On Growth and Form

textiles and the engineering of nature

CURATED BY

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KENNETH SNELSON ✦ CHUCK HOBERMAN ✦ ANN RICHARDS

DONALD E. INGBER ✦ SOPHIE ROËT ✦ APOTEX MEDICAL TEXTILES

CLAUDY JONGSTRA ✦ ANIKO MESZAROS ✦ GEOTEXTILES

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Textile Museum of Canada

On Growth and Form:
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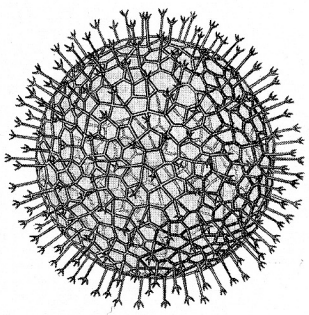
Making Nature

By Philip Beesley

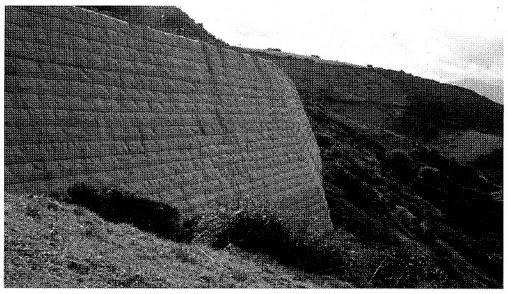
"I am not interested in policing the boundaries between nature and culture—quite the opposite, I am edified by the traffic."[1]

On Growth and Form: textiles and the engineering of nature explores the extraordinary qualities of a new generation of textile materials, illuminating the science that makes them possible and the poetics they express. The phrase "On Growth and Form" refers to the 1917 text of the same title by D'Arcy Wentworth Thompson. Thompson studied systems of form and structure running throughout species of nature. The eloquence of his writing and the extraordinary illustrations in that text had a profound effect on generations of artists and contemporary thinkers. This exhibition honours that legacy by extending Thompson's way of thinking into the new art and science of hybrid materials and structures. The structures of nature are a fundamental source for this collection of new work. Some of these fabrics employ natural processes, flexing, responding to sensory stimuli and transforming themselves. Others take their form by imitating the organizations of microorganisms and cellular tissues. The synthetic materials that result come from opening the boundaries between organic and artificial forms and ultimately involves making living things. The projects here speak of an uncanny plastic nature.

The works in *On Growth and Form* come from the disciplines of textiles, architecture and medicine and involve scales ranging from microscopic tissues to planetary landscapes. Weaving by textile artist Ann Richards emulates natural structure such as the elastic folding of skin in bats wings. Textile designers Sophie Roët and Claudy Jongstra's beautiful yardages make complex nonrecursive patterns based on protoplasmic



View of *Aulastrum Triceros* organism structure, from D'Arcy Wentworth Thompson's *On Growth and Form*.



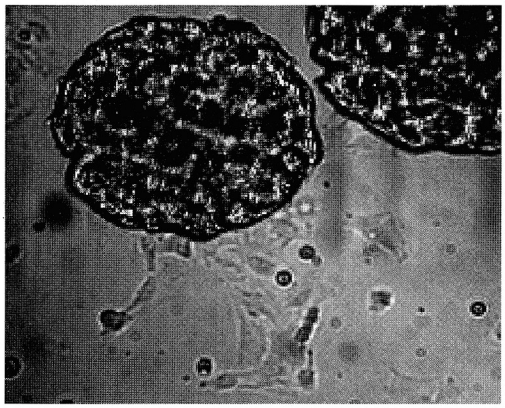
and cytoplasmic systems. Working at the scale of landscape, architect Aniko Meszaros has conceived a floating geotextile, an artificial reef populated by light-eating algae. Commercial geotextile systems by the corporations Maccaferri Canada Ltd. and Terrafix Geosynthetics Inc. demonstrate how similar constructions are in fact used every day in the engineering of civic works. Inventor Chuck Hoberman's *Expandagon* construction is a fabric made from a new child's toy system using reflexive mechanics, expanding and contracting in undulating movements. The sculptor Kenneth Snelson's structures display the universal principle of *tensegrity*, a natural structural system using compression struts floating within tensile webs. Medical researcher Dr. Donald Ingber works with human tissues, demonstrating how subtle structures of plasm within cell bodies can work as tensegrity systems. The biotechnology firm Apotex Research Inc. presents an artificial skin replacement using a slurry of skin cells suspended in a nutrient matrix.

D'Arcy Thompson, the first biomathematician, assumed that all science and learning were one. He claimed that all animals and plants could be understood in terms of pure mathematics. Thompson said, "*no organic forms exist save such are in conformity with physical and mathematical laws. . . The form, then, of any portion of matter, whether it be living or dead, and the changes of form which are apparent in its movements and in its growth, may in all cases be described as due to the action of force. In short, the form of an object is a 'diagram of forces'.*" [2] Thompson went far beyond the encyclopaedic and essentially static systems of nineteenth century biology. He conceived form as a product of dynamic flux. He said, "*Matter as such produces nothing, changes nothing, does nothing... [it] can never act as matter alone, but only as seats of energy and as centres of force.*"[3] An astonishing optimism accompanied this work, giving a vision of the physical world as a great symphony of harmonious forces. How beautiful and moving is the universe when understood as an ethereal palpitation of waves of energy making up all things! There are numerous examples of artists

Wire gabions reinforce a slope in Tuscany, Italy. Image: Maccaferri Canada Ltd.

and designers influenced by these words. For example, mid-20th century architect Richard Neutra said "*...The new landscape reaches into vastnesses and smallnesses beyond the normal sensory range; above all it reaches right into our own innermost physiology, the processes within our own skin, within our organism, our nervous system. There are no boundaries in [the new] nature; membranes are permeable, gases and liquids and energy volleys penetrate and are in perpetual exchange or transformation . . .*"[4] And yet, these are nothing if universal laws had not formed them into structures perceptible to our senses and intelligence which are themselves adapted to that universal structure. With such optimism we make a world of art out of chaos, in return giving a mirror of our proper structure back to us.[5]

But optimism falters. Looking into the future, Scientific American Magazine in their "Key Technologies of the 21st Century" 150th anniversary issue, amended their usual tradition of American confidence with a mounting, anxious vertigo: "*The truth is that as technologies pile on technologies at an uneven pace, it becomes impossible to predict precisely what patterns will emerge. Can anyone today truly foresee what the world will be like if, for example, genetic engineering matures rapidly to its full potential? If organisms*



can be tailored to serve any function (even becoming living spaceships...), can anyone guess what a 21st-century factory will look like?"[6]

What does happen when nature is replaced? The projects of this exhibition offer new qualities. One kind of result is durable, borne of patient study and craft. The subtle qualities in these works emulate the biology that preceded them. For example, Ann Richards says: "*In aiming for elasticity in the fabrics I design for wear, I am obviously seeking to create something of a 'second skin.' Fibres such as spandex seem to mimic the elastin in skin, in that they present a smooth surface on the body, provided that they are already strained while at rest. The extension of the fibres provides the stretch. In contrast, the way my fabrics work is more akin to the*

Sphere and cells, artifical skin replacement system by Apotex Research Inc., Toronto, 2001.

skin in bats wings, where a fine texture of folded skin allows extension through unfolding. One of my fabrics was directly inspired by the bands of elastic fibres that run across bats wings, creating an elastic 'seersucker' structure."[7]

On the other hand, another quality is radical and almost deliberately unstable—Kenneth Snelson's constructions are like this. Buckminster Fuller, the engineer and 20th-century prophet of American progress, took Kenneth Snelson's invention of tensegrity[8] and presented it as an *optimum* technology. In Fuller's hands, tensegrity seemed like a universal structural solution that could be used for harnessing and coordinating the earth's energy in order to build a greater human empire. However the tensile forces that accumulate from the compounds of stretched cables in tensegrity structures are enormous. Along with working as stable, efficient structures, the huge proportion of embodied energy in these constructions tends to makes them work as catalysts, reacting and encouraging counter-reactions. They hover, tensed, quivering at the slightest touch. Snelson's constructions invoke dissolution. They are agents of change.

In their various natures these materials—from plastic meshes to microscopic cell slurries, from durable and permanent synthetics to unstable catalysts—change our world. The consequences of introducing hybrid materials into the environment are fundamental. A web of reactions and counterreactions accompany each new ingredient. We can think of every material as a *replicator*, the centre of a field of influence on the world at large. Causal influence radiates out from the material, but its power does not decay with distance. It travels wherever it can, along the avenues of inanimate structures and of animate biology, of bodily form, of cultural imagination and industrial production. It radiates out beyond the individual form to touch and inflect inorganic objects and living organisms through the world.[9]

Ann Richards *Elastic Seersucker* silk and wool. Plain weave and waffle weave with over-twisted wool. The fabric is almost flat in the loom state and develops its seersucker structure during wet finishing, through the strong contraction of the high-twist wool. Design based on the structure of bats wings.

An artificial human skin, a gabion-reinforced landscape, and a cloth that flexes along with the movements of its wearer are all ingredients of a transformed world. The interwoven bodies that result are complex and the process of making them involves deep uncertainty. The anxiety, even vertigo, that results may be all-too-familiar emotion to us, but the works of this exhibition represent the thinking of generations that have moved beyond simple anxiety about the loss of the natural world. The works of this exhibition speak of creative and poignant involvement with technology. Making new nature.

NOTES

1. Haraway, D. J. (1991) *Simians, Cyborgs, and Women: The Reinvention of Nature*. Free Association Books, p. 180. Haraway says, *"We're inside of what we make, and it's inside of us . . . Intense pleasure in skill, machine skill, ceases to be a sin, but an aspect of embodiment. The machine is not an 'it' to be animated, worshipped, and dominated. The machine is us . . . "*

2. D'Arcy Wentworth Thompson, *On Growth and Form*, Cambridge Press, 1942, p. 11

3. *Ibid.*, p. 14

4. Richard Neutra, "Inner and Outer Landscapes", in Gyorgy Kepes, editor, *The New Landscape* MIT 1956, Paul Theobald + Co., p. 83

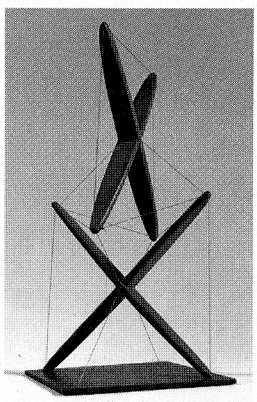
5. Paraphrasing Amadée Ozenfant, in *Foundations of Modern Art*, John Rodker, 1931, p. 285, a wide-flung manifesto which itself expanded upon Thompson's text.

6. *Key Technologies for the 21st Century: Scientific American—A Special Issue*, W. H. Freeman and Company, New York, 1995, p. xiii

7. Ann Richards, correspondence with the curators, August 2000.

8. Kenneth Snelson's large scale constructs demonstrate *tensegrity*, the construction system in which compression members provide rigidity while remaining separate, not touching one another, held in stasis only by means of tensed cables. By means of discontinuous compression and continuous tension, Snelson's multi-story towers and large scale amorphous exoskeletons of wire and steel give visible expression to the idea that tension and compression are the eternally complementary elements in any structure. In Buckminster Fuller's *synergetics*, tensegrity becomes a metaphor for how the Universe itself is constructed.

9. Adapting Richard Dawkins, *The Selfish Gene*, Oxford: Oxford University Press, 1983, 237-8. Dawkins describes how complex living systems are transformed by dynamic exchanges of inanimate materials.



Kenneth Snelson *Early X Piece, 1948* wool and nylon. 11.5" x 5.375" x 5.375"