Building 2 March 2001

Welcome to the jungle

Eden is the biggest greenhouse in the world and the most eagerly anticipated construction project of the year. With two weeks to go before it opens, Gus Alexander explored Cornwall's jungle in a bubble. Photographs by Andrew Southall

It looks like a jungle shack, but the hut is actually an air-conditioned chill-out room for explorers overcome by the tropical climate.

IF YOU WANT TO BE HAPPY FOR A DAY, GET DRUNK. IF YOU WANT to be happy for a week, take a mistress. If you want to be happy for the rest of your life, make yourself a garden. The ancient sage who offered this advice was probably thinking of a perfumed bower in a balmy Mesopotamian plateau. If he'd been living in grey, rain-splattered England, no doubt he would have specified that you plant it indoors. In which case, he would have been delighted with the £75m Eden Project, the ultimate indoor botanic wonderland, which opens to the public two weeks tomorrow.

The centre's transformation from Buckminster Fulleresque construction exercise to pulsating, larger-than-life terrarium is almost complete and Tim Smit, Eden's charismatic client, and his team of gardeners have been planting it out for the past six months. It has been created at the bottom of a 60 m deep disused china clay quarry at Par in Cornwall. Visitors arriving at a reception centre are greeted by the spectacular sight of two huge transparent enclosures that look for all the world like gargantuan soap bubbles, connected and accessed through a delicate low cafeteria with a turfed roof.

Andrew Whalley, project director at architect Nicholas Grimshaw & Partners, explains that the futuristic bubbles evolved from the practice's design for the glass roof and external steel trusses of London's Waterloo International Terminal. "Technology has come full circle," he says. "The Victorian railway engineers pinched the cast-iron technology from the greenhouse brigade, and now we are using our railway technology to cope with the plants."

Although the whole site has been extensively landscaped and is approached through a sexy visitor centre enclosed by rammed earth walls, and an understated modern restaurant, the crowning glory of the operation are these two "biomes", or biological domes. These are the greenhouses that enclose the plant life, one for temperate flora and the other for tropical. One cannot help but be astonished at the scale and grandeur of the enterprise. The taller tropical biome rises to a height of 55 m, four times higher than the Palm House at Kew Gardens, and the domes' combined footprint covers 29 football pitches.

One's usual experience of big conservatories, as at Kew, is that different microclimates are contained within the main structure and separated by glass partitions, whereas in the biomes, everything is open plan. Although the vegetation in the temperate zone is not that exotic, the combination of light, heat and scent at this intensity has an overwhelming effect on the senses. If this was the sole exhibit, you would still come away astonished.

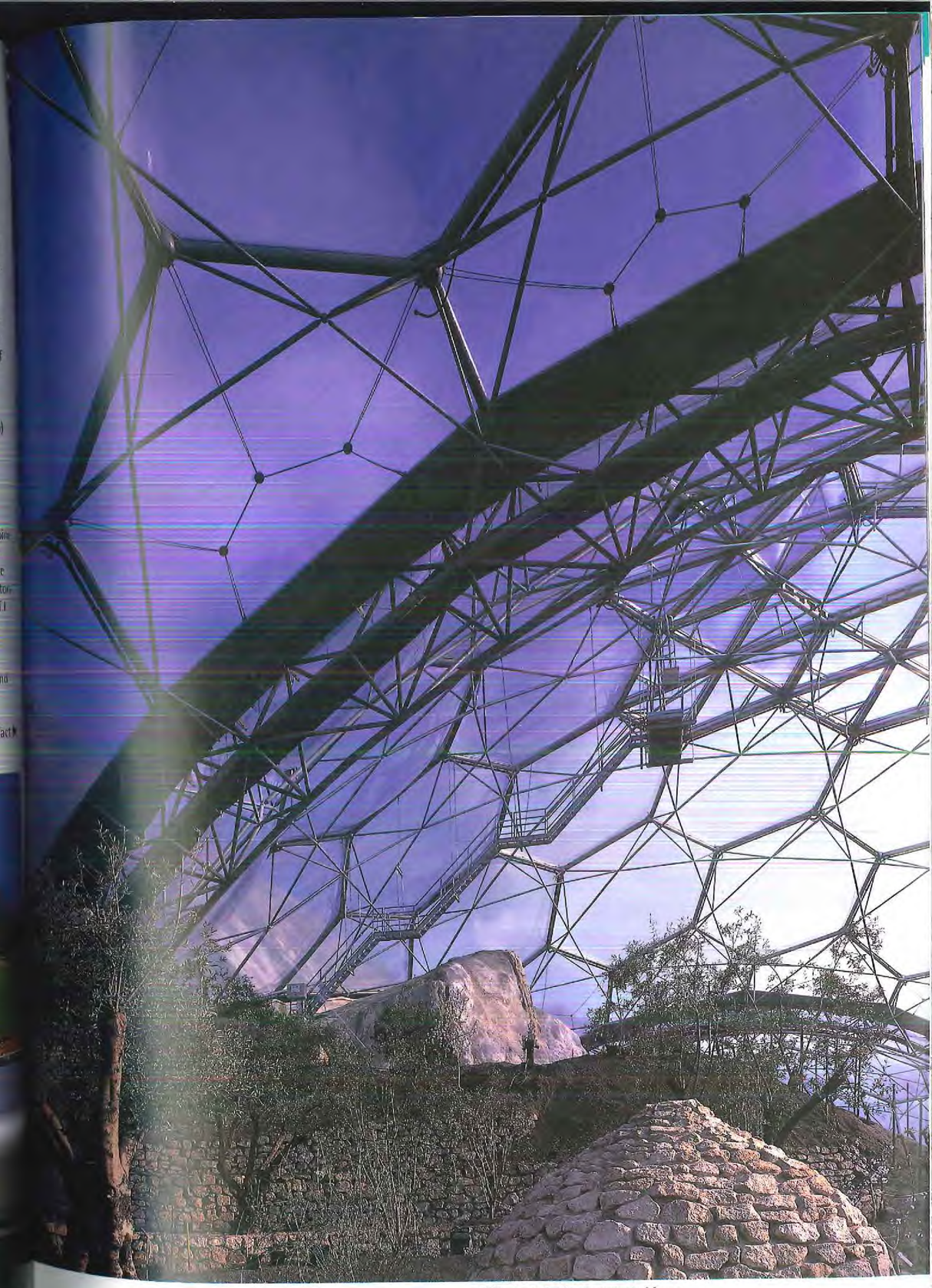
If the temperate biome is the combination of every greenhouse experience you've ever had, the larger tropical biome is something else altogether. You have the sensation of being in the Amazon or the Congo, or some kind of uncharted territory – the lost world of Conan Doyle's Professor Challenger, perhaps. The whole space is essentially an enclosure built around a cliff face, which permits features such as waterfalls and rivers. The wet, steamy heat (steel fixers had to wear gloves for extra grip during construction) and the pungent jungly atmosphere literally take the breath away. There's even a native's wooden hut that is actually an air-conditioned chill-out room where novice explorers can recuperate before completing their itinerary.

We were shown around by Keith Pizzey from Sir Robert McAlpine, part of a contracting joint venture with Alfred McAlpine. He is happier building motorways than guiding people through jungles but has become more of a David Bellamy figure since he spent last summer explaining the operation to the 500,000 visitors who came just to look at the site. "I wouldn't touch that tree if I were you," he says, gesticulating at an outlandish green shoot. "And if you do, don't wipe your eyes or you'll go blind."

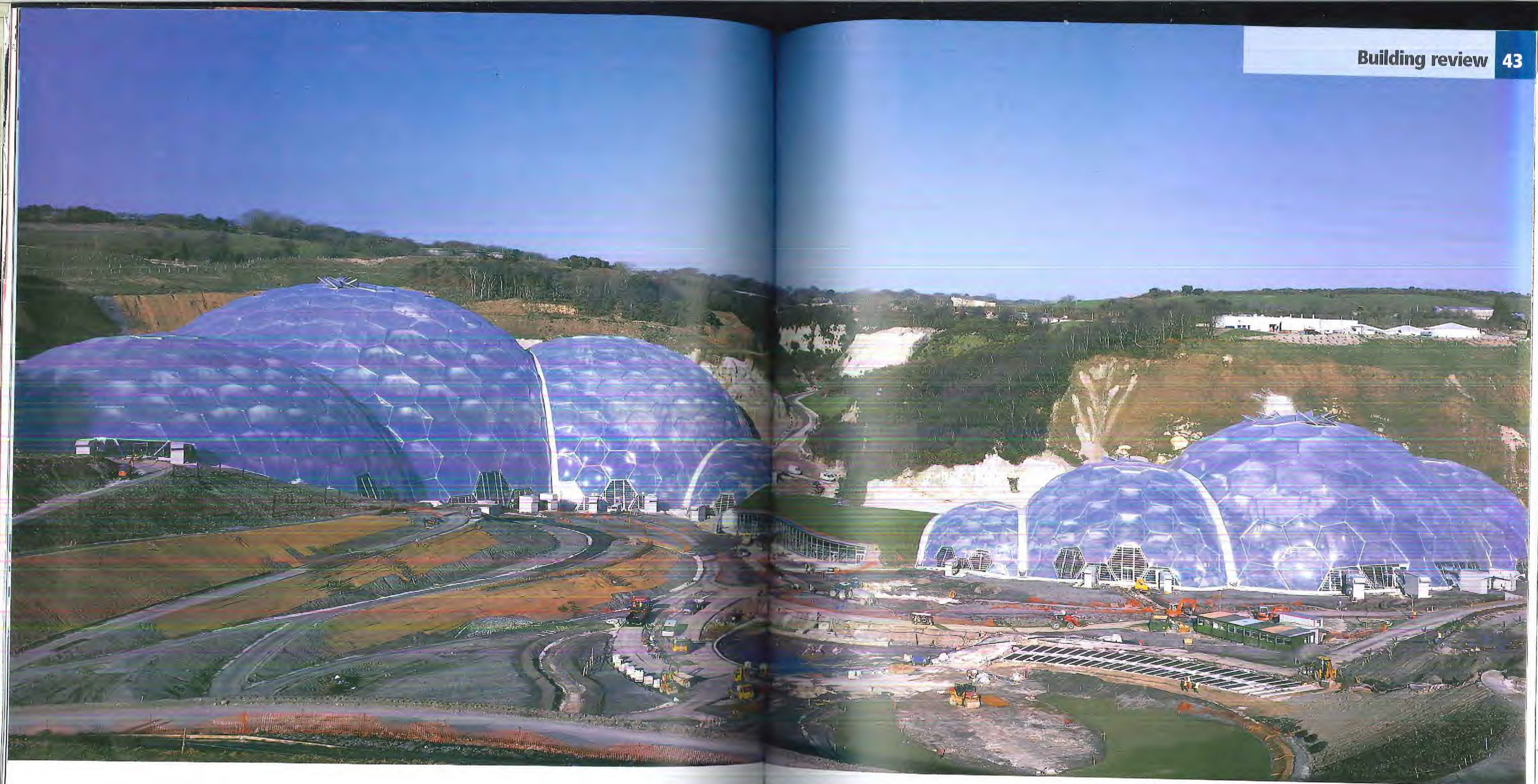
The architect's touch cannot be seen inside the enclosure. Construction is more jungle shack than European high-tech and you feel that any minute Johnny Weissmuller could appear swinging across the void on a giant liana.

The most impressive feature of the design is the matter-of-fact

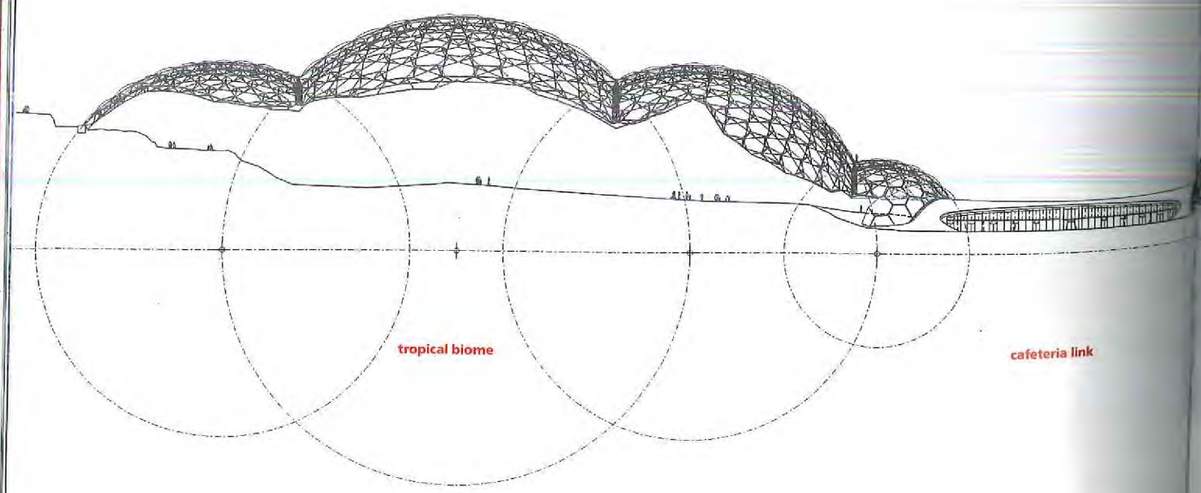
The biomes are connected by a restaurant topped by a turf roof.

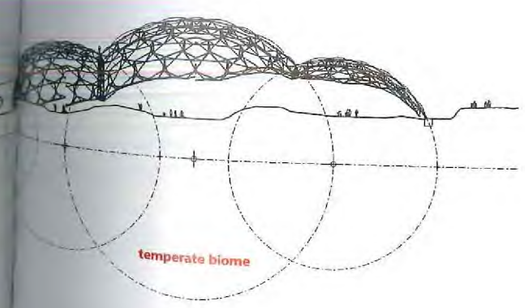


Olive trees in the temperate biome.



Eden: the long view.





How the bubbles were blown

Building Eden's huge spaceframe domes, one of which rises to a height of 55 m, would have been all but impossible using conventional glazing. Instead, the biomes are covered in a transparent ETFE membrane, which is as thin as polythene but much stronger, has one-hundredth the weight of glazing, and transmits more daylight and ultraviolet for plant growth.

The glazing units are hexagonal frames of tubular steel. They are glazed with two or more layers of ETFE, which are inflated to form stiff "pillows". The lightness and strength of the pillows has enabled the hexagons to be expanded to up to 11 m in diameter without intermediate glazing bars.

The hexagons were assembled into complex double-layered spaceframes, with an inner layer of steel triangles. The design of the spaceframes, by Nicholas Grimshaw & Partners and Anthony Hunt Associates, was only possible with advanced computer modelling. When manufactured, each hexagon had a tolerance of ± 10 mm.

The visitor centre, a shingle-clad rammed-earth structure, may well be Nick Grimshaw's first low-tech building.

▶ way the enclosure has been put together. As in a typical horticultural greenhouse, everything is very practical. It somehow seems perfectly natural that the steel struts to the hexagonal framing sections have pneumatic pipes clipped along them (they're there to maintain the inflation of the ETFE foil "pillows" that fill the hexagonal frames and are only one-hundredth of the weight of glass). It doesn't seem such a big deal that each hexagon is an unprecedented 11 m across and has the same area as a two-person Parker Morris flat.

No fuss has been made of the fact that every single strut, every single tie, every single threaded face of every single node on the whole site is a one-off – a tribute to German engineering by subcontractor Mero of Würzburg. Indeed if it were not for a breakthrough a few years ago by Dr Pavlov, a Russian mathematician, it would not have been possible to compute the manner of linking the hexagons. The extract ducts and ventilators follow the same aesthetic. Galvanised sheet steel. Gently humming.

What is so satisfactory about the whole project is that it is not some tired piece of heritage themery, still less a cynical American reconstruction of the sort of fantasy childhood that nobody ever had, tricked out in rides and merchandise to milk the punters. It is a genuine scientific adventure. Somehow it combines a British love of nature with our tradition of global exploration. It is sited about as far away from London as you can get while remaining in England, and is recycling a worked-out mine that might otherwise have become a waste landfill site. And despite its size, it's so well behaved in the landscape that you cannot even see it until you're in it. Not to mention the economic benefits for Cornwall, the county with the highest level of unemployment in England.

Oh, and by the way, it happens to be a world-class botanic research centre. The aim is to to make sure that vegetation survives on the planet, so it can return the favour. In the words of Whalley: "Turning solar energy into plant life. That's what it's all about." Spend 10 minutes in Eden, and you'll find it hard to disagree.

Find out how the ETFE pillows are attached to the structure in Detail, pages 72-73.

Project team

client **The Eden Project**
architect **Nicholas Grimshaw & Partners**
main contractor **Alfred McAlpine/Sir Robert McAlpine joint venture**
landscape architect **Land Use Consultants**
project manager **Davis Langdon Management**
civil and structural engineer **Anthony Hunt Associates**
services engineer **Arup**
quantity surveyor **Davis Langdon & Everest**
quality supervisor **Land Architects**

Principal subcontractors and suppliers

superstructure **Mero UK**
ETFE pillows **Foiltec**
foundations **Dean & Dryborn**
M&E **Colston**
water features **Ritchie MacKenzie**

Half a million people have already come to the visitor centre to watch the progress of the spectacular biomes.