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DESIGN AT ALL SCALES
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The Tech Issue

SUSTAINABLE

Making Space for Life

Building systems complement ecosystems in an airy, energy-efficient transformation of Montreal's Biodome.

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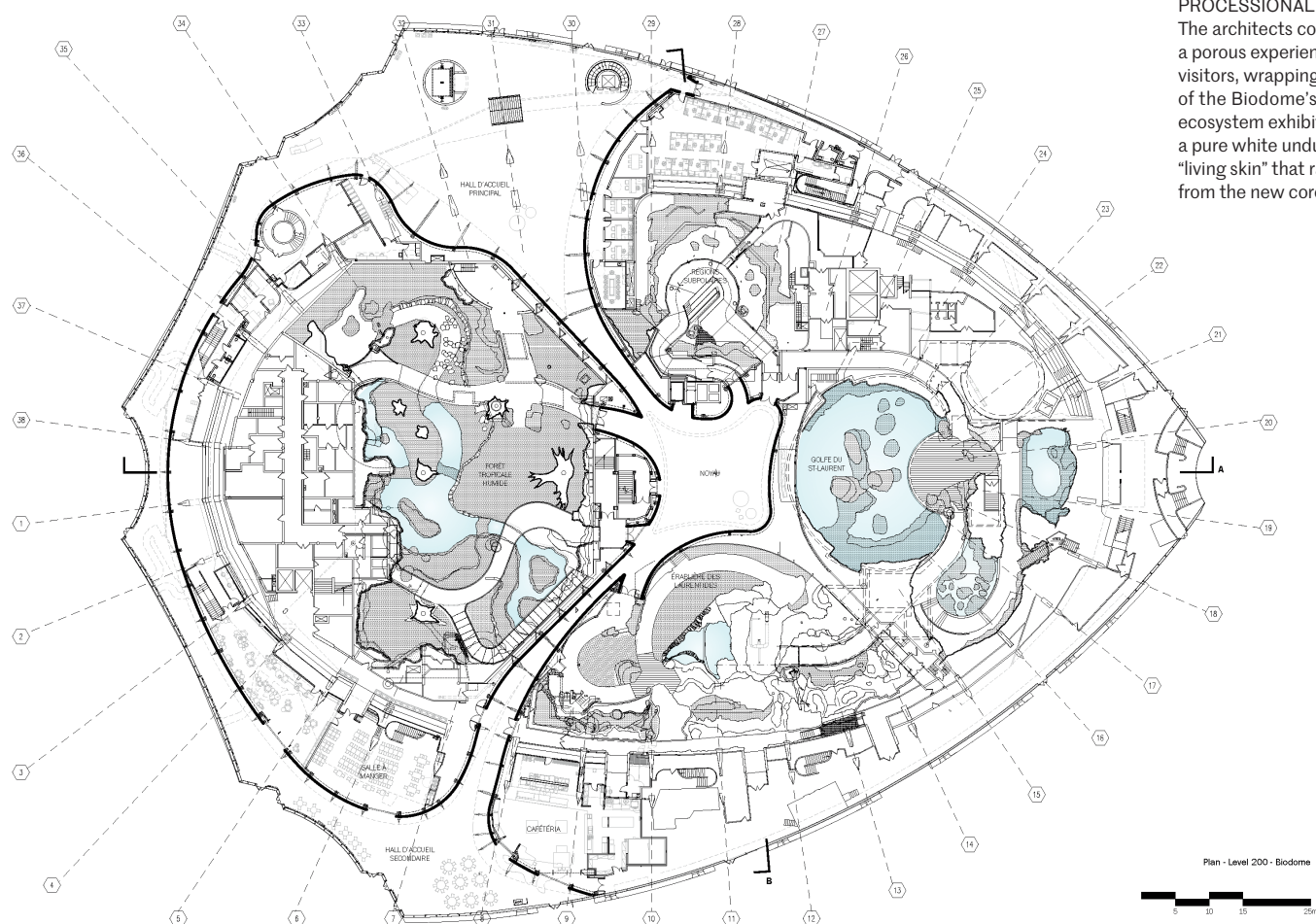
LIGHTS OUT

A team led by KANVA has recently redesigned Montreal's Biodome, housed in a former velodrome in the city's Olympic Park. The main intervention was to declutter the structure's core, leaving it open to the huge glazed roof above, obviating the need for much artificial lighting.



COURTESY MARC CRAMER





PROCESSIONAL ROUTE
The architects conceived a porous experience for visitors, wrapping each of the Biodome's five ecosystem exhibitions in a pure white undulating "living skin" that radiates from the new core.

Every two years a city somewhere in the world spends millions upon millions on infrastructure for obscure sports like speed skating, equestrian events, and synchronized diving. But when the Olympic torch is passed to the next host and the world's athletes, spectators, and TV cameras move on, the city is left to figure out what to do with all sorts of outmoded purpose-built structures.

One such building, a structure at Montreal's Olympic Park that was originally designed as a velodrome by French architect Roger Taillibert for the city's 1976 Summer Games, has been returned to nature. Instead of fans, the stadium's soaring concrete vault and skylights have provided shelter to hundreds of species of plants and animals from around the Americas since the 1990s,

when the building was repurposed as the Montreal Biodome. A massive zoo-cum-terrarium that is home to a wide array of plant and animal species including penguins, macaws, and Canadian lynx, the Biodome is one part of Space for Life, Canada's largest natural science museum.

A recent renovation has brought the Biodome into the 21st century. Led by local firm KANVA with NEUF architect(e)s, a new museum within the shell of the original ferro-cement structure has boosted the center's sustainability credentials and introduced a biophilic visitor—and animal—experience to the museum.

After the firms won a public competition in 2014 that was judged not only by architects and civil servants but also by



EXPERT OPINION
The Biodome, part of the multisite natural science museum Space for Life, collects and presents flora and fauna from five ecosystem exhibitions. The creation of each required a multidisciplinary approach involving biologists, veterinarians, and other experts.



WEB OF LIFE
To help inform the design of the sub-Antarctic Region, the team studied the resident penguins' swimming patterns (below). A new second level weaves through ecosystems including the Tropical Rainforest (above) and leads to a mezzanine with additional educational space.



OPEN SKIES

With some ecosystems open directly to the sunroof above and each requiring unique climatic conditions, heating and cooling the space was no easy feat. A system of heat exchangers uses excess heat from the cooling of the cold-weather exhibitions to warm up the tropical one (opposite).

TIGHT FIT

The prefabricated skin was stretched tautly around a new aluminum structure developed by the architects and engineers and installed within the disused velodrome, which was built for the city's 1976 Olympic Games. Junctions throughout the skin structure allow future tweaks or modifications as needed (left).



SKELETAL FRAME

The architects worked with electro-mechanical engineering firm Bouthillette Parizeau and structural engineering firm NCK to design and install the skin, which encloses each of the ecosystems but allows sound and smell to draw in visitors.

biologists and biophilia expert Stephen R. Kellert, the learning process began. "When we are designing an apartment for humans, we can take so much for granted," says Rami Bebawi, cofounding partner at KANVA. "But if I asked you to design a water basin for penguins or puffins, you have to learn their swimming patterns, how they come out of the water, the angles of the rocks, and so forth."

Before KANVA's renovation, visitors followed a linear path through the museum's five immersive exhibition spaces, which are modeled on five ecosystems: the tropical rain forests of the Americas; the Gulf of St. Lawrence, with a focus on marine life; the Laurentian Maple Forest, which echoes the forests just outside Montreal; sub-Antarctic islands; and the Labrador coast, where puffins abound. KANVA's redesign called

for a choose-your-own-adventure-style experience, with what Bebawi calls the "nucleus" at its heart.

"The nucleus is a void," he explains. "We emptied the center of the building and opened it up fully to the skylights above." From the undulating white walls of the nucleus, constructed of fabric stretched over steel and aluminum supports, visitors can access each of the ecosystems through sliding doors hidden in the folds and corners of the nucleus's polyester skin.

"Your first engagement and interaction with an ecosystem is through the smells, the sounds, the humidity, the temperature," says Bebawi, explaining that the sense of sight is overstimulated everywhere else in our daily lives.

A similar effect is at play as visitors make their way through the tunnel that links



the entryway to the nucleus. About 30 feet long, the entry tunnel was built at a slight incline that is imperceptible to the eye. Says Bebawi, “Without you being aware, it calms down your pace.”

Along with the reflective whiteness of the nucleus’s walls, opening up the center of the Biodome to the 1976 structure’s skylights means that very little artificial lighting is required. It’s a simple gesture that—combined with other sustainability features such as a high-albedo roof, which mitigates the urban-heat-island effect, and a geothermal heating system—helps the museum lead by example.

Energy efficiency is no easy feat in a building that must house both penguins and parrots, demanding that tropical and polar conditions coexist. To cool the polar region, a preexisting system of heat exchangers

and glycol loops uses “waste” heat energy to keep the rain forest tropical—even in the brutal Montreal winter. “It’s like your fridge that shoots out heat from behind,” explains Bebawi. “Well, I’m building an ice tunnel, and I need heat right next to it to build a tropical forest. Having extreme conditions side by side is actually complementary.”

Since the Biodome is a science museum with a mission to educate the public about sustainability and the imperiled future of our planet, KANVA didn’t hide the building systems that make these five eco-exhibitions possible. Rather, from the top of the building, called the belvedere, visitors can take in a full view of the structure. “We’re also revealing the systems, the mechanics of the Biodome,” says Bebawi. “We want to reveal this so that people understand how complex the balance of life is.” ■



BIG REVEAL

From the newly installed mezzanine level, visitors have a bird’s-eye view of the habitats. An additional venue for public education, it also lays bare the structure’s underlying supportive technology and original 1976 features.