



Production herd



Dr. Jeffrey Turner



Dr. Costas Karatzas

Photo: Sean O'Neill

## OFFICE OF TECHNOLOGY TRANSFER

# Nexia Biotechnologies

**W**here other scientists have tried but failed to mass produce or mimic spider silk, a super strong and supple creation, Nexia Biotechnologies has succeeded. "It's an immense achievement," says founder and president Jeffrey Turner. "When we announced it, our shares went up 40 percent in one day." The silk's amazing properties make it an alluring substance for myriad uses, including medical, military and commercial applications. Nexia is working on lightweight bulletproof vests, and surgical suture filaments that hold knots better than nylon yet are strong enough for ophthalmological, vascular or neurological surgery. New ideas crop up routinely, and discipline is needed to focus on bringing the first handful of products to market.

Nexia's current success has little to do with its roots. The company was founded in 1993 to make lactose-free milk, using a gene test system called MAC-T, developed by Turner, a McGill Department of Animal Science professor. The sponsoring milk company merged with another shortly after Nexia was set up, however, and the project folded. Fortunately, Nexia had signed a contract to make tPA, a pharmaceutical product used to treat heart attack and stroke now in pre-clinical testing. Dr. Turner also cast about for another new product, and decided to try inserting a spider's silk-making gene into a goat's embryo. Others had tried to farm spiders, but the aggressive creatures kill each other if in close proximity. Turner hoped to produce goats whose milk would be laden with spider silk protein, which could be harvested and processed into long threads. The process mimics a spider's own internal machinery, forcing the proteins through a nar-

row opening, then stretching it. This strengthens the protein by aligning and pressing the crystals into a tight zigzag configuration.

The genetic modification was possible due to research by Dr. Randy Lewis of University of Wyoming. Lewis, who cloned the key proteins in four types of spider silk, licensed the technology to Nexia, who in turn chose proteins from a group of orb weavers, which includes a common garden spider. "It's a super high-performance substance," says Turner. "Small things - like spiders - tend to be under-appreciated. But the orb spider's dragline silk, if made as thick as your thumb, can support a fully-loaded jet."

Investors were so enamoured of the company's potential that its initial public offering in 2000 gleaned \$42.4 million, the most ever raised in a Canadian IPO. Nexia's expanding herd of about 1,500 goats in St-Télesphore and Plattsburgh produce thread that is about one-third the strength of natural webs. "There's work to be done," says Turner, acknowledging that the current product's qualities are sufficient for some uses, but not everything he hopes to develop. Turner is encouraged not only by initial results, but also by confirmation that the gene passes from one generation of goats to the next. "We're up to three generations. The genes are not being lost and so far we've not detected any adverse effects." Chance of mutation is miniscule: the spider gene is only one among 70,000 goat genes. A hundred goats can easily produce enough thread to service the global medical market, estimates Costas Karatzas, Nexia's senior vice-president, research and development. To be commercially viable, one litre of goat milk must produce between one and 10 grams of

# Fact Sheet

Nexia Biotechnologies Inc.

## INDUSTRY SEGMENT

Performance biomaterials,  
transgenic animals.

## BUSINESS

Spider silk for medical, military  
and commercial uses.

## FOUNDED

Founded in September 1993 by  
Dr. Jeffrey Turner, Professor,  
Department of Animal Science,  
McGill University.

## EMPLOYEES

100

## FINANCING TO DATE

Initial financing:

\$2.5 million in 1993

Initial public offering,

December 2000: \$42.4 million

Total to date: \$66.9million

## CONTACTS

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silk; one gram produces 9,000 metres of silk. Turner projects that the company will begin reaping sales from medical products soon, followed by sales of industrial product in a few years.

Turner's project has an earthy appeal that goes beyond humans' enduring fascination with spider silk. "We domesticated goats 8,000 years ago to produce food," he says. "Now we want them for life-saving processes. It's important to look to nature, not as something to exploit, but as something to learn from." As further evidence of Nexia's environmentally friendly attitude, Turner points to one product under development - biodegradable fishing line. Jacques Cousteau's son, Jean-Michel, has publicly challenged the biotech industry to produce it. Traditional nylon line's decomposition is measured in thousands of years, threatening wildlife; Nexia can make a coated thread that, once broken, dissolves in less than a year and begins losing its strength long before.

The multi-faceted nature of spider silk has led to corporate alliances. For example, Nexia is working on a research project with the Canadian Department of Defence, and has a Collaborative Research and

Development Agreement with the U.S. Army. "The U.S. military are looking ahead to 2010, and 2020," says Karatzas. "They want a revolution [in products], a huge leap forward. Each time we finish one contract with them, they begin working on another." Karatzas, who worked with Turner in animal sciences, is one of about 30 employees with links to McGill. "Our association with McGill has been deep and continuous," says Turner. "We can see the evolution of technology transfer at McGill," adds Karatzas. "It has become much more sophisticated. They know our needs, accurately measure the benefits to the university, and have sensitivity for our industrial partners." "McGill is a tremendous fundraiser, and is attracting the world's best talent," says Turner. "Putting the resulting research to public use by helping start-up companies is an excellent value for taxpayers."

## TECHNOLOGY

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# Nexia Biotechnologies Inc.

Using patented processes, Nexia Biotechnologies Inc. is creating a herd of transgenic goats - animals with an additional gene. The goats, which contain a spider's silk-making gene, produce milk loaded with spider silk protein. The milk is collected, and the silk protein extracted. The protein is then processed into steely strong but supple filaments with medicinal, military and commercial applications.