity customers on clean energy schemes previously paid a premium. Now they pay slightly less than consumers whose electricity is produced using fossil fuels. This has led to rapid growth in the development of wind power, but this may not last as demand for wind power outstrips supply and the price of natural gas falls from its late 2005 high. Over the longer term, however, as reserves of natural gas are depleted, its price is projected to rise, giving a strong advantage to wind.

Overall, US wind-generating capacity expanded by 36 percent in 2005, reaching 9,149 megawatts, with commercial wind farms in 30 states. In 2006, growth could reach 50 percent.

Wind energy is emerging as a centrepiece of the new energy economy, because it is abundant, inexpensive, inexhaustible, widely distributed, clean, and climate-benign.

Source: Earth Policy Institute, March 22, 2006, www.earthpolicy.org/Updates/2006/Update52.htm.

Problems Mount From 9/11 Fallout

The number of people with medical problems linked to the 9/11 attacks on New York is on the rise.

One list of sufferers has been compiled at the Mount Sinai Medical Center. Its World Trade Center Screening Programme has 16,000 people on its books, of whom about half require treatment. A further 7,000 firefighters are recorded as having a wide range of medical problems. But the overall numbers affected could be far higher.

In a first, the death of a policeman who developed a respiratory disease was "directly linked" to 9/11 by a coroner in April.

People in New York were exposed to a wide range of contaminants after the World Trade Centre buildings fell on September 11. These included lead from 50,000 computers, asbestos from the twin towers' structures, and dangerously high levels of alkalinity from the concrete.

In the days following the attacks, the head of the US Environmental Protection Agency (EPA) declared that monitoring operations had proved the "air was safe to breathe". And with that reassurance, the authorities reopened Wall Street.

Many of the victims say the government offered false reassurances that the Manhattan air was safe and are now pursuing a class-action lawsuit. The federal courts have allowed a class action to be filed. In March, a judge described the EPA's reassurances as "misleading" and "shocking the conscience". The legal process could last years.

Source: BBC, April 12, 2006, www.news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/4904188.stm

New Law Forces Manufacturers To Pick Up Recycling Costs

Maine has become the first US state to pass a law requiring manufacturers of disused televisions and computer monitors to pay the cost of sending them to recycling centres where toxic materials such as lead and mercury are removed.

The law mirrors the approach taken in Europe and Japan. The Maine recycling law is the first to charge manufacturers directly for the cost. A Californian law requires customers to pay a disposal fee when they buy a TV or computer monitor, while Maryland imposes registration fees on computer manufacturers and disburses the proceeds to municipalities for use in recycling old hardware.

TVs and older computer monitors contain between 1.8-3.6 kilograms of lead, along with an array of other toxic materials, and newer flat-screen monitors contain mercury.

The primary purpose of the law is to prevent toxic materials from being released into the environment from incinerators or landfills, but it is also expected to encourage manufacturers to use less toxic materials and to design products that lend themselves to recycling.

The US Environmental Protection Agency has called electronic waste the nation's fastest-growing category of solid waste.

Source: Jerry Harkavy, Associated Press, January, 2006

Three Reports Undermine UK Nuclear Push

Three recent reports have undermined the British government's push to build a new generation of nuclear power plants.

A cross-party parliamentary environment committee released a report in late March, 'Keeping the lights on: Nuclear, Renewables and Climate Change'. The reports conclusions include the following:

• *We remain convinced that the vision contained in the 2003 White Paper—with its focus on energy efficiency and renewables as cornerstones of a future sustainable energy policy - remains correct. What is now needed is a far greater degree of commitment from the Government in implementing it.*

• *Nuclear power raises a variety of issues which would need to be satisfactorily resolved before any decision to go ahead is taken. These include long-term waste disposal, public acceptability, the availability of uranium, and the carbon emissions associated with nuclear. There are also serious concerns relating to safety, the threat of terrorism, and the proliferation of nuclear power across the world.*

The report is on the internet at:
www.publications.parliament.uk/pa/cm/cmenvaud.htm

The British government also commissioned a report by the Sustainable Development Commission (SDC). The report concluded that even if the UK's existing nuclear capacity was doubled, it would only give an 8% cut on greenhouse emissions by 2035 (and nothing before 2010).

The report identifies five major disadvantages of nuclear power:

1. Long-term waste – no long term solutions are yet available, let alone acceptable to the general public; it is impossible to guarantee safety over the long- term disposal of waste.

2. Cost – the economics of nuclear new-build are highly uncertain. There is little, if any, justification for public subsidy, but if estimated costs escalate, there's a clear risk that the taxpayer will be have to pick up the tab.

3. Inflexibility – nuclear would lock the UK into a centralised distribution system for the next 50 years, at exactly the time when opportunities for micro generation and local distribution networks are stronger than ever.

4. Undermining energy efficiency – a new nuclear program would give the wrong signal to consumers and businesses, implying that a major technological fix is all that's required, weakening the urgent action needed on energy efficiency.

5. International security – if the UK brings forward a new nuclear power program, we cannot deny other countries the same technology. With lower safety standards, they run higher risks of accidents, radiation exposure, proliferation and terrorist attacks.

The SDC report concludes that it is possible to meet the UK's energy needs without nuclear power, with an aggressive expansion of energy efficiency and renewables.

The SDC report is on the internet at:
www.sd-commission.org.uk/pages/060306.html

A report released in March by UK churches also rejects the nuclear option. The report, 'Faith and Power', describes a low consumption, non-nuclear, energy strategy as a "moral imperative."

The report argues that: "the high consumption, nuclear path may appear easier for government to pursue in the short term, but we believe that there is a moral duty to follow a more challenging and more sustainable option. We conclude that substantially enhanced Government support for efficient, less profligate energy consumption and investment in renewable sources of energy supply rather than nuclear power is a moral imperative."

The report is on the internet at:
www.christian-ecology.org.uk/pr-fp.htm

Australia's Endangered Species Law On Trial

Tasmania's migratory Swift Parrot, iconic Wedge-tailed Eagle and ancient Wielangta Stag Beetle are federally listed endangered species. *Bob Brown v. Forestry Tasmania* is Senator Bob Brown's personal bid to save them from logging by taking action in the Federal Court.

Bob Brown v. Forestry Tasmania is a landmark case. It is so important that both the Commonwealth and Tasmanian governments have intervened to back the loggers. At stake is whether Australia's endangered species law can protect three of our most vulnerable animals and their habitat in Wielangta Forest, and ultimately the power of the federal government to look after threatened plants and animals everywhere.

Details and updates can be found at:
www.on-trial.info

Traditional Owners have their say on Parks in the NT

Joint management planning for NT parks and reserves has started. A joint approach between Traditional Aboriginal owners, NT Parks and Wildlife, and Land Councils seeks to create a set of rules for each place which will protect cultural values and meet the aspirations of the Aboriginal community.

In addition new positions for Aboriginal rangers have been created and cultural mapping is being carried out to assess, map and document cultural values in areas like the East MacDonnell Ranges, Devils Marbles Conservation Reserve and the Davenport Range National Park. This information will then be used in park management programs.

Source: Land Rights News, March 2006.
www.clc.org.au

News

Friends of the Earth Australia

Friends of the Earth Australia is a federation of independent local groups. You can join FoE by contacting your local group. For further details on FoEA, see: www.foe.org.au There is a monthly email newsletter, you can subscribe via the FoEA website.

Beyond Nuclear Symposium

Melbourne will be playing host to a two-day national anti-nuclear Symposium on September 15-16. The Symposium will provide an opportunity for people to hear from expert speakers and experienced campaigners, and also to engage in discussion and planning towards a nuclear-free future.

Friday September 15 will be a day of panel presentations from leaders in the fields of science, medicine, nuclear non-proliferation, nuclear impacts on global warming, the Indigenous community, and unions.

Saturday September 16 will be a day of workshops and open spaces in which people can come together to concentrate on areas of interest, develop strategies, networks and plans of action to take the campaigns forward.

This Symposium is one of the key events on the 2006 anti-nuclear calendar and will require a lot of assistance from people with a variety of skills to make it a huge success.

There are a few specific skills that are needed at the moment such as people with graphic design, sound mixing and recording skills, as well as a burning desire for and skill at organising benefit events to help subsidise travel costs for activists from interstate.

If you can help with those tasks - or any others - please contact Louise Morris: louisemorris@graffiti.net

(This is an initiative of the Beyond Nuclear Initiative, a collaboration between the Poola Foundation (Tom Kantor Fund), Friends of the Earth, and the Australian Conservation Foundation. See: http://www.foe.org.au/bni.htm for further details).

Food Irradiation Guide Launched

In May, Food Irradiation Watch launched Australia's first "Irradiation Free Food Guide". The guide was put together to help people make informed choices about foods that may have been exposed intentionally to nuclear radiation.

Based on the popular Greenpeace True Foods Guide, it will help food consumers make better informed decisions about the foods they eat.

Irradiation in Australia is carried out by the Steritech corporation, who have three plants, in Dandenong (VIC), Wetherill Park (NSW) and in Narangba (QLD). They use gamma rays from a nuclear source (Cobalt 60), ostensibly to improve food sterility, however irradiation's ability to do so is questionable. Tropical fruits, herbs and spices have been approved for irradiation in Australia.

The Irradiation Free Food Guide is a pocket guide to companies opposed to irradiation. It rates the most popular brands based on their company policy and provides some interesting background about the process and the many alternatives.

The guide is available on line at: www.foodirradiationinfo.org/ifg.html

You can get a hard copy by sending your address to Food Irradiation Watch (FIW), PO Box 5829, West End QLD 4101 or by emailing FIW a: foodirradiationwatch@yahoo.com.au
Food Irradiation Watch is an affiliate member of FoE Australia.

Norman Myers in Melbourne

In March, FoE joined with the Globalism Institute at RMIT to host Norman Myers, considered by many to be the foremost researcher on climate refugees in the world. Professor Myers gave a strong presentation on the likely human impacts associated with global warming, including threats to security, conflict over resources, and potentially enormous numbers of people displaced from their homes.

He stated that "it is scandalous that we are so indifferent to the plight of such impoverished communities", noting that the ability to deal with global poverty and displacement is well within our means. He cited as one example the fact that the global community would need to spend around US$20 billion per year to provide all people with access to clean water, yet we currently spend around US$100 billion on bottled water. It is about commitment and priorities, not availability of resources. He suggests that the cost of mediating the effects of global warming would amount to roughly US$97 billion per year (this would provide clean water for all, slow deforestation and desertification, ensure energy efficiency, protect biodiversity hotspots, provide family planning to those who want it, amongst other measures). This is roughly equivalent to 32 days of combined military spending of all nations on earth.

Adelaide Update!

Friends of the Earth Adelaide's Clean Futures Collective recently returned from its second successful Indigenous community work program. Established in December 2005, the program aims to strengthen relationships with the Adnyamathanha through volunteer work in the Nepabunna community. Tasks include working in the community's bush tucker garden, saving seed, cultivating fruit

and vegetables for community use, child care and helping support Nepabunna's eco-tourism initiatives. The work trips are open to anyone and are proving to be profound experiences. With an enthusiastic invitation to return any time, the collective plans to run the program three or four times a year to coincide with school holidays. The Beverley and Honeymoon uranium mines are sited within Adnyamathanha native title lands.

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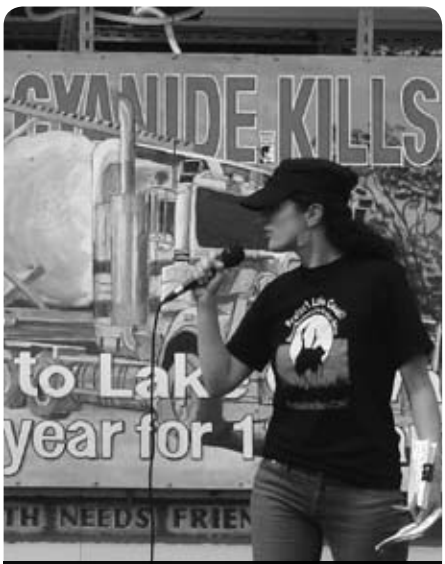
FoE Blue Mountains

In January this year a small group of dedicated mountain folk set up a Friends of the Earth local group in the Blue Mountains. As a new member group we have been warmly welcomed by the FoE network as well as by the local community.

FoEBM's first public event, a Climate Change Forum, was held on 4th March at the Blue Mountains World Institute (BMWHI) in Katoomba. Speakers included FoE Climate Justice campaigner, Michelle Braunstein, energy academic and former Greens Senate candidate, Dr. John Kaye and Blue Mountains Archaeologist and Rock Art Specialist, Wayne Brennan. The forum was a huge success with over 50 people attending. New groups and alliances were formed and the level of awareness and empowerment surrounding the grave concerns of Climate Change was greatly increased.

Friends of the Earth Blue Mountains has also been cranking up the campaign to protect Lake Cowal in central western NSW. Canadian gold mining company Barrick has started mining gold at Lake Cowal using cyanide and lethal chemicals. FoEBM co-organised RAIN Corroboree at Lake Cowal over Easter which was attended by over 120 supporters that included local Wiradjuri elders, environmentalists, students and activists. The success of RAIN corroboree continued with FoEBM co-organising a local action with Cyanide Watch, (the campaign to stop the transport of bulk cyanide by road and rail), with a community SpeakOut in Katoomba against cyanide being transported through the Blue Mountains to Barrick's gold mine at Lake Cowal.



Natalie Lowrey, FoEBM coordinator, at the SpeakOut action in Katoomba against Cyanide being transported through the Blue Mountains, 29 April 2006. Photo: Cyanide Watch <www.peacebus.com/CyanideWatch>

In the next two months FoEBM is looking forward to hosting FoE affiliate group, PACE (Pedal Australia for Clean Energy) as well as The Change Agency.

FoEBM will also be actively involved in the Winter Magic Festival in Katoomba, the biggest street party in regional NSW with over 30,000 people attending. FoEBM will have a presence in the street with an installation in an empty shop space as well as a chai and info tent.

Friends of the Earth Blue Mountains will continue building its profile in the local community with the launch of its membership program in June at the Winter Magic Festival and an official launch in the Blue Mountains later in the year.

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natalie.lowrey@foe.org.au

PACE Underway

A group of young people are circumnavigating the Australian continent powered only by pedal power (bikes) and a van powered by vegetable oil. They aim to promote the use of sustainable energy and showcase sustainable transport during their educational journey. PACE will be raising awareness about the environmental and social implications associated with the use of fossil fuels as our main source of energy.

For regular updates on their progress, please see: http://www.foe.org.au/pace.htm

Thanks!

• To **Lonely Planet** for supporting our tsunami relief and recovery fund-raising efforts. WALHI/ FoE Indonesia continues to work with affected communities in Aceh to rebuild lives after the Boxing Day tsunami. For further details please see: www.eng.walhi.or.id/tsunami

• To **Poola Foundation** (Tom Kantor Fund) for supporting the Beyond Nuclear Initiative

• To **Donkeywheel Foundation** for supporting our nuclear freeways project

• To the **members & supporters** who responded to our autumn appeal (details are available on our website: www.foe.org.au).

Please support FoE!

Friends of the Earth Australia is a national environmental justice network. We work on a range of local, national and global projects and campaigns.

Individuals can support us and get involved by joining their local group (see page 48). We are also seeking direct financial help for our national level work – our campaigns, projects and other national activity (see page the back page for a full list).

For further details, please see: www.foe.org.au/mainfiles/contribute.htm

News

Friends of the Earth International

Friends of the Earth International (FoEI) is a federation of autonomous organisations from all over the world. Our members, in 73 countries, campaign on the most urgent environmental and social issues, while working towards sustainable societies. For further information, see: www.foei.org

Friends Of The Earth And Others Challenge World Water Forum

The World Water Forum was held in Mexico City, Mexico from March 16-22. The official Forum was attended by the World Bank, the UN, the IMF, and energy and water corporations among others. Although the official forum was purportedly meant to enable collaboration between policy makers and stakeholders, it was extremely difficult for non-corporate organisations and groups to attend the forum and have their voices heard. Therefore, Friends of the Earth International and others organised an alternative forum, bringing together indigenous and farmer organisations, community groups, academics, trade unions, students, grassroots and women's groups, public health advocates, and social movements from within Mexico. A March 22nd press release signed by various civil society organisations including FoE groups pointed to the emptiness of the World Water Forum's closing declaration as proof of its incapacity to tackle the world's water crisis. Civil society groups call for the failed World Water Forum to be replaced by an UN-hosted process.

Contact: Longgena Ginting, FoEI IFI co-coordinator, ginting@foei.org
A briefing on the GM trade dispute is available at: www.foeeurope.org/press/2006/AB_8_Feb_WTO_ruling.htm

Victory Against Investment Bank-funded Water Project

One day before the opening of the World Water Forum, the Argentinean government decided to re-nationalise water utilities in Buenos Aires. A state company has been created to replace Aguas Argentinas, which was owned by Suez and Aguas Barcelona and received funding by the European Investment Bank (EIB). Aguas Argentinas failed to raise water quality to appropriate standards for human consumption, but insisted on increasing water prices.

Contact: Magda Stoczkiewicz, CEE Bankwatch Network, magdas@bankwatch.org

Small Victory Against Biotech Foods In Brazil

UN talks on global trade of genetically modified (GM) foods and crops were held in Curitiba, Brazil from March 13-17. The meeting brought together developing countries and some of the world's biggest corporations and addressed the issue of identification and labelling of GMOs. Most GM food and crops are not clearly identified and labelled, making it difficult for developing countries to protect themselves against GMO contamination. Although the meetings concluded with an agreement to label GM grains worldwide, more remains to be done to protect the food and crops of developing countries from GMOs.

More info: www.foei.org/media/2006/0317.html

Biological Diversity Meeting Amidst Farmer's Protests

Following the UN talks on GM crops and food, the eighth Convention on Biological Diversity (CBD) started in Curibita on 20th March. In parallel, a Civil Society Forum, bringing together 70 representatives from international organisations including many Friends of the Earth activists, was organised to feed into the convention's discussions on privatisation of natural resources and biodiversity. A massive mobilisation of farmers on the streets, in combination with effective inside campaigns, led to a concrete result in terms of a continued moratorium on so-called terminator technology (sterile seeds). FoE International and many others raised the call for a moratorium on the release of genetically engineered trees into the environment at the meeting, and insisted that the CBD launch a thorough global examination of the risks and impacts of genetically engineered trees.

Contact: Simone Lovera, FoE Paraguay, simone@conexion.com.py

US Government Opposes World Heritage Action On Climate Change

The UN Educational, Scientific and Cultural Organization (UNESCO) World Heritage Committee, of which the USA has recently become a member, is proposing that action be taken to protect World Heritage property threatened by climate change. Petitioners have asked that five sites already experiencing damage from climate change -- glaciers in the Waterton-International Peace Park located in the USA and Canada, on Mount Everest and the Peruvian Andes, and coral reefs in Belize and the Great Barrier Reefs -- be placed on the "In Danger List". FoE Nepal is among the petitioners, and FoEI's Climate Justice Project is providing legal support. The committee is calling on UNESCO to protect the sites and to take international action to reduce carbon dioxide emissions. However, the USA is against taking action, arguing that the science behind climate change is not unanimous.

More information: http://whc.unesco.org/en/events/301
Contact: Catherine Pearce, FoEI climate campaign coordinator, catp@foe.co.uk

UK: Government's Climate Change Program Lacks Political Will

Friends of the Earth has described the recently published review of the UK government's

climate change program as "pathetic" as it fails to demonstrate political will and take serious action. In spite of electoral promises to cut carbon dioxide emissions by 20 per cent of 1990 levels by 2010, emissions have risen by three per cent since 1997. The review also fails to respond to calls of many MPs, as well as Friends of the Earth, for a law requiring the government to make annual cuts in carbon dioxide.

More information: www.thebigask.com

France: Success As Banks Do More For The Climate

FoE France's campaign "French banks: save the climate!" is celebrating its first success as the Banque Populaire agreed to mainstream across the country an attractive loan for renewable energies and energy efficiency that they had piloted in three regions. The loan was developed to support solar roofs, heating systems with wood and other environmentally friendly systems. Other banks claim to be prepared to follow this trend. This news comes in parallel to the findings of Les Amis de la Terre's report "French Banks and Environment: almost everything has to be done", published in March, which highlights that no bank in France has a real environmental policy.

Contact: FoE France, finance@amisdelaterre.org

Indonesia: Protests Against Freeport Mine In West Papua

In March, protesters including WALHI /FoE Indonesia urged the government to revoke the license of the US gold and copper mining company PT Freeport Indonesia and close down the company in West Papua. Protesters pointed out that while huge profits gained by Freeport are exported to the company's headquarters in the US, many Papuans suffer from hunger and poor education. Furthermore, the company has damaged the structure of community relations, and negatively impacted people's rights and traditions.

In May, WALHI released a report on the environmental impacts of the Freeport mine. It is available at: www.eng.walhi.or.id/kampanye/tambang/frpt-report-may-06/

Malaysia: Mobilisation Against Free Trade Deal With USA

Activists in Malaysia have launched a campaign against a planned bilateral free trade deal with the US, saying it could undermine job and food security and the nation's economy. Concern was raised following the way the free trade agreements between the US and Thailand were handled, with disputes over drug patents and intellectual property rights, and fears of disadvantages for local farmers. Third World Network, FoE Malaysia and the Consumers Association of Penang organised a forum in Kuala Lumpur for a wide range of NGOs, unions, parliamentarians, students and journalists.

Contact: Meena Raman, FoE Malaysia, meenaco@pd.jaring.my

Middle East: Plans For A Peace Park

As part of the campaign to rehabilitate the Jordan River, FoE Middle East gathered Jordanian, Palestinian and Israeli mayors to initiate a Peace Park. The Park will straddle both banks of the Jordan River at the site of the "Three Bridges" park, where Roman, Ottoman and British mandate bridges still stand today. Ultimately, the site will become a trans-boundary tourist zone. Although municipalities and local residents are in favour of the project, Jordanian and Israeli governments must still release some of the water back into the river - a first step towards its rehabilitation.

Contact: Mira Edelstein, FoE Middle East mira@foeme.org

Nigeria: Court Orders Shell To Stop Gas Flaring By April 2007

On the April 11, the Nigerian High Court decided that oil giant Shell must stop flaring gas in the Iwherekan community in Delta State by April 2007. This is a welcome victory for the impoverished people affected by the damaging and wasteful practice of flaring in the oil-rich Niger delta. Nigeria has been the world's biggest gas-flarer, and the practice has contributed more greenhouse gas emissions than all other sources in sub-Saharan Africa combined, as well as poisoning localities with their toxic cocktail. The practice costs Nigeria about US$2.5 billion annually, while about 66% of its population live on less than US$1 a day. Oil giant Shell has now been told twice to stop gas flaring. Nevertheless, it plans to continue flaring until 2009. FoEI campaigner Paul de Clerck asserts " it is time that Shell starts to respect Nigerian law and stops breaching human rights in the Iwherekan community and in the rest of Nigeria".

image source: //www.foe.co.uk/resource/images/shell_nigeria_2006

Scotland: Two Energy Successes

FoE Scotland welcomed recent findings in the government's Sustainable Development Commission report that nuclear power should be rejected as a solution to climate change. This critically important report comes as a new poll found the majority of Scots opposed to building nuclear power stations but in favour of more renewables. FoE Scotland is also happy to report that legislation designed to tackle climate change, reduce fuel poverty and boost micro-renewables finally passed the report stage in the House of Commons.

Contact: Lang Banks, FoE Scotland lbanks@foe-scotland.org.uk

editorial

big concerns about the science of the small

The emerging field of nanotechnology has the potential to bring about changes as big as the European Industrial revolution in the late 18th and early 19th century. A hundred and fifty years ago, the mechanization of industry, the introduction of steam power and improved transportation systems brought huge technological, socioeconomic and cultural changes. The scale of change and upheaval that will follow nanotechnology's attempt to remake the world from the atom up will be enormous.

Nanotechnology has the potential to impact across virtually all industries and sectors of the economy worldwide. Nanotechnology will lead to far-reaching changes in social, economic and ecological relations, as well as posing serious new threats to the health of all living creatures. And like the industrial revolution, which took almost 50 years to come to fruition, its impact is likely to be gradual and almost evolutionary until we find ourselves in the midst of what analysts are predicting will be a "technological tsunami".

The promise of nanotechnology – that it will deliver smarter, faster, cleaner, cheaper industrial production - is irresistibly seductive for the corporate sector and governments world-wide. The world is already battling with the all too obvious ecological limits to growth – climate chaos, water shortages, pollution and desertification. The human consequences of huge inequities in wealth, power and quality of environment are also starkly evident – poverty, disease and social unrest grip a large proportion of the world's population. The idea that a new technology could "decouple economic growth from resource use", enabling endless environmentally benign economic expansion and material abundance for all, is understandably very powerful. However the current trajectory of nanotechnology's development indicates that a nano-utopia is unlikely to be realised.

Technological solutions alone cannot fix problems stemming from flawed economic ideologies, a failure to value the natural world, socio-economic inequity or the unequal distribution of power. Nanotechnology, like other new technologies, does not exist in isolation from its economic or political context. Undoubtedly there will some socially useful and truly green nano products or processes, but it is critical that we do not allow such examples to be used to "greenwash" the vast majority of products and processes that are not. Efforts to split the environment and social change movements around the promise of "green" nanotechnology have already begun. It's vital that we always question the bigger picture objectives of nanotechnology's development when considering the potential for net social or environmental gain - nanotechnology's development has so far been driven by corporate and military interests, and there is no indication that (without robust civil society intervention) its future path will be any different.

In the midst of the global race to come out ahead in a future world of "nano haves" versus "nano have-nots", governments and corporations have so far failed to address pressing public interest issues surrounding nanotechnology. Ethical problems, the risks posed by nanotoxicity, socio-economic disruption and the erosion of democracy have to date been trivialised or ignored. Already firmly committed to nanotechnology, governments have been largely reluctant to initiate public engagement programmes; the little government communication on nanotechnology that has taken place has been firmly geared towards overcoming public resistance. Awareness about nanotechnology remains very low within both the general public and within many civil society organisations whose activities are directly affected by nanotechnology.

This issue aims to introduce the main issues surrounding nanotechnology, provide a brief overview of the key problems it raises, and serve as a call to action for its democratisation.

We believe that Friends of the Earth, in Australia and internationally, can make a valuable and timely contribution to the debate over nanotechnology we have yet to have. But to change the path of nanotechnology's development we need everyone affected by this technology to get involved – individuals, environment groups, unions, social justice advocates, peace groups, civil liberties organisations, disability rights advocates, public health associations, consumer advocates, medical organisations, farming and faith groups.

Please get in touch if you are interested in working with the Friends of the Earth Nanotechnology Project or if you would like to know more about nanotechnology.

FoE Nanotechnology Project Collective
http://nano.foe.org.au

Nanotechnology 101

what is nanotechnology?

Nanotechnology is a powerful new technology for taking apart and reconstructing nature at the atomic and molecular level. It is being touted as the basis of the next industrial revolution and will be used to transform and construct a wide range of new materials, devices, technological systems and even living organisms.

Nanotechnology will underpin and impact upon all industries and sectors of the economy, and is likely to facilitate far-reaching changes in social, economic and ecological relations, as well as pose serious new threats to the health of humans and other living creatures.

Nanotechnology involves the manipulation of matter at a size so small that it is measured in nanometres (one billionth of a metre), the scale of atoms and molecules. To put this in perspective: a human hair is 80,000nm thick, a red blood cell is 7,000nm in diameter, a DNA molecule is 2.5nm wide and 10 hydrogen atoms side by side measure 1nm.

The term 'nanotechnology' is now generally understood to encompass both nanotechnology and nanoscience:
• Nanoscience: The study of phenomena and materials at the atomic, molecular and macromolecular scales, where properties differ significantly from those at the larger scale
• Nanotechnology: design, characterisation, production and application of structures, devices and systems by controlling shape and size at the nanoscale
• Nanoscale: having one or more dimensions of the order of 100nm or less, or having at least one dimension that affects functional behaviour at this scale
• Nanomaterials: particles, nanotubes, nanowires, quantum dots, fullerenes (buckyballs) etc that exist at a scale of 100nm or less, or that have at least one dimension that affects their functional behaviour at this scale
• Nanobiotechnology: the use of nanotechnology to manipulate living organisms and to enable the merging of biological and non-biological materials.

why are people touting nano as the next industrial revolution?

Nanotechnology embodies the dream of controlling the building blocks of both living and non-living things, and the ability to remake the world from the atom up.

The excitement around nano is building because people believe that it will bring changes as significant, and potentially more far-reaching, than those that accompanied the industrial revolution. Proponents and critics alike suggest that nanotechnology will enable breakthroughs in a wide number of different fields – communications, agriculture, cognitive science, medicines, military and environmental remediation to name a few. In this way, nanotechnology can be considered to be a "platform" or an "enabling" technology.

"The real power of nanoscale science is the potential to converge disparate technologies that can operate at this scale. With applications spanning all industry sectors, technological convergence at the nanoscale is poised to become the strategic platform for global control of manufacturing, food, agriculture and health in the immediate years ahead".

H Shand and K Wetter (2006). "Shrinking Science: an introduction to nanotechnology". Chapter 5 In "State of the World 2006: Special focus: China and India". The Worldwatch Institute. WW Norton & Company, New York, USA.

why are nanoparticles different from larger sized particles?

The properties of atoms and molecules are not governed by the same physical laws as larger particles, but by "quantum mechanics". The physical and chemical properties of nanoparticles can therefore be quite different from those of larger particles of the same substance. Altered properties can include colour, solubility, material strength, electrical conductivity and magnetic behaviour. Nanoparticles can also be more chemically reactive and more mobile than larger particles, within both the environment and the human body.

For example, larger particles of zinc oxide are white in colour and chalky in texture. Used in sunscreens, it is opaque and greasy

David Emerson
source http://www.illotoons.com.au

NANOTECHNOLOGY APPLICATION	COMPANIES INVOLVED
Computers/Electronics	IBM, NEC, Fujitsu, Hitachi, Phillips, HP, Samsung, Motorola, Mitsubishi, GE
Food	Kraft/Altria, Unilever, Nestle, Heinz
Drugs/Healthcare	GlaxoSmithKline, Smith and Nephew, Merck, Elan
Oil/Energy	BP, Exxon, Chevron/Texaco, Shell, Halliburton
Clothing	Burlington Industries, Nike, Gap
Defence/Aerospace	Sandia/Lockheed Martin, Boeing, Qinetiq, Raytheon
Cosmetics	L'Oreal, Body Shop, Boots, Revlon, Avon
Chemicals	Dupont, Degussa, Dow, Henkel, ICI, Lanxess, Bayer, BASF
Agriculture	Syngenta, Monsanto, Bayer

– like the zinc creams used by lifeguards of old. However at a size of 20nm, these particles become transparent and non-greasy, enabling the development of see through sunscreens that don't leave a white film.

The altered properties of nanoparticles have created opportunities for the development of new profitable products and applications. However they also introduce new risks that have yet to be regulated.

nanotechnology is already making a commercial impact

In 2005, global sales of manufactured goods that incorporated nanotechnology totalled more than US$32 billion (as calculated by industry analysts Lux Research www.luxresearchinc.com). The overwhelming majority of this revenue came from sales of products that incorporated nanomaterials, with a very small amount coming from nanodevices.

Lux Research estimates that in 2004 products incorporating nanotechnology constituted around 0.1% of global manufacturing output. They estimate that by 2014 products that incorporate nanotechnology will comprise around 15% of global production, with a total value of as much as US$2.6trillion. To put this into context, that would approach the size of the information technology and communication industries combined.

Who is involved?

About US$9.6 billion was spent on nanotechnology research and development in 2005. At least 60 countries have now established publicly funded nanotechnology research programmes. Public investment is led by the Japan, US, and EU countries. Additionally, virtually all of the Fortune Global 500 companies whose business involves manufacturing are also investing in nanotechnology research. The table above shows just some of the commercial applications of nanotechnology and the companies involved.

Multinational companies specifically involved in Australian nanotechnology include Rio Tinto, AstraZeneca, BHP Billiton, Dow Chemical, DuPont, L'Oréal, Motorola, Orica and Revlon. Nanotechnology has also spawned hundreds of small nano-specialist companies. Australian nanotech companies include pSivida, Starpharma and Advanced Nanotechnology Limited.

nano products are already out there!

In their chapter on nanotechnology in the "State of the World 2006" report, the ETC Group estimates that over 720 products containing nanoparticles are currently commercially available. Most of these are not labelled as such. Australian nano products already on the market include:

- UV-resistant paints and furniture varnishes
- Transparent sunscreens

- Cosmetics and personal care products
- Wine and beer bottles with special finishes
- Self-cleaning, moisture-wicking, and stain and odour repellent fabrics
- Windows and building surfaces
- Specialist automotive and aerospace parts
- Industrial catalysts

For an interactive database of products that incorporate nanotechnology see the Woodrow Wilson International Center for Scholars inventory at: www.nanotechproject.org.

what's coming next?

Nano-encapsulation
Food, cosmetics, pharmaceutical and chemical companies, as well as the military, are working on nano-sized capsules containing flavourings, nutrients, drugs, pesticides and even chemical/ biological weapons designed to break open when subject to certain triggers. Simple nanocapsules are already being used in cosmetics, foods and pesticides.

Nano-devices
Nanoscale electronic components, electronic devices, medical equipment and diagnostic tools and sensors are being developed. Already the US defence research agency and Intel are using advances in nanotechnology to develop ever smaller wireless sensors capable of monitoring everything from farms to threats to 'homeland security'.

Nanobiotech
An area of expanding research is nanobiotechnology. Different approaches to nanobiotechnology being explored include manufacturing synthetic materials and systems that incorporate biological materials, or vice versa; harnessing natures' ability to 'self assemble' to build complex structures from the level of atoms up; and atomically engineering life atom by atom.

Human enhancement
The goal of improving human performance using convergent technologies at the nanoscale may sound like the stuff of a bad sci-fi novel. However human enhancement projects are already attracting interest and funding from powerful supporters including major corporations and US defence agencies.

Molecular manufacturing
The Foresight Institute (www.foresight.org), founded by nanotechnology pioneer Eric Drexler, suggests that nanotechnology will enable the development of molecular assembly-based nanofactories capable of decentralised, atomically-precise manufacture of everything from bicycles to supercomputers and weapons. However at present sophisticated

molecular manufacturing remains hypothetical and opinion is sharply divided as to which aspects will come to fruition.

why the science of the small brings huge problems

The expectations and hype surrounding nanotechnology have fuelled a nano gold rush. Governments and corporations world-wide have scrambled to be part of the 'next industrial revolution', not wanting to be left on the wrong side of a future divide between 'nano-haves' and 'nano-have-nots'.

In the midst of this race to boost research, seek patents and commercialise as quickly as possible, serious questions regarding ethics, human and environmental safety, socio-economic disruption and democracy have been ignored.

The transformative power of nanotechnology is such that we must take the democratisation of science seriously. Friends of the Earth believes that it is unacceptable that the introduction of such a transformative new technology should be driven by business and political interests without the involvement of the community.

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For further information about all aspects of nanotechnology, please refer to the following websites:

Friends of the Earth Australia nanotechnology
http://nano.foe.org.au

Corporate Watch
http://www.corporatewatcg.org.uk

The action group on Erosion, Technology and Concentration (ETC Group)
www.etcgroup.org

Royal Society and Royal Academy of Engineering (UK)
www.nano.org.uk

Swiss Re Global Reinsurance
www.swissre.com

nanobot and a dust particle

What would a nano world look like?

It's hard to imagine what a "nano world" would look like. Part of the difficulty lies in disentangling science fact from science fiction. Another part of the difficulty lies in guessing who will emerge as the winners and losers from particular developments, and so what the longer term implications for existing power dynamics will be. And finally it is intrinsically difficult to forecast the implications of any new transformative technology – undoubtedly as a result of nanotechnology's introduction and expansion, changes will come that can scarcely be imagined now.

It's become a cliché to joke that although billions of dollars have been invested in nanotechnology research and development, the most newsworthy product to date has been stain-resistant trousers. The applications of nanotechnology that have been commercialised so far lack the "wow" factor of some of the wackier proposals floating around - nanobots manufacturing steak from air (as envisaged by senior food scientists at DuPont); molecular manufacturing plants the size of a microwave capable of producing bicycles, bioweapons or new computers (as envisaged by the Foresight Institute); or the ability to upload your brain to a supercomputer (as envisaged by the US National Science Foundation).

Current applications of nanotechnology are based mainly on the use of nanoparticles of familiar substances (for example metal oxides), nano-encapsulation, and to a smaller extent, simple nanodevices. Products include: scratch proof sunglasses, transparent sunscreens, stain-repellent fabrics, dirt-repellent bathrooms, longer-lasting paints, nano-encapsulated fertilisers and vitamin supplements, more efficient fuel cells, more reactive industrial catalysts, lighter and stronger specialist automotive and aerospace components.

However the fundamental goal of nanotechnology is not just the use of new materials science. Nanotechnology embodies the dream of controlling the building blocks of both living and non-living things, and the ability to remake the world from the atom up. Proponents and critics alike suggest that the real transformative power of nanotechnology lies in its capacity to converge different technologies that can operate at this scale. They suggest that nanoscale science will act as a platform technology, enabling break throughs in a wide number of different fields – communications and information technology, cognitive science, biotechnology, agriculture, medicine, manufacturing, energy production, military and environmental remediation to name a few.

For more information on nano visit: http://nano.foe.org.au

The analysis of the implications of such a powerful new technology remains sharply divided. Nano optimists see nanotechnology delivering environmentally benign material abundance for all, by providing: universal clean water supplies; atomically engineered food and crops resulting in greater productivity in agriculture with less labour requirements; nutritionally enhanced interactive "smart" foods; cheap and powerful energy generation; clean and highly efficient manufacturing; radically improved formulation of drugs, diagnostics and organ replacement; increased human performance through convergent technologies; much greater information storage and communication capacities; and personalised interactive "smart" appliances.

Nano sceptics suggest that it will simply exacerbate problems stemming from existing socio-economic inequity and the unequal distribution of power by: creating greater inequities between rich and poor through a nano-divide; entrenching corporate concentration and enabling its control of even the very building blocks of the natural world; distorting international power relations through its military applications and trade impacts; providing the tools for ubiquitous surveillance, with significant implications for civil liberty; introducing new and poorly understood risks to the health of humans and the environment; and breaking down the barriers between life and non-life, redefining even what it means to be human.

Central to any discussion of what a nano world would look like lie the same old issues of politics, economics and power, and the hubris of humans in their attempts to control the natural world. Nanotechnology's development has so far been driven by corporate and military interests, and there is no indication that (without robust civil society intervention) its future path will be any different.

It is interesting to question what our world would look like if the wildest dreams of the nanotechnology proponents were realised. What would the ability to manufacture food from air mean for our relationship with the natural world? What would the ability to produce atomically precise manufactured goods from a home nano-factory mean for global trade and labour markets? How would the ability to upload our brains to a supercomputer and dramatically improve human performance beyond species-typical boundaries alter what it is to be human?

The massive disruptions and disconnects in agriculture, trade, manufacturing, culture and social relations that would accompany such developments are extremely difficult to conceive or comprehend. It is also difficult to understand what the chances are that some of these hypothetical nanotechnology applications will actually be realised. Fierce debates continue to rage within the nanotechnology industry about whether or not sophisticated molecular manufacturing is possible and achievable. Wishing to avoid a public backlash against "weird science", most in the industry prefer not to speculate about nano-robots capable of assembling a steak, or whether or not we will be able to upload our brains. However, given the number of nano-analysts and nano-scientists who predict that molecular manufacturing will be achievable in the next 20-50 years (eg see a series of recent essays commissioned by the Center for Responsible Nanotechnology published in the journal Nanotechnology Perceptions), it is important to give some thought to its potentially devastating implications for human society.

Using desktop molecular factories would reduce the need for labour in the manufacturing sector to virtually zero. It would also dramatically reduce the need to transport, warehouse or sell goods and would have flow on effects for labour in many associated industries. Michael Vassar, in a recent Center for Responsible Nanotechnology (CRN) article, estimated that 60-80% of all work would become unnecessary in the USA within the decade of widespread availability of desktop molecular manufacturing. What sort of society would we have in Australia where 70% of the population did not work? How would this vast group of people feed themselves and meet their basic needs? Would a large part of the population descend into the lumpen proletariat – denied a way of making a living and living on the charity of molecular manufacture? Beyond these basic questions of survival, what would a life dependent on charity without work or the means to purchase non-essential goods mean for people's sense of identity, purpose, self-fulfilment and happiness?

Certainly our current model of representative democracy can not be upheld in a society where most people have nothing to do and are resentful of the elite which can entertain itself with work. Concurrent with the rise of molecular manufacture then would be the need for ubiquitous surveillance powered and facilitated by nano machines. Apart from the obvious impact of molecular manufacturing on democratic society and employment levels its creation also invites the risks of escalating global terrorism and fuelling an unstable omnicidal arms race.

For those who question the feasibility of molecular manufacturing, it is perhaps useful to turn our attention to the near term implications of the modest further development and commercialization of existing capabilities in nanomaterials, nanodevices and nanobiotechnology. We know that such applications will in themselves have serious implications for manufacturing, commodities markets, political economies, military capabilities, medical treatment, and the differentiation between living and non-living matter. In 2004 industry analysts Lux Research estimated that by 2014 products incorporating nanomaterials would constitute around 15% of global manufactured goods. The ETC Group suggests that nanomaterials could replace many existing commodities, for example cotton, rubber, copper or platinum, and that the demise

of these commodity markets could happen near simultaneously. This would disrupt trade, result in large scale structural change within many industry sectors and economies, and eliminate massive numbers of jobs in nearly every industry. We may not experience unemployment levels of 70% in Australia as a result of commodity displacement (albeit many countries in the Global South certainly will), but the structural collapse of cotton, copper and platinum production could certainly have profound effects on rural Australia and quite likely on the rest of Australia as well.

The experience of the European Industrial revolution tells us that with rapid technological change come winners, losers and massive social upheaval. A nano-divide is bound to develop irrespective of whether or not desktop molecular manufacturing is achieved. This divide will develop firstly between the nano-poor (most of the world's poorest countries) and the nano-enabled nations (the US, Japan, China, Europe, maybe Australia). It will also occur within each nation, as the gap between those who control the new nanotechnologies and those whose products, services or labour are displaced by them, and those whose can afford nano enhanced medicines, materials and goods and those that cannot, becomes ever larger. When considering the question of what a future nano world would look like, it is critical to go beyond the rhetoric of the nano optimists and ask first who controls this emerging powerful new technology, for what purposes is it being developed, and in whose interests is it being managed?

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Divide between rich and poor

Nanotechnology & Democractic Control

Despite the huge transformative potential of nanotechnology, and the billions of dollars of public funding invested in research and development, there is little transparency in how the decisions shaping this technology are being made. Nor has there been any genuine effort to engage the public in decision making about its introduction. What little public engagement there has been has focused on overcoming public resistance to nanotechnology rather than seeking real input into the course of its development.

Meanwhile, every indication is that nanotechnology's expansion will lead to the further erosion of democracy, through the widening of existing inequities and the concentration of existing corporate control.

The development and commercialisation of nanotechnology is being driven by corporate and military interests in an atmosphere akin to a gold rush. In the global race to boost research, seek patents and commercialise as quickly as possible, serious questions regarding ethics, human and environmental safety, socio-economic disruption and democracy have been ignored.

The current trajectory of nanotechnology suggests that it will:

- exacerbate existing inequities between rich and poor;
- entrench corporate concentration and enable its control of even the very building blocks of the natural world;
- further marginalise existing marginalised social groups, for example disabled people;
- distort international power relations through its military applications;
- provide the tools for ubiquitous surveillance, with significant implications for civil liberty; and
- break down the barriers between life and non-life, redefining even what it means to be human.

These impacts are discussed in detail elsewhere in this issue.

deliberative models for public participation

There is a plethora of mechanisms by which deliberative public participation in decision making can occur. Asides from the dictum that say that those affected by a technology should have a say in its deployment, participatory methods are also premised on the idea that legislative and bureaucratic processes are simply unable to draw out all the nuances surrounding the public interest implications of a particular technology – direct public input is required. Deliberative models aim to provide a random group of people with the information, resources, support and time they need to offer informed input into the policy development and decision making process.

Consensus Conferences
Consensus conferences are made up of 10 - 20 randomly selected participants. They consider background materials compiled by the conference organisers, propose a list of questions they wish to explore and decide on which experts they would like to consult. Following a public hearing in which the selected experts answer questions from the panel, the panel develops recommendations on how the technology or issue in question should be handled by the authorities.

Citizen Juries
Citizen Juries are similar to consensus conferences except that the jurors do not get to choose which experts to consult. Following the presentation of 'evidence' the jurors are asked to respond to a series of predetermined questions.

Deliberative Polling
Deliberative polling involves a random sample of participants who are initially polled on a given topic. They are then provided with additional information and attend a weekend session where they can question experts and political leaders, and discuss the issues amongst themselves. Participants then have an opportunity to further discuss their ideas and understandings with their friends and family before being polled a final time for their views.

Other mechanisms include "televoting", 21st Century Town Meetings, residents' feedback panels, surveys, focus groups, "search" conferences, citizen's assemblies, referenda, online deliberation, science cafes, future panels and more. Often a public engagement programme around a particular issue will use multiple approaches.

For more information on these and other forms of public participation refer to: The Danish Board of Technology: www.tekno.dk
Lyn Carson's "Active Democracy" website: www.activedemocracy.net
The Deliberative Democracy Consortium: www.deliberative-democracy.net

we need to inject democracy into nano development

Nanotechnology has a huge potential to place people and environments at risk and to generate and exacerbate social and economic inequalities. In the public interest, governments have a clear responsibility to involve the public in decision making about nanotechnology's development and commercialisation, and to put in place laws to protect people and the environment from nanotechnology's risks. Unfortunately it seems they have all been asleep at the wheel – none of these things has happened. No mechanisms have been established to ask the community if they want the kind of future that nanotechnology appears to be offering. And despite over 720 products containing nanomaterials now being commercially available, no government worldwide has to date established dedicated regulations for nanotechnology. For the most part nanoparticles don't even require safety testing before being sold.

Why is this? Nanotechnology has received a lot of attention from governments, who see it delivering the next industrial revolution. In the brave new nano world, governments have been keen to ensure that their markets are lucrative and that their corporations are competitive on the global stage. In their rush to gain a competitive advantage it seems governments have overlooked funding research into the inherent risks of social disruption, and harm to environment and health, associated with nanotechnology, and have been unwilling to critically assess nanotechnology's broader implications for society.

Does this prioritisation of profit over safety and socio-economic ramifications reflect what people want for nanotechnology? Well, have we ever been asked? It seems that governments around the world have succumbed to the hype surrounding nanotechnology and been reluctant to slow its development by involving the community in a discussion about whether or not we want it in the first place.

What is needed then is much greater citizen control over decision making regarding the development of nanotechnology. Advocates of participatory mechanisms for public participation in policy making have proposed various models via which this could be done (see box). These models seek innovative ways to resource, inform and support groups of "ordinary" people to grapple with complex issues, and to deliver their views on priorities and directions for future policy development.

With these and other models of public participation it is important to remember they are a means and not an end to the democratisation of technologies like nanotech. A key problem is that often there is no link between the outputs of these processes and the development of government policy. Friends of the Earth recognises that it is essential to establish formal mechanisms that require decision makers to integrate outcomes from public

to avoid institutional bias they also need to avoid being captured by particular interests, be unrestricted in scope and fully canvas the broad array of relevant issues. Friends of the Earth is strongly in favour of a wide programme of public participation around nanotechnology. We propose that a public participation steering group, comprising representatives from research, industry, union and non-government organisations, is established to oversee this programme and to ensure its transparency.

Stakeholder groups who will be impacted by nanotechnology (e.g. labour groups, public health organisations, disability rights advocates, civil liberties advocates, environmental organisations, consumer organisations, farmers, medical associations, specialist and industry organisations) should also be involved in public policy and regulatory development. Resources should be provided to enable all participants to take part in these processes in a meaningful way.

key deficiencies in public participation in nanotechnology decision making

A key underlying problem is that all too often public participation is simply viewed and used by governments as a tool to overcome public resistance – rather than to actually enable meaningful public input into decision making. The focus of all public participation around nanotechnology to date has clearly remained gaining public acceptance for what is perceived as an essential (and lucrative) technology, rather than seeking genuine public involvement in a decision about whether or not to pursue nanotechnology development.

Another key problem is the narrow frame within which governments are seeking to shape the discussion about nanotechnology. In many instances governments are seeking to focus the debate almost exclusively on the question of whether nanotechnologies can be made to be safe.

In framing public dialogue so narrowly, governments fail to allow for the investigation of deeper questions such as who controls nanotechnology and for what purpose, can they be trusted, what are the social consequences, and why this technology and not another, if any at all. It is these questions that ultimately lie at the heart of public responses to technologies and allowing for their expression must be central to the democratisation of nanotechnology.

For more information on public participation around nanotechnology see:
ETC Group's report NanoGeoPolitics, available at: www.etcgroup.org
Demos Publications See-through Science available at: www.demos.co.uk/catalogue/paddlingupstream/
TECHNE- an email list for discussion, activism and organising around technology and democracy issues. Subscribe at: www.lists.riseup.net/www/ info/techne

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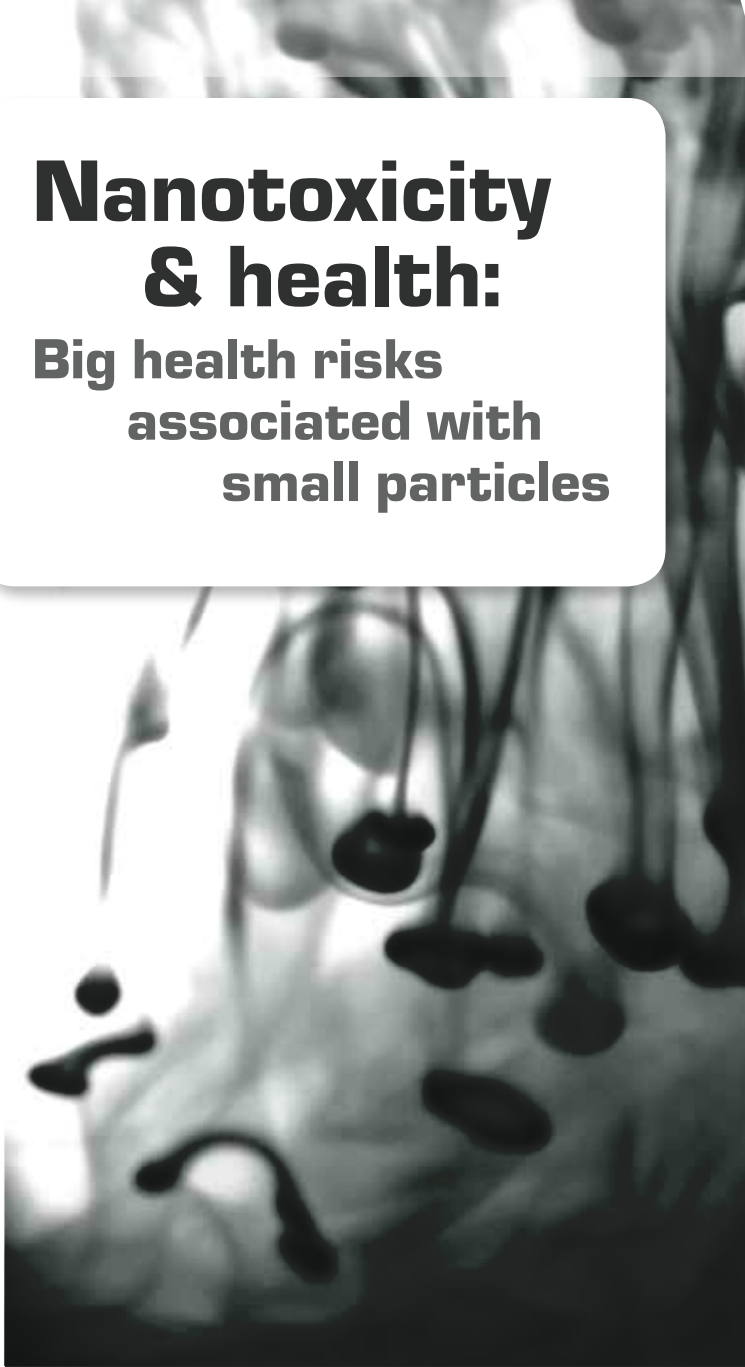
Nanotoxicity & health:

Big health risks associated with small particles



There is a small but growing body of scientific evidence that demonstrates the potential of nanomaterials to be toxic to humans, animals and environmental systems.

Leading scientific organisations, including the United Kingdom's Royal Society, have warned that the risks of nanotoxicity are serious. In its 2004 report on nanotechnology the Royal Society recommended that nanomaterials should be treated as new chemicals and be subject to new safety assessments prior to their inclusion in consumer products. The Royal Society further recommended that factories and research laboratories should treat nanomaterials as if they were hazardous, and until the environmental impacts

of nanomaterials are better known, their release into the environment should be avoided as far as possible.

However almost two years after the Royal Society's report, there is still no regulation in place to protect workers, the public and the environment from nanotoxicity. There is no requirement for manufacturers of products that contain nanomaterials to conduct safety testing of nanoscale ingredients before products are released onto the market, or to make the results of any testing public. Meanwhile, the Canadian-based ETC Group estimates that over 720 products containing nanomaterials are being manufactured commercially and released into the environment without being subjected to adequate — if any — health and safety testing or environmental impact assessment.

The failure of government regulators to take seriously the early warning signs surrounding nanotoxicity suggests that they have learnt nothing from any of the long list of disasters that resulted from the failure to respond to early warning signs about previous perceived "wonder" materials (like asbestos, DDT and PCBs).

The extremely high human costs associated with asbestos exposure-related disease are well known. In Australia, between 1987 and 2010, asbestos exposure is predicted to result in 16,000 deaths from mesothelioma and 40,000 deaths from lung cancer. In 2004 the Head of the Science Strategy and Statistics Division of the UK Health and Safety Executive recommended that rigorous regulation be developed to prevent workplace exposure to nanoparticles becoming the 'new asbestos'. He noted that if regulators introduced "controls that are too lax, significant health effects [will] harm many people. The history of asbestos should warn all of society of the human and financial costs of this possibility". However despite these strong words, there is still a regulatory vacuum surrounding nanotechnology, and the health of workers and the general public is still very much at risk.

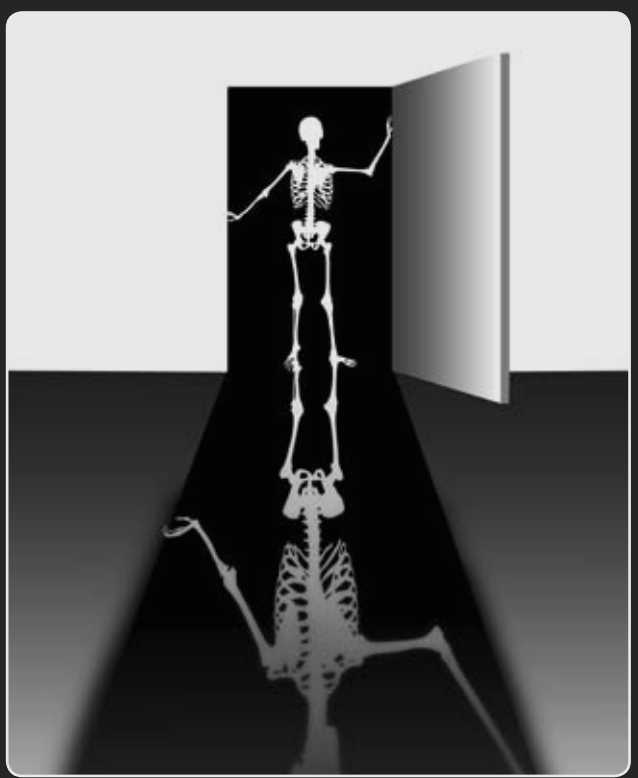
Nanotoxicology is an emerging field with only a small number of peer-reviewed studies published to date. It is often suggested by nano proponents that we do not yet know enough about the behaviour of nanoparticles to determine whether they pose enhanced risks to human health. However, the existing body of toxicological literature suggests clearly that nanoparticles have a greater risk of toxicity than larger particles. This is in part because as particles get smaller, their surface area to volume ratio increases. As surface area increases, so too does chemical reactivity and biological activity, increasing the risks of toxicity. Other factors influencing toxicity include shape, chemical composition, surface structure, surface charge, aggregation and solubility.

Nanoparticles are also much more mobile than larger sized particles. Nanoparticles readily enter the human body and gain access to the blood stream via inhalation and ingestion. It also appears likely that nanoparticles can penetrate the skin, although this requires further research (see article on cosmetics and sunscreen for further discussion). Once in the body, nanoparticles are able to cross membranes and gain access to cells, tissues and organs that larger sized particles cannot.

Inhaled nanoparticles are more likely than larger particles to penetrate the protective mucus lining of human lungs and be deposited in the deeper lungs. Scavenger cells usually intercept foreign bodies and any larger sized particles that make it past the mucus lung lining and into the deeper lung. However these cells have difficulty recognising nanoparticles, are readily overloaded, and their action is impaired. Because nanoparticles penetrate so deeply and are cleared so poorly, they result in far greater damage to the lungs than larger particles. Animal studies have routinely demonstrated lung inflammation, oxidative stress and negative impacts in other organs and the cardiovascular system following inhalation of engineered nanoparticles.

Inhaled nanoparticles can cross from the deeper lungs to the blood stream, from where they can circulate around the body. Once in the blood stream, nanoparticles are transported around the body and are absorbed by organs and tissues including the brain, heart, liver, kidneys, bone marrow and nervous system. Unlike larger particles, nanoparticles are transported within cells and taken up by cell mitochondria and the cell nucleus, where they can interfere with cell signalling, induce major structural damage and result in DNA mutation.

It appears that once in the bloodstream, nanoparticles are



deposited mainly in the liver, followed by the spleen. The length of time that nanoparticles may remain in vital organs and what dose may cause a harmful effect remains unknown. However even low levels of exposure to carbon fullerenes (buckyballs) have been shown to be toxic to human liver cells. Carbon nanotubes cause the death of human kidney cells and inhibit the growth of new cells. Carbon fullerenes (buckyballs) have also been found to cause brain damage in fish.

Researchers are investigating the ability of surface coatings to make dangerous nanomaterials such as fullerenes and cadmium-containing quantum dots (used in biological labelling) safe. However studies have shown that both surface coatings and modifications can be weathered over a short 1-4 hour period by exposure to the oxygen in air, or by ultraviolet irradiation. It is also thought possible that the coatings of ingested material could be metabolised in the body to expose their toxic inner core.

There is a complete lack of direct data for human and environmental exposure levels of engineered nanoparticles. This is of grave concern, especially for workers handling nanomaterials as they are likely to be exposed at much higher levels than the general public, and on a more consistent basis.

Workers may be exposed to nanoparticles during the research, development, manufacture, packaging, handling, transport and use of nanotech products. Exposure may also occur in cleaning and maintaining research, production and handling facilities. Rates and levels of existing workplace exposure to nanomaterials within all these sections of the production chain are unknown. However it seems reasonable to suggest that very large numbers of workers have been exposed at some point in the production of the more than 720 consumer products that now contain nanomaterials. The US National Science Foundation estimates that by 2015, 2 million workers world-wide will be directly employed in nanotechnology industries. By this point, the number of workers exposed routinely to engineered nanoparticles in the workplace throughout the production process will clearly be much larger.

The public is increasingly exposed to engineered nanoparticles while using products that contain nanomaterials. The risk of exposure is obviously heightened when nano products are applied directly to the skin (eg cosmetics or sunscreens), or ingested (eg food). Cosmetics and toiletries that now contain nanomaterials include toothpaste, soap, deodorant, shampoos, sunscreens, lipsticks, face powders and moisturisers. The Therapeutic Goods Administration states that close to 400 sunscreens sold in Australia alone now contain nanoparticle metal oxides. Food products containing nanomaterials now include canola oil, chewing gum, meal-replacement milk shakes, vitamins and colour additives. Most of the big food companies have nano research and development projects underway and the use of nanotechnology in food production and packaging is expected to expand significantly in the next ten years. The public may also be exposed to nanoparticles as a result of nanopollution, which will inevitably increase as the industry expands.

In summary, while not all nanoparticles are toxic, the existing research indicates that nanoparticles pose greater risks of toxicity than larger sized particles. We have enough evidence to conclude that nanotoxicity poses serious risks to health, especially for people who experience high levels of exposure on a routine basis, as happens in the workplace.

Regulatory systems must be established to manage the risks associated with exposure to nanomaterials before the industry expands further. A precautionary approach to nanotechnology's commercialisation could prevent huge human and financial costs, and waves of expensive compensation claims from injured persons, as has been seen with asbestos.

For references for any of the research discussed in this article please contact the author:

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Nanotechnology & threats to workers – will nano become the 'new asbestos'?

The world is rushing forward with the production and use of new and untested materials that could have a considerable impact on peoples' health. If we are not careful, it is possible that we will be facing a future epidemic that could even surpass the millions of deaths that have been caused from asbestos exposure. I'm talking about the development of nanotechnology. Despite the fact that there are very few practical applications for nanotechnology at present, it is already a huge industry with over 10 billion Australian Dollars spent on research and development worldwide in 2004. Much of this is public money. Nanotechnology could potentially lead to significant developments in many areas of our life including medicine, manufacturing and computing. However it could also bring significant new health hazards.

Most of the press coverage that there has been around the dangers of nanotechnology have been more in the realms of science fiction rather than fact. This has concentrated on the threats of "nano-goo" such as self-replicating particles that get out of control, or the "nano-robots" of Michael Crichton's novel "Prey". While there may, or may not, be some element of truth in prophesies of major risks from nano-particles or nano-machines that can reproduce themselves indefinitely, there are simpler, and much more real, risks.

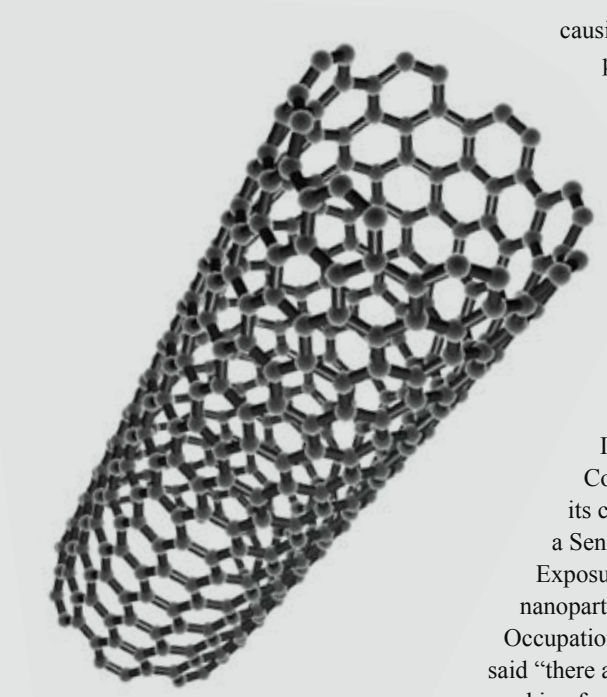
Nanoparticles are likely to be dangerous for three main reasons.

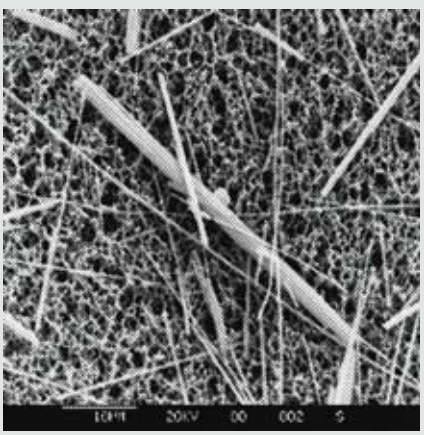
The first danger is that many nanoparticles are likely to damage the lungs. We already know that "ultrafine" particles from diesel machines, power plants and incinerators can cause considerable damage to human lungs. This is partially because they are such a small size that they can get deep into the lungs, and also because they carry other chemicals including heavy metals and hydrocarbons in with them. This may lead to lung disease and cancers, or they may have a general toxic effect on the body.

The second danger is that nano-particles can get into the body through the skin and digestive system. Again this could have a toxic effect, however in addition it may help create "free radicals" which can cause cell damage. There is also concern that once nano-particles are in the bloodstream they will be able to cross the blood-brain barrier.

The third possible danger is that the body has no natural immunity to new substances likely to be created as a result of nanotechnology. Our bodies have developed a considerable tolerance to most naturally occurring elements and molecules that it has had contact with. This has developed over millions of years of evolution. The body will not be able to recognise completely new substances and may either treat them as toxic, or they could trigger autoimmune disorders. The danger of contact with nano-materials is not just speculation. There is growing research that some nano-particles do actually cause damage. Some cause lung damage in rats, while others have been shown to cause brain damage in fish and dogs.

At the moment no one knows for certain how dangerous the many different types of nano-particles are likely to be for humans. Part of the difficulty is that many diseases, in particular lung diseases and cancers, often take decades to develop. It is therefore important that we do not allow workers, or the public, to be exposed to an unknown danger where effects may not be known for many, many years. There are those who have already recognised this. In a recent report, the British Royal Society, one of the leading scientific bodies, said that "nanotechnology offers many potential benefits, but its development must be guided by appropriate safety





IMAGES
Top: Carbon nanotube
Bottom:Asbestos fibres
source: www.etcbrunel.co.uk.tif

assessments and regulation to minimise any possible risks to people and the environment".

Within the United States consumer groups have already started calling for enforceable regulations so companies don't put unknown materials into commercial products unless we know they can be used safely over the full life cycle of the product, and can be disposed of safely without causing health or environmental problems. At a recent US house science committee hearing both environmental and industry representatives said federal spending on environmental, health and safety implications should be about 10-20% of the government's nanotechnology development budget.

In Australia, the Australian Council of Trade Unions raised its concerns in a submission to a Senate Inquiry into Workplace Exposure to Toxic Dust and nanoparticles. Steve Mullins, ACTU Occupational Health and Safety Officer said "there are thousands of workers working for those companies that are potentially exposed to this hazard". He called for action now.

The insurance company, Swiss Re has also warned that the uncertainty about the risks that nanotechnology and nano-pollution pose mean that they currently will not offer insurance to the industry. In some countries insurers are trying to offset responsibility for what they call "long tail" diseases onto the government so that in the event of any major health implications from new technologies neither the insurance companies nor the manufacturers will have to pick up the tab. Instead it will be left to taxpayers to foot any bill.

Consumer groups, environmentalists and trade unions have to start calling now for regulations to be in place to ensure that there is no exposure to nanotechnologies. This is different from saying that there should be no research or production of nano-particles. Instead it is simply saying that the production and use of nano-particles should be done within a contained process so that employees are not exposed to any potential unknown risk. Arrangements for the safe use and disposal of nano-particles must also be made prior to production commencing. Nano-materials must be treated just like any other serious unknown health risk and the same regulations that most countries have on dangerous chemicals should be applied just as rigorously to nanotechnology.

Within the UK, workplace safety advocates have managed to get the government health and safety body to produce advice on nanotechnology which confirms that employers must take a precautionary approach and ensure that workers are not exposed to nano-particles. It states that "as the risks arising from exposure to many types of nano-particles are not yet completely understood, control strategies must be based on a principle of reducing exposure as much as possible". However the TUC recognises that serious knowledge gaps compromise our ability to ensure that workers are not exposed to nanomaterials. Further work is required to make sure that engineering control systems and personal protective equipment can be effective in preventing exposure. Furthermore, at present little information exists about which workers in which sectors are actually facing exposure. Nonetheless, the government advice that employers must ensure that workers are not exposed to nanoparticles has been welcomed by trade unions and we are now involved in discussions with employers and the government to ensure that this advice is adhered to.

Nanotechnology has enormous potential and will almost certainly change many aspects of our lives in the coming years. However we must not let these potential benefits prevent us from protecting the health of our workers and the public. We must act now to ensure that we do not have a rerun of the asbestos tragedy where millions of people were exposed to a killer dust that even today kills tens of thousands of people across the world.

Hugh Roberston
Trades Union Congress, United Kingdom

Nanomaterials in sunscreens, cosmetics & toiletries:

making the risks of small particles very personal

Nowhere are nanomaterials entering manufacturing faster than in "personal care products" – cosmetics, sunscreens and toiletries. There are hundreds of personal care products which contain nanomaterials that are on the market right now. The Australian Therapeutic Goods Administration states that there are close to 400 sunscreens sold in Australia alone that now contain nanoparticle metal oxides.

The rush to incorporate nanomaterials in these products is especially concerning given the poorly understood risks of nanotoxicity. Personal care products pose clear risks of exposure to untested nanomaterials: they are used daily, are designed to be used directly on the skin, may be inhaled and are often ingested. Multiple products are often used at the same time, raising concerns that 'penetration enhancers' in some products may promote absorption of nanoparticles contained in another. Products already commercially available include: anti-wrinkle creams and moisturisers; transparent sunscreens and lotions; foundations and face powders; lipstick, blush and eye shadow; nail polish; deodorants; toothpastes; soap; shampoos and hair conditioners (See the recent FoE report *Nanomaterials, sunscreens and cosmeticds: Small ingredients, Big Risks,* available at : http://nano.foe.org.au).

In 2004 the world's oldest scientific organisation, the UK Royal Society, warned that the risks of nanotoxicity were serious enough to warrant nanomaterials being assessed as new chemicals. It warned against relying on existing safety tests of chemicals with larger particle size. The Royal Society recommended rigorous independent safety testing of cosmetics containing nanoparticles prior to their commercial release. They also recommended that products containing nanoscale ingredients should be labelled clearly, to enable people to make an informed decision about using these products. But despite recognition at the highest scientific levels of the enhanced risks associated with nano-cosmetics, two years subsequent to the Royal Society's report there are still no regulations anywhere in the world that specifically cover their manufacture and marketing.

In Australia the National Industry Chemicals Notification and Assessment Scheme (NICNAS) regulates the use of chemicals in cosmetics and toiletries, and the Therapeutic Goods Administration

For more information on nano visit: http://nano.foe.org.au

(TGA) regulates the use of chemicals in products that make therapeutic claims (eg sunscreens). However neither NICNAS nor the TGA requires manufacturers of cosmetics and personal care products to conduct new safety assessments for nanoscale ingredients where the use of substances in bulk form has already been approved. The NICNAS and TGA policies rely on the disproved assumption that substances known to be benign at a larger particle size will remain safe when manufactured at the nanoscale. This assumption is well-recognised to be fundamentally flawed – the toxicity of nanoparticles cannot be predicted from the known properties of larger sized particles. Furthermore, there is no requirement for labelling of nano-scale ingredients to allow the public to make an informed choice about using nanoproducts.

The health risks posed by nanoparticles are discussed in detail elsewhere in this issue and will only be mentioned briefly here. However it is worth noting the health risks associated with some nanoparticles already in use in the cosmetics industry.

The nano forms of titanium dioxide and zinc oxide, used in large numbers of cosmetics, sunscreens and personal care products, are photoactive and cause DNA damage to human skin cells when exposed to light. Perhaps of even more concern, carbon fullerenes (buckyballs), currently being used in face creams and moisturisers, have been found to cause brain damage in fish, kill water fleas and have bactericidal properties. Even low levels of exposure to fullerenes have been shown to be toxic to human liver cells. It defies belief that regulators would permit fullerenes to be included in moisturisers and face creams in the absence of independent safety assessment. Yet in an act of regulatory failure reminiscent of approaches to PCBs, DDT and asbestos, that is exactly what is happening.

Researchers are investigating the use of surface coatings and modifications to make nanomaterials such as fullerenes and metal oxides safe. However studies have shown that both surface coatings and modifications can be degraded over a 1-4 hour period by exposure to the oxygen in air, or by ultraviolet irradiation, suggesting that the protective qualities of surface coatings can be short-lived. The potential for the coatings of ingested materials to be metabolised, exposing the toxic core material, is also a concern.

Some cosmetics manufacturers and even the Australian TGA, claim that the potential for nano-ingredients in personal care products to be toxic to living cells and tissues is not a serious risk as nanoparticles remain in the outer layers of dead skin. The problem is that no one knows if this assertion is true. Other substances, for example organic liquids, pharmaceuticals and pthalate monoesters in personal care products, are known to be able to access the blood stream via skin uptake. However there has been very little published research into skin uptake of nanomaterials in commercially available cosmetics and personal care products.

Penetration of intact skin is in part dependent on particle size, meaning that skin uptake of nanoparticles is comparably more likely than uptake of larger particles. The ability of 1000nm sized particles to access the dermis when intact skin was flexed has been demonstrated. This suggests that uptake of 100nm sized particles is possible in at least some circumstances.

Preliminary studies of the ability of nanoscale zinc oxide and titanium oxide to penetrate the skin has produced conflicting results, with most studies indicating that nanoparticles do not reach the living cells and others suggesting that they can. However the few studies that have examined the ability of nanoparticles to reach the living cells of the dermis have generally been narrow in scope and have not adequately investigated the role of key variables that may influence the ability of nanoparticles to cross the skin. It is especially important to investigate the role of base carriers that enhance skin uptake of nanoparticles by altering skin structure or increasing the solubility of the nanoparticle in the skin.

Skin condition is another key variable that has not been adequately investigated. We know that broken skin is an ineffective barrier and enables particles up to 7,000nm in size - 70 times the size of nanoparticles - to reach living tissue. This suggests that the presence of acne, eczema or shaving wounds is likely to enable the uptake of nanoparticles. The fact that many cosmetics and personal care products are used on blemished skin or following shaving has been largely ignored in the discussion about skin uptake of nanomaterials found in personal care products to date.

One of the key problems is that we don't know how much safety research the sunscreen and cosmetics manufacturers are actually conducting. In the absence of laws that require peer-reviewed, publicly accessible information from the cosmetics companies, it is impossible to know how adequate safety assessment has been. Publicly funded research into the interactions between nanomaterials and the skin is being undertaken currently by both the European Union and the United States government. However little of this information has yet been published in peer-reviewed, publicly accessible literature, and most studies are likely to continue for several years before publishing their results.

For references for any of the research discussed in this article please contact the author.

For a more detailed overview of the research in this area, and for a database of over 100 sunscreens, cosmetics and personal care products that now contain nanomaterials please refer to the recent Friends of the Earth report "Nanomaterials, sunscreens and cosmetics: Small ingredients, big risks". The report is available at our website: http://nano.foe.org.au

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Nano-technology & the Environment:

The Nano-Atomic Reconstruction of Nature

introduction

Nanotechnology is a new set of techniques for engaging with and reconstructing nature at the level of atoms and molecules, or what I'll refer to as the *nano-atomic level*. Nanotechnology is not so much a distinctly new techno-scientific field, but a new platform and paradigm for enabling a range of existing techno-sciences to shift further down into the nano-atomic level, including chemistry, physics, biotechnology, information technology and engineering.

The applications and products of nanotechnology will range from breaking existing chemical compounds and materials into nano-particles and creating new types of nano-scale materials; enabling new ways of genetically modifying and reconstructing living organisms; and inventing new ways of manufacturing and putting together products from the ground-up. In some cases the end-products will be nano-scale in size, in others they will be larger-scale products manufactured using nano-scale techniques or by incorporating nano-scale materials. The range of applications and products will be enormous and span all sectors of the economy.

Addressing the question of the ecological implications of nanotechnology cannot just entail considering a narrow and defined set of new products and new problems. It also requires consideration of how nanotechnology might *re-frame* our relationship with nature, as well as how existing industries, economies and cultures — and the demands for commodities and resources — will be shaped and transformed by the development of nanotechnology.

However the current debate over nanotechnology's environmental 'impacts' has largely failed to adequately grapple with these broader issues and processes. On the one hand, nanotechnology is rather disingenuously presented by its proponents as an essentially 'green' technology that will improve the environmental performance of existing industries, reduce our consumption of resources and energy, and allow us to shift to an environmentally sustainable economy and way of life. In other words, nanotechnology will provide a panacea to existing resource constraints and environmental pollution – we will be able to continue a 'business as usual' path of economic expansion, they suggest, while minimising our ecological impacts.

Nanotechnology critics and regulatory institutions, on the other hand, have mostly emphasised the new forms of environmental hazards and risks from the release of nanoparticles — as well as other potential hazards — that mostly come under the banner of the 'unintended and unpredictable side-effects' of nanotechnology.

What has barely been explored, however, are the broader environmental implications of nanotechnology, if its radical potential for taking apart and reconstructing nature is exploited fully by the corporate-industrial global economy. For nanotechnology may ultimately facilitate the next wave of

expansion of the global economy, and the transformation and integration of ever more parts of nature into our systems of production and consumption.

a green and sustainable nano-economy? the ideology of nano-atomic precision

Some of the specific environmentally-beneficial applications of nanotechnology being developed or promised by the nanotech industry include: more efficient energy production technologies, such as more efficient solar and renewable energy generation technologies, as well as the more efficient use of fossil fuels; improved water and air filtering technology for cleaner drinking water and for reducing air pollution emissions; 'smarter' energy-saving building materials; biosensors for the detection of pollutants and pathogens; and environmental remediation applications such as products for cleaning up contaminated water and soils.

Beyond these specific applications, it is claimed that nanotechnology will enable the more efficient use of resources and energy across all industrial and economic sectors due to the capabilities of new nanomaterials and production techniques. This includes the prospect of nanomaterials that are stronger, lighter, more durable and reliable than the conventional materials they replace, or that require less resources and energy to produce and create less wastage and pollution by-products. Lighter materials for transport technologies such as aeroplanes, for example, may reduce energy consumption.

If the more distant promise of 'molecular manufacturing' is realised, then it is claimed that products may eventually be able to be manufactured from the ground up — atom-by-atom — to fit our precise specifications. Molecular manufacturing may entail being able to use any number of cheap and interchangeable natural resources as raw materials. In general, it is presented as a taken-for-granted certainty that nano-atomic precision will translate into the ability to precisely manufacture products with a minimum of resource inputs and waste outputs, and that these efficiency gains will in turn translate into a reduction in our current environmental impacts. I refer to this way of framing nanotechnology as the *ideology of nano-atomic precision*, whereby the degree of precision and control over nature at the nano-atomic level — as well as the control over the products of nanotechnology — are to some extent exaggerated, as are the supposed environmental benefits that will flow from this precision. At the same time, concerns over the imprecision, unpredictability and uncertainties surrounding the techniques and products of nanotechnology are down-played.

For nanotechnology proponents, the combination of these environmentally beneficial applications, incremental efficiency gains, and precise manufacturing techniques all add up to the promise — or is it just the techno-capitalist fantasy? — that nanotechnology will enable us to "decouple resource consumption from economic growth through initiatives in the recovery, recycling and reuse of material products", as expressed in a recent CSIRO report.

This promise/ fantasy of decoupling of resource consumption and economic growth goes hand-in-hand with the hope that nanotechnology will enable a purely technical solution to the global ecological crisis, sparing us the messy and painful business of having to reduce existing levels of production and consumption, or to otherwise tamper with existing political and economic structures.

novel environmental hazards and the threat of nano-pollution

However the ability to more or less precisely modify nature at the nano-atomic level is not matched at present by the ability to precisely predict or control the ecological impacts of the release of these nano-products into the environment. Nanotechnology now threatens to introduce an entirely new form of pollution into our ecological lexicons and into the world: *nano-pollution*.

In particular, nanoparticles and devices may constitute a whole new class of non-biodegradable pollutants. Like chemical pollution, the concerns over nano-pollution are based on the persistence, bioaccumulation and toxicity of nanoparticles and other nano-structures and products. Nanoparticles and other nano-structures will be released into the air, soil and water in the form of environmental remediation products; through waste streams from factories and research laboratories; as fixed or unfixed nanoparticles in composite products and particularly after nanoproducts have been disposed of; in the form of nano-chemical pesticides and fertilisers; accidental releases during handling or transport; as components of military weapons; and through the explosion of nano-powders.

The ecotoxicological impacts of nanoparticles remain poorly researched and poorly understood. However preliminary studies suggest that the size and toxicity of nanoparticles pose a serious threat to animals, plants and micro-organisms. Early studies also suggest that micro-organisms and plants may be able to produce, modify and concentrate nanoparticles that can then bio-accumulate following ingestion by other organisms. One of the few environmental studies carried out to date has shown that the carbon nanoparticles known as 'buckyballs' or fullerenes may cause brain damage in largemouth bass, a species accepted by regulatory agencies as a model for defining ecotoxicological effects. These carbon nanoparticles have also been found to kill water fleas and have bactericidal properties. Nanoparticles may travel through soils and be taken up by plants, thereby providing an avenue for entering the food chains of humans and animals. Because of their size and bonding properties, it has also been suggested

that nanomaterials may adsorb and provide an avenue for transport of other environmental contaminants already present, such as cadmium and petrochemicals. This tendency would make them a potential mechanism for long range and wide-spread transport of pollutants in groundwater.

The antimicrobial properties of nanoparticles have led to concerns that they may shift into microbial populations and disrupt signalling between nitrogen-fixing bacteria and their plant hosts. Any significant disruption of nitrogen fixing could have serious negative impacts for the functioning of entire ecosystems. High levels of exposure to engineered nanoparticles of aluminium (currently used in face powders and sunscreen) have been found to stunt root growth in five plant species.

Nanoparticles and devices which are non-biodegradable and are released *en mass* into the environment — such as nano-scale sensors or 'smart-dust', or nano iron oxide used already in the US for remediation — may also simply introduce their own set of environmental pollutants and hazards that cannot be cleaned up but clog up and pollute ecosystems.

Beyond the specific hazards of nanoparticles, the transformative power of nanotechnology also poses more far-reaching environmental threats and challenges. One of the inherent dangers associated with nano-biotechnologically modified organisms — such as modified viruses — is not only that they reproduce, but that they may also mutate and evolve in unpredictable and uncontrollable ways. The ETC Group has referred to the dangers posed by the release of nano-biotechnologically engineered living organisms as 'green goo'.

Adding to all of these concerns is the premature commercialisation of nano-products before adequate regulatory systems are in place and adequate safety testing and environmental assessments have been carried out.

the deep integration of nature into the economy

The range of environmental crises we now face are not caused by the inadequacies of existing technologies. They are instead a result of the extent to which we are willing to exploit,

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transform and manipulate nature in order to meet the ever expanding consumption levels and resource demands of over-developed and hyper-industrialized economies.

To suggest that any new production efficiencies and environmentally-beneficial applications made possible by nanotechnology will simply be translated into environmental 'savings' and a lessening of environmental impacts, is to assume that — after the introduction of a new technology — everything else essentially remains static and unchanged.

But new technologies do not only directly reshape nature and the material world, but also tend to shape and reconstitute the social structures and cultures of production and consumption. In particular, new technologies may facilitate the expansion of productive capabilities, changes in economic structures, and the creation of new types of commodity and material demands.

In the case of a new technological platform like nanotechnology, the ability to more precisely engineer living and non-living nature at the nano-atomic level offers an enhanced ability to reconstitute nature in order to meet the precise requirements of the dominant systems of production and consumption.

Nanomaterials and manufacturing processes may well introduce new efficiencies in the use of materials or energy consumption. But these very efficiencies per *unit of production* can also facilitate an overall *expansion* in the quantity and range of products manufactured. New production efficiencies often simply translate into cheaper materials and cheaper end-products. Improvements in the efficiency and endurance of batteries, for example, may simply enable the proliferation of a new range of portable electronic equipment.

Nanoparticles will be able to be manufactured from a wide range of materials, yielding new qualities from older materials, or finding new uses for previously unused or under-utilised natural resources. In this sense, natural resources may increasingly be encountered as *interchangeable* inputs for manufacturing systems. The new and improved properties of nano-materials and other nano-structures will also enable the development of ever more novel products with new features and capabilities.

Nano-biotechnology will enable the integration of living and non-living materials, such that nano-bio modified organisms will be able to be constructed from a tool-box of interchangeable parts. The smallest units of nature — including cells and viruses — may be transformed into tiny production units — or *nano-factories* — for producing commercially useful materials.

Molecular manufacturing techniques for manufacturing products from the ground-up — atom-by-atom — may be developed precisely because they produce commodities more quickly and efficiently than existing methods, and from a range of interchangeable raw materials, thereby accelerating and cheapening production processes.

In essence, nanotechnology represents the most powerful attempt to date to deconstruct the world into its most basic elements or units, and to then reconstruct them to meet our requirements. In contrast to the 'green' imagery promoted by the nanotech industry, this level of taking apart and reconstituting nature could be understood as one of the most radical interventions and even most violent assaults on nature to date.

In these various ways, nanotechnology opens up new avenues for the exploitation of the earth's resources, as ever more parts of the earth become mere putty to be reconstructed and harnessed to the goals of commodity production. Rather than decoupling resource consumption from economic growth — or simply *decoupling* nature from the economy — nanotechnology represents the deepest *integration* of nature into the economy yet attained.

In terms of specific applications of nanotechnology, for every environmentally 'beneficial' application we could probably identify other more directly harmful or destructive environmental applications. For example, nanotechnology is already being used to develop a new range of military weapons, new forms of chemical pesticides, and new technologies to assist in the extraction and processing of fossil fuels and for producing nuclear power. While some nano-materials and nano-products may require less resources and energy for their manufacture, other nano-materials may be very energy intensive and polluting.

The fact that nanotechnologies, nano-materials and nano-products are likely to be patented and controlled primarily by large corporations — and given that nanotechnology is likely to facilitate the concentration of corporate control both within and across industrial sectors — also reinforces the likelihood that the nano-economy will be biased towards large-scale, globally-oriented, and corporately-controlled forms of production. It is these corporations that will determine what products are developed and commercialised, driven of course by commercial interests and the profit-motive rather than green principles *per se*.

In the absence of any challenges to the dominant political and economic structures, we can expect this power to reconstruct the natural world to primarily be used to feed the global economy's insatiable appetite for resources and commodities.

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The risks of military applications of nanotechnology

Historically, the military have been at the cutting edge of science and technology in an effort to gain an upper hand on the battlefield and in strategic affairs. The emerging nanotechnologies are no different with significant investment in military nanotechnology from public and private sector organisations alike.

funding and why is the military interested?

By far, the single most well-funded sector of nanotechnology research and development is the military. In the USA, the National Nanotechnology Initiative 2006 fiscal year request was for $1.3 billion. The Department of Defence received 33.5% of total allocated resources[1] or a total of $US 436 million. In Europe as well, the military is one of the key investors in nanotechnology, though getting detailed budget information is more difficult.

Although investment in military research is hardly a new thing (in the USA $75 billion is invested in military R&D compared to $56 billion on non military R&D), it is worrying to see how disproportionately the nanotechnology research effort is funded by the military. What aims is the defence sector pursuing in funding research in this area? What are the associated risks?

the strategic vision and examples of programs

The vision that drives military research is not one filled with nano-robots. It is not today envisioned that nanotechnology itself will provide new types of weapons. The changes brought by nanotechnology will be of a more pervasive nature. In the words of Clifford Lau, the Pentagon senior science adviser: “Nanotechnology is a ‘force multiplier’. It will make us faster and stronger on the battlefield.”

In the short term, nanotechnology will be used as a continuation of previous programs that rely on “traditional” material science, microelectronics and chemistry. Nanomaterials will provide stronger and lighter armour, reduce maintenance costs and marginally improve the performance of kinetic weapons (better penetration of shells, etc). The shrinking of electronics circuits and the concurrent reduction in energy consumption will enable sophisticated communication devices and sensors to be deployed on a near permanent basis. The survivability of troops will also be improved by the insertion of sensors in their uniforms providing real time medical monitoring and deployment of sensors to detect chemical and biological agents[2]. In the medium term, the army will be seeking to improve human performance on the battlefield by means of an exo-skeleton[3]. All these technical advances will combine to produce an increase in the soldiers’ “lethality”. The US army anticipates that the deployment of troops with capabilities so far beyond that of their enemies would provoke awe and thus ensure victory.

Nanotechnology advances will also affect development in the field of bio, chemical and nuclear weapons in several ways. For example, it is believed that the nano-structuring of nuclear material pellets is essential to provoke chain reactions in laser driven nuclear research facilities, which in turn has the potential to enable new nuclear weapons to be developed[4]. The potential effect on global security will be discussed later.

the various risks

Risks resulting from military nano-research are wide ranging. They include scientific and geo-strategic risks, but the very development of these technologies and their operational deployment also creates military risks. In fact, it is anticipated that the increased complexity of military systems, the speed at which they react, as well as the deployment of thousands of sensors will soon render the battlefield unmanageable by humans[5]. With the limiting factor becoming the presence of a human operator in the decision loop, the temptation will be strong to remove any human involvement to increase the lethality of the system.

The huge research efforts carried out in the Global North to develop new military applications also create a dangerous geo-strategic situation. Other countries with significant research capabilities will not stay idle when the wide ranging consensus is that armies relying on nanotechnology will be vastly more effective. As a result one can only expect that the research bias in favour of the defence sector will provoke a new kind of arms race between countries. China and India for example have been increasing their own investments in nano related military research in the past few years. This in turn will provide justification for continuing or increasing budgets in our countries as disingenuously one could ask: how else are we supposed to defend ourselves from future Chinese nano-weapons?

Nanotechnology also has the potential to threaten existing weapons treaties. Coupled with recent biotechnology discoveries, nanotechnology will provide new development options such as targeted bio/chemical weapons, easier delivery methods, etc[6]. By making chemical and biological weapons easier and "safer" to use, it might provide further incitation to make use of them.

Lastly, military funding of research has, in itself, several risks and drawbacks. While this is not specific to nanotechnology and nanosciences the consequences might be quite severe in these fields as they could have a huge potential impact on society. Military funding of research often puts barriers to the diffusion of scientific results thus producing a lack of transparency. It also prevents proper (independent) risk assessment of research from taking place. Lastly, it tends to steer the advancement of science toward military objectives even when funding non-military fundamental science programs.

conclusions and recommendations

The first priority is to reduce military R&D and where possible ensure that the basic research carried out with military money is transferred to non-military funding agencies. As a way to ensure transparency of military funding of research a list of universities and companies receiving funds from defence agencies should be compiled and published on a yearly basis. The creation of independent risk assessment mechanisms for nano-military programs is required to ensure that dangerous fields will not be investigated. For example, the author supports Jurgen Altmann's proposed moratorium forbidding the development of non medical intra-body sensors[7] (a technology which could develop massively as a result of nanotechnology advancements). This moratorium could be extended to other areas where, even if the military rational exists to justify development of a technology (e.g. it is understandable that a commander wants to know the whereabouts of his troops and the environment they are in), the inevitable use of such technologies in civilian spheres would most certainly have a detrimental effect.

In conclusion, nanotechnology and nanoscience is a very broad field: it's a new way to see a whole range of subjects. The choice of applications developed will shape the impact this field will have on society and its perception by the public. We have to keep in mind that some discoveries require heavy investments but once the knowledge is out it becomes relatively cheap for others to re-discover them[8]. We therefore need to choose responsibly which technologies to develop and which to steer away from.

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[1] Note that not all military applications are funded by the Department of Defense; research in explosive and bio/chemical/radioactive agents detection sensors is the second priority of the NSF research budget.

[2] These sensors are often used to convince that nano-military research is required: if widely deployed in cities and airports they would potentially minimize the effect of terrorist attacks using bio or chemical weapons.

[3] The Natick Soldier Centre (NSC) website.

[4] See for example: André Gsponer in Disarmament Diplomacy No. 67.

[5] As noted by a military writer – (T. K. Adams in Parameters 31 2001)

[6] See Jurgen Altmann – Military Uses of Nanotechnology (2004)

[7] More drastic proposals have been voiced such as the "inner space treaty" by Sean Howard. See Disarmament Diplomacy No. 65.

[8] A typical example might be the development of the atomic bomb first by the USA, then by the USSR and Britain... and now by India, Pakistan, etc.

Nanotechnology and surveillance - Little Brother is watching you

Will the nano-enabled society also be a surveillance society? There are good reasons to be concerned. As nano-engineering shrinks the size of computer circuits and improves the ability of tiny sensors to gather information, the key technologies are now falling into place for powerful social monitoring systems. These could breach the privacy of individuals and be used to suppress dissent.

For example, consider the notion of 'smart dust' – once science fiction, now commercial reality. In 1994 Professor Kris Pister of Berkeley Robotic Lab began a project to develop 'dust motes' which are tiny autonomous sensors, powered by light and motion, that could be sprinkled across a battlefield, providing nearly invisible electronic eyes and ears to the US military. Today these working motes are the size of a penny but will rapidly shrink as nano-electronics develop. They self assemble into a wireless network that collaborates to track the movement of enemy troops, temperature and the presence of chemical and biological weapons. However these invisible networks could also be functionalised to monitor other goings on: - the state of crops in farmers fields, the working of factory machinery or the movement and behaviour of 'terrorists', workers or the rest of us. Pister's new spinout company, Dust Inc, is now commercialising his military motes for civilian uses as are Intel, Motorola, Honeywell and Crossbow Technologies. By 2015 these companies expect a world in which millions of ubiquitous invisible sensors, woven into buildings and everyday items, are able to monitor and control the environments we live and work in - a vision sometimes called 'ambient intelligence'.

While Pister's motes will create active surveillance, the framework for passive surveillance systems is already well established. Radio Frequency ID (RFID) tags - chips as small as a grain of sand- are already being built into packaging throughout Walmart, Tesco and other supermarkets. These can be read by a remote electronic reader from as far as 10 metres away with each RFID tag emitting a unique identifying signal. Hooked up to large databases this enables the large-scale tracking of goods, animals, documents and even people.
RFID chips are already implanted in some cars, tyres, credit cards, medicines, pets, prisoners and even passports with US passports due to incorporate RFID by October 2006. One company, Verichip, has developed an RFID tag which can be implanted under the skin in workers to control access to certain rooms in a building. A similar remote tagging approach has been developed by Californian startup Nanoplex (now owned by Oxonica). Their SERS nanotags are unique metal oxide nanoparticles that can be can be read remotely by a scanner. Since each nanotag emits a unique signal these nanoparticles mixed into everyday items could provide a truly invisible means of tracking people and goods.

The application of nanotechnology to medical devices will raise ever trickier questions of genetic and medical privacy. For example gene-chip technology by Affymetrix, in which thousands of strands of DNA are arrayed on a chip, can provide an almost instant readout of an individual's genetic predispositions. Other nanotechnologies, known as microfluidics and nanofluidics, can also provide rapid analysis of biological samples such as blood by forcing them through nanosized channels etched onto a chip. This is information that employers and insurers may be very keen to get hold of. In the longer term nanomedical researchers aim to build sensors directly into the body to monitor health and wellbeing. Once again employers and insurers could be very keen to have that personal data. They may even insist upon it.

If ubiquitous nanosensors do intrude into our lives and act as spies for the state, military and corporations, their impact could be psychological as well as undermining civil liberties. Social Scientist Michael Mehta of the University of Saskatchewan has warned that if civilians feel they are always under surveillance from invisible eyes and ears it could affect our behaviour as though we were living in a fishbowl - he calls this nano-panopticanism. The UK Royal Society also seems to agree the threat is real. In its 2004 report on nanotechnologies it recommended reviewing the existing privacy laws:

"As new forms of surveillance and sensing are developed, further research and expert legal analysis might be necessary to establish whether current regulatory frameworks and institutions provide appropriate safeguards to individuals and groups in society".

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Nanobiotechnology: the 'science' of vandalising life

While the 20th century heralded the arrival of gene manipulation, the 21st century brings us an extension of these capabilities: the manipulation of atoms and ultimately the creation of artificial life itself using nanobiotechnology.

'Ordinary' nanotechnology is concerned with the manipulation of matter at the nanoscale and expands the exploitation of the environment to the exploitation of the atomic and molecular interior of matter. Nanobiotechnology goes further: it aims to stretch the capabilities of biology beyond the limits imposed by evolution and species separation. Nanobiotechnology's holy grail is to fabricate/ invent/ create molecular machines containing both biological and engineered synthetic components – combining the living and the non-living, integrating the biochemistry of life with the chemistry of the non-living.

Nanobiotechnology's ultimate aim is to (re)create life itself. Proponents view living beings as a natural resource that should and must be further exploited to satisfy human needs. Biological systems become "replicating machines that make mistakes during the replicating process"; the goal of nanobiotechnology is to eliminate these 'mistakes' and economic inefficiencies arising from the 'mistakes'.

According to Touch Briefings, the nanobiotechnology industry had reached a value of $US960 million by 2005, with the market value of nanobiotech applications projected by researchandmarkets.com to increase to an incredible $US300 billion by 2020. Key application areas focus on the development of pharmaceutical and health care products (e.g. targeted drug delivery systems, medical devices using biological motors) and also hybrid biomaterials.

A crucial part in the endeavor towards hybrid/artificial life is played by the field of 'synthetic biology'. Synthetic biology views biology as an applied, engineering science and aims to redesign biological molecules, structures and organisms using standardized and interchangeable biological parts. To facilitate this development the Massachusetts Institute of Technology hosts a "Registry of Standard Biological Parts" <MIT; http://parts.mit.edu/>, currently containing about 100 parts (operators, protein coding regions, and transcriptional terminators), as well as devices (logic gates built from these basic parts). Biobricks, standard DNA parts that encode basic biological functions, are also available from the same website.

Craig Venter's company "Synthetic Biology" goes one step further: attempting to synthesize large segments of DNA to eventually construct full chromosomes and ultimately artificial bacteria. He claims that they will not be able to reproduce outside of the laboratory.

Robert Freitas at the Institute of Molecular Manufacturing is developing an artificial red blood cell, "powered by endogenous serum glucose", and "able to deliver 236 times more oxygen than natural red cells ... An onboard nanocomputer and numerous chemical and pressure sensors enable complex device behaviours remotely reprogrammable ...Primary applications will include transfusable blood substitution; tumor therapies and diagnostics; ... and a variety of sports, veterinary, battlefield and other uses." One can only wonder what will happen in the body if these artificial blood cells deliver such vastly inflated levels of oxygen to a non-target organ, or perform some other unexpected activity. Will it be really possible to thoroughly test for such an eventuality?

Nanobiotechnology is a field of key interest for the US government. It is envisaged that nanobiotech 'enhanced' soldiers will have super strength, endurance and reflexes, and nanobiotech clothing will provide necessary on-board hospital care. Nanobiotechnology will also enable the development of ever more lethal weaponry. A key concern is the development of genetically or otherwise targeted nanoweaponry, include nanobiological weapons. Artificially created or engineered bacteria may be able to infect only undesirables/ enemies. At a minimum they will be used for surveillance and scouting activities.

unimaginable hazards

Products of this technology will open us and the environment to unimaginable hazards, different from anything that we have experienced previously. At the most basic level is the problem that our current safety and testing standards (chemical, biological, toxicological) will not be sufficient to predict the behaviour of hybrid materials/ beings or to adequately manage the risks that large-scale introduction of nanobiotechnological organisms (eg for agriculture, bioremediation or warfare) introduces.

It is therefore concerning that nanobiotechnology scientists are pushing for industry self-governance without any government regulation, restrictions or assessment of the societal impacts of this

technology. A recent 'town meeting' of synthetic biology scientists held at MIT in the United States argued strongly for self governance. They argued that there was no need for government regulation regarding the type of artificially enhanced deadly viruses you can buy or sell, just a screening and recording of buyers. The main concern of the participants of this meeting was to ensure that 'good' people would still have access to synthetic sequences. The meeting therefore opposed government regulation of the sector, as the participants feared this would hinder the 'progress' of science. No time was spent discussing societal, environmental, human rights or ethical issues.

If a nanobiotechnology disaster does not come intentionally, it will certainly arrive by mistake. The debacle with GM crops has already shown how difficult it is to control and contain living organisms. Jean Pierre Dupuy points out that the reason for this danger lies not so much in the propensity of living beings to replicate, but is related to the inherent uncertainties associated with both the realm of quantum mechanics (see Nanotechnology 101 article) and the behaviour of complex systems.

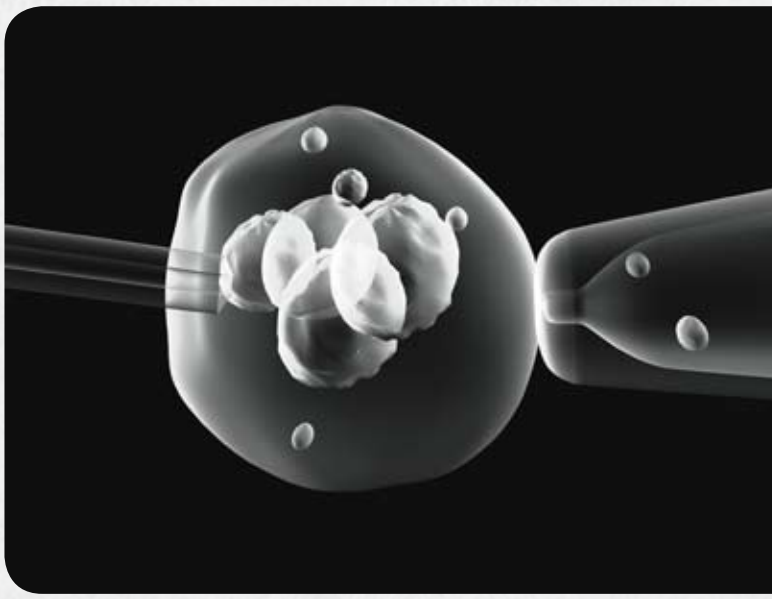
Most biological systems and their nanotechnological derivatives are complex systems. The behaviour of complex systems is inherently unpredictable – they are not governed by probability. It is the very complexity of the system that makes it robust and resilient to most events, until a threshold or 'tipping point' is reached. Beyond this point a sudden collapse of the system occurs with potentially undesirable consequences for humans and the environment. Mostly the location of these tipping points is unknown - alarm bells literally go off when it's too late. As Dupuy points out "the only way to determine the future of a [complex] system is to run it ...this is radical uncertainty....perfect knowledge of the initial conditions would not be enough to predict the future states of the system." The sobering conclusion is that we will never be able to predict with certainty the behaviour of systems based on nanobiotechnological organisms and hence we will NEVER be able to devise means of protection against malfunctioning of such systems.

a clash of values

The nanobiotechnology project also raises some important questions: what is nature and do we need to recognise limits on its exploitation for industry? What is life? These are fundamental questions and their answers will shape human destiny and the life of all beings, sentient or not.

The issue is one of values – a clash of values to be precise. Nanobiotechnology will give us the tools to totally modify or eliminate anything contained in nature. Of course, humans have always made tools and on some level interfered with nature, but we are talking here of a new level of interaction and manipulation, the ultimate reductionist point of view. This reductionist view has in the last 50 years taken on ever more extreme forms: from nature as machine, to nature as information and mere processes.

The proponents of nanobiotechnology see a cell as a natural machine. Nature and the living system is viewed as being akin to human artifacts – merely (self-replicating) machines. The desire is to become



the 'engineer' of evolution, to do better than evolution, to relegate all of nature and life to the realm of 'mere' artifact. This ambition to (re) make nature is an important value dimension of this and other 'modern' technologies. This then is the struggle between the military-industrial complex versus the rest of us.

Many people, and especially people in the South view life and nature as sacred and humans existing in interdependence to nature. Life and nature can be envisaged as Indra's net, a Buddhist metaphor, that imagines a vast net of pearls, arranged in such as way, that if you look at one, all others are reflected in it. Everything in the universe is not merely itself, but reflects and is involved and connected with everything else.

When subscribing to such a worldview, atom engineering and recreating life becomes unimaginable. Life/Nature/Earth then is not some arbitrary artifact either made by evolution or a collection of processes and parts to be improved by humans, but something to be cherished and cared for.

Sean Howard proposes a radical and ambitious solution – a treaty on the Prohibition of Nanotechnological Exploration and Engineering of Inner (Atomic and Molecular) Space. "Instead of reserving the nanosphere for peaceful human exploitation, it would seek its preservation as a natural [sanctuary], treating any exploitation as a criminal violation of sanctuary".

This not only reflects the value system of the majority of earth inhabitants, but it is also the safest course of action for the preservation of all beings. Can we make it happen?

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Small nano + large corporations = giant profits

Cotton farmers in Burma

"Just as the British industrial revolution knocked hand-spinners and hand weavers out of business, nanotechnology will disrupt a slew of multi billion dollar companies and industries"

Lux Nanotech Report 2004

who is investing in nanotechnology?

Nanotechnology investment is big business. While up until 2004 the majority of nanotechnology investment was made by governments, corporations now dominate nanotech research and development. The recent expansion of private sector investment in nano is not surprising given the forecasts of lucrative market opportunities: the US National Science Foundation predicts that the market for nanotechnology products will be $US 1 trillion in 2012, while Lux Research predicts that by 2014 the sale of manufactured goods that incorporate nanotechnology will run to $US2.6 trillion – 15% of all manufactured goods worldwide.

To reach such large returns, billions of dollars need to be spent in research and development. In 2004, the public and private sector spent a total of US$10 billion on nanotechnology worldwide. Multinationals from across all industry sectors are involved (IBM, Canon, Hitachi, L'Oreal, Kodak, Proctor &

Gamble, Syngenta, BASF, DuPont, Dow Chemicals to name a few), as well as many governments from across the globe.

A research paper by the South Centre in 2005 summarized the issue as follows: "the immediate and most pressing issue is that nanotechnologies are likely to bring huge socio-economic disruptions for which society is not prepared.... In the coming decades, nano-scale technologies could make geography, raw materials, and even labour, irrelevant."

our concept of raw materials will change

Possibly the most profound and apparent impact of nanotech products will be on our concept of what raw materials are and where they come from. Raw materials will cease to be merely grown in fields or dug up from the earth. Nanotechnology will enable the very atoms of commonly available elements such as carbon to become the raw materials that will underpin industrial manufacture.

Carbon is already the basis of nanotubes (and nanotube based fibres), nanofoam and fullerenes. Carbon based nanomaterials may well replace many raw materials currently used in a wide variety of sectors, from batteries to textiles. This will have profound impacts on the markets for these commodities and the economies which are now reliant on them.

Take the case of cotton. There are currently an estimated 350 million people in the world directly involved in the production of cotton. China, USA, Pakistan and Brazil accounted for almost 75% of the world's cotton production which was valued at US$ 30 billion in 2004/05. Southern countries such as Burkina Faso, Benin, Uzbekistan, Mali, Tajikistan, Cote D'Ivoire and Kazakhstan rely on cotton as a major source of revenue. Cotton is also an important export commodity for Australia, worth AUD$1.5 billion in 2004/05 making it Australia's 4th largest export commodity.

What if 50% of all cotton was replaced by nanofibres? Will governments in the Global South have prepared for such an occurrence by supporting the development of new livelihoods for farmers? Or will the price of cotton simply fall to rock bottom and farmers and other cotton workers be left unemployed and suddenly unskilled? What will happen to the Australian cotton industry?

Technological change and the social disruption it usually brings, has been with us for millennia. What will be different this time is that it is not one industry sector or one commodity that will be affected. We are confronting the potentially simultaneous demise of a number of key commodity markets (eg cotton, rubber, copper, platinum) and structural change to many industry sectors. The results may be devastating for many countries in the Global South and even in the Global North e.g. Australia.

One billion people in the Global South derive a significant part of their income from the production of export commodities. Ninety-five out of 141 Southern countries depend on commodities for at least 50 per cent of their export earnings. As for cotton production in Australia, we may feel that a crop that requires so much water and such heavy spraying is not suitable for production in arid Australia anyway. But what would happen to the many rural townships and communities that rely on cotton? It is not just the cotton farmers and workers, but the support infrastructure that surrounds this industry that would be affected – hospitals, schools, shops, transport to name a few.

increased corporate control and restructuring of industries

Technological 'advancements' are not inevitable but a result of deliberate strategies by industry and government. In the case of nanotechnology the strategy is to advance commodification right down to the atomic level. The enactment of this goal requires the concentration of capital and knowledge (many of the tools required for nanotechnology do not come cheap).

Proponents of nanotechnology will often proclaim that nanotechnology will help conserve energy and materials and will enhance our quality of life. But the reality is likely to be very different. In the last 100 years, efficiency gains in producing energy and materials, rather than leading to benefits for the environment, have instead resulted in increased production leading to increased consumption and more and

more throw away products. And as the means of production have become increasingly mechanised and automated, fewer and fewer workers have been required to achieve greater and greater productivity. Burgeoning corporate profit margins have therefore occurred at the same time as massive job shedding. Nanotechnology stands at the pinnacle of this trend. As for the promise that nanotechnology will enhance our quality of life – and perhaps even lead to a "leisure economy" - such perceived advantages of nanotechnology are likely to be accessible only to the privileged few.

the privatisation of everything

Nanotechnology will be the first 'platform' (or enabling) technology that is almost wholly owned by private interests. Many of the key ideas and the fundamental processes of nanotechnology have already been patented. This is unusual as the basic building blocks of other major technologies (e.g. biotechnology, computer software, hardware) were initially all in the public domain. The licensing deals that enable these patents are complicated and hidden by confidentiality agreements. This amounts to a wholesale privatization of a technological tsunami that may change many areas of our life. Patent holders will control who gets access to the technology and at what price. On the upside for civil society, these early patents are so broad and appear to overlap with so many other patents that the industry may be held up for years by legal fighting.

Over the last few decades we have seen a seismic shift from valuing the public good towards valuing privatisation as a holy grail. Now that we can vandalise nature/matter/beings at the atomic and subatomic level, everything can become private property: not just land, not just water, not just 'things', but life forms (artificial or otherwise) and the very building blocks of everything.

The fundamental question is then whether patents can be and should be granted on all these 'things'. A corollary to this is the question of what sorts of 'things' should be shared by all, what things can not and should never be 'owned' and what can be considered private property. Are some things owned by all of human kind and hence in some sense impossible to own? Sattish Kumar in 2006 calls for a paradigm shift in our idea that nature can be owned whether by individuals or governments. Kumar calls for a shift from ownership to relationship, from control to participation. As the 19th century anarchist Proudon proclaimed: 'property is theft' - especially if this 'property' is nature, and not just particles, processes and parts as nanotechnology proponents will suggest.

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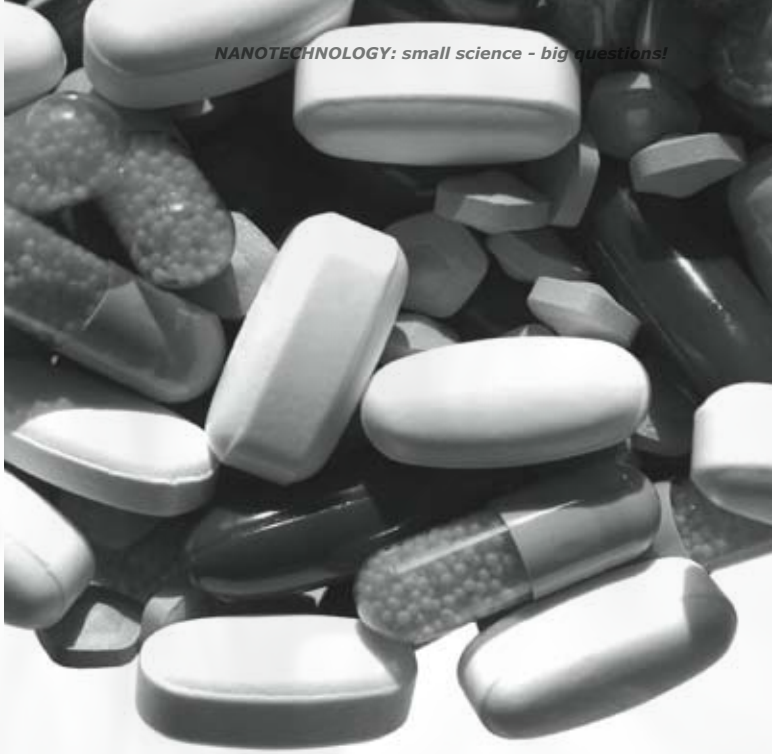
Rubber tapper in Malaysia

Nano enhancement medicine



Nanoscience and nanotechnology by itself or in convergence with (a) biotechnology and biomedicine; (b) information technology; and (c) cognitive science ('NBIC' -nano-bio-info-cogno) is envisioned by some to have the answer for global problems of disease and ill medical health. Others pursue extreme lifespan extension, if not immortality. Whereas others again argue for the pursuit of 'morphological freedom' allowing the human body to move beyond species typical functioning. Significant questions remain about nanomedicine – how much of the vision will become reality; who will have access to the products; are they safe; how do certain products impact on the 'social contract' between humans; and what impact will nanomedicine have on the lives of the poor and marginalized?

what is nanomedicine

The webpage 'Nanotechnology Now' describes nanomedicine as follows:

(1) the comprehensive monitoring, control, construction, repair, defense, and improvement of all human biological systems, working from the molecular level, using engineered nanodevices and nanostructures; (2) the science and technology of diagnosing, treating, and preventing disease and traumatic injury, of relieving pain, and of preserving and improving human health, using molecular tools and molecular knowledge of the human body; (3) the employment of molecular machine systems to address medical problems, using molecular knowledge to maintain and improve human health at the molecular scale.

According to Frost and Sullivann, nanotechnological processes in medicine will obtain a sales volume of about $180 billion by 2015. According to the Freedonia group, "demand for nanotechnology health care products in the US is projected to increase nearly 50 per cent per year to $6.5 billion in 2009, and by 2020 demand for nanotechnology health care products is projected to exceed $100 billion."

nanomedicine applications

Numerous applications for NBIC medicine are envisioned, in development or already in use. The Alliance for Nanotechnology in Cancer formed by the National Cancer Institute (NCI; USA) sees five areas where nanotechnology can help fighting cancer: (1) role of nanotechnologies in advanced imaging, (2) cancer detection/diagnosis via nanotechnologies and nanosensors, (3) nanotechnology-enabled therapeutics development and delivery, (4) nanotechnology devices and smart machines, and (5) nanobiology and nanooncology.

Nanomedicine offers to greatly improve existing drug delivery, increasing drug solubility, increasing potency, allowing controlled release over longer time periods, and enabling molecules to be targeted to individual organs or diseased cells for drug delivery or imaging purposes. The first three nanodrugs have recently been approved by the Food and Drug Administration (FDA) in the USA: Emend®, Tricor® and Rapamune®.

A recent EU "Nanoforum" report on health suggests that in the future, nano-formulated drugs will contain far more intelligence than the entire current system of drug delivery. Smart drugs will be able to travel through the body, 'diagnosing' problems, and providing targeted doses of medicine to diseased cells. More can be found in the Roadmap Report "Concerning the Use of Nanomaterials in the Medical & Health Sector."

Nanomedicine 'futurists' such as Robert Freitas go a step further suggesting that programmable and controllable nanobots will be used to circulate through the body, carrying out surgery at the cellular level. However whether or not such nanobots are possible remains a source of controversy in the nanomedical community.

many NBIC - 'health products' are envisioned for disabled people and others

Some NBIC advances are in the area of brain–machine interfaces; bionic implants; bionic ear; bionic eyes; next generation autonomous wheelchair control; bionic legs and arms; bionic knee; neural prostheses; spinal cord prosthese; speech; cranial, neural, and other implants; artificial joints, artificial muscles, artificial nose and tongues, nose on a chip, artificial kidney, artificial liver, artificial lungs, artificial discs.
Other envisioned products relate to immortality/longevity, the artificial wombs, the separation of our consciousness/ mind from the human body and the generation of new life forms (synthetic biology).

issues with NBIC medicine

Enhancement medicine

Enhancement medicine, using NBIC technology, is an emerging field that seeks to modify the human body beyond its Homo sapiens typical boundaries by improving on existing capabilities or by adding new capabilities.

It is a consequence of the emerging transhumanist/enhancement model of health and disease, in which health is no longer characterised as the normative function of biological systems within species-typical frameworks. Instead, health is characterised as the achievement of optimal functioning that is no longer determined by species-typical boundaries. The human body – no matter how conventionally "medically healthy" – is defined as limited and defective, in need of constant improvement made possible by new technologies appearing on the horizon (a little bit like the constant software upgrades we do on our computers) .

The emergence of enhancement medicine could lead to a perception of basic medical treatment without obtaining performance productivity outcomes being seen is futile care, and where the provision of enhancements with a positive performance productivity outcome is seen as the only acceptable treatment.

This preference for enhancement over curative medicine is a real possibility. To quote Murray the designer of the Disability Adjusted life years "Individuals prefer, after appropriate deliberation, to extend the life of healthy individuals rather than those in a health state worse than perfect health" (p.726). Such a preference would inevitably result in the exacerbation of existing inequities and the creation of new ones.

NBIC medicine for whom?

NBIC 'health' products which are employed in the field of nanomedicine or NBIC medicine are sold in terms of better and/or more sustainable health care, better medical health, more efficient health systems and health care delivery.

However, it is questionable whether the emergence of NBIC medicines will really benefit the poor and the marginalised. The Global Forum for Health Research found that only ten per cent of worldwide expenditure on health research and development is devoted to the problems that primarily affect the poorest 90 per cent of the world's population. As the poor and marginalized still do not have access to existing medication and even basic health care it is doubtful that they will have access to NBIC products. Some social not techno changes are needed to rectify this problem.

One has to ask whether NBIC products will even tackle the diseases that most affect the poor and the marginalised. Given that there are many 'healthy people ' who have the money to pay for enhancement products and the likely high profit return for enhancement products, one can anticipate that the 10/90 gap will increase.

It is also important to realize that technological change will not address the social determinants that underpin many diseases and the social well being experienced by the world's poorest people. If we are serious about reducing these diseases, we must address social as well as medical determinants, something which is often ignored.

NBIC and disabled people

The transhumanist model of health and disease leads to the transhumanist model of 'disability/impairment' where every unenhanced human being is, by definition, 'disabled' in the impairment /patient sense. The only way out is to enhance oneself beyond species typical boundaries.

A focus on enhancement medicine could significantly exacerbate existing inequities, creating ever increasing divides between the techno/ enhancement haves and the have nots, leading to an ability divide. A new marginalised class (techno poor disabled) could emerge in the form of people who can not afford techno bodily enhancements.

NBIC products related to diagnostic technologies could lead to an increase in preventative medicine especially in the prebirth stage.

The favouring of enhancement over curative medicine will lead to a shift in resources hurting the access of disabled people to medical services. The 'techno poor disabled' might compete with the traditional disabled people for 'health' dollars.

Transhumanism and the enhancement model may well be disquieting, but it is important to recognise that the 'able-ism' that exists already is underpinning their emergence. Able-ism can be understood to be the network of beliefs, processes and practices that produce a particular kind of self and body (the corporeal standard) that is projected as the perfect, species-typical and therefore essential and full human.

Safety

The use of nanomaterials in drugs raises safety questions. Nano-formulated drugs will be manufactured to increase potency and to increase penetration into individual cells and organs, across membranes that are impervious to larger particles. However these properties also increase the chances of nanomedicine proving toxic. It is obvious that nanomaterials should be tested for toxic side effects. It is important that new nanoformulations of existing approved drugs are subject to safety testing as new drugs.

Dr Gregor Wolbring is a health researcher, a vari-ability/disability studies scholar, a governance of science and technology researcher, a bioethicist and a biochemist. This article is an edited version of a longer article. For the full referenced version please see Dr Wolbring's webpage: www.bioethicsanddisability.org/start.hml or go direct to: www.bioethicsanddisability.org/foe.html

Nanotechnology & the quest to improve humans

The quest to perfect humans is centuries old; however, the convergence of nanotechnology, biotechnology, robotics and cognitive science is redefining the very nature of the human. The idea of the perfectibility of the human has been central to Western culture and is one of the cornerstones of liberal humanism. Generally, perfectibility has been seen in terms of striving toward moral perfection. During the late 19th and 20th centuries, however, ideas of perfectibility were extended to biological perfectionism and led to practices such as enforced sterilization programs in the USA and mass extermination of populations in Germany. Based on doctrines of 'degeneration', such population eugenics sought to enhance human 'stock' by getting rid of people who were seen to be slowing the progression toward biological and moral perfection.

Today, ideas of biological perfectionism have taken a new turn. No longer based on the blunter instruments of population management, perfectionism is increasingly high-tech. This is clear in reproductive technologies that allow extra-uterine screening of embryos, as well as within technologies that allow for the enhancement of human cognitive, sensory and physical capacities. Converging technologies that include nanotech, biotech, info-tech and cognitive science are seen as providing unprecedented opportunities for enhancing human performance through the integration of technologies with the building blocks of biological matter.

Nano-structuring opens an enormous range of possibilities, from high-performance cement to DNA that carries out basic mathematics. Exploiting these possibilities, the USA's Defense Advanced Research Projects Agency (DARPA) is developing exoskeletons to enhance physical capacities, neuro-pharmacologies to reduce the normal sensory and cognitive costs of sleep deprivation, and direct interaction of the human brain with peripheral devices. This would allow soldiers – the 'weakest link' in the military armory, and certainly the most politically costly – to fight harder for longer. No doubt, some are dreaming of the day when wars are fought without soldiers at all, replaced by uninhabited combat equipment. Others may be dreaming of – or dreading – a time when these military technologies are taken up within civil society, leading to a hierarchy of wealthy enhanced people and a poor underclass of the un-enhanced.

But not all uses of biotech and nano are geared toward enhancement. Nano-structuring and functional nano devices also open possibilities for targeted drug delivery and treatments for many diseases of the modern world, including cancer. They may also allow for the technological 'overcoming' of impairments of sight, hearing and nervous systems by, for example, linking exoskeletal limbs directly to the brain. The question, though, is when do such 'treatments' or therapies cross over into a perfectionism that makes a diversity of capacities illegitimate? Many are concerned that these 'therapeutic' measures will lead not only to increased discrimination against people with disabilities, but to their elimination through embryonic screening. As earlier movements of biological perfectionism remind us, there are dangers in seeking technological solutions to social problems.

Converging technologies are seen as a 'new renaissance' in science that is crucial to the future well-being of humanity. However, extending the idea of perfectionism this far means that liberal humanism is now turning into its opposite – post-humanism. But the new integration of the technological, biological and cognitive is not just a matter of treating the human being as if it were a machine – such ideas have been around since the 17th century, summed up in the rationalist motto of 'man as machine'. Instead, we are currently witnessing the transformation of the very 'nature' of the human – for better or worse, we are on the verge of becoming something other than what we have been for millennia.

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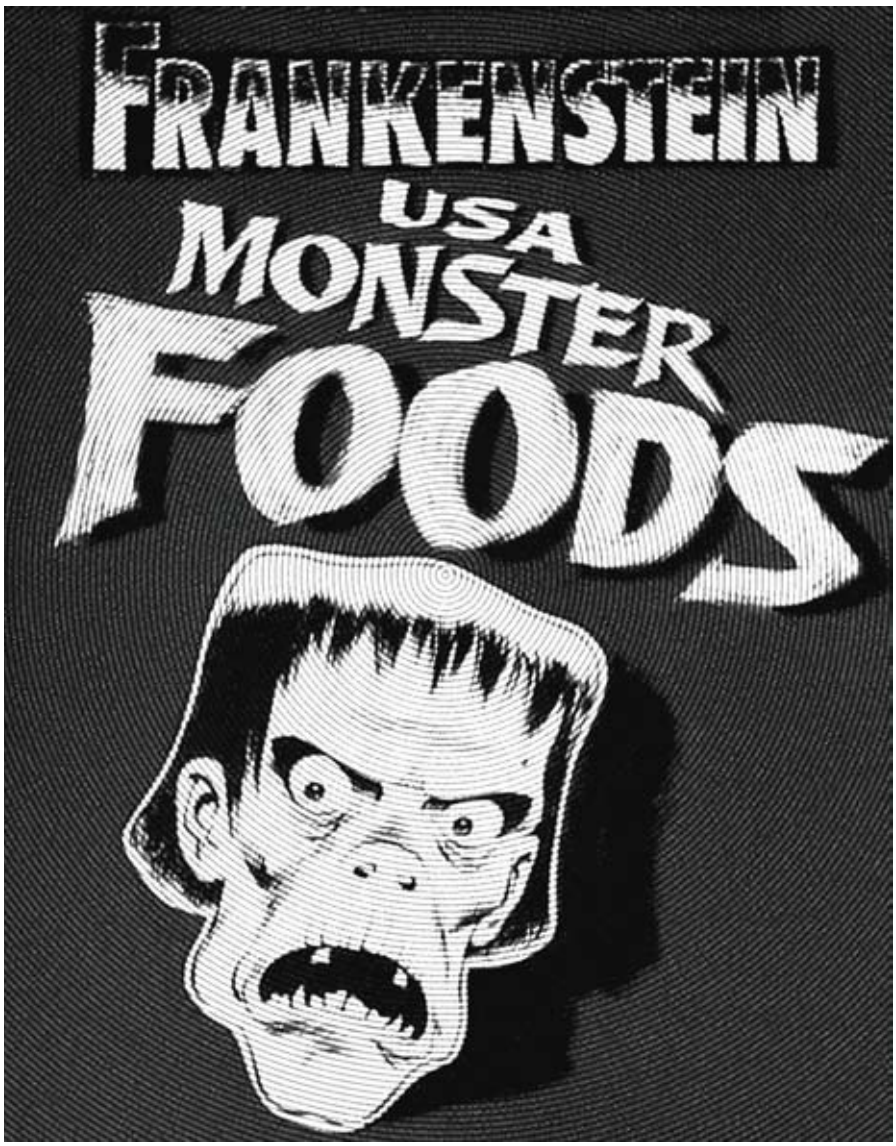
Nanotech Food Futures?

Photo: The Rich Can feed the World Already.
source: www.groundscore.org

Remember the moment when Willy Wonka[1] opened the doors to his chocolate factory to an unimaginable world filled with chocolate rivers, Oumpa Loumpas, and an astonishing mix of sweet edible treats? As a child, I thought Wonka's most remarkable invention was his 'ever-lasting gob-stopper', a chewing gum that could alter its flavour – from a creamy soup, to a roast dinner, and finishing up this three course meal with blueberry pie. This invention defied explanation in 1971 when 'Charlie and the Chocolate Factory' was originally released. However, recent applications of nano-technology to the food and agricultural industries mean designer flavour-changing food is now possible to fathom, and if developments in nano-tech continue at the current momentum they are set to radically alter food production systems. The market for nano-technology food and food processing is currently valued at over $2 billion, and this is projected to grow to $20 billion by 2010[2].

Nanotechnology, as the name suggests, refers to the manipulation of matter at the scale of atoms and molecules (under 100 nanometres). At the nano scale, common materials display new – and often unpredictable – properties, including altered electrical conductivity, strength, colour, and perhaps of most concern, toxicity levels. Due to their minute scale, nanoparticles can make their way deeper into the bodies of human and non-human animal species, in ways we don't yet understand, and produce impacts we have not yet realized and are perhaps currently unable to detect[3].



source: www.groundscore.org

Despite the risks of nanotechnology, food industries appear determined to add nano-materials to the mixing bowl. Leading the pack, in 2000 the $34 billion company Kraft launched 'NanoteK', a global research consortium involving universities and research labs. According to the Research Director, the rationale driving this project is to "keep a leadership position in food science. . . (and) to know how to use this technology for food safety and quality"[4]. It is somewhat ironic that while food safety appears a significant driver for nano-technology research, recent scientific findings indicate nanomaterials can cause adverse health impacts, by introducing new toxins into food chains[5]. Despite a growing body of evidence supporting concerns of nanotoxicity, nanotechnology R&D and its translation into commercial nano-materials largely proceeds in a regulatory vacuum.

There is already a wide range of applications of nano-technology to the food industry, some of which are available in Australia. These include:
• Functional foods that contain nutrient rich nano-materials. For example, since 2005 Australian food company George Weston have sold 'Tip Top Up Omega-3 DHA' bread containing Omega-3 powder. The source of Omega-3 is tuna fish oil from Canadian company Ocean Nutrition, encapsulated (packaged) via

cochealates that are able to mask the undesirable smell and taste of the tuna.
• Other nanotechnology functional foods available on the global market include: 'Canola Active', an encapsulated cooking oil that reduces absorption of cholesterol (currently sold in Israel); nanoscale capsules to prevent flavour and aroma loss; and nanoscale technologies able to create "on-demand" functional foods, enabling consumers to design when specific components of food (for example specific minerals and nutrients) will be available to their body.
• A range of "intelligent packaging" materials. For example, Nanocor produces Nanomer Nanoclays. By limiting the passage of oxygen and carbon dioxide, this packaging is able to keep food fresh longer. It is unclear whether this product is currently used in Australia, however with the market for "active, controlled and smart" food and beverage packaging worth at least $38 billion, it is not difficult to envisage the expansion of nano-packaging[6].
• Meanwhile, Kraft is funding university scientists to build "electronic tongues" that are capable of detecting food pathogens. When the pathogen is detected, packaging will change colour to alert consumers. Research into other forms of "smart packaging" includes a wrapper that releases a preservative when the food is beginning to spoil.
• And Samsung has recently released a 'Nano Silver Seal' refrigerator in Australia (and elsewhere). For around $6,000, you can rely on nanosilver coatings to sanitise the air and water in your fridge, keeping out bacteria and fungus.

The unreal vision of nanotechnology does not stop here. Plans to extend nano's reach beyond the farm gate and into the paddock include:
• Nanotechnology seeds with in-built switches for specific traits that can be externally turned on or off (including fertility).
• Pesticides where the active ingredients are encapsulated into a nanoscale "envelope" to control the conditions in which they become active.
• "Smart fields" that are monitored via wireless nanosensors that can detect when to apply water, pesticides and fertilizers. These inputs can then be supplied via encapsulated seeds.
• "Particle farming" by growing plants that are able to soak up nanoparticles that can then be industrially harvested.

Nanotechnology is being promoted as the technological fix we need to remedy our food insecure world, however, the claims made by nano proponents do little to address the underlying challenges to ensure the world's population has secure access to reasonable quantities of safe food, procured in culturally respectful and environmentally responsible ways. While functional foods might address one dietary deficiency – for example by providing food consumers with a powerful punch of Omega-3 – they overlook the range of other health problems associated with modern industrial diets. These health problems arise from the hidden caloric, sugar, salt and fat content of highly processed foods (many of which are ingredients in functional foods). In addition, our sedentary car-based lifestyles increasingly shape how we buy (for example our dependence on drive-through restaurants) as well as what we buy (including 'neat' food that can be eaten while driving). It is no coincidence that the emergence of a processed, packaged fast food diet has coincided with an increase in rates of preventable diseases, including heart disease, diabetes and obesity. Will nanotechnology come to the rescue? While some food companies claim new functional foods could solve these health problems, surely a simpler option is to eat more fresh fruit and vegetables and do a moderate amount of exercise. In addition to the problems associated with nanotech foods, the reliance on nanotech packaging for determining food safety ignores the capacity of normal people to make intelligent decisions about simple everyday things.

The lack of regulation of nanotechnology products leaves food industries to cook up a storm in the nano-kitchen without needing to share their recipes with anyone. Protected by patenting, trademark laws and a lack of mandatory labelling, food companies defy consumers' fundamental right to know what they are eating. The expansion of nanotech foods also intensifies the concentration of ownership and profits amongst a few global food, plastics and bio-delivery companies.

While some herald the application of nanotechnology to food and agriculture as a panacea for addressing the health, safety and environmental problems associated with modern food systems, emerging evidence suggests the contrary. Perhaps more critically, in a political and regulatory vacuum, it is difficult to envisage how we might even begin to accurately recognise the problems associated with these new technologies.

Violet, the obnoxious child in 'Charlie and the Chocolate Factory' discovered the 'ever-lasting gob-stopper' was not all it was cracked up to be when not only her gum became blueberry flavoured, but she herself turned into a blueberry. Like Willy Wonka, food industries and government will also need to more adequately assess the impacts of new food technologies before they sneak any further into our daily meals.

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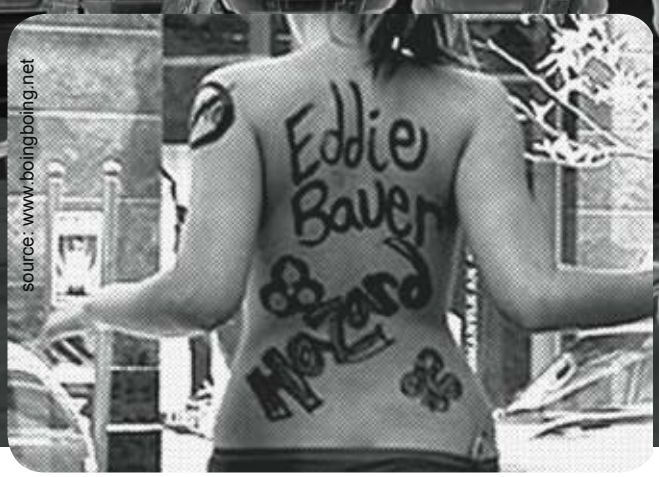
[1] Willy Wonka was one of the lead characters in 'Charlie and the Chocolate Factory'. This film, made in 1971, traces the story of five children who gain entry to Willy Wonka's mysterious Chocolate Factory after finding one of five lucky golden tickets. Wonka is an inventor of chocolate, and the film follows the children and their guardians as they traverse the factory discovering Wonka's inventions.
[2] ETC Group, (2004) 'Down on the farm: the impact of nano-scale technologies on food and agriculture', November. www.etcgroup.org.
[3] ETC Group (2004) ibid.
[4] Arabe, K. (2002) 'Food: edible nano is the new frontier', Industrial Market Trends, September 5.
[5] ETC Group, (2004) ibid.
[6] Kuzma, J. (2005) ibid.

Technology, risk and values - from genetic engineering to nanotechnology



source: www.boingboing.net

The scientific and business community are still struggling to understand the global public rejection of genetically engineered (GE) foods, and with the growing discourse around the risks and disruptive impacts of nanotechnology, many are becoming increasingly worried that history is about to repeat itself. There is a blossoming of reports and conferences that explore 'From bio to nano' and how governments can avoid 'fighting the last war'. PR consultancies and think-tanks are doing a roaring trade in communications advice and 'upstream engagement' tools to minimize the risk of backlash. However, it is becoming clear that virtually all of the issues that have made GE food so controversial are also present with nanotechnology. The only real question that remains for executives and politicians worried about a nano backlash is... when?

In some ways, the outrage over GE was the accumulated and unexpressed outrage over the role of industrial agriculture and chemical companies in our lives for the past fifty years. It was a gut-level reaction that the industrial experiment had gone far enough. When pesticides were first introduced, it was done with little or no knowledge by the general public of the negative effects, and it was done when the modern environmental and consumer movements had yet to develop. However, 40 years after Rachael Carson wrote 'Silent Spring', after 4 decades of creeping revelations about the health and environmental impacts of industrial agriculture, after 4 decades of increasing public skepticism about the impacts of science, the public was not willing to idly accept the next major technological experiment with the environment and with their health.

Social movements don't spring out of nowhere. They emerge and grow within a context – a mixture of culture, counter-culture, hopes, fears and ideas. The dramatic rejection of GE foods in the mid-late 1990's was a trigger event in a movement that started long before. The groundwork was laid by the many groups who had been campaigning against GE since the mid 1980's, so by the time Monsanto started planting commercial GE crops in the US in 1996, there was a clear political, social, intellectual and cultural context for the movement to flourish. The public was recently attuned to the problems of industrial food systems following BSE and other food/health scares, and was already distrustful of chemical companies. The obvious and immediate question over GE foods was, and still is, who benefits and who bears the risks? The answer was obvious. So was the response.

The official debate about GE has largely been limited to a narrow discussion of risk – involving an assessment of both the probability of some negative event happening, and the magnitude of the consequences. However, theorists such as Ulrich Beck have argued that the potential consequences of new technologies such as nuclear fusion and biotechnology render this traditional risk assessment approach inadequate because of the new and potentially massive scale of the consequences and the fact that, in the long run, the least likely event will occur. But even this critique misses what has been one of the primary sticking points for public acceptance of GE foods - the simple fact that the people who create the risks are not necessarily the ones who accept the consequences. Why should a person or a community accept any

level of risk whatsoever if there is no benefit for them? On the other hand, it is easy to see why companies are less concerned about creating and imposing risks if they are not accountable for consequences.

The mainstream debate on risk has flourished because it essentially leaves the paradigm of technological development intact. The basic assumption is that new technologies will be introduced unless a relatively narrow scientific assessment indicates that there will be negative impacts. This is in stark contrast to the model proposed by many critics of GE who argue that the burden of proof should be reversed – and that proponents of risky new technologies should be required to prove safety prior to introduction of their products. There is a rather compelling argument that both the probability of negative effects of genetic engineering, and the scale of any negative consequences are fundamentally unpredictable. This justifies a precautionary and enduring ban on the release of GE organisms into the environment.

Despite the early stage of technology adoption, the debate about nano risks is already quite well developed. This is probably due to a combination of a number of factors, including a more active regulatory and public/media context around risk following 10 years of relentless public conflict over GE. The other factors are the similarities between nanoparticle toxicity and the known toxicity of other ultra-fine particles (vehicular emissions etc) and the doyen of public health scandals – asbestos. However, issues of direct environmental and health risks are only one small part of a bigger picture. The introduction of transformative new technologies also raises more fundamental questions about values and ideas about our future.

source: www.groundscore.org

The problem is that it has somehow become taboo to contest ideas. It's as if industrial capitalism is somehow not an idea and is therefore exempt from scrutiny, while anything else can be dismissed as 'ideology' – a slur that implies a lack of critical perspective. At this point, it is worth asking what kind of society is it where anyone who raises criticisms of new technology is immediately derided as an ideologue and a Luddite? It's almost as though science has achieved a quasi-religious status, where bio and nanotech might well be regarded as the new creationism.

So what are the values that underpin the coming nanotechnology revolution? To answer this question, we need to ask a few closely related questions. Who is funding the technology? In whose interests is it being developed? To what end? How are decisions being made about the technology and by whom? The short answer is that nanotechnology is primarily being developed by the world's largest corporations and by the US military in order to introduce a range of new products and processes either for the purposes of increasing profits or extending military supremacy. While there are some genuinely interesting and possibly beneficial applications of nanoscience, this is not where the real action is and certainly isn't what is driving research agendas.

At a fundamental level, the debate over nanotechnology will be about democracy. It will be about our future and who gets to define it. About who benefits and who bears the negative impacts. That's what the GE campaign is about, and that's what is at stake with nano. In the absence of a cautious and responsible approach by governments and industry to such a powerful set of technologies, the community is faced with little choice but to put the brakes on - using whatever means are possible.

John Hepburn
http://johnswheelbarrow.blogspot.com

Research & regulation – what is being done now, and what more is needed to manage nanotechnology's risks?

introduction

In response to growing criticism from eminent scientists and civil society, governments are slowly starting to fund research into nanotoxicity, and to a far lesser extent, nanotechnology's broader ethical and social impacts. However there are still no laws anywhere in the world governing the use of nanotechnology or nanomaterials to ensure that they do not cause harm to the public using them, the workers producing them, or the environmental systems into which waste nanoproducts are released. Meanwhile, nanotechnology's broader ethical and socio-economic impacts are being ignored, despite the clear potential for nanotechnology to result in significant disruptions to our world.

what is being done now?

The United Kingdom's Royal Society, the world's oldest scientific organisation, released a report on nanotechnology in 2004. The Royal Society made a series of recommendations to government on measures it considered necessary to manage nanotechnology's immediate risks:

• The release of free nanomaterials into the environment should be prohibited until it is shown that the benefits of such release outweigh the risks.

• All nanomaterials should be treated as new substances and be subject to dedicated environment, health and safety (EHS) risk assessments that incorporate lifecycle analysis.

• In laboratories and manufacturing plants nanosubstances should be treated as would hazardous waste, and workplace exposure limits be set at a minimum.

• The social and ethical issues of nanotechnology should be examined and public engagement be initiated around the development of nanotechnology.

In the two years since the release of the Royal Society's report, governments have largely failed to act on the Royal Society's calls for caution. Whereas research into the commercial and military applications of nanotechnology has received literally billions of dollars of public funds, funding of research into nanotechnology's environment, health and safety (EHS) risks remains woefully inadequate. For a breakdown of this spending see the text box [page 44].

In addition to the very low amounts of EHS research funding, governments have been criticised for the lack of a systematic framework directing EHS research. In both the US and UK, EHS funding is distributed through grants, where it is up to individual scientists and institutions to identify areas of inquiry and submit proposals. Under this arrangement, there is a risk that whole categories of nanohazards will be overlooked. For example, at a workshop for nano scientists held last year by the Royal Society and the Science Council of Japan, no one present was able to identify any research being conducted in the UK into the environmental risks of nanomaterials.

The failure to adequately fund and direct EHS research means that the risks of nanotoxicity remain poorly understood. This is an obvious obstacle to the development of comprehensive regulatory regimes to manage these risks. An absence of political will remains another obvious key obstacle to ensuring that the safety of nanomaterials is assessed and managed adequately, as recommended by the Royal Society. Although there has been a flurry of committee enquiries and reports, nano-specific regulation remains to be implemented anywhere in the world. In the US for example, the approach has been to focus on the potential for using voluntary measures and existing, inadequate, regulations to manage nanotechnology's risks. In the UK efforts are being made to identify where existing regulations are unsuitable for the risks presented by nanomaterials, but this process is a slow and incremental one.

In Australia the federal government has established a Nanotechnology Taskforce to advise it on the development of a national nanotechnology strategy. This strategy is to encompass research priorities and support for commercialisation, but has so far yet to make any comment on the need for dedicated new regulations and EHS testing of nanomaterials.

Beyond beginning to address the need to regulate the obvious risks of nanotoxicity, no government has yet suggested how the complex ethical problems and socio-economic impacts of nanotechnology could be managed.

what more is needed to manage nanotechnology's risks?

The Precautionary Principle

The precautionary principle states that where there is risk of serious or irreversible harm, a lack of scientific certainty shouldn't stop action being taken to prevent such harm from occurring. Although the dangers of nanomaterials require much further research, preliminary toxicological study has indicated that nanomaterials introduce new and significant risks to human health and environmental safety. The precautionary principle suggests that governments should take action now to protect the well being of people and environment. This means that nanomaterials should not be released until their proponents are able to prove them safe.

A precautionary approach requires the manufacturers of new nanoproducts to demonstrate safety, rather than relying on society to prove products unsafe. In Europe the regulation of chemicals has followed this route. The REACH framework has a 'no data no market' rule which requires chemical manufacturers to explicitly prove the safety of new chemicals. While REACH does not cover nanomaterials, it offers a starting point for ways nanomaterials could be regulated.

Efforts to apply a REACH-like framework to nanomaterials have met with resistance from the US nano industry. At a Nanotechnology Conference and Trade Fair in the US last year speakers applauded the business friendly Toxic Substances Control Act which does not require manufacturers to provide comprehensive assessment of product safety. Critical of a REACH-like framework applying to nanotechnology, they were concerned that any such requirement would "stifle the development and distribution of those materials and products."[1]. For those advocating precaution, this is exactly the point – if a product won't stand up to comprehensive safety assessment, it shouldn't be on the market.

Technical Risk Isn't Everything

The social consequences of nanotechnology are likely to be just as, if not more, severe than the extensive EHS risks. Significant social disruption, increased power disparities and the erosion of democracy figure as just a few examples of the impacts that this technology will have. These are expanded in other articles in this issue.

In discussing the lessons to be learnt from the public rejection of GMOs in the UK, Professor Brian Wynne says of nanotechnology, "risk assessment has to be done - but we should beware of idolising scientific knowledge, and learn to place its insights and limitations in the context of effective debates about the proper social purposes and priorities of knowledge and technology - to invent a science-informed democracy where human ends are debated, not simply presumed."[2]

Here Wynne is saying that even if nanotechnology can be proven to be (technically) safe, it is still not necessarily valid to deploy it. Deliberation of the social impacts of nanotechnology and the ends to which it is applied must also feature in the processes governing nanotech. We must decide whether or not the introduction of nanotechnology is socially desirable, not simply whether or not we can manage its toxicological risks.

To put this into practice requires a radical shift away from current discourses of risk that sees it just in terms of the material harm caused by the physical properties of objects. What is required is a means by which the socio-economic impacts of nanotechnology, and other emerging technologies, can have equal footing in regulatory decision making.

How can we ensure that socio-economic impacts are not overlooked in the regulation of nanotech?

Answering this question is made all the more difficult when the current mantra of minimal government is increasingly to let 'the market decide' many aspects of social policy that were previously the responsibility of government.

The German Scientific Advisory Council for Global Environmental Change is an interesting example of a body that is developing ways of incorporating the potential for social disruption into its technology assessments. In addition to technical risks they also look at whether a technology will lead to:

- "violation of equity: the discrepancy between those who benefit and those who bear the risks";
- "potential violation of individual social or cultural interests and values"; and the
- "inequity and injustice associated with the distribution of risks and benefits over time, space and social status." [3]

It seems clear that given nanotechnology's potential for large-scale socio-economic disruption that incorporating social impact assessments into the regulatory process is essential. In any decision making process, assessment of the broader social impacts of nanotechnology should be accorded equal importance to the toxicological risks that it introduces.

The involvement of futurists, social scientists and technology forecasters will be essential in beginning to identify the socio-economic risks and changes that nanotechnology may bring. However broad public participation will be required to help decision makers develop mechanisms to consider and prioritise these impacts within an assessment system. Public engagement will be critical to determining which of these impacts we are prepared to accept and which we want regulatory systems to help prevent.

Conclusion

Currently lots of talk within government and industry circles is centred on avoiding a repeat of the 'debacle' of public rejection of GMOs with nanotechnology. Despite this no concrete legislation has been developed to manage nanotechnology's risks and public interest science remains seriously under funded. Without concerted public action it appears likely that governments around the world will continue to put profit before the public interest, leaving us all vulnerable to a Pandora's Box of new risks.

Government Spending on Nanotechnology Research into EHS and Social Risks

In 2005 more than US$10 billion was spent globally on nanotech R&D. Of this, 2/3 was from the corporate sector in private laboratories. Over 60 countries have nano research programs, but very few of them publish breakdowns of specific funding allocations. Because of this the total amounts going to research into the EHS and social risks of nanotech are not readily available.

US: In 2006 the US government allocated a total of US$1.3 billion to its National Nanotechnology Initiative (NNI). The Department of Defence was the single largest recipient, receiving US$436million. This figure doesn't include the considerable military applications funded through other Departments, including the Department of Energy. Only 4% of the NNI budget went to research into environmental and health impacts. Only 0.023% of the total NNI budget was allocated to studying workplace safety risks, despite the urgent need to ensure that workers already exposed to nanomaterials are not being put at risk of harm. The US allocated US$42million to the social and ethical implications of nano (3% of total NNI budget in 2006), but most of this money is going to public education projects with the aim of increasing public acceptance of nanotechnology.

UK: In the UK EHS research also receives far less funding than commercial nano research. There the government is funding research aimed to firstly establish methodologies for EHS studies and then to determine hazards specific to nanomaterials. The exact amount of funding is yet to be finalised, but it is expected to be in the tens of millions of pounds[4]. This is while total UK government funding on nanotech research and commercialisation will reach 200 million pounds by 2008. The UK government allocated 2.5million pounds (1% of total funding in 2006) to social and ethical implications of nanotechnology, but indicated that this would also fund public education into the benefits of nanotechnology in order to develop market acceptance.

Australia: In Australia the government itself doesn't even know how much public funding is reaching studies into EHS risks. Although the Department of Education, Science and Training has begun an audit of publicly funded EHS research, they haven't committed to making their findings public. Without this it is hard to determine the extent to which EHS studies are being funded, but without a firm government commitment to funding public interest science it can be guessed to be insufficient.

For further information:
ETC Group NanoGeoPolitics available at http://www.etcgroup.org
The IRGC Report 'Survey on Nanotechnology Governance' available at http://www.irgc.org
The US National Nanotechnology Initiative http://www.nano.gov
The UK Government http://www.ost.gov.uk
Australian Nanotechnology Taskforce http://www.industry.gov.au

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[1] 'Nanotechnology and the Environmental: Will Emerging Environmental Regulatory Programs Stifle the Promise?'
[2] Paper at the May 2005 Nano Science and Technology Institute Nanotechnology Conference and Trade Show www.nsti.org/Nanotech2005/showabstract.html?absno=438.00
[3] Brian Wynne *Learning the Real Lessons from GM*, available from www.esrcsocietytoday.ac.uk/ESRCInfoCentre/about/CI/CP/the_edge/issue16/index.aspx?ComponentId=6447&SourcePageId=1047
[4] DEFRA UK *Characterising the potential risks posed by engineered nanoparticles*, available at http://www.defra.gov.uk/environment/nanotech/nrcg/pdf/nanoparticles-riskreport.pdf

FoE Australia's Position on Nanotechnology

Nanotechnology's proponents and critics agree that this powerful new technology will bring unprecedented change, remaking our world from the atom up. Yet public awareness about the science of the small remains extremely low, and there have been no genuine attempts by government to involve civil society in a discussion about whether or not it actually even wants nanotechnology.

The serious health and environmental risks associated with nanotechnology, and its potential to result in wide-scale social disruption, remain poorly understood and wholly unregulated. The profound ethical questions raised by nanotechnology remain unanswered – and in many cases unasked. Is it acceptable to attempt to remake the world from the atom up? Whose interests is nanotechnology being developed in, and for what purpose? Who bears the risks and who will receive the profits?

Friends of the Earth believes it is time to put the brakes on the commercialisation of nanotechnology until some of these fundamental questions are addressed, until we have laws in place to manage the risks of nanotoxicity and social disruption, and most importantly, until we have genuine public control of the decision making process regarding nanotechnology's introduction.

FoE Australia calls for a moratorium on nanotechnology

In recognising the wide range of hazards and risks associated with the release of nanoparticles into the environment and into human systems, coupled with the likely disruptive social and economic impacts of nanotechnology, Friends of the Earth Australia supports a strongly precautionary approach to the development of nanotechnology.
In the absence of any established regulatory system to manage nanotechnology's risks, and in the absence of mechanisms to enable democratic decision making regarding nanotechnology, Friends of the Earth is calling for an immediate moratorium on all commercial research, development and release of nanotechnological materials and products. We recognise that further scientific research on the health and environmental safety of nano-materials and products is required to inform the development of regulations to manage the risks of nanotoxicity. However, for even this non-commercial research work to proceed, precautionary protocols will be required to protect the health and safety of researchers and to strictly minimise any environmental releases.

A comprehensive, national regulatory framework must be established that specifically addresses issues of nanotoxicity as well as the broader social and ethical issues related to the research, manufacture, consumption and environmental release of nanotechnological products. A regulatory process should also ensure the democratic control of and public participation in decision making on nanotechnology and other new technologies.

Public participation in decision making

We recommend the initiation of a wide range of participatory processes, including those based on the deliberative design model, to enable direct input from the general public into new technology assessment and determination of priorities and principles for public policy and legislation.

Stakeholder groups who will be impacted by nanotechnology (e.g. labour groups, public health organisations, disability rights advocates, civil liberties advocates, consumer organisations, environmental organisations, farmers associations, medical groups, specialist and industry organisations) should also be involved in public policy and regulatory development. Resources should be provided to enable all participants to take part in these processes in a meaningful way.

Please support FoE's Nano project!

Nanotechnology has huge implications fro environment, health and democracy, yet public awareness remains very low. please consider a donation to support our work on this important issue. **Visit: http://nano.foe.org.au**

For more information on nano visit: http://nano.foe.org.au

Social and economic impacts assessment

The disruptive social and economic impacts of nanotechnology are likely to reach far further than hazards to human health and the environment. We recommend an assessment process to ensure the development, application and control of nanotechnologies do not reinforce or create new forms of socio-economic inequalities, concentrations of wealth and power, means of social control and oppression, or weapons of destruction.

Comprehensive and precautionary regulation

We recommend the establishment of a regulatory regime involving comprehensive assessment of nanomaterials, and in which:

- All nanomaterials and products are subjected to rigorous health and environmental impact assessment, including evidence based testing, prior to commercial production and/ or environmental release.
- Due to the radically altered characteristics of nano materials compared to their larger scale counterparts, nano materials are assessed as new substances, even where the properties of larger scale counterparts are well-known.
- The assessments are based on the precautionary principle and the onus is on proponents to prove safety, rather than relying on an assumption of safety.
- Risk assessment of nanomaterials includes the entire life cycle of the products in question, from 'cradle to grave'.
- All relevant data related to safety assessments, and the methodologies used to obtain them, are placed in the public domain.
- Nanotechnological products are subject to a social impact assessment to ensure the development, application and control of nanotechnologies do not reinforce or create new forms of socio-economic inequalities, concentrations of wealth and power, means of social control and oppression, or weapons of destruction.
- Nanotechnological products are subject to an ethical assessment within a robust framework developed with widespread public input.

The urgent need for civil society action

Friends of the Earth recognises that the development of nanotechnology will be one of the defining issues of our time. Given its serious implications for every member of the community, it is critical that civil society participates in decision making regarding nanotechnology's introduction. We cannot allow the development of this transformational new technology to be driven exclusively by the interests of business and the military.

Many government advisers and industry leaders have stated publicly that "nanotechnology has learnt from the lessons of biotechnology". This statement is meant to reassure critical observers that this time around, the promoters of a controversial new technology are acting responsibly to avoid the widespread rejection that greeted genetic engineering. However nanotechnology's promoters have yet to demonstrate that they have in fact learnt anything about acting in a manner deserving of public trust.

The commercialisation of nanotechnology has proceeded rapidly, whereas public awareness remains extremely low. Because of this, there has been little pressure on either government or industry to take public interest issues seriously, or to give civil society the opportunity it needs to be involved in decision making about whether or not we even want such a disruptive new technology.

One of the key aims of Friends of the Earth's nanotechnology project is therefore to end the near silence that has enveloped nanotechnology's development to date. We want everyone who will be affected by nanotechnology to have the opportunity to consider the issues and implications, and to participate in a debate about whether or not we want nanotechnology, and if so, how it should be managed and utilised.

At this critical stage of nanotechnology's development, community action can divert and define its trajectory. Our voices and actions can have a profound impact on decision makers and on the future. It's time for environment groups, unions, disability rights advocates, civil liberty organisations, public health associations, farmers, consumer advocates, peace organisations and social justice advocates to work together to democratise decision making about this powerful new technology.

We encourage you to learn about the issues, develop your own ideas about nanotechnology, and if you share our concerns, then take action in your own way, in your own community. For further information about FoE Australia's nanotechnology project and how you can become involved, please visit our website, email the project coordinator Georgia Miller georgia.miller@foe.org.au or contact any of the project collective.

FoE Nanotechnology Project Collective
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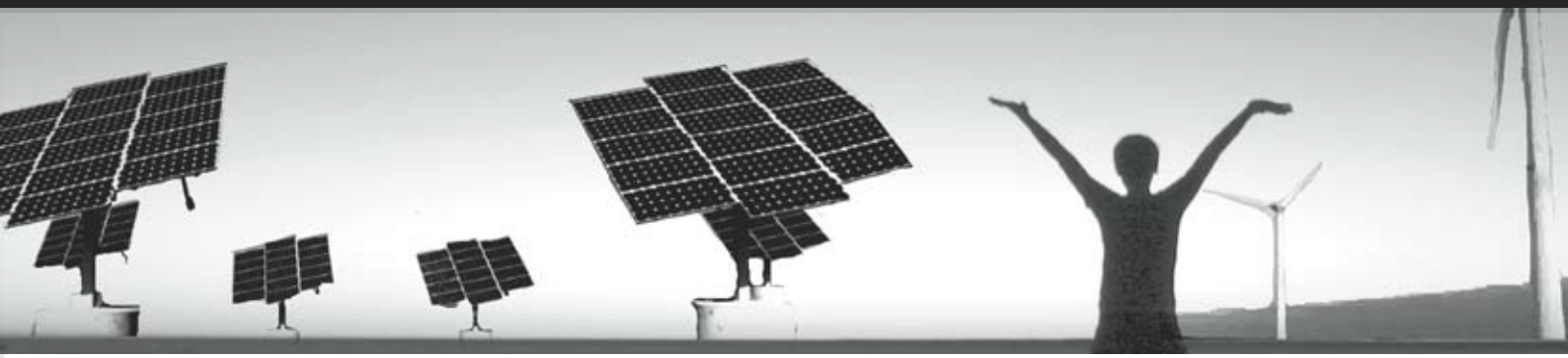
feature essay

The nuclear 'solution' to climate change ... and the real solutions

Jim Green



The nuclear industry is once again trying to exploit concern about climate change to reverse its ongoing decline. Nuclear power is being promoted not only as the solution to climate change, but also to water shortages and drought (by desalination), and world poverty - too cheap to meter, or too expensive to matter?

You begin to wonder if there's anything nuclear power can't solve!

One positive aspect of this debate is that it has highlighted the need for action to avert the social and environmental impacts associated with climate change. But it's been a limited debate. Only the nuclear 'solution' to climate change is being debated. Never mind that nuclear power simply can't do the job. Or that the adverse impacts of nuclear power are as alarming as those of climate change. The false 'debate' has diverted attention from the range of renewable energy sources and energy efficiency measures that, combined, can avert climate catastrophe.

The 'debate' has been based on several premises - all of them demonstrably false:

• It is not true that nuclear power is enjoying a resurgence - the global picture is one of stagnation. If there is a resurgence of interest in nuclear power, it is only because the manufactured nuclear 'debate' in Australia is being played out elsewhere.

• The media have also made play of alleged divisions within the environment movement over nuclear power - but you could name the pro-nuclear 'environmentalists' on one hand. To fill out the ranks of pro-nuclear 'environmentalists', corporate front groups are at work. One example is the Clean and Safe Energy Coalition, an 'astroturf' group funded by the Nuclear Energy Institute to convince a sceptical public that nuclear power is clean and green and that black is white.

• A third false premise is the claim that nuclear power is greenhouse-free. Significant emissions arise across the nuclear fuel cycle. Nuclear power can only reduce greenhouse gas emissions if the comparison is with fossil fuels. In comparison with renewables and energy efficiency, nuclear power increases greenhouse gas emissions, in addition to its proliferation, environmental and public health and safety problems.

Nuclear is no solution to climate change.

There are significant constraints on the growth of nuclear power, such as its high capital cost and, in many countries, lack of public acceptability. As a method of reducing greenhouse gas emissions, nuclear power is further limited because it is used almost exclusively for electricity generation, which is responsible for less than one third of global greenhouse gas emissions.

Because of these problems, the potential for nuclear power to help reduce greenhouse gas emissions by replacing fossil fuels is limited. Few predict a doubling of nuclear power output by 2050, but even if it did eventuate it would still only reduce greenhouse gas emissions by about 5% – less than one tenth of the reductions required to stabilise atmospheric concentrations of greenhouse gases. And that assumes that nuclear power displaces fossil fuels rather than renewables and energy efficiency measures.

Of the problems with nuclear power, by far the greatest is its contribution to the proliferation of nuclear Weapons of Mass Destruction.

• Of the 60 countries that have built nuclear power or research reactors, over 20 are known to have used their 'peaceful' nuclear facilities for covert weapons research and/or production.

• Four or five countries have produced nuclear arsenals under cover of a 'peaceful' nuclear program – Israel, India, South Africa, Pakistan, and possibly North Korea. Others have come close – most notably Iraq from the 1970s until the 1991 Gulf War.

• Nuclear power programs also provide pools of expertise for weapons programs in the five major nuclear weapons states – the US, Russia, the UK, France, and China. It is no coincidence that these five countries account for almost 60% of global nuclear power output.

• The 'peaceful' nuclear power industry has produced sufficient plutonium to produce about 160,000 nuclear weapons, each with a yield similar to the bombs dropped on Hiroshima and Nagasaki. Australian uranium has resulted in the production of over 80 tonnes of plutonium - sufficient for over 8,000 nuclear weapons.

• There's no longer any need for a systematic critique of the International Atomic Energy Agency's safeguards system since the IAEA has been surprisingly frank about its limitations in recent years. The IAEA's Director-General Dr. Mohamed El Baradei has acknowledged "vulnerabilities" in its "fairly limited" safeguards system and complained that the inspection system operates on a "shoestring budget" comparable to that of a "local police department".

A clean energy path.

A clean energy future will involve a wide array of renewable energy sources and energy efficiency measures. For example, a July 2002 study by The Australia Institute maps out a plan to achieve a 60% reduction in greenhouse gas emissions in Australia by 2050. The study envisages widespread energy efficiency measures, a major expansion of wind power, modest growth of hydroelectricity, significant use of biomass, and niche applications for solar photovoltaic electricity.

The biggest gains are to be made in the field of energy efficiency. The Australian Ministerial Council on Energy has identified methods to reduce energy consumption and greenhouse emissions in the manufacturing, commercial and residential sectors by 20-30% with the adoption of commercially available technologies and with an average payback time of four years. To achieve the same reduction of greenhouse emissions by nuclear power would require a capital investment of some tens of billions of dollars, and produce a legacy of high-level nuclear waste and plutonium.

A number of studies have considered the relative cost of various means of reducing greenhouse gas emissions. Replacing fossil fuels with nuclear power does not fare well in these studies. Energy efficiency measures are shown in a US study to deliver almost seven times the greenhouse gas emissions reductions as nuclear power per dollar invested.

Renewable energy, mostly hydroelectricity, already supplies 19% of world electricity, compared to nuclear's 16%. The share of renewables is increasing, while nuclear's share is decreasing. Wind power and solar power are growing by 20-30% every year. In 2004, renewable energy added nearly three times as much net generating capacity as nuclear power.

But in Australia, only 8% of electricity is from renewable energy – down from 10% in 1999. The Howard government:

• closed the Energy Research and Development Corporation in 1997-98;

• shut-down all renewable energy research within the CSIRO;

• withdrew funding from the Co-operative Research Centre (CRC) for Renewable Energy in December, 2002 (there are three CRCs for fossil fuel research);

• allowed fossil fuel interests to buy their way on to the Australian Bureau of Agricultural and Resource Economics climate change modelling team;

• refuses to increase the Mandatory Renewable Energy Target, which was set at a paltry 2%;

• recently blocked wind farm projects in Victoria and WA and is developing a "national code" to block more wind farms;

• established a secret cabal of fossil fuel interests, the Lower Emissions Technical Advisory Group, to help formulate energy and climate change policy; and

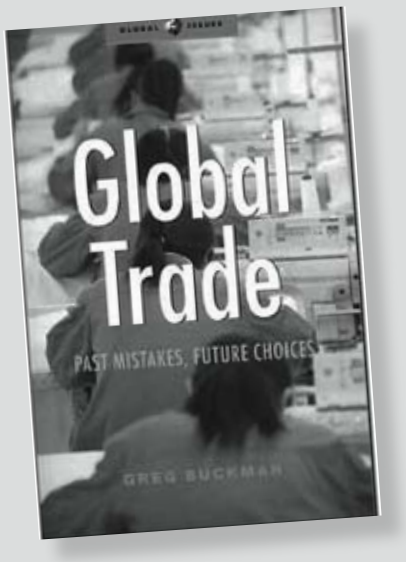
• has had some success with its relentless efforts to kill, weaken, and more recently marginalise, the Kyoto Protocol.

Dr. Mark Diesendorf wrote in the Canberra Times on February 15: "The producers and consumers of fossil fuels, and their supporters among public officials, the Federal Government and CSIRO, are well aware that we already have the technologies to commence a rapid transition to an energy future based on renewable energy and efficient energy, with gas playing the role as an important transitional fuel. The barriers to this transition are not primarily technological or economic, but rather are the immense political power of vested interests."

So we have the tools for a clean energy future, but entrenched fossil fuel interests are a major block, and meanwhile the government is using concern over climate change to boost the nuclear industry. We'll have to fight harder to turn the debate around. Let's start now.

For more information:
• 'Nuclear Power: No Solution to Climate Change', by Friends of the Earth and other environmental and medical groups, at: www.melbourne.foe.org.au/documents.htm
• Clean Energy Future Group reports at: wwf.org.au/ourwork/climatechange/cleanenergyfuture
• Climate Action Network of Australia, "Australia's Climate Change Strategy: The Real Way Forward", www.cana.net.au/documents/real_way_forward.pdf
• Friends of the Earth's climate and nuclear campaign websites :www.foe.org.au

book reviews



Global Trade: PAST MISTAKES, FUTURE CHOICES

Greg Buckman. Zed Books. London. 2005

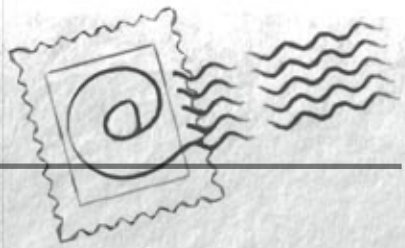
Greg Buckman follows up his 2004 book on globalisation with this very well written review of the past, present and future of global trade. The many complex issues surrounding world trade and its consequences (intended and perhaps unintended) are carefully laid out and extensively referenced. The chapters Trade, Poverty and Inequality, and Trade and the Environment are particularly harrowing for the careful dissection of the edacity of the global trade system. This book contains a terrific section entitled The Future of Oil, quantifying as well as anyone the simple mathematical house-of-cards that our energy future appears to be built upon. Buckman deals with peak oil mainly from the perspective of its impact upon world trade, and whilst there is considerable discussion regarding the current state of fuel and energy alternatives, the author makes no more than a passing reference to the very probable disruption to all aspects of society that peak (or end) oil will entail. It is highly likely that global trade will more than just recede into the background as more fundamental requirements take precedence. It is not all doom and gloom, however, as Buckman includes a critique of the alternatives proposed by the numerous arms of world trade reform, and the directions world trade needs to start heading in, now.

Concise and exhaustively researched, Global Trade concludes that we now find ourselves at the "... crossroads where we either start making daring decisions about our future as a race or we sink into a mire created by our past mistakes". With Global Trade, Greg Buckman is making great efforts to ensure it is the former.

Patrick O'Neill

Letters & feedback

CR 96 – environmental racism



Dear Readers,

The South West of Australia is Australia's only international biodiversity hotspot and one of the top ten in the world.

It is proposed to extract 45 gl. per year of water from Western Australia's South West deep aquifer, the Yarragadee, to pipe to Perth. This is a proposal fraught with an abundance of risks, and the cheapest quick fix to Perth's water problems. Changes in the hydrology would impact on terrestrial and aquatic biota. Drawdown of groundwater would affect freshwater flows of the south west's major river the Blackwood and its tributaries; with far reaching impacts on vegetation communities, old growth and re-growth forests; potential acidification of high and medium risk acid sulphate soils and consequently impacts on wetlands throughout the Swan (Western) and the Scott (southern) Coastal Plains.

It does not take into account climate change. Seasonal recharge to the aquifer in a drying climate is seen to be the solution. Water Corp. believes that if draw down problems arise the remedy is pumping up more water to fix the problem.

Solutions are available, not the least being conservation, adaptive use behaviour, other catchment processes from run offs, recycling, dual use and desalination.

The south west of WA has approximately 0.86% of forested land, the vast majority of the state is arid and semi-arid. Living on the fringe of a desert we cannot use water like European's do.

This is the most serious issue the South West of WA has had to face. There is a strong campaign to save the Yarragadee. Check: www.yarragadee.org

Joan Jenkins, Bunbury, WA

Dear CR,

the last issue was great! As always, an inspiring read, but most importantly it dealt with issues that other groups don't: enviro justice, climate refugees, radioactive racism ... and i had never even heard of conservation refugees until now. FoE is doing the cutting edge work, good on you for your efforts.

Tara Collins, Wollongong, NSW

Corrections – Chain Reaction #96

- Black GST article. Camp Sovereignty was established on Boon Wurrung land, just south of the Yarra River in Melbourne.

- Conservation Refugees. Mark Downie is the author of this article.

Chain Reaction appeal

Many thanks to the subscribers who supported our autumn appeal. Chain Reaction needs extra subscribers and financial support to continue.

Please consider making a tax deductible donation. See: http://www.foe.org.au/mainfiles/cr.htm for details

interview with

Annie Kajir

about stopping international logging in Papua New Guinea's rainforests

Anne Kajir accepting the Goldman Prize in San Francisco. Photo courtesy of The Goldman Environmental Prize

The order came from a woman: a person you couldn't ignore. Energy seemed to flow from her – the type of energy that could mobilise people and stop bulldozers. 'You follow me. I want you to see something,' she said.

So the law student obeyed. Following the woman onto her land in Wawoi Guavi in Papuan New Guinea's Western Province, the fledgling advocate – Annie Kajir – was shocked by what she saw. River waters that had been sullied by both soil loosened by logging and chemicals used to preserve the felled trees. Logs that had been ploughed into the earth, sticking out of the denuded surface. This was sacred ground – a sago making area. But it looked like the aftermath of a volcano. 'The way that they are logging my land, I won't have anything to feed my children,' explained the women.

Annie Kajir felt helpless. She explained that she was still a University student with not one law case before a court. But Annie's protestations fell on deaf ears. 'The woman turned to me and said: "You're a lawyer. You stop the logging."'

So Annie did as she was told. Back in Port Moresby, the capital of Papua New Guinea (PNG), the lawyers told her that the case was too difficult for them to take on. Undaunted, she sent the brief to senior barristers in Brisbane who said she had a case. On behalf of the traditional landowners, she filed a claim. There was a technicality. The case was withdrawn.

Annie persisted. By the end of her first year as a lawyer, she'd successfully defended a precedent-setting appeal in the Supreme Court of PNG forcing the logging industry to pay damages to the traditional landowners in another part of PNG (Warangoi in East New Britain province). Nine years later, the Wawoi Guavi claims are still before the courts. Of the woman who started her on this journey for justice, Annie says simply: 'I can't walk away from her. I see her all the time.'

Consequently, Annie is now the CEO of the Environmental Law Centre that she helped to establish. It's work that regularly brings her into contact with her uncle, Patrick Pruaitch, the PNG Minister of both Finance and Forest – but in courtrooms, not kitchens. Through a stream of cases run by the Centre, she is successfully challenging the corruption of government officials who have for over two decades continued to concede PNG's rainforests to the 'robber barons' in the timber industry.

Around the world, forest the size of a football field is lost every second. In PNG – where illegal logging is nurtured by governments' long-standing lucrative relationships with sections of the timber industry – as much as 46 per cent of the forests have already been sold as concessions to the logging industry. The Malaysian timber company Rimbunan Hijau dominates the industry. Through some 60 separate companies, it controls timber rights in an estimated three million hectares of PNG forest. The company figures prominently in the cases being brought by Annie and the Environmental Law Centre – cases that both challenge licenses on the grounds that they have been given to the company unlawfully and bring trespass claims for illegally logging indigenous land.

At first glance it's the dream of every progressive young lawyer who is straining to right the mountain of wrongs so efficiently bypassed by the legal system. Yet it has required the stamina of a championship boxer. Annie has been threatened many times. Having her boarding pass ripped up by a stranger at an airport is comparatively mild. She has been kidnapped, for which she's received therapy. ('I can't talk about it. It's under police investigation.') She has had her laptop computer and bag removed from her dining room table and stacked neatly on the balcony of her home as she slept. She's got the message: 'They're saying: "Who do you think you are? There's no where you're going to hide!" That's why my children don't live with me. They are living with my parents. [But] their threats will not stop me. If that means they will take my life, then so be it.'

No wonder that her bravery has been acknowledged this year with a prestigious Goldman Environmental Prize. As persistence builds her credibility, the doors to international politicians are opening so that she can put her present case: 'A lot of the illegal timber is bought by China and Japan, then converted to products that are sold in Europe, Northern America, Australia and New Zealand. It's coming from areas that are destroying livelihoods – destroying people. So by buying these products you are buying into genocide.'

The Europeans are paying attention. After steady campaigning by Greenpeace and others, there's been a significant drop in the EU market for products made from illegally obtained PNG wood.

Now Annie is off to China to deliver the message. Just how difficult will it be for a woman from PNG to get an audience within the Chinese Communist Party? Annie's response is typical: 'I have no idea yet, but I'm going to try.'

Chris Richards is a co-editor of New Internationalist magazine – a publication with parallel principles to Chain Reaction.

This column seeks to acknowledge some of the inspirational people in our movements. Please feel free to send stories for future editions to Chain Reaction

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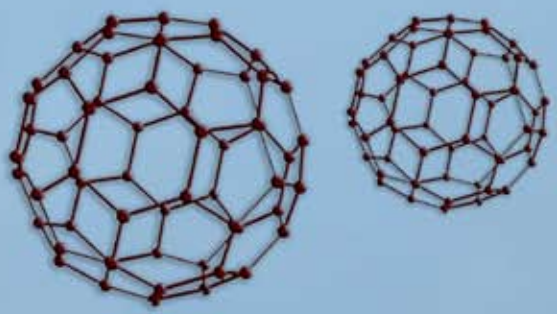
nanotechnology

small science, big questions



? Who controls nanotechnology

? Who bears the risks

? Who stands to gain

? Who is protecting the public interest

? Who gets to decide what our future world looks like

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