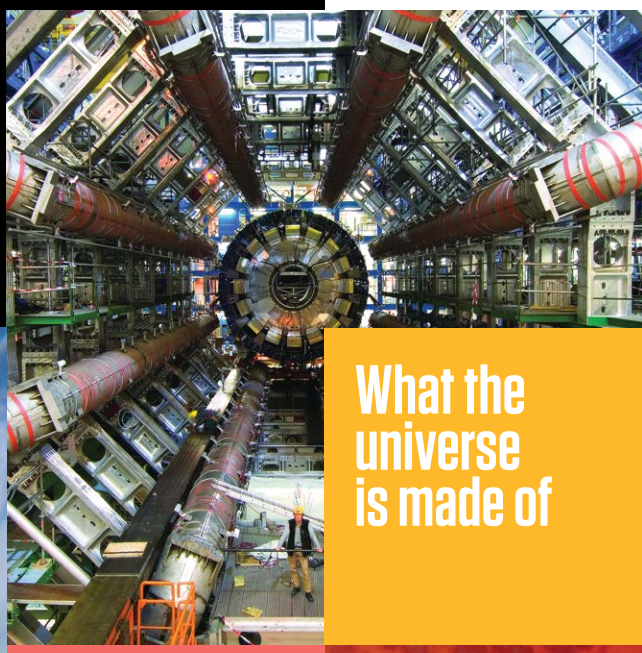
STORIES OF FRENCH-AUSTRALIAN INNOVATION



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Australia CRÉATIVE FRANCE

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Australia CRÉATIVE FRANCE

L'Astrolabe opens up Antarctica

For French and Australian explorers

Without the help of icebreaking ships, all-terrain vehicles and tough machinery, most Antarctic science could not happen. The French ship *L'Astrolabe* is a crucial facility for scientists exploring the Earth's climate, oceans, atmosphere and ecology.

Every year, the ship and its crew, managed by the French Navy for the Institut polaire français Paul-Émile Victor (IPEV) from Hobart, support approximately 50 French and international scientific projects based out of the French stations Dumont d'Urville and Concordia. *L'Astrolabe* also transports food, supplies, logistics officers and scientists to and from Australia's Macquarie Island base.

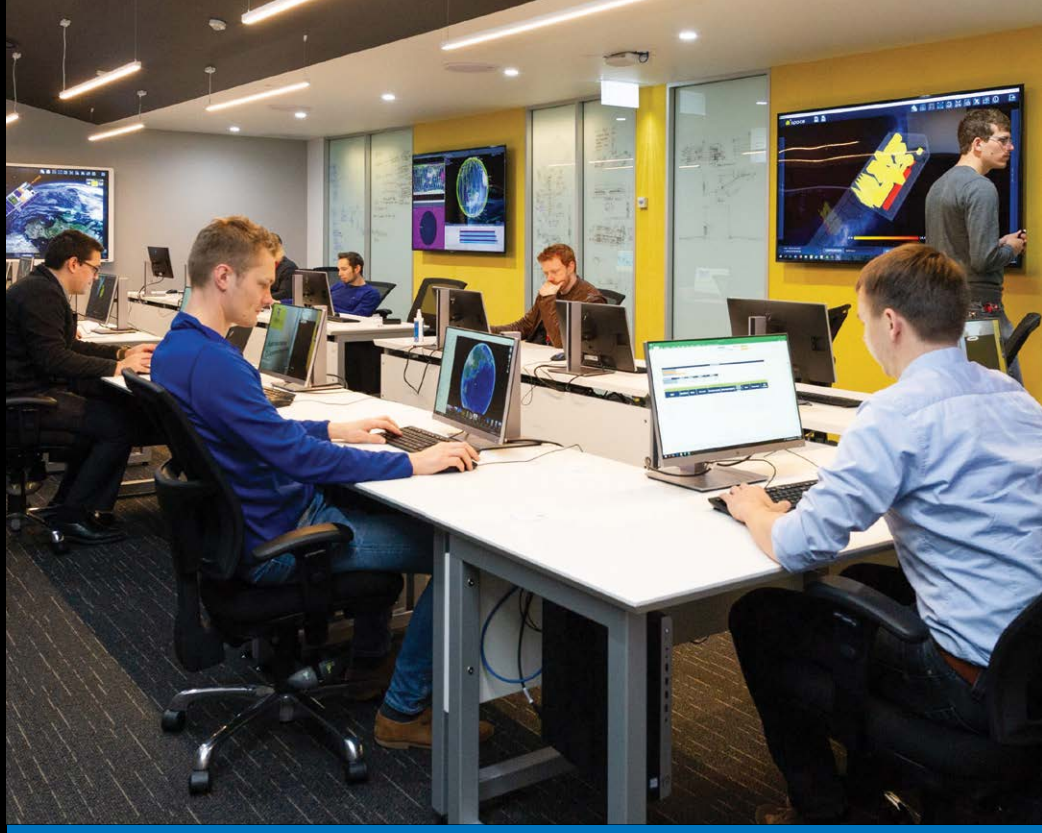
IPEV also supports the high priority Australian-led project Aurora Basin North, which drills down into the ice to collect frozen records of how our planet has evolved and changed to provide information on what might be in store for the future. Scientists are currently working towards the 'holy grail' of a million-year-old ice core.

In 2013/14 the French team led the 15-day traverse from Dumont d'Urville to the Aurora site and back, which was a 2,500 km round trip. As a result of this expedition scientists could, for the first time, look back in time 3,000 years by collecting 400-metre deep ice cores.

According to Dr Jérôme Chappellaz, Director of IPEV, the French-Australian Antarctic cooperation agreement optimises the investments made in research and operations for both countries.

"Working in Antarctica is all about cooperation. France and Australia have a collaborative history that started several decades ago," Jérôme says.

"Through our spirit and our joint logistic and scientific interests, this relationship will be even stronger in the future. And during the French President Emmanuel Macron's visit to Australia in May 2018 he and Australian Prime Minister Malcolm Turnbull reiterated their commitment and desire for continued collaboration."



Hundreds of students have participated in satellite design workshops at the ANCDF

Mission design at rocket speed

Planning space missions is traditionally a time-consuming and costly process. But the new Australian National Concurrent Design Facility (ANCDF), housed at UNSW's Canberra campus, speeds things up so a mission can be planned in weeks rather than months.

Harnessing the expertise, design processes and software of the French Space Agency CNES (Centre National d'Etudes Spatiales), the UNSW team has created Australia's first concurrent design facility. The ANCDF allows engineers and scientists—both professionals and students—to design different parts of a mission in parallel rather than one after the other, which is the traditional approach.

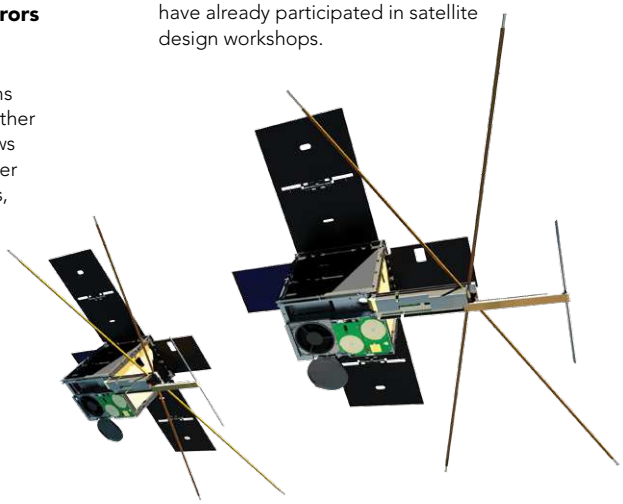
Better communication and consistency means fewer errors

According to Jan-Christian Meyer, ANCDF Manager and Space Systems Engineer with UNSW, bringing together experts from different domains allows for better communication and greater consistency. This means fewer errors, a greater variety of options, and ultimately more suitable designs and less uncertainty for customers.

"Engineers are eager to run studies in the ANCDF because they see the value of this new, agile approach," Jan-Christian says.

"This is an exciting opportunity for UNSW Canberra Space because as a relatively young group we can more easily change the way we work. That's a lot more difficult for a large enterprise with long-existing processes," he says.

Since becoming fully operational in June 2018 the ANCDF has already been used by engineers and scientists to prepare for missions launching in 2019. Plus, hundreds of school students and undergraduates have already participated in satellite design workshops.



Photos: Fish market image, credit: Shutterstock.com; Studying baby sharks in French Polynesia, credit: Tom Vierus; The ANCDF makes planning space missions much faster, credit: University of New South Wales; The icebreaker *L'Astrolabe* runs the Tasmania-Antarctica route carrying scientists and supplies, credit: Marine Nationale

"We make bacteria do amazing things"

Creating living cell factories

Researchers at the University of Adelaide and the Pasteur Institute in France are creating biological factories within cells to make and detect molecules for a wide range of uses in health, environmental monitoring and industry.

Synthetic biology—the application of engineering principles to build new biological parts, circuits and devices—has been used to build tumour-killing bacteria, for example, and has great potential for green chemistry that uses fermentation rather than petrochemicals.

Custom biological "circuits" can create proteins and polymers

According to Associate Professor Keith Shearwin at the University of Adelaide, the team has developed new tools to speed up 'synbio' science and biosensors that can detect molecules in the environment.

"We make bacteria do amazing things by integrating biological pathways, which we call circuits, into the bacterial genome. These circuits can be custom designed to create proteins, polymers or other molecules," he says.

"We've recently been able to increase the number of integration positions where circuits can be installed in the *E. coli* genome. Plus, we've sped up the construction of these cell factories, so scientists can create new molecules faster," Keith says.

The collaboration has been successful so far and currently consists of four researchers and a PhD student involved across the two institutions.

"Synthetic biology has a valuable philosophy of sharing and open access, which is great. But organised international collaboration and cooperation is vital for efficient and exciting scientific progress," Keith says.

In other projects, the team has constructed circuits that monitor whether DNA-binding proteins are performing efficiently or not, and circuits that cause bacteria to glow red when they encounter particular substances, such as vitamin B7.

This could allow bacteria to become living diagnostic tools sensing and responding to the presence of substances in a range of environments, including the human gut.

Peptides to fight pain

A new approach to the global chronic pain problem

Chronic pain affects around 20 per cent of the world's population at any one time. It is the most common reason people seek medical help in Australia. Chronic pain often goes hand in hand with anxiety and depression.

Short chains of amino acids—known as peptides—may offer hope. A collaboration between neurobiologists at The Florey Institute of Neuroscience and Mental Health at The University of Melbourne and CNRS units affiliated with the Universities of Bordeaux and Strasbourg has made significant progress towards an entirely new approach to treating pain.

They have shown that chronic pain and related anxiety can be reduced by stimulating particular neurochemical pathways in the brain. Using specific peptides, they activate neural membrane receptors to create an analgesic effect.

The team has completed studies on the cholecystokinin and oxytocin receptor systems in areas of the brain including the amygdala. A new project aims to determine the role of relaxin-3 receptor signalling in the plasticity of descending circuits associated with inflammatory pain and related anxiety. The goal is that the research will lead to novel treatment strategies.

According to Professor Andrew Gundlach from The Florey Institute, there are substantial benefits from the international links.

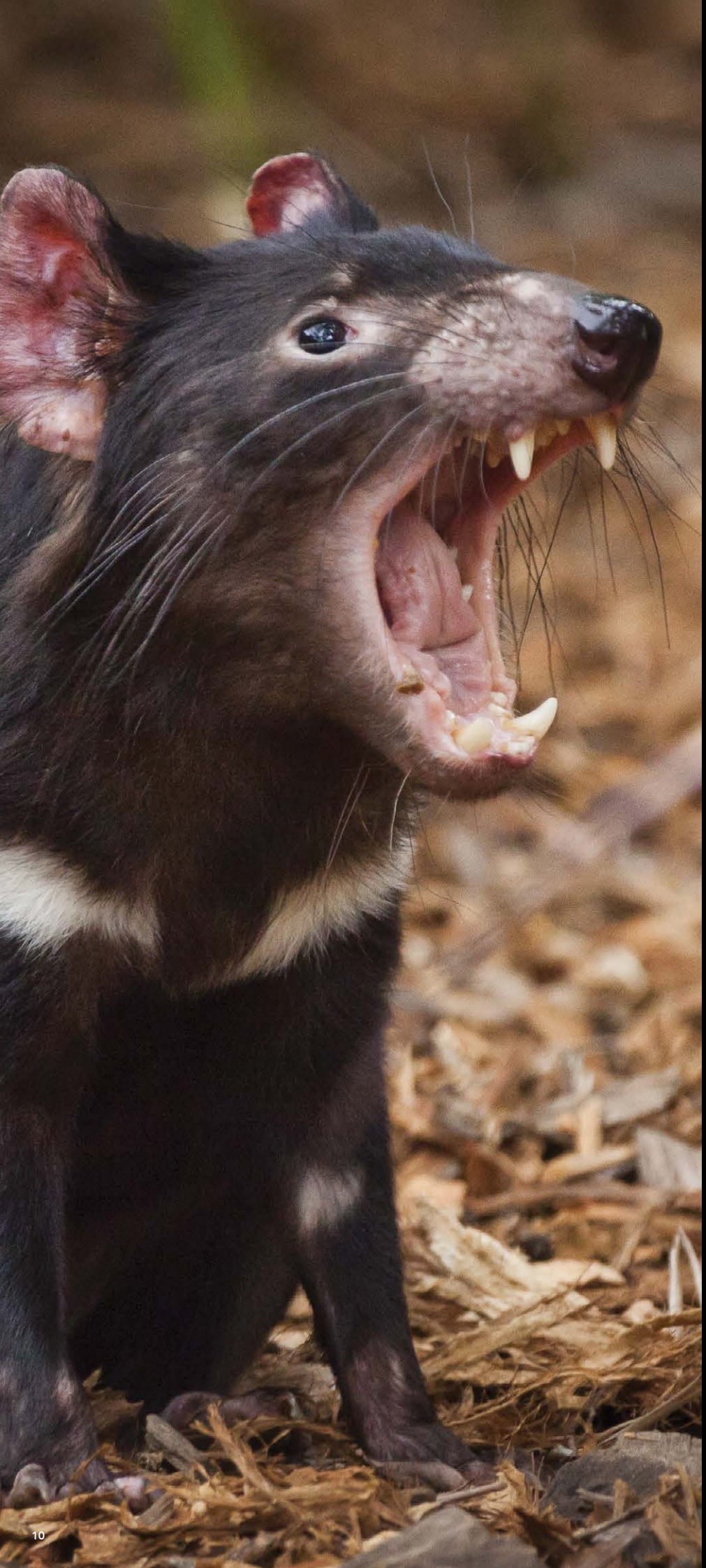
Research will lead to novel treatment strategies

"It's exciting to see the additional intellectual and technical resources that have been brought together to find solutions for this major burden of disease," Andrew says.

"This collaboration has so much potential. We have obtained promising results so far, and with additional funding our studies might progress all the way to clinical trials," he says.

The collaboration has been supported through a memorandum of understanding between The Florey and the University of Bordeaux.

Photos: The PILOT balloon being readied for launch, credit: CNES/OMP/IRAP/UT3/CNRS/Sebastien Chastanet



Cancer, maths and evolution

Shifting the cancer battleground

A new French-Australian joint cancer laboratory is forging a new way to study cancer by joining experts from different fields including mathematics, cell biology, evolutionary biology, and behavioural ecology.

Cancer is not only a major cause of human death worldwide, but also a disease that affects all multicellular organisms. Despite this, oncology and other biological sciences such as ecology and evolution have developed in relative isolation, according to Dr Beata Ujvari from the Roles of Cancer in Ecology and Evolution International Associated Laboratory at Deakin University.

Cancer has evolved together with life on Earth

"We know that there is a clear reciprocal interaction between malignant cells and their hosts, with malignant cells evolving in response to the organism's defence mechanisms," Beata says.

"Cancer also directly and indirectly impacts the physiology, immunology and behaviour of organisms. But very little is actually known of the evolutionary impact of these complex relationships. We are changing that with this type of research, which has rarely been explored before," Beata says.

The goal is to transform the understanding of cancer, its origin, how to halt its progression, and to prevent therapeutic failures. At the same time, the role of cancer in ecosystem functioning is something that ecologists need to consider.

Researchers say that cancer's impact on ecosystems could be significant. It can influence an individual's competitive and dispersal abilities, susceptibility to pathogens and vulnerability to predation. In some cases, such as the facial tumour disease that afflicts Tasmanian devils, it can heavily impact a species.

The joint laboratory is a collaboration between: Dr Frederic Thomas of the Centre for Ecological and Evolutionary Cancer Research at the National Scientific Research Centre (CNRS) in France; Deakin University; and the University of Tasmania, Australia. In Australia, the team has partnered with the Tasmanian Government's Save the Tasmanian Devil Program and Zoos Victoria.