

Home & Garden

The New York Times

 New York State
World Trade Center Relief Fund



HOME

- TOP HEADLINE
- REAL ESTATE
- AUTHOR LINKS
- NEWS

SEARCH [Go to Advanced Search](#)

Past 30 Days

GO TO MEMBER C
Welcome, t

E-Mail This Article

Printer-Friendly Format

sponsored by



Most E-Mailed Articles

REAL ESTATE

International
National
Nation Challenged
Politics
Business
Technology
Science
Health
Sports
New York Region
Education
Weather
Obituaries
NYT Front Page
Corrections

OPINION

[Editorials/Op-Ed](#)
[Readers' Opinions](#)



FEATURES

Arts
Books
Movies
Travel
Dining & Wine
Home & Garden
- Columns
Fashion & Style
New York Today
Crossword/Games
Cartoons
Magazine
Week in Review
Photos
College
Learning Network

SERVICES

Archive
Classifieds
Theater Tickets
NYT Mobile
NYT Store
E-Cards & More
About NYTDigital
Jobs at NYTDigital
Online Media Kit
Our Advertisers

MEMBER CENTER

[Your Profile](#)
[E-Mail](#)
[Preferences](#)
[News Tracker](#)
[Premium Account](#)
[Site Help](#)

NEWSPAPER

April 4, 2002

DESIGN DEBUT

Trade Secrets of the 6-Legged Set

By CHEE PEARLMAN

BERKELEY, Calif. · DON'T pity Prof. Robert J. Full, a biologist who spends most days handling giant cockroaches, finger-biting geckos and poisonous centipedes. These creepy crawlers may not be his friends (the cockroaches in particular disgust him), but they are his inspiration. Their legs, especially, stir his ardor, not to mention the geckos' feet, which "uncurl like a party favor and peel away from the wall like a piece of tape," said Professor Full, who finds in nature — specifically, in the way animals and insects move — design secrets that can change the way hapless Homo sapiens is able to navigate his own world.

These creatures are a source of wisdom in his designs for robots like Mecho-gecko, the all-terrain Hummer of mechanical movers, or RHex, a cockroach-inspired robot built at the University of Michigan and McGill University, which can



Peter DaSilva for The New York Times

SWIFTY Prof. Robert J. Full with Sprawlita, a robot built at Stanford University and inspired by the high-speed cockroach.

MULTIMEDIA

[Video: The RHex Robot in Motion](#)

TIMES NEWS TRACKER **NEW**

Topics

Robots
Biology and Biochemistry
Science and Technology

Alerts

[Create Your Own](#) | [Manage](#)

[Home Delivery](#)
[Customer Service](#)
[Electronic Edition](#)
[Media Kit](#)

[Text Version](#)

climb through rubble and up stairs and can even swim. Professor Full expects that such robots, equipped with sensors, will someday be deployed to search out people trapped in buildings by earthquakes or other disasters.

As the director of Berkeley's Poly-Pedal laboratory, Professor Full leads a team that is racing to decipher the secrets of locomotion and apply them in a host of ways, to do things like defuse land mines or help animators put a believably springy step in cartoon creatures.

Seventeen research institutions are collaborating with him, and he has been asked for advice on materials and movement by companies like Nike and agencies like NASA. (Pixar Animation Studios wanted help with a caterpillar in "A Bug's Life.")

Unlike the cartoon image of the Jetsons' mechanical maid, the next generation of robots, he said, will be nimble crawlers. In this quickly developing field, the challenge is to turn ungainly motors and metal into feisty ground-hugging machines.

During a conversation in his laboratory at the University of California at Berkeley recently, Professor Full pulled a Death's Head cockroach as long as a cigarette lighter from a Tupperware container and put it on a bug-size treadmill. At top speed, a roach can rear up on its two back legs and run 3.4 miles an hour. (Roaches are dashing about everywhere, he noted. "You just can't see them because they move so fast." If you can see them, in fact, "that means you have a lot.")

Plucking an enraged scorpion out of a shoe box and dropping it onto the treadmill, he sat down to answer questions about the convergence of biology and design.

[Alerts](#)
[Take a Tour](#)

[Sign Up for Newsletters](#)

NYT STORE

[Circuits: How Electronic Things Work](#)



[Buy this Book for \\$29.95.](#)



Peter DaSilva for The New York Times

Devers, built at Berkeley, was also modeled on insects.

E-L
 Refin
 Yo
 Co

Not ev
 is buyin
 car the

See ho
 you'll
 by refin
 your c
 auto

E-LOA

- No Lenc
- Low Rat
- Online L

SEARCH

You can a
 New a
 Auto



ADVERTI

[Discover Ne
 Topics of the](#)

[Find More Lc
 Experience C](#)

Q. As a biologist, how do you contribute to the design of robots?

A. We provide biological inspiration to the design process. Our goal is to give information to the best engineers in the world, to get them to build things that don't exist now.

REPRINTS &

[Click here to Reprints or F of this Article](#)

Q. How do bugs move at such high speeds?

A. Insects and centipedes have an advantage with respect to stability. They can go over rough terrain with very simple control systems very rapidly. Which is why they can use less brainpower. Each of them has a secret, and that's really what we do to unlock that secret is our job.

Q. Where does the genius of a cockroach's motion come from?

A. We typically think that control of locomotion comes from your brain. But in principle, without any brain or reflexes, the animal could self-stabilize by using its amazing skeleton because the skeleton can act as a spring and a shock absorber. These animals function in general like a tripod or a stool. Three legs are on the ground at once, and as a result they're incredibly stable.

Q. So you're taking lessons that took animals millions of years to learn and transferring this knowledge to designers.

A. We are at a moment when we can start to take advantage of what nature does. Engineering is getting to the point where we can make things that are small, curved and compliant. So nature will now become a wonderful teacher.

Q. How has nature informed the design of transportation so far?

A. We've built these things like cars and planes that are metal and stiff, so nature has influenced design only in the grossest sense. Planes have wings. Birds have wings. But there's no airplane that can do what a fly does. So there's only a very weak inspiration.

Q. But that's changing?

A. Yes, because revolutionary technologies are developing

in sensors and in materials · that allow us to design things that are more like creatures. Creatures are flexible and have many different senses and many muscles. But now you have these little tiny sensors. And you have artificial muscles. If you put all those together, ultimately, you will be able to venture into any kind of environment.

Q. What about in the home?

A. Robots will definitely be useful. But I suspect they won't be in the form that you would expect, like the Jetsons, and I don't think you're going to see Rosie the Robot any time soon. But what's going to happen is devices that you have will get smarter and be able to do work and manipulate things. They will interact with the environment, so you can give a command, like vacuuming.

A.T.M. machines are pretty good robots in terms of being able to respond to things, so robots in some form are already taking hold. The concept of the large humanoid robot will take longer.

Lots of people are working on them, and they're making enormous advances in every area, from emotions to locomotion.

Q. And in projects like the robots RHex and Sprawlita, based on cockroaches, what's the goal?

A. Even before Sept. 11, one of our major goals was to be able to go anywhere. Why? Because we couldn't believe how police and firefighters would go into hostage situations, burning buildings, buildings that had collapsed because of earthquakes, and try to find people.

And now we've seen it publicized, and see what can happen. We know it will be possible to have a swarm of mobile robots, whether they be flying or running or whatever, to get into a building and as quickly as possible locate everybody. So that these incredibly brave people can save other lives without jeopardizing their own. I think this is something we can definitely help with.

Q. I suppose people could learn to appreciate the ingenious design of insects if they knew more about them.

A. Every animal has something interesting to teach. It's just a question of how you look at it.

[Home](#) | [Back to Home & Garden](#) | [Search](#) | [Help](#)

[Back to Top](#)

 [E-Mail This Article](#)

 [Printer-Friendly Format](#)

sponsored
by



 [Most E-Mailed Articles](#)

Job Market [Search](#) our job listings for the best opportunities
or [post](#) your resume to attract top employers.



[Copyright 2002 The New York Times Company](#) | [Privacy Information](#)