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Ignition switch

The US National Ignition Facility has so far failed to generate fusion energy, but repurposing it as a tool to study nuclear weapons and basic science could be its saving grace.

On a breezy day in 2009, action star Arnold Schwarzenegger, then governor of California, took to the stage to dedicate the National Ignition Facility (NIF), the world's most powerful laser. "I can see already my friends in Hollywood being very upset that their stuff that they show on the big screen is obsolete," the governor quipped in front of the recently completed facility, which uses lasers to squeeze fusion energy from a tiny pellet of hydrogen fuel. "Fusion energy may be exactly what will power future generations on the globe," he added.

Fast-forward three years and the script is somewhat different: the lofty hopes of Schwarzenegger and other politicians who attended the ceremony that day seem less realistic. At the end of September, officials at Lawrence Livermore National Laboratory (LLNL) in Livermore, California, where the NIF is based, announced that the facility would miss a crucial milestone to produce ignition — releasing as much energy from fusion as is supplied by the lasers. After an intense, six-year effort, the facility remains a factor of ten away from that goal. In the coming weeks, LLNL scientists are expected to lay out an alternative, much longer, path to ignition, while senior officials refocus the laser's work (see page 170). For now, thanks in large part to the NIF's role in nuclear-weapons science, politicians will allow the research programme to trundle on at a cost of US$280 million per year. But the great unfulfilled promise of the NIF should serve as a cautionary lesson for scientists who promote Hollywood solutions from their research.

The NIF is a jaw-dropping piece of technology. It trains 192 separate laser beams on to a capsule of hydrogen fuel a few millimetres long. The power from the lasers compresses the fuel until it fuses, creating energy from the mass of the hydrogen isotopes. The NIF's goal is to produce break-even energy from this fusion — no mean feat, considering that the input energy can be up to 1.8 megajoules.

In 2005, the LLNL and the US National Nuclear Security Administration, which oversees the lab, laid out a plan to reach the break-even point. The National Ignition Campaign, which kicked off the following year, aimed to bring the fledgling facility up to full power, kit it out with diagnostics and perform a series of tests on its hydrogen fuel. Tellingly, the original plan does not commit the lab to reach ignition, but instead called for "a credible ignition experimental campaign".

But during the past six years, expectations around the NIF have grown well beyond that credible campaign. In many ways, the lab itself is to blame for the unrealism. Lab officials gave tours to prominent politicians and journalists in which they promised a lot more than just ignition. The NIF, they claimed, was the first step on the road to potentially unlimited fusion energy. In support of their dream, LLNL scientists developed a prototype for an electricity-producing reactor that they hoped would gain financing once ignition was achieved.

But problems were mounting even as the lab eagerly promised clean, cheap electricity. Outside reviewers noted that the hydrogen fuel was not being compressed properly. The computer codes used to predict the facility's performance were themselves operating badly. Privately, most people familiar with the programme had known for more than a year that the NIF could not reach ignition in the time allowed. Yet the LLNL stubbornly insisted that it might yet meet its goal. Enthusiasm gave way to saving face, as the leadership struggled to hold the line and keep up the appearance that all was going well.

Fortunately, this is not the end of the NIF. In addition to carrying the far-off promise of clean energy, the facility also mimics the physics of nuclear weapons. Scientists at the lab will now use it to address questions about the ageing US nuclear stockpile. The lasers can provide physicists with an invaluable tool to study how materials behave at enormous temperatures and pressures — similar, say, to those in Earth's interior. Despite the bluster of some at the lab, politicians have always recognized the value of this work, and they are willing to continue funding it for now.

"The line between optimism and overselling is a thin one that can too easily be crossed."

The size and cost of the NIF make it an easy target for criticism, but those working there are hardly alone in their hubris. From stem cells to materials science, researchers around the globe make daily headlines with bold claims about what can be done in their fields. Politicians and the public, eager for solutions to the world's many problems, embrace their words. The process is often healthy: scientists insert caveats, and citizens are given a vague sense that things may not work out. But striking the balance between enthusiasm and conservatism can be difficult. The NIF reminds us that the line between optimism and overselling is a thin one that can too easily be crossed.

Pride comes before a fall. Now the NIF has to find its feet all over again. ■

Science aid

Donors and African governments must invest in advanced science and maths education.

Of the eight United Nations Millennium Development Goals — the flagship international-development targets that world leaders set themselves for 2015 — none addresses how to improve education beyond the primary level.

Increasing literacy, eliminating hunger and reducing child mortality are all laudable goals and they have rightly been the focus of global development policies, especially in Africa. But the failure to consider secondary education, and beyond, as a development issue is an oversight. And it is a blind spot shared by Western donors,

non-governmental aid organizations and African governments alike.

Without support for post-primary mathematics and science education, Africa will remain dependent on foreign experts to craft policy, meet the needs of industry, perform research, combat disease and run the economy. Africa needs African experts, for the local knowledge they bring — particularly in fields such as epidemiology — but also because true independence will be achieved only when such skills can be found domestically.

In a report to a 2009 UN conference in Addis Ababa on strengthening sciences in Africa, Aderemi Kuku, a US-based Nigerian mathematician and founder of the Mathematicians of the African Diaspora network, said that the continent has no critical mass in a single field of mathematics. He warned: "When the present generation of University teachers and researchers in Mathematics and Physics, disappear from the scene due to retirement etc., the situation will be near disaster unless urgent steps are taken."

As we report on page 176, Neil Turok, a South African cosmologist and head of the Perimeter Institute for Theoretical Physics in Waterloo, Canada, has led efforts to combat this trend. Turok pioneered the construction of the African Institute for Mathematical Sciences (AIMS), a hothouse of post-secondary mathematics teaching and research in Muizenberg, South Africa. The model has now been adopted in Ghana and Senegal, too. Turok hopes for a total of 15 institutes across the continent. He laments what he calls a science faculty "generation gap" and is critical of the way that international donors tend to emphasize basic education.

"Nobody's been interested," he told *Nature*. "The West for many years has been happy to deal with Africa on a charity basis, but investing in skills in people was not a priority. This was a major error."

Bravo to AIMS for responding to the crisis of maths and science education on the continent, but, as Turok and his colleagues will be the first to say, the efforts remain modest given the scale of what is needed.

"Science needs Africa as much as Africa needs science."

International donors and African governments must learn from the example. They should consider how to add post-secondary maths and science education to their development plans. It need not be expensive and it need not drain significant resources from other projects. In the space of ten years, AIMS has built a network of successful mathematics institutes for a few tens of millions of dollars.

And think of the payback. Science needs Africa as much as Africa needs science. What a waste of human talent not to have Africa participate as a scientific peer, for a world content to wait for Africa's entry into science. What advances has humanity missed out on by having the continent so cut off from the mainstream of scientific debate and discovery?

The late evolutionary biologist Stephen Jay Gould once said: "I am, somehow, less interested in the weight and convolutions of Einstein's brain than in the near certainty that people of equal talent have lived and died in cotton fields and sweatshops." Africa has that talent. Some of it may be discovered at AIMS. But much of it will not be. ■

John Maddox prize

Two strong-minded individuals are the first winners of an award for standing up for science.

The British psychiatrist Simon Wessely and the Chinese science writer Shi-min Fang are the two inaugural winners of the John Maddox Prize. Sponsored by *Nature* and the Kohn Foundation, and stimulated and organized by the UK-based charity Sense About Science, the prize commemorates a former Editor of *Nature*, John Maddox. John was distinguished for his championing of robust science. The prize rewards individuals who have promoted sound science and evidence on a matter of public interest, with an emphasis on those who have faced difficulty or opposition in doing so. In this inaugural year, the judges (see go.nature.com/9rvd1t) were able to make two awards, each of £2,000 (US$3,200).

China's rush to modernize and the communist government's celebration of science and technology have firmly embraced scientists and scientific achievements, sometimes uncritically. And into that permissive milieu has walked a plethora of opportunists ready to take advantage of the situation with padded CVs, fraudulent and plagiarized articles, bogus medicines and medical procedures carried out without clinical evidence.

In 2000, Shi-min Fang started to expose these escapades in his New Threads website. As an outsider, trained as a biochemist but turned science writer and commentator, he has done much of what the scientific community aims, but often fails, to do — root out the fakers.

For example, Fang called into question DNA supplements that were widely advertised as a means to rejuvenate the tired, the pregnant and the old. Eventually, the government issued warnings about the supplements. Fang seemed to especially relish smacking down powerful or popular scientists. He even challenged official support of traditional Chinese medicine. But his targets fought back, in one case with particular hostility. In the summer of 2010, thugs hired by a urologist attacked Fang with a hammer and, according to Fang, tried to kill him. Fang had previously challenged not only the efficacy of a surgical procedure developed by the urologist, but also his CV.

Fang imposes transparency on an opaque system. He has opened a forum for criticism and debate in a community that is otherwise devoid of it.

Simon Wessely is a psychiatrist at the Institute of Psychiatry, King's College London, who has specialized in two areas above all — the mental health of military personnel and veterans, and chronic fatigue syndrome. He and his colleagues demonstrated substantial overlap in symptoms between chronic fatigue syndrome and clinical depression. He carried out a massive and ambitious study to test the link between common viral infections and later fatigue, and found that there is no simple causal association. He subsequently developed a treatment approach using cognitive-behavioural therapy techniques, which in many cases brought about substantial improvement and in some was life transforming. This treatment was tested in large clinical trials and can now be found in the guidelines of the United Kingdom's National Institute for Health and Clinical Excellence.

"All along the way," says the individual who nominated him for the prize, "Wessely has had to suffer continued abuse and obstruction from a powerful minority of people who, under the guise of self-help organizations, have sought to promote an extreme and narrow version of the disorder. This version repudiates any psychological or psychiatric element to the extent that psychiatry is viewed as a contemptible discipline, which, by association, denigrates psychiatric patients. Hostile letters, e-mails and even death threats have been directed at Professor Wessely over two decades. Mischievous complaints have been made against him and his clinical team, and bogus questions raised in the Houses of Parliament. He has suffered a vigorous Internet assault and coordinated attempts have been made to turn him into a hate figure. He has been compared to Josef Mengele — particularly hurtful since Simon is the son of holocaust survivors. Simon has, perhaps naively, tried to deal with most of these by seeking dialogue and trying to educate and reassure, rather than by responding in kind."

Wessely is the first to acknowledge that others working in this field have received similar or even worse abuse. Nevertheless, the prize recognizes the very public stand that Wessely has taken over these issues.

Nature congratulates Simon Wessely and Shi-min Fang on their awards. ■

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