Housed in the Canadian Pavilion in the Giardini in Venice during the 2010 Architecture Biennale, the Hylozoic Ground project provided visitors with the unique experience of interacting with a responsive and 'live' textile matrix. Philip Beesley and Rachel Armstrong describe the extraordinary 'soil-less' environment that they collaborated on and how it provides a new model for a synthetic but evolutionary ecology.

SOIL AND PROTOPLASM
THE HYLOZOIC GROUND PROJECT
Hylozoic Ground is an environment organised as a textile matrix supporting responsive actions and 'living' technologies, conceived as the first stages of self-renewing functions that might take root within a future architecture. Can soil be constructed? The architecture of the Hylozoic Ground project pursues qualities of new soil. Hylozoic Ground is an environment organised as a textile matrix supporting responsive actions and 'living' technologies, conceived as the first stages of self-renewing functions that might take root within a future architecture. This environment, Canada's entry to the 2010 Venice Architecture Biennale, is part of a series of collaborative installations that have been developed over the past four years with a collective associated with the University of Waterloo, Canada, including designers led by Hayley Isaac at PBAI (Philip Beedie Architect Inc) in Toronto, engineers directed by Rob Gerber in Waterloo, and the AVATAR and FLint research centres in London and Odense. The first of the series was commissioned for the Montreal Museum of Fine Arts in 2007-8 and interim stages have appeared in Lima, Madrid, New Orleans, Enschede, Quebec City and Mexico City. Like the current environment in Venice, each of these stages of development has been framed as an open system that combines details from preceding environments with contributions from numerous designers and assistants in each city. The work has been developed and components manufactured by digital fabrication within the PBAI studio.

The work is conceived as a new primitive but that speaks of cultural origins within wilderness. The Hylozoic building system forms embroidered surfaces of a hybrid public architecture, a sprawling, tangled series of small public spaces. If attention turns from social gathering within these spaces towards the enclosing 'soil matrix' fabric, close inspection will reveal physical and chemical elements in various stages of transformation. The Hylozoic environment is a model system of a synthetic ecology undergoing an evolutionary process. Visitors can observe the initial state of the environment's ingredients, influence dynamic processes that respond to external paractice, and review these ongoing modifications over time.

The geotextile forms and procoll circulation systems that prevail in recent generations of the ongoing Hylozoic Ground project pursue practical methods for building synthetic earth. The oscillation of this new soil's alternating collapse and expansion offers an emphatically ambivalent, fertile building material for a renewed architecture. The Hylozoic Ground environment can be described as a suspended geotextile.
Artificial chemical cell species form habitats within the Hylozoic soil matrix that are capable of thriving under the initial conditions. Given enough time to evolve, new species take hold, as spontaneous physical and chemical changes take place within the living technology.

Organic soil is made of structurally repetitive organic and inorganic materials that possess heterogeneous properties. Similar to the complex assembly of tissues and organs in living systems, soil contains functions that are supported by an orchestrated variety of cells. The various elements of a soil matrix are spatially arranged in a way that provides suitable surfaces for self-organising and evolving biochemical exchanges. The chemistries self-regulate and interact and they confer the various molecular species with behaviours of living systems such as growth and sensitivity to their surroundings.

Similar to these properties of organic soil, the soil matrix of the Hylozoic environment is composed of a responsive framework made of inert materials and a ‘living’ technology layer made of the various species of adaptive chemistries that include organic ‘protocol’ technology and inorganic ‘iChell’ (chemical cell) membranes. Protocells and iChells are chemical models of primitive artificial cells working together to form the tissues and organs of the soil matrix. The self-assembling chemistries of the protocells and iChells offer ‘minimal cell’ criteria – container, metabolism, information. These cells therefore exhibit some of the properties of living systems, even if not considered by researchers to be truly alive.

Artificial chemical cell species form habitats within the Hylozoic soil matrix that are capable of thriving under the initial conditions. Given enough time to evolve, new species take hold, as spontaneous physical and chemical changes take place within the living technology. The new species further modify the habitat by altering physical variables such as the amount of carbon dioxide in the atmosphere or the mineral composition of the synthetic tissues and organs of the Hylozoic soil. The exchanges between adaptive chemistries, responsive materials and environmental fluxes within the Hylozoic soil matrix oscillate and respond to each other and, crucially, to people passing through the environment. Together these processes result in a series of transformations within the soil matrix that manifest over time as a ‘synthetic succession’. This living succession of protocol and iChell technology forms the tissues and organs of the Hylozoic soil matrix. Key ingredients include incubators (protocells), carbon-capture proteopcorals (protocells) and trache membranes (iChells).
section left: Porous fluid bed systems. Ferris wheel-like batteries are suspended between air and sleigh-like spherical platforms liquid layers.

section right: Polysulfate bath systems. Reaction: Pseudosolid suspensions result from the passing through an tween vapor analyzer by polysulfate trunks within the tank system.

section left: Extended caulk-off system. Decorated oil puddle would settle over gelatinous scaffold in the next generation of Polyspec series.

section right: Filter tower, high-pressure sand and meshwork tank system. The gas-fed systems diagram shows the polysulfate "tunnels" set at a lower level associated with separately layered layers by shape-memory array mechanisms. Feeds of humidity-loaded water and are suspended above, and separated from meshwork canopies support the humidity.

Cross-sectional slice of effluent.

1. Copper sulfate
2. Ferris-wheel reflection
3. Repurposed sodium hydroxide solution
4. Magnetic crystallinum
5. Distilled phosphates (DOP)
6. Complex of various paraffins forming sulfuric acid
7. Calcium chloride
8. Oil mist
9. Prospex

Prospex列出:
1. Syringe driven with prospex formulation
2. Air-impregnated copper, cobalt bronze
3. Ventricular markings
4. Arteries and veins
5. Copper ions, metal ions, in solution form:
   - Venice canal water
   - Seawater
6. Agglutination
7. The air-flow outlet will ag as overflow
8. Reverse/decant water in reservoir form, drain form
9. Polysulfate tanking
10. Prospex
11. Prospex

Extended caulk-off mechanism:
1. Copper sulfate + platelet
2. Metal-impregnated paraffin
3. Ventricular markings
4. Arteries and veins
5. Agglutination
6. Reverse/decant water in reservoir form, drain form
7. Copper hexagonal platelet + complex polymer scatting/gelation
8. Copper hexagonal platelet + gelation/solution
9. Agglutination
10. Prospex
space boils out of local circumstance. As with the fabric that emerges from the steady evidence of burning or coagulating, the chemks links are combined in repeating rows, and their numbers tend to drift and bifurcate. Adding links within linked rows crowds the surface, producing warped and reticulated surfaces that push outwards in three dimensions. In the next phase of development, following the Venice installation, a thrush membrane/cholesterol systems will be included within the Hylotic filter layers. A thrush cell is an artificial, ionic-gel model of a cell that consists of a semipermeable membrane surrounding a vesicle that allows water to pass inside, but not back out again. The growing, seaweed-like membranes of thrush cells are driven by hydraulic forces that create expanding and deflating forms. A continuous supply of raw materials provided through a syringe driver will ensure continuous remodeling of the thrush cells. The membrane produced by the copper hexacyanoferrate is initially soft and hardens on drying. A centenial flood of a thrush cell, supported on an organic polymer matrix such as agar, creates a sequentially layered structure that adds thickness to the membrane. The combination of older dried layers and younger moisture-laden deposits creates a many-layered matrix that traps water for growth and adds structural integrity to the developing chemistry. In these next stages, thrush cell functions might move out of the secure containment of current systems of glass flasks and flexible tubing, flowing over the supports of porous meshwork and scaffold systems. The generation of viscous, mucous-like membranes in open air involves a host of practical design challenges, while offering increasingly direct fulfillment of active geometric/human boundary functions. Installations containing these evolving details are slated for Salt Lake City, Osaka, and Beijing during 2011.

What ground, what soil, might be adequate for viable and involved dwelling? Soil has always been the prime material of architecture. But this contemporary soil does not quietly offer itself to the enlightened framing of space. Natural soil might seem to stand silently, apparently offering secure mass and compression as plastic, frutile resources for framing human territory. But soil’s lumpy, sodden masses counter any enlightened world of social construction. Soil desires collapse. Soil’s inexorable infolding of matter within matter maximizes surface area and dissipates space, compacting intermittently into dirt. Soil eliminates and evaporates space. The soil crust of the earth’s crusts and disintegrates myriad layers formed from condensation and evaporation. Soil consumes and erases daily circumstance within its unspokably silent, primal fertility. And, soil also desires springing growth. The soil crust of the earth searches with myriad seeded rivers, minuscule fragments gathering and efflorescing, coalescing with churning oceans of growth to come. Soil’s immovable flowering genesis of matter building upon matter overwhelm the spaces, riddling voids and breathing and flaming onwards. The ambivalence latent within soil makes it a monotonous dopplegänger for architecture.

The Hylotic series offers a diffuse matrix, a site for assimilation and transformation. This matrix offers a map of a dissociated body moving to and fro across junctions of conception, charged with territory whose gestural roots speak of birth. If, quirked by a humid microclimate and organic atmospheres blooming around human occupation, the vestige and primitive glands crowding the Hylotic Ground surface spoke, they might call here, voicing object hunger. This soil is pulling. Its environment seels and depends on human presence as elemental food.

Notes
1. The ongoing series is directed by Philip Galat and principal collaborators Rob Galat and Rachel Arnott. Key individuals include design associates Hanson Isaac, Eric Bury, and Jonathan Taitt. The Hylotic Ground Venice term includes production director Perreti Christel, lending and promotion for Paul, former Chair of the Department of Visual Arts, University of Oxford, professor Carole Crivelli, Filippo Perlino Piater, Cesare Piva, and Adam Schwartzblut and engineers Blanton Edict and Anna Maler, principal research assistant Martin Franco, and Davide De Luca, and photographer Jorge Chaves.
2. Geometric and visual engineering structural layers that provide support for landslides. Many geotechnical structures are undergoable, and are eventually taken over by organic growth.
5. The geometry of this section is "superpositional", combining right mention with cored incisions and intact formations following the 10-way division of a circle alternate with circle-packed regular hexagonal geometry.

Some images from this essay are adapted from Philip Besley, Perreti Christel and Malay Haas (eds), Hylotic Ground / Lumen Responsive Architectures, Versatile Architectural Press (Cambridge, MA, 2010).