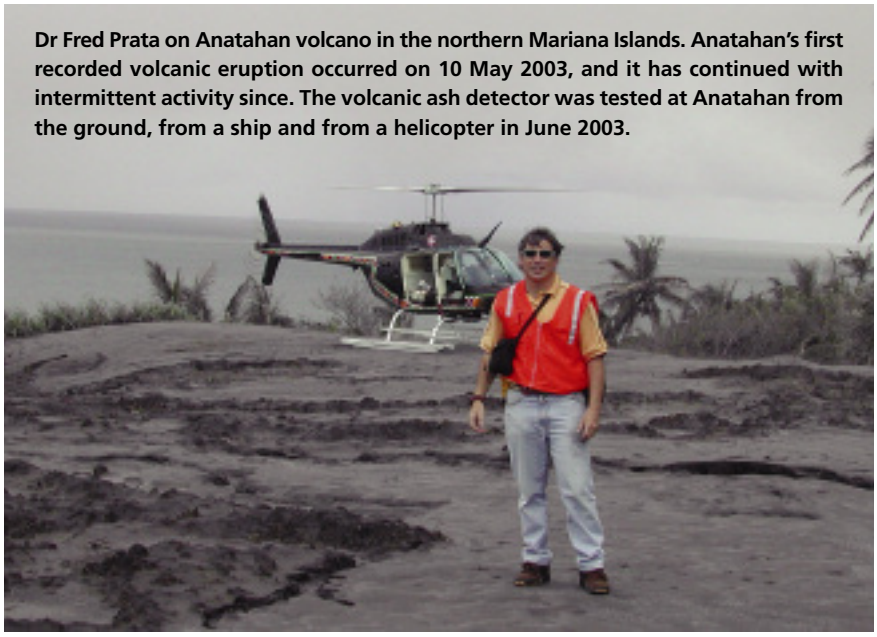


Dr Fred Prata on Anatahan volcano in the northern Mariana Islands. Anatahan's first recorded volcanic eruption occurred on 10 May 2003, and it has continued with intermittent activity since. The volcanic ash detector was tested at Anatahan from the ground, from a ship and from a helicopter in June 2003.

CSIRO Innovation Goes UP IN SMOKE

Fred Prata developed a volcanic ash detector that could save the airline industry millions of dollars, and potentially the lives of their passengers, but says that CSIRO tried to commercialise the technology before the science was ready.

In 1982 a British Airways 747 on a routine flight from Singapore to Perth inexplicably lost power to all four engines while cruising at 30,000 feet. Due to the skill of the pilot and crew, and a bit of luck, the aircraft made a safe landing at Jakarta airport.

Later inspection showed that the aircraft had unwittingly flown through a cloud of volcanic ash from the Javanese volcano Mt Galunggung. The damage to the aircraft and subsequent repair bill were significant.

A similar incident occurred in December 1989 near Mt Redoubt volcano in Alaska, when power was lost to three engines. The cost to repair the KLM jumbo was estimated to be ~US$80 million.

Following the June 1991 eruption of Mt Pinatubo, 15 passenger jets suffered damage after encountering volcanic ash clouds, and just about every year since there have been reports of aircraft running into ash clouds. The problem is that there is no way for an aircraft to "see" these hazardous clouds. The ash is too fine to be detected by radar, and visual identification is difficult because the ash is dark and often looks just like ordinary clouds.

When I first heard about the British Airways incident I was working as a research scientist at the CSIRO Division of Groundwater Research in Perth, where I was in charge of the Remote Sensing Group. While my focus was on the State's groundwater problems (CSIRO later disbanded this Division), I was encouraged to follow my nose in addressing any practical problem of interest.

So, out of inquisitiveness, I put my mind to thinking about how ash clouds could be discriminated from meteorological clouds, and in particular how they could be seen at night when the most severe incidents have occurred. I wrote a computer program to solve some rather complex equations that arise from the ways photons can interact with clouds of particles in the atmosphere.

I had a "Eureka" moment when it struck me that there was a way to solve this problem, and in no time I was writing papers. I presented my "breakthrough" at a meeting in Europe, but no one else was quite as excited as me by the discovery.

When my Division in Perth was disbanded I joined the prestigious CSIRO Division of Atmospheric Research in Melbourne. In 1987 the Division contained many world leaders in atmospheric studies, such as boundary layer meteorology, stratospheric dynamics, radiation and cloud physics. The situation now is quite different. Today the Division is an outpost of the much larger Marine Division in Hobart, and just about all of those experts have either retired, resigned or been made redundant.

Around 1989 a delegation from Boeing visited CSIRO. I was asked to give a short talk on something that might interest Boeing and I thought of the volcanic ash problem. At the time I was not researching in this area at all. In fact, I was looking at evaporation from Lake Eyre, developing a theory for deriving land surface temperatures from satellites and setting up a network of field stations to measure atmospheric radiation as a contribution to our climate research program.

After I put up my fifth overhead one of the Boeing representatives interrupted to ask whether we had intellectual property protection on this work. I think I said: "What's IP?". At that moment the CSIRO business representative stopped the talk and, after some discussion, a non-disclosure agreement was produced and signed. Then, I carried on with the talk.

Back at the Division it was decided

that we should apply for patents. However, my ideas were largely theoretical. Although they seemed to work well from satellites, for use on an aircraft I had made some assumptions and hypotheses that needed to be tested. All I needed to do was have a quick word with the divisional chief and money and resources were made available for me to build a working device and test it at a volcano.

A colleague and I tested the instrument at Sakurajima volcano in Japan (near Kagoshima city and its busy airport). We tested the instrument from the ground and from a light aircraft. Everything worked well. We applied for the patents, which were granted, and wrote a paper for *Nature*.

In the meantime we had been looking for a commercial partner to take the device to the next step and make a marketable product. We were keen to keep it all in Australia and looked hard for an Australian company to take it on. We had also visited several US avionics companies who were keen to take it on, but we held back in the hope that an Australian company would invest.

After a few false starts we entered into a licensing arrangement with Australian company Tenix, which had experience in avionics and had engineers, a marketing group, business acumen and money. I gave a talk to one of their executive team and provided a vision of where this business opportunity could go.

I realised that my device, a thermal imaging camera, had much wider applications than just volcanic ash and the airline industry. Here was a niche opportunity to be the foremost company in South-East Asia in thermal imaging applications, including pipeline leak detection, night vision, toxic chemical gas detection, homeland security applications, industrial and environmental pollution monitoring and so on.

Soon we had started on more field trials using a newly developed camera with parts supplied by a US company and modified by us for our applications. The work was going well but was not without problems.

The volcanic ash detector monitoring volcanic eruptions from Tavurvur volcano at Rabaul, New Britain, in Papua New Guinea.

By now CSIRO was being run by Dr Geoff Garrett and his team of people tasked with changing CSIRO from a scientific research agency into something else. A business development manager was appointed to my division and he quickly attached himself to my project (he has since moved on).

Until then all the research, resources, planning and productivity had been managed entirely by me. Now we had a business manager looking after the commercial side, a financial manager doing contracts, a legal person advising us on litigious matters, a communications person looking after the "messages" and a nervous divisional chief looking on but focused on how to maintain his budget and who to make redundant.

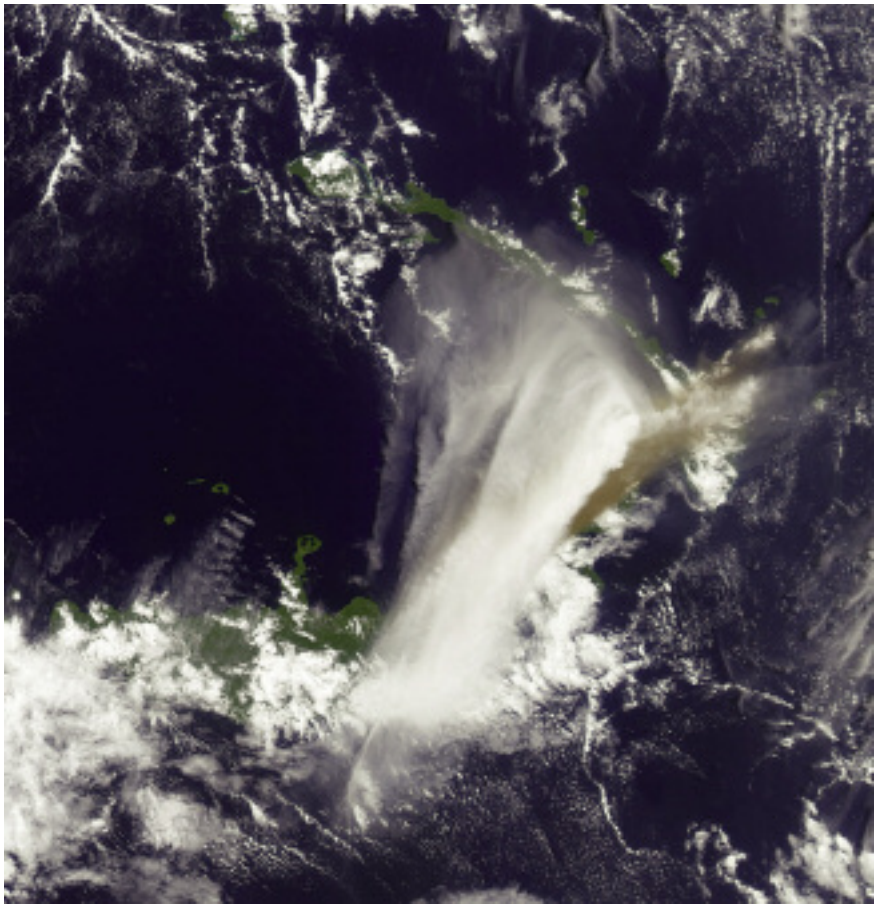
In this atmosphere the chief had an interest in maintaining and increasing a revenue stream from this commercial activity; the business manager had key performance indicators to meet in order to maintain his career path; and our commercial partner was expecting a good return on investment and wanting it by 5pm. My team – myself and a very bright postdoctoral scientist employed on a very short-term contract using Tenix money – were focused entirely on getting the science right.

In September 2003, while doing field work with the device at the foot of Mt Etna in Sicily, I received a frantic email from the CSIRO business manager asking me to send results, data and specifications for a new patent application. I refused.

More emails and a final one citing a clause from our license agreement – which basically said I had to comply – caused me great concern. I sent the information but asked for my strong objections to be noted. They were, but the patent process had begun.

Back at the Division I voiced concerns to my business manager and divisional chief that the commercial interests were leading the science, which wasn't complete. I was told not to worry because the patent application was provisional. We could amend it later.

On that basis, and having been told that I had no choice, I eventually signed over all my rights to the patents to CSIRO for the stately sum of A$1 (which I never



A satellite image of the significant eruption of Tavurvur, New Britain, on 7 October 2006. The brownish cloud is volcanic ash, and the white clouds contain a mixture of sulfur dioxide gas (which is also a hazard to aviation), ice and volcanic ash. The volcanic cloud reached altitudes of ~15 km. Image: NASA

actually received). Signing was a mistake in hindsight but had I refused I suppose I could have been sacked.

After this incident it became clear to me that neither CSIRO nor Tenix (perhaps understandably) had little interest in getting the science right. They mistakenly believed that the R&D was now mature and they could take it to market. My colleague and I were sidelined.

I kept objecting and found myself in deeper and deeper trouble with my divisional chief. I was reprimanded for writing an email to Tenix informing them of my concerns about the science.

The CSIRO business manager wrote a counter email stating that my views were not congruent with CSIRO's views. My divisional chief banned me from further communication with Tenix and my annual performance assessment was marked "unsatisfactory".

These incidents may seem petty and irrelevant, but the effect was that my chief and I were at odds with regard to the way the project should proceed. Understandably, my chief had little knowledge of the science I was concerned about and I was not fully aware of the external revenue targets or other requirements put before him by CSIRO's executive. I did remind him about CSIRO's Code of Conduct, which allows a scientist to refuse a chief's instructions based on ethical and other grounds.

In the meantime Tenix wanted to take complete control of the project by setting up a "spin-off" company. CSIRO embraced the idea and co-opted yet another businessperson with experience in start-ups to run the negotiations for CSIRO. I was never consulted about exactly what this "spin-off" would do, and in fact my new line manager (another business manager rather than a scientist) told me that it was not within my delegated work area to even ask about progress.

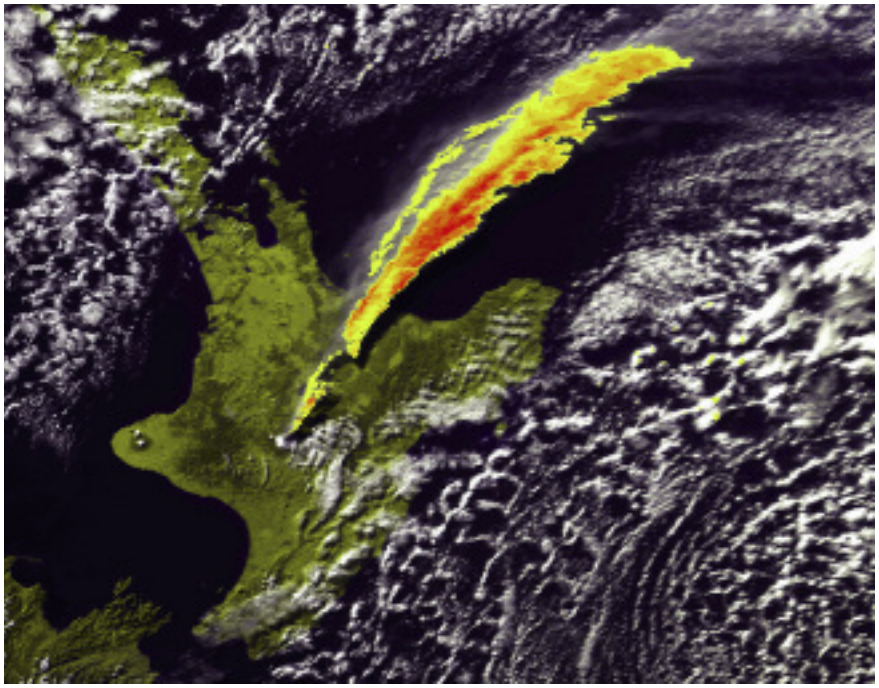
While I had been sidelined by CSIRO in the project, it was beyond CSIRO's sphere of influence to prevent potential customers from contacting me. Tenix and CSIRO were pinning their hopes on a large contract from a US agency to supply thermal cameras to monitor their restless volcanoes. Scientists from the agency contacted me privately to ask why I was no longer involved in the project, and I gave honest replies.

On 27 January 2006 I was made redundant by CSIRO on the basis that the project was now finished and had been moved to the commercial partner. There was no more work for me to do, so I was "surplus to requirements". One month after I was made redundant I started as a senior scientist at an atmospheric research institute in northern Europe.

My colleague's contract with CSIRO had not been renewed, and he left before me. He now works for an Australian company based in Canberra.

It seems odd to me that a company as successful as Tenix would choose to ignore the advice of the scientists whose work they were funding. Furthermore, Tenix's spin-off company does not have the services of the IP creators, and any investor would have to question where any new ideas might come from. CSIRO's use of public money and conduct in this project have been rightly questioned in recent Senate estimates hearings.

For my last 3 years at CSIRO (20 years altogether) I was working with a client to commercialise some technology to make flying safer, with a potential to earn Australia many millions of dollars in a niche market. With several patents, an advanced R&D program and a network of clients, one might think this was a great example of Dr Garrett's "RIPPERs": Reclaimed Intellectual Property Prom-



A satellite image of a volcanic cloud from Ruapehu volcano, New Zealand, in June 1996. The image has been manipulated using the techniques invented by Dr Prata. In this case volcanic ash (coloured yellow to red) is clearly discriminated from meteorological clouds. Volcanic ash advisory centres worldwide use this technique when issuing aviation volcanic ash warnings. Image: NOAA

ising Extraordinary Revenues.

Yet here we are with two of the world's experts in the field no longer with CSIRO, the R&D program has been closed down, the new IP will be hard to defend and the spin-off company is weaker without the IP creators.

The process of innovation, invention and patenting is fraught with difficulty at CSIRO because there is no clear mandate or incentive for individual scientists to be involved in the cycle of research, development, innovation, patenting and commercialisation. In general, the motivation for scientists is the production of research papers published in the peer-reviewed literature. This very motivation is at cross-purposes to commercialisation, which often involves an industrial partner that needs the certainty of non-disclosure.

My own experience at CSIRO eventually caused me to become redundant and my assistant to leave. Yet, even after leaving CSIRO, employees are bound by certain "obligations" included in the standard Terms & Conditions of employment at CSIRO. These may include non-disclosure clauses and non-compete requirements. These obligations may also require that ex-employees assist CSIRO in pursuing IP. They make no mention of any compensation for this assistance.

In my own case, 9 months after being made redundant I was presented with a letter demanding that I sign certain documents. Copies of the CSIRO Terms & Conditions, together with a reminder of my obligations, were attached and I was told to seek legal advice "if in any doubt about my obligations".

The purpose of the letter was to encourage me to sign off on various US trademark and patent office forms, which would be difficult for me to do as I could not honestly give the assurances required by the forms. A false declaration on these forms is punishable by fine or imprisonment under US law. This is a heavy-handed approach by CSIRO and it may have been better to approach me on a personal basis to request assistance.

Apart from these IP problems, the business model adopted by CSIRO assumes that the IP creators are willing to associate their names with promoting and selling products arising from the commercial development. Ex-employees are not obligated to help in this way and still have "moral rights".

The casting out of the IP creators from the spin-out activity needs to be addressed in some way. According to Recommendation 4 in *Commercialisation of Public Sector Research*, a 2001 paper published by the Prime Minister's Science, Engineering and Innovation Council (PMSEIC): "There should be few, if any, restrictions on the opportunities for researchers to directly and personally benefit from the commercialisation of their work, through a share of royalties or equity in the venture or other means." Obviously, CSIRO has not taken up this recommendation.

Likewise a recent OECD study concluded: "The most important channel for licensing PRO patents is researcher contacts". Removing them from the commercial chain is an error.

My experience in CSIRO may not be normal, but I am assured that all decisions made were done in accordance with CSIRO policy. The current CSIRO policy is to reward inventors by giving them A$1 in exchange for all IP rights to their inventions, now and into the future. It is completely at the discretion of the CSIRO executive to give any further rewards.

The result of CSIRO's attitude to innovation for the Australian public is a loss of IP to overseas interests, loss of expertise through loss of staff, loss of continued R&D and no new industry or employment generated within Australia.

This is one reason why Australia has been unable to turn government R&D into new commercial opportunities and new high-tech companies, and it is certainly a disincentive for bright government scientists to be involved in the innovation process.

Fred Prata is a former Senior Principal Research Scientist with CSIRO Marine and Atmospheric Research.