

Research takes a back seat

Dumont d'Urville & Paris

"It is complicated", says Françoise Praderie, director of the Earth, Ocean, Space and Environment Department at the French Ministry of Research and Technology (MRT). "I'll do you a drawing." Indeed, French Antarctic research is structured like interconnecting sets of Russian dolls. And even plans for reorganization are unlikely to make life much easier.

For historical reasons, government grants for research in the French Antarctic territory, Terre Adélie and the four sub-Antarctic islands (Kerguelen, Crozet, Amsterdam and St Paul) are managed by Terres Australes et Antarctiques Françaises (TAAF), a government department set up in 1955 specifically to preserve French territorial claims in the areas. TAAF, in turn, is under the tutelage of the Ministry for Overseas Departments and Territories (DOM-TOM).

Last year, TAAF's budget from DOM-TOM comprised about FF45 million out of the civil research budget and a further FF75 million of 'territorial' money. Most of the DOM-TOM money is spent on transport: hire of the Antarctic supply vessel, *Astrolabe* (FF17 million) and running TAAF's own oceanographic ship, the *Marion Dufresne* (FF50 million).

Because the administrative chain of command is so complex, while the unexpected nearly always happens, expeditions to the Antarctic are handled by a separate, non-profit-making association, Expéditions Polaires Françaises (EPF), set up in 1947 by the polar explorer Paul Emile Victor. With grants from TAAF, EPF makes sure everything runs smoothly 'in the field'. It orders clothes, food and fuel, schedules flights, organizes who goes and at which dates and sorts out the chaos when things go wrong.

Since the end of whaling and seal exploitation, the uninhabited TAAF districts have had almost no economic, strategic or political interest. And over the past ten years, DOM-TOM's contribution to TAAF's budget has dwindled from FF103 million to FF75 million.

As a result, EPF — almost entirely dependent on TAAF money — is itself feeling the pinch. Last year it had FF25.5 million (not counting FF20 million for the airstrip being built at Dumont d'Urville). And this year, a FF26-million budget proposal was whittled down to FF20 million by DOM-TOM.

According to Bernard Morlet, secretary general of EPF, this is not enough for both a winter and summer research programme. Fixed costs alone are about FF17.5 million, he says, and during the summer about 190 people will pass through Dumont d'Urville, including 35 incoming and 33 outgoing overwinterers. There is even talk of cancelling next year's programme altogether.

The money crisis has not helped interministerial negotiations to set up a new FF210-million polar research institute, eventually to replace EPF and leaving TAAF something of a clearing house.

In July last year, a change of chief administrator at TAAF brought discussions between the MRT and DOM-TOM to a halt. Nine months later, negotiations have restarted, the major question being the boundary between research and 'minding the shop', as far as TAAF is concerned.

Even when the institute finally gets off the ground, there will be no full-time scientific staff. In France, polar researchers come from CNRS or university laboratories all over the country, while technicians and engineers are either on fixed-term contracts or are 'volontaires à l'aide technique' (VAT) — young men doing their military service — together with a handful of military personnel, such as the surgeon, the radio operator and the helicopter pilots.

If the institute does not simplify funding, it should help France to develop a coherent polar research strategy. At present, there is almost no research in the Arctic and TAAF's scientific committee decides the Antarctic research programmes directly, either on the basis of applications from scientists, or as a result of common orientations decided by the international Scientific Committee on Antarctic Research (SCAR). As a first step, a group of French industrialists has joined

MICROMETEORITES

Prospecting in the ice

Dumont d'Urville

FOR Michel Maurette the Antarctic ice could be a storehouse for extraterrestrial matter going back to the origins of the Solar System — micrometeorites. And to prove he is not on a wild goose chase, Maurette, from the CNRS centre for nuclear and mass spectrometry near Paris, has set out to gather 20,000 micrometeorite particles in under two months. This means melting 300–400 tons of Antarctic ice without contaminating it, thanks to a 'factory' technique developed by Michel Pourchet, a chemical engineer from the University of Grenoble laboratory of glaciology.

Maurette has been working up to this gargantuan task ever since he abandoned Moon dust in 1980. Impressed by the purity of a 1978 Antarctic ice core he was able to study, and its capacity to preserve dust particles, he wanted to test an idea that it would be the perfect place to look for micrometeorites, a much more abundant and possibly more primitive source of extraterrestrial matter than meteorites. About 10,000 tons of micrometeorites measuring 50–100 µm fall to Earth every year, he says, the range of sizes also most abundant in near-Earth space —

Capital philately

ONE of the oddities of the French base at Dumont d'Urville is that it is, technically, the 'capital' of one of France's overseas territories. The overwinter leader is a district administrator, a sort of governor appointed by TAAF. And, as a territory, Terre Adélie can issue its own stamps.

Not surprisingly, this novelty has turned into something of a cottage industry. Last year, postmaster and radio operator Jean-Marie Jaguenaud sold stamps worth a staggering FF310,000. "That's a lot of mail for 33 people", quips one disapproving veteran. And of the 38 mailbags arriving on the second visit of the *Astrolabe*, ten (about 10,000 letters) were from stamp dealers asking for first-day covers and special issues with the Terre Adélie franking mark. Amateur stamp collectors get more personal treatment, a note from the helicopter pilot, or a bit of news.

From 1 January to the time the last ship leaves, says Jaguenaud, most of his time, from 8 in the morning till 10 at night will be spent dealing with post and philately. So, when Marcel 'Big Ben' Renard retires next year, he should have a pretty nest-egg. He has been collecting Terre Adélie first-day covers since the very first base at Port-Martin in the early 1950s. P.C.

with MRT, CNRS, TAAF and EPF to set up 'DIPOL' — a research foundation dedicated to the development of polar engineering technology. P.C.

compared to a "few thousand meteorites over 100 grams". And evidence suggests that over 80 per cent of micrometeorites come from comets, whereas meteorites are fragments of the less primitive asteroids.

In the 1970s pioneering attempts to 'trawl' micrometeorites in the stratosphere came up with a total of 1,000 particles, the biggest measuring 50 µm, explains Maurette. And while a magnetic rake drawn over the Pacific ocean bed in 1976 produced 100,000 magnetic 'spherules', they were all larger than 100 µm. Not only were these bigger than the most abundant micrometeorites — and therefore atypical — but it turned out that they had all melted following heating as they entered Earth's atmosphere.

So, in 1984 Maurette and a team of Danish researchers (led by Claus Hammer of the University of Copenhagen) went to Greenland to test his 'hunch' that ice would be the best preserver of micrometeorites. In Greenland the ice melts naturally, forming blue lakes, with a black sediment, 'cryoconite', on the bottom.

Maurette and Hammer recovered 25 kilograms of cryoconite which proved to be the "best preserved and richest mine of micro-

LANDING STRIP

Engineering feat or blight?

Dumont d'Urville

meteorites" available at the time. But the smaller grains (less than 100 μm) were inseparable from dust blown by the permanent wind, while 'cocoons' of bacterial material had grown around the larger grains. This made them difficult to study without damage and made analyses of their possible organic content meaningless. The only hope of finding intact micrometeorites was the Antarctic.

In 1988 Maurette and Pourchet set up their equipment in a polar caravan at Cap Prudhomme, 10 km from the Dumont d'Urville base.

Pourchet's 'factory' process involves injecting hot water into a small hole in carefully chosen blue ice (with no fractures), and pumping the water and melted ice back into a boiler. This cycle is repeated, gradually creating a pocket under the surface of the ice, about 1.5 m deep and 2 m long. At the end of the day the melted water is passed through a series of filters to trap the meteorites.

In the two available months of the Antarctic summer Maurette and Pourchet melted 100 tons of ice. And instead of the 500 or so grains they expected, they recovered 5,000 micrometeorites and about the same number of melted cosmic spherules. "About 3,000 of the micrometeorites turned out to be between 50 and 100 μm ," says Maurette, the size range most abundant in the Earth's neighbourhood, leading him to believe they might be very well preserved. He attributes the unexpected success of the expedition to a 'superconcentrated layer' of ice between 20 cm and 1.5 m below the surface, where micrometeorites were far more common than at other depths. Analyses of the micrometeorites showed that they were even better preserved than those in Greenland and some still contained friable material.

For Maurette, some of their properties seemed to confirm that they were not fragments of meteorites. And they appeared unlike micrometeorites and interplanetary dust recovered from the stratosphere, suggesting that they may be more primitive. "So," says Maurette, "we have a new puzzle. Are these micrometeorites more primitive than the most primitive meteorites? We don't know. But we have a new population of material, it is very abundant and it is very primitive."

Maurette's current expedition to Antarctica with Michel Pourchet aims to collect new material, making sure "there is absolutely no contamination". Dust and particles of soot from diesel exhaust can look remarkably similar to some extraterrestrial material. But, ironically, the success of this expedition will add to his worries. He already does not know how to meet the increasing demand for micrometeorite samples from different laboratories. Each grain has to be analysed with a scanning electron microscope and then catalogued — a full-time job which he has been doing himself. But a solution seems to be at hand. Last year he helped launch EUROMET (see page 308) and was awarded a grant of FF630,000 over three years for a 'curator' for the collection. **P.C.**

"REALLY, it is the only solution", says affable Michel Engler with a broad grin, as if he is used to speaking to people who are not convinced. Engler is director of Expéditions Polaires Françaises (EPF) and is in charge of engineering work on the FF100-million landing strip nearing construction at Dumont d'Urville. A feat of engineering that has won reluctant applause from sceptics, the landing strip is to be the springboard for French Antarctic research into the next century.

But construction of the runway conflicts with concerns to protect the environment. As there is no ice-shelf to serve as a temporary runway — as at the US McMurdo base — EPF engineers have had to blow up six islands, using the rubble to form a dyke. And these islands formed the only available nesting site for about 10,000 birds — notably Adélie penguins, Cape pigeons, snow petrels and Wilson's storm petrels.

At present, the only access to Dumont d'Urville is by sea. And until mid-December, a barrier of more than 300 km of ice makes it impossible for the modest class 1 ice-breaker, *Astrolabe*, to reach the base. This restricts the summer research programme to



Dumont d'Urville base (bottom left) and its controversial airstrip. The *Astrolabe* can be seen at its moorings (centre).

the months of January and February, whereas the weather is already good in October. And the feasibility of the proposed Dome C base rests entirely on researchers being able to arrive by air.

Extensive efforts are being made to limit the environmental impact of the airstrip. The TAAF, which has responsibility for the base, has earmarked FF4 million for detailed conservation measures — approved by the environment ministry and by the Scientific Committee on Antarctic Research (SCAR). As part of the arrangement, TAAF pays Vincent Bretagnolle, a biologist from the CNRS Centre for the Study of Wild Animals at Beauvoir-sur-Niort in western France, to supervise the protection measures.

Some problems have proved less intract-

able than was feared. Greenpeace protestors tried to stop building work in 1988, claiming that the strip cut across the preferred migration path of an important colony of Emperor penguins. Now, says Bretagnolle, two years of observations have shown that the Emperors will either walk around the dike or over it, using specially constructed gentle ramps and encouraged by lifelike dummies. And the 3,000 Adélie penguins reproducing on the destroyed islands have — against expectation — shown that they readily find nests nearby. Bretagnolle estimates that only two or three adult Adélies have been killed since 1984, less than the daily meal of a sea leopard.

More at risk, he says, are the colonies of snow petrel and Cape pigeon. "These birds live for over 30 years. They take about eight years to find a mate and a nest, but keep both for life. If you destroy the nests, you destroy the colony." For these birds, all suitable nest sites in the archipelago were already taken. So Bretagnolle arranged for rocks to be broken on uncolonized islands, to create the right kind of crannies.

Although the emperor penguin colony has been less affected than was feared, says Bretagnolle, he fears that the worst is to

come. "The emperors stampede when frightened", he says. Last May, 7,000 king penguins, mostly chicks, died on the Australian Macquarie Island when the colony stampeded, apparently because of a low-flying aircraft.

Michel Engler says it should not be possible for this to happen at Dumont d'Urville. The emperor colony has already returned to the sea at the height of the summer programme and (in theory) is not in the flight path.

"Now our biggest problem is finding the right plane for the runway", says Engler — a 'cart-before-the-horse' predicament that further fuels critics' accusations of poor planning. And no-one yet knows whether it is possible to predict weather conditions at the base with such accuracy that planes can take off from Hobart on the 6½-hour flight and be certain to be able to land. The biggest risk is from blizzards whipped up by sudden katabatic winds of up to 200 km an hour. So, this year, meteorologists from the national weather centre are installing sensors and building a model of the base for wind-tunnel tests. And there is one final worry, France has a poor ecology image in Australia and there is a slight risk that the powerful Green party in Tasmania might try to ban French flights. **P.C.**