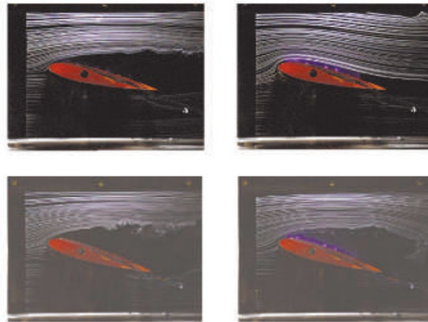


From aircraft engineer to FBI suspect

On his return from a trip to China on 26 May, J. Reece Roth, an emeritus professor of electrical engineering at the University of Tennessee in Knoxville, was greeted at the airport by agents from the Customs Service and the Federal Bureau of Investigation (FBI). The authorities photocopied the contents of his wallet and seized his laptop, he says. Earlier that day, they had searched his office and laboratory, and carried away hard drives and notebooks.

As *Nature* went to press, Roth had yet to be charged with a crime. "I'm still not sure what I'm being accused of," he says. "This is an Orwellian experience." Search warrants seen by *Nature* for Roth's office, laboratory and computer indicate that he is suspected of violating the Armed Export Control Act, a law that prohibits the transfer of military technologies to foreign countries or nationals.

Roth came to the University of Tennessee in 1978, where he developed a technique for creating a type of ionized gas, or plasma, in air at room temperature. Since 1994, he has been experimenting with using the plasma to control the flight of aircraft. By ionizing air as it travelled around a wing's surface, Roth created a plasma that could reduce drag dramatically (pictured above); the technique could allow airplanes to take off and land at steeper angles and on shorter runways.



J. R. ROTH

J. Reece Roth's (right, inset) work with a Chinese student, to develop a drag-reducing technology for unmanned planes, has sparked an inquiry.

In 2000, Roth's work won him a three-year grant of about \$500,000 from the Air Force. The technology has also been licensed in part to Atmospheric Glow Technologies (AGT), a small Knoxville firm. In June 2005, AGT received a \$750,000 Air Force contract to develop the plasma for use in unmanned aerial vehicles. Then AGT gave Roth a subcontract to further develop his ideas.

Foreign affairs

Roth arranged to work with a Chinese graduate student who had helped him with earlier research, and contends that officials at the



University, AGT executives and Air Force administrators were all aware of the collaboration. "Everybody knew that a Chinese student would be involved, and nobody raised a red flag," he says. But when, in early May, a

Dam project threatens living fossil

We are about to lose a key piece of our evolutionary history, warn biologists. They are campaigning to save the Australian lungfish, which they fear could be sent extinct by an enormous dam planned for southeastern Queensland.

The hefty, muddy-brown fish (*Neoceratodus forsteri*) is thought to have survived virtually unchanged for at least 100 million years, making it one of the oldest known vertebrate species around and earning it the moniker of 'living fossil'. It is also one of the closest living relatives of the ancestral fish that crawled on to land and

eventually gave rise to all land vertebrates, including humans. Being able to study the species is important for understanding how that transition took place.

The lungfish is now largely confined to two river systems in Queensland — among the only places that provide the shallow, running and weedy water in which the fish likes to spawn. A dam in one of these, the Burnett river, was completed last year in order to supply water to the drought-stricken region. The area has the fastest growing population in the country, and delivering water to the

inhabitants is likely to be a huge problem in the future. But lungfish researchers say that by flooding or drying them out, the dam will eventually destroy nearly half of the lungfish spawning areas.

On 5 July, Queensland Premier Peter Beattie announced a decision to dam the second river, the Mary. Partly because the Australian lungfish is listed as a threatened species, the dam must pass a federal environmental-impact assessment before the project can proceed. But lungfish supporters believe the second dam could be enough to drive the species to extinction.

The latest decision prompted lungfish expert Jean Joss at Macquarie University in Sydney to step up a campaign to block the dam and persuade the federal government to intervene.

Joss has asked colleagues to e-mail Beattie and federal environment minister Ian Campbell to tell them about the scientific importance of the fish — so far more than 100 scientists have responded to her call. "It would be a calamitous and irreplaceable loss if this animal went extinct," says Per Ahlberg of Uppsala University, Sweden, who collaborates with Joss and



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travelled to the Research Institute of Tsinghua University in Shenzhen and Fudan University in Shanghai in May, to give lectures and assist the translation of a textbook he had authored. Roth says he discussed the plasma technology generally, but didn't mention specific work being carried out by AGT. Everything in his lectures is available through the openly accessible literature, he claims.

A price to pay

FBI officials declined to comment on the ongoing investigation but Tom Reddoch, director of AGT, confirms that the company has been cooperating with the authorities. Sue Murphy, a spokeswoman for the Air Force Research Laboratory at Wright-Patterson Air Force Base in Ohio, says they too have been contacted. Murphy says that: "There's no reason to suspect any release of Air Force sensitive material."

So why is Roth being investigated? The Armed Export Control Act requires most researchers undertaking military-funded applied studies to follow a set of rules known as the International Traffic in Arms Regulations, explains Peter Lichtenbaum. Lichtenbaum previously ran export controls at the US Commerce Department, and is now a partner at Steptoe & Johnson, a law firm based in Washington DC. "With very narrow exceptions, any release of military technology to a foreign national would require a licence." Licences for cooperation with Chinese nationals are particularly difficult to get, as they require a special presidential waiver.

It is possible that Roth's original plasma research would not have been subject to export controls, but once he was working under contract with AGT to develop specific military applications, he may have required a licence and waiver to work with his Chinese graduate student. The maximum penalty for breaching such regulations is a \$1-million fine and up to ten years in prison. But Lichtenbaum says that if charged, tried and convicted, Roth would probably face a fine of up to \$500,000.

"It never occurred to me that a small research contract could trump the bedrock policy of non-discrimination."

This is not the first time that university researchers have come up against US arms export regulations. In 2003, NASA-funded astrophysicists were barred from working on Double Star, a Chinese satellite designed to explore the interaction of the solar wind with Earth's magnetosphere (see *Nature* 426, 375; 2003). But it's rare, says Robert Hardy, of the Council of Government Relations, a Washington-based organization representing research universities. "We are not aware of very many cases where a situation like this has arisen."

Roth maintains that he did not believe such restrictions would apply at his university, which encourages cooperation with foreign researchers. "It never occurred to me that a small research contract could trump the bedrock policy of non-discrimination," he says. He hopes the affair can be resolved quickly, saying the seizure of lab materials has brought his research to a halt. "This whole thing has not helped me, it has not helped the university," he says. "And it has probably not helped this country, either."

Geoff Brumfiel

newly hired contract manager at the university became aware of the situation, she apparently notified the authorities.

The concerns of the law-enforcement officials were exacerbated, it seems, when Roth



The Australian lung fish could shed light on the origin of all land vertebrates.

ancestor of land vertebrates.

Biologists say that living fish can be used for genetic and embryology studies that probe how vertebrates moved from water to land — analyses that would be impossible with preserved specimens. Joss and Ahlberg, for example, are studying the lungfish's patterns of gene activity, to try to work out how fins became limbs. "These things are amazingly important organisms in the history of the Earth," says William Bemis who studies vertebrate evolution at the University of Massachusetts, Amherst.

The Queensland government has guaranteed that the dam will include a 'fish elevator' to carry

lungfish across the dam and says that it will do whatever it takes to meet federal environmental requirements, as it did with the last dam. But Joss says that this is not enough, because the lungfish's old spawning grounds will still be destroyed. Lungfish lay very few eggs, and return to the same spawning sites year after year.

Should the campaign fail, Joss says she will petition Beattie for money to set up a lungfish breeding centre. But guaranteeing the species' survival in captivity would be tough. So far Joss is the only researcher who has managed to breed them, using two ponds, each the size of an Olympic swimming pool.

Helen Pearson

is helping with the campaign.

There are five other species of lungfish living in South America and Africa. But the Australian

lungfish, which can live for a century and grow 1.5 metres long, is thought to most closely resemble the last common