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A Coat of Many (Changing) colors Nears Reality---Apparel of Shifting Shades May Have Applications For Fashion and Military
By Ellen Sheng

Henry Thoreau warned us to beware of all enterprises that require new clothes.

But that was before scientists dreamed up the concept of fabrics that can change color at the will of the wearer. Imagine a blouse that takes on a serious color, like black, for work, then morphs into a colorful pattern for an evening out. Or a military uniform that changes colors to blend into the battlefield.

With this kind of flexibility, who needs new clothes?

But you'll have to wait for these fashions of the future, because researchers are still working on prototypes.

Joey Berzowska, a director of XS Labs and design professor at Montreal's Concordia University, has created a simple dress with decorative spots that disappear when touched. She also has a shirt embroidered with a fanciful bug design that lights up when whispered to or touched.

Ms. Berzowska's current designs resemble art projects more than commercial design at the moment, but she sees practical uses that could appeal to many fashion-conscious women.

At the U.S. Army Soldier Systems Center in Natick, Mass., which designs uniforms and equipment for the military, researchers have developed a conceptual model of the soldier of 2025.

The prototype resembles the storm trooper uniform from "Star Wars," complete with the covered helmet. But unlike in the movie, where the footmen remain garbed in white, this uniform would be able to change appearance to match the environment. With such a flexible uniform, the military would no longer need to issue different sets of uniforms to match different environments, like woodlands and deserts.

Researchers are examining two concepts for camouflage of the future, said Jean-Louis "Dutch" DeGay, an equipment specialist at the Natick center. Under one concept, soldiers would choose from a database of existing patterns, such as South American jungle or African jungle, that would be replicated on the garment.

Other camouflage researchers are examining ways to create clothes with the ability to take digital images of the surrounding area then duplicate them on the uniform. This is

referred to as the "Predator" effect, Mr. DeGay said, referring to the 1987 movie starring Arnold Schwarzenegger as the hero who hunts down a chameleon-like alien.

While fabric researchers are pursuing as many avenues as there are colors in the rainbow, supplying the necessary paoer to facilitate the color changes is a big hurdle.

Ms. Berzowska uses thermochromic materials, which change color in response to heat, as well as electro chromic materials, which change color when an electrical charge is applied. To power and control the color changes, she uses a small, rechargeable battery and made-to-order threads and yarns that include conductive elements such as silver or stainless steel.

"Making a product that incorporates electronics is super challenging and super expensive," said Ms. Berzowska, who has done consulting work for sports apparel manufacturers. The battery adds weight and the conductive nature of the threads adds concerns about durability, cost and insulation against short-circuiting. Ms. Berzowska said she worked with a sports company to design a running shoe that could change color as the wearer ran faster. But the idea was ultimately shelved as researchers tried, unsuccessfully, to harness an alternate energy source- such as the user's walking motion- to power up the shoe.

Another possible chameleon technology uses microscopic beads, embedded in a fabric, that flip over when exposed to electricity. Mr. DeGay, the equipment specialist at Natick, has seen a demonstration in which a small swatch of fabric changed from black to white and back again as an electrical current passed through. But the challenge of using that in a real-life environment is, again, the power source. Soldiers already carry lots of equipment that requires power and can't be burdened with more, Mr. DeGay said.

Other researchers pursuing the "Predator" effect have demonstrated technology that uses cameras to record the surrounding environment, then projects the image onto a garment. Because the recording and projection are in real time, it makes the garment appear almost invisible. A professor and researcher at the Tokyo University, Susumu Tachi, demonstrated two years ago a raincoat covered with reflective material that seemed to disappear when a projection device was turned on.

Aside from technical issues, color-changing fabrics must also be affordable for consumers and manufacturers.

"Both the clothing and electronics industries run on small margins," explaind Ms. Berzowska, and sophisticated technology can be costly.

Nonetheless, upgrading fabrics with technology is a concept that's catching on.

With the U.S. textile industry struggling to face the onslaught of cheap textiles from countries like turkey and China, research and development of hi-tech fabrics is a good

way for U.S. manufacturers to get ahead of the game, said David Brookstein, dean of the School of Textiles and Materials Technology at Philadelphia University.
"The industry is trying to differentiate itself by having products that are proprietary," he said.

Higher production costs, within reason, don't necessarily scare off fabric mills or customers. Privately held **Nano-Tex**, which is owned by International Textiles Group, has several high-tech fabrics on the market and has found that customers are willing to pay 10% to 20% more for apparel with special stain-resistant, anti-static, or cooling properties.

Demand for the company's best-selling product, its stain-repellant fabrics, is growing, says Renee Hultin, president of **Nano-Tex**. Meanwhile, retail stores and fabric mills like the products because they often yield better profit margins. While the products typically sell for 10% to 20% more than comparable, untreated products, production costs are only about 5% to 10% more, Ms. Hultin said.

Nano-Tex is working with the military on some stain-resistant fabrics as well as some more high-tech ventures. As for a color-changing fabric that requires a power source?

"We think that there are a lot of applications that can be brought to enhance clothing that hasn't been done before," said Ms. Hultin. "But, our mission statement is to focus on everyday apparel."