PRINT

Buried treasure

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Australia's first amber discoveries are proving an unexpected cornucopia of perfectly preserved insects and plant matter - and pockets of ancient air, water and perhaps even DNA. By Ashley Hay.

On a cool spring afternoon, in the basement of the Australian Museum, Dan Bickel props a small russet-coloured wedge on a little nugget of Blu Tack, balancing both in a Petri dish which he fills so full with water that its meniscus bulges like a dome. He positions it below his microscope, turning the lenses like old radio dials.

The room is quiet, the air-conditioning cold above the heavy smell of naphthalene that wafts around entomologists like Bickel. Down the corridor, thousands of the world's insects sit pinned and arranged in cabinets that stretch to the ceiling. Nearby, heavy metal compactor filing cabinets hold a vast library of journals, books, papers, reports.

But in all these references - written, drawn, pinned down - there is no trace of the creature that's coming into focus through Bickel's microscope. "You might have to fiddle a bit," he says in a soft North American accent as he pats the dials, "but you should be able to see it."

At first, it's like looking at warm, thick light, like honey. Adjusting the lenses, something brushes in and out of focus - and then, there it is. Millions of years old, now extinct, it's an insect never seen anywhere before, a tiny fly from the genus *Chaetogonopteron*.

People have often fantasised about time travel, but scientists have found ways of actually doing it, at least in part. From the earliest years of the 19th century, palaeontology has used fossils to look into the past. Some fossils replace the hard parts of animals - bones, teeth - with sediments or other minerals that harden to hold the original shape; others cast and hold the imprint of a shell, a footprint or leaf.

The ultimate fossilisation requires "unaltered preservation", and for that you need a resin - the sap-like exudate of a tree or some other plant. Perhaps originally a defence mechanism, or a balm for damage, it also functions as a sticky trap, catching insects, arthropods, small vertebrates, pieces of plants and pollens, even bits of skin, fur and tissue, and holding them intact. Across millions of years, polymerisation takes place as the resin hardens and is buried. When it reappears, usually washed out of the lignite deposit that's formed over time from its original trees, it's amber.

There's something seductive about amber: Frederick I of Prussia created a whole room lined with its warm, rich glow, and Roman women used to carry little lumps of it "simply for the enjoyment of its touch". The most famous deposits, washed up from the Baltic Sea onto the northern European coast, have been collected and traded for thousands of years, sometimes explained as the tears of the gods or the tears of birds. The material trapped in these Baltic specimens alone has revealed more than 5000 previously undescribed insect species.

Some amber holds swarms of gnats; some holds spiders that yield preserved spiders' blood; some holds mating midges; some - called "menagerie pieces" - holds entire biological conversations, dozens of different species of insects snapped in with the flowers they lived among. Some specimens show death throes, egg-laying, the struggle between predators and prey, between parasites and hosts. Deposits span a record of life from the oldest specimens (formed 130-140 million years ago and discovered on the Isle of Wight and at Hastings), to the youngest (formed 12 million years ago in Borneo). Samples have also been recorded in Burma, Lebanon, North America and the Dominican Republic.

What makes this little *Chaetogonopteron* fly special - all 2.8 millimetres of him - is that he's not only a new species, he's a time traveller, carried into the 21st century as part of the first amber deposit encountered in Australia. He's part of a new Australian fossil field, now the most northerly, and of the first haul of amber ever to be studied scientifically - as a whole sample - before any other collections, commercial or otherwise, can take place.

The story behind this first Australian discovery is as irresistible as amber itself. Imagine a wild stretch of far north Queensland coast - "a little bit romantic, if you like crocodile-infested rivers," says Bickel. "Basically full of uncharted reefs," says Henk Godthelp, a palaeontologist from the University of NSW. Now imagine a commercial fisherman, Dale Wicks, and his partner Beth Norris. In the evenings, they walk along these far-flung shores, and on one trip, in 2003, they find some strange plastic-looking rocks along the high-tide strandline, mucked in with the bottletops, rope, thongs and seaweed.

They collect a few pieces, head home, and track down one of the world's amber experts, based overseas. Is it amber, they wonder, and he replies that there is no amber in Australia.

And there the story might have ended. But instead, the couple send their samples to the Australian Museum where "standard gemmological tests" - including pricking the substance with a hot pin to see if it exudes a "resinous" or piney aroma - determines that these pieces do indeed include the first Australian amber, and also specimens of copal, or resin that hasn't fossilised to quite the same extent. A restrained announcement is made in *The Australian Gemmologist* in 2006 about "amber-like fossil resin from North Queensland" which will be "of interest to gemmologists".

Professor Mike Archer is not a gemmologist, and "of interest" doesn't begin to describe his response. The museum's former director, he became dean of science at UNSW as the amber was being tested, and is now one of the chief investigators on a three-year Australian Research Council Discovery Grant that will study the amber and the life forms it holds.

"I certainly knew that amber was unknown in Australia, so that much was very exciting," Archer says. "But I also knew that amber almost always has beasts - we call them inclusions - in it, and the thought of that sent a bit of a flip-flop through my heart." Travelling back from Australia's famous Riversleigh fossil site in north-west Queensland in 2006, he and UNSW senior research scientist Sue Hand called in on Beth Norris to see her collections.

"All the things we already thought about the amber paled into insignificance when we first visited Beth," he says. "She took us into her kitchen and there was this stuff - the colours are just mind-boggling, from greens to reds, there's the whole spectrum of the rainbow. And the blue is almost psychedelic. Some blue ambers require ultraviolet light to be able to see them,

but this is a beautiful tinge of blue. And the incidence of inclusions - it's among the highest in the world. I think you heard the sound of jaws dropping when we saw what was sitting on her table."

"Beth had one piece," says Hand, also a chief investigator, "that was really beautiful deep red amber, and inside it was what looked like a gold insect. It was just stunning. It was gold, and it was as if it was glowing in the red. It was the most beautiful thing I've ever seen." In her narrow office, made narrower by filing cabinets and desks and by the skeletons and bones piled on the surfaces, Hand almost sparkles when she talks about these gems.

"I've got a bit here," she says, rummaging for a zip-lock bag to produce two pieces of amber. One is a rich brownish red, its edges rough, but only in the way that velvet feels rough. There are caves and hollows in it, and it's light, so light. The second, cut down and polished, has that familiar amber glow, warm, orange, almost pulsing with light. Held up, they both illuminate like stained glass, and the smaller, polished piece has tiny flecks in it that are easy to see as spores, pollen, insects' legs.

Light, warm, they feel more alive than any rock or stone, no matter how smooth, and their smoothness, against a thumbprint, the palm of a hand, is comforting, compelling. "It's supposed to be a healing stone, so …" Hand pauses.

"Have a look at those," Godthelp proffers another zip-lock bag, "and sniff them as well. It's mandatory to sniff this material." The resinous edge is there, more retsina than disinfectant, but still pleasant, and somehow familiar.

More than 50kg of this Australian amber has been collected, by latest calculations, including, as Godthelp matter-of-factly puts it, "amber that's just in barrels and hasn't really been looked at. We came back from the last trip with a huge sack … some pieces are the size of footballs." When work for the grant gets underway in 2008, space will have to be found for the machine Norris will use to cut and polish the pieces.

"That's what I like about this project," says Godthelp, "we're bringing people into science who not only discovered the material but discovered that they were part of this really interesting thing. That doesn't happen terribly much these days." As a research assistant, Norris will smooth and refine the amber to get what Bickel describes as "nice views, best at a perpendicular angle, of the specimens".

Apart from his new fly, this amber has been recognised as holding enough faunal and floral material of the quantity and quality to put it into the highest-grade category of fossil deposit. Cape York has already offered up ants, wasps, millipedes, beetles, butterflies - and more than 50 plant specimens.

"We expect to find bark and pollen, the odd flower or two, hopefully," says Mary Dettmann, a palaeo-botanist at the Queensland Museum and, like Bickel, a partner-investigator on the grant. "Being entombed, they're beautifully preserved, which means you get all the detailed cellular structure too. We've often remarked that there's no amber in Australia, and not much is known palaeo-botanically in the time interval that we assume the amber was formed. So to have it turn up is quite exciting."

Given that the amber's deposit sites, and potential sources, are known to contain several

different-aged materials, Hand laughs: "there are a lot of Jurassic sediments. We might find dinosaurs - who knows?"

"No matter what treasures turn up," says Archer, "my heart will reserve a special flip for the first piece of a mammal, or a backboned animal, in that material … it could be a lizard or a frog or even a small marsupial." As the man who most famously champions reviving the extinct Tasmanian tiger from extracted DNA, he is also more than a little interested in claims that viable DNA has been retrieved from amber elsewhere.

"It's one of the prime candidates argued about for producing ancient DNA," he says. "Now, a lot of people are very sceptical about this; no one's quite sure if it's happened. But the interesting thing is that it's forced people to question definitions of life."

Some researchers claim DNA extracted from amber can code for protein production in the right situation. "Any tissue or molecule that can actually perform its function is still alive," says Archer. "So you can argue you're getting living stuff out of amber."

And then there are the pockets of air and water captured by the resin: "In a way, if you could reach into the past, open a test tube and then close it and bring it back into the present, that's what we've got," he says. "With the current interest in the composition of the atmosphere, percentages of CO^2 - all these things can theoretically be checked against what conditions were like about 15 million years ago in Australia."

From that air, from that water, "we can tell the temperature, how much rain was falling, all manner of things," says Godthelp. "We've got records like this from Antarctica and from the Arctic icecaps, but we don't have them from elsewhere. That could be incredibly valuable … if we can get it processed in time."

With everything it might reveal about Australia's geology and biodiversity, the phylogenetic and evolutionary histories of its plants and animals, those all-important climatic conditions, and - given where it was found - important clues as to how species moved to and from Papua New Guinea, being able to work on this amber is, for the scientists, "a bit like Christmas", says Hand.

"And we've got so many new tools available to us as well," says Archer, "like the synchrotron in Victoria which can image this thing as if it were outside the amber buzzing round … it's like the past and the future uniting."

It's only the beginning. In 2005, Godthelp suggested that less-polymerised resin - copal - might turn up further down Queensland's coast. "Fraser Island has kauri trees [prime floral candidates for the initial resin], so I said, well then, we would expect to find copal on Fraser, and we would expect to find it on the beach, in this particular zone. And someone went out to Fraser and had 15 minutes to kill, and he went down to the beach and picked up a piece of copal, exactly where I'd said to look. It worked a treat."

Just last month, Godthelp received a small packet from the other side of the continent. It was a specimen collected on the West Australian coast, "quite different from the Cape York material," he says, "but also different from the copal you'd find Madagascar". Collected a decade ago, it had, like Norris' specimens, been dismissed as an impossibility.

The beaches that face east on Cape York's coast are picture-perfect. Geographically secluded, they've cradled the amber for thousands of years, its discovery forestalled by crocodiles, uncharted reefs, tides and extreme weather. Just getting there, says Hand, can be "almost like a movie".

Washing north with the currents in winter, south in summer, the amber rolls ashore among the trash with each high tide. As he walked along with Norris and Wicks earlier this year, Godt-help had an even more cinematic moment: there on the shore, from distant, exotic places, were two bottles holding messages. Just like the amber itself.

Ashley Hay has written four books of non-fiction which all reveal an ongoing fascination with fabulous people and their obsessions. She has also published essays, short stories and journalism. Hay lives in Sydney and is finishing her first novel.