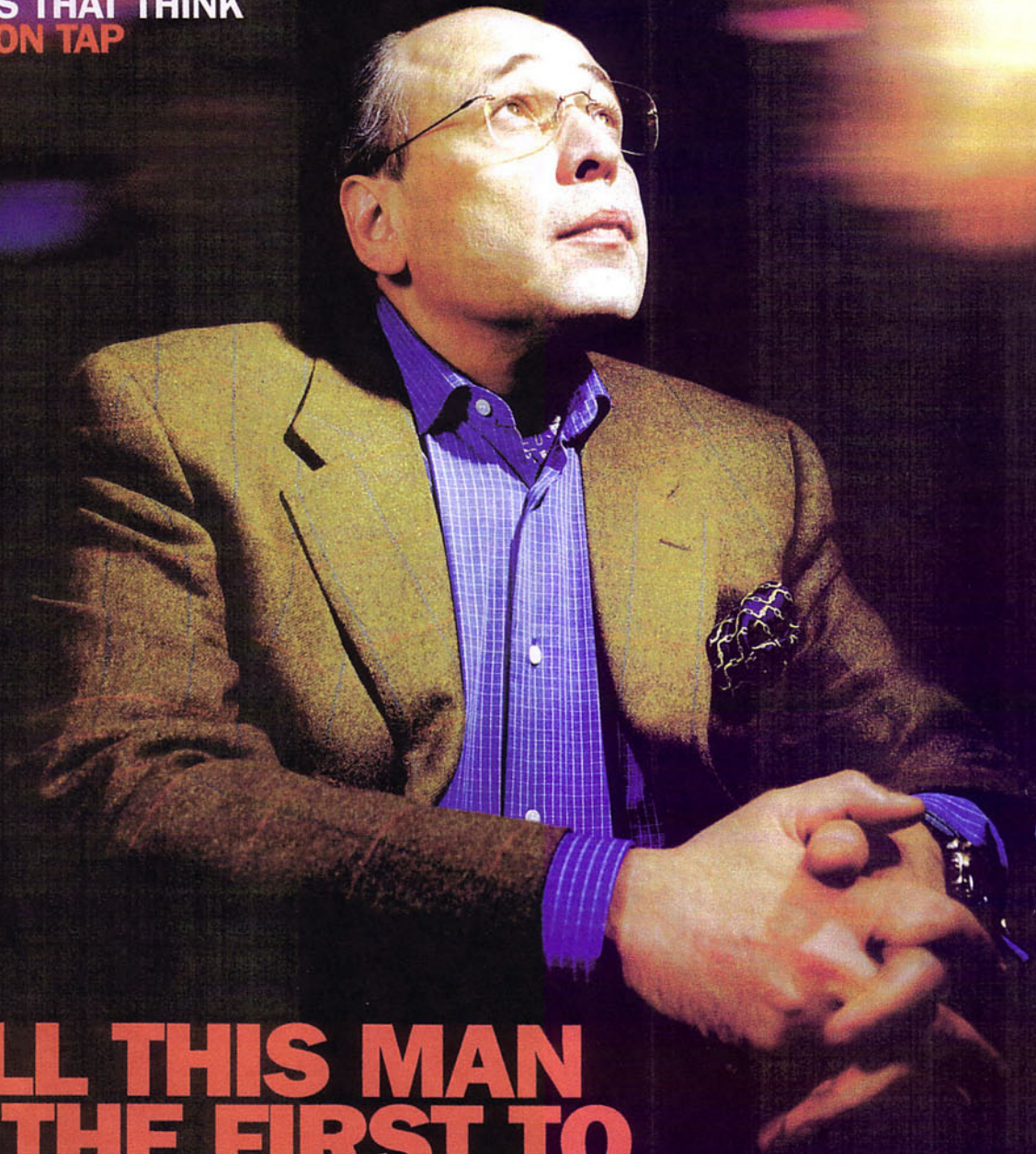


HUNTING CANCER VACCINES It's getting more personal by the minute

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COMPUTERS WITH HUNCHES
CLOTHES THAT THINK
CHAOS ON TAP



**WILL THIS MAN
BE THE FIRST TO
SAIL INTO SPACE?**



geek CHILL

CLOTHING OF THE FUTURE WILL BE SMART, SO SMART IT WILL ORGANISE YOUR DAY. IT'LL TAKE YOU JOGGING, MASSAGE YOUR EGO AND EVEN FIX YOUR LOVE LIFE, SAYS SCOTT LAFEE.

IF DRESSING well is a sign of advanced civilisation, you could be forgiven for thinking that we're heading for disaster. Science fiction tends to clothe the next generation in drab stuff: dull white-on-white spacesuits or rags, animal hides and other post-Apocalyptic apparel. Only extraterrestrials boast anything like a decent wardrobe, what with their shiny metallic tunics, form-fitting body armour and multi-tentacled cardigans.

But fret not, real life will be different. Right now, teams of chemists, physicists, designers, and even a few electrical engineers, are busy weaving the high-tech future of haute couture. If these fashion visionaries are right, tomorrow's garb will do a lot more than merely keep you warm, cool or reasonably safe from embarrassment. Clothing of the future will be smart. You'll know because it will tell you.

"Clothes will completely organise your life," says Jenny Tillotson, director of the Sensory Design Lab in London, a spin-off from the Massachusetts Institute of Technology's Media Lab. "You will not need to wash them because they will self-wash, self-condition and repair themselves," she says. These clothes will be your friend and confidant. They will keep you well by administering medication and daily vitamins. They will help you remember your car keys and what you did last holiday. They might even stop you from wearing plaid with paisley.

One of the most ambitious smart clothing projects began in December 1999 at Starlab, a private research group in Brussels. Starlab's chief science officer, Walter van de Velde, manages the project dubbed "i-Wear"—short for "intelligent wear" or clothing that thinks.

According to van de Velde, i-Wear aims to create clothing that communicates with the world. Levi's already sell a range of jackets complete with built-in connectors that link mobile phones or MP3 players in the pockets to headphones or microphones in the collar. Eventually, says van de Velde, electronics will be invisibly embedded everywhere. The fabric itself will be woven from conductive fibres capable of generating electrical power from body heat or movement. Buttons and zippers will contain information-gathering sensors. Imagine a wedding dress that records all of the sights and sounds of the day, including that heart arrhythmia at the moment you say, "I do".

Not that geek chic is new, of course. Researchers at MIT's Media Lab, for example, have been tinkering with wearable electronics since the 1970s. A few companies already sell ready-to-wear computers, at prices ranging from \$2,000 to \$10,000. They generally have a processor chip and associated circuitry the size of a small textbook, a battery worn on a belt, plus a wraparound wrist keyboard, headphones and a tiny computer screen projecting from a pair of glasses.



'If you leave the house without your wallet, a processor chip on your lapel lets you know'



Jon Jackson/Camera Press/PVCA

But these wearable computers are already old hat, says Alex Pentland, head of the Media Lab at MIT. "The first thing is to take the idea of computers and programming in clothing and throw it out." Even everyday apparel will be imbued with extraordinary powers. "In the future, people will want their clothing to be functionally intelligent, able to do its thing without our help," he says. In other words, you won't need an owner's manual to don that version 3.1 Armani suit.

Some significant advances are already well established. Synthetic fabrics like Gore-Tex and Spandex are commonplace. But numerous textile manufacturers worldwide are marketing fabrics threaded or plated with silver, copper or stainless steel. The metals are supposed to inhibit odour and kill bacteria.

Metal underpants have other ways of keeping you healthy. Several Internet companies sell dresses, shirts, caps, bras and boxer shorts impregnated with metals that reportedly keep out the high-frequency electromagnetic radiation some people believe causes cancer. They're also marginally better looking than the old standby: tinfoil.

But most future clothing will be interactive. Take microcapsules—micrometre-sized bags made from ceramics, polymers or gelatin films. You can fill these capsules with dyes, drugs or a variety of cosmetics. Mix the capsules with polyurethane or silicone binders and spray them onto textiles for clothing with extra oomph.

French fashion designer Elisabeth de Senneville, for example, has created dresses with microcapsules containing heat-sensitive dyes that change colour according to body temperature and dresses that release a continual dribble of moisturising sunscreen or wafts of perfumes. She even has dresses with stripes of moisture-sensitive pigments that change colour according to the weather. They will turn blue when the sun's out, grey on cloudy days and pink when it's raining.

Japanese manufacturer Kanebo is promoting a nylon filament yarn embedded with microscopic ceramic spheres that constantly release silver ions that kill bacteria. Company officials say the washable, antibacterial yarn is ideal for undergarments, swimsuits, socks, uniforms and towels. Since the microcapsules are bound chemically to the fibres, the manufacturers claim they should retain their particular properties through several dozen washings. And last year, Victoria's Secret, a company based in Reynoldsburg, Ohio, filed a patent for tights loaded with theophylline acetate (THA), a compound they claim can treat cellulite. THA is bound to the fabric with an organic polymer, but when the tights are worn, sweat from the skin raises the pH of the fabric slightly and breaks the polymer glue, releasing the THA onto the skin.

Other benefits of future clothing are more obvious. The Intelligent Polymer Research Institute at the University of Wollongong in Australia is working on the "smart bra". The bra will automatically adjust its support to match extra strain on the straps and bra cups during sports, for example.

It won't reach the shops for at least two years, says researcher Kelly-Ann Bowles. Test bras have a tiny computer chip embedded in the strap, wired to a fabric sensor capable of monitoring stresses upon the bra. When the chip detects excessive movement, it signals a second layer of electricity-conducting polymer fabric to contract, causing the bra to become more rigid and supportive. If it gets too tight, the chip orders the polymer fabric to loosen up. Prototypes rely on batteries, but researchers aim to make the two fabric layers react and communicate with one another chemically.

Back at Starlab, van de Velde and his team are developing a prototype ensemble of multiple layers of specialised clothing. The clothing itself is ordinary—what sets it apart are the i-Wear accessories. The "energy supply

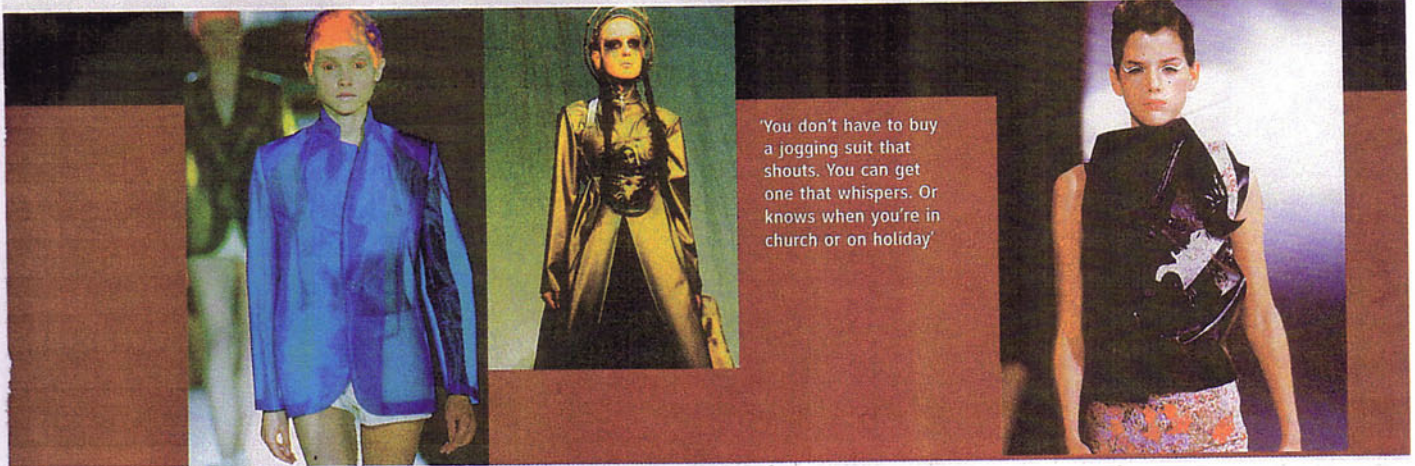
layer" consists of various compartments housing small, lightweight batteries that supply power to all the other layers. Future versions, says van de Velde, might have special conductive fibres that generate electricity from movement, or flexible solar cells.

A "motion-sensing layer" monitors the wearer's location, via satellite, and what the body is doing via sensors that track conditions like ambient temperature, motion, sound and light. Another layer, closest to the body, contains sensors that monitor body functions like heartbeat, blood pressure and temperature. All of this data is transmitted wirelessly, via flexible antennas built into each layer, to a "memory layer", where chips stash away the information for future use. A "sound layer" contains embedded microphones and speakers, perhaps a camera, to record daily goings-on. And an outer "storage layer" features special pockets for personal items like keys, money and a cellphone.

These pockets are electronically coded to match specific items. If you leave the house without your wallet, for example, a processor chip on your lapel lets you know. The current prototype is a small, disc-shaped electronic device nicknamed Spyglass. Basically it's a tiny PC with a small screen and a couple of buttons to control it. You use Spyglass to request data, such as battery levels for example, or to switch on the built-in microphone or play back recordings through the suit's speakers.

For now, news that any items are missing from the pockets is flagged up as a message on the Spyglass screen. Future versions might employ other attention-getting features, such as blinking lights or vibrations, or might simply whisper something in your ear.

Admittedly Starlab's existing prototypes are fairly crude and impractical. Right now, each layer is built into a separate shirt. Putting on the complete suit involves wearing half a dozen shirts, one on top of another. Eventually though, van de Velde hopes, these layers



will be built into a single garment in any style the user chooses and the wearer will be able to adapt to changing circumstances by switching each layer on or off as required. "Our research work is still in progress," said Katrien Van Gerwen, Starlab's public relations manager. "There are no finished products. It is up to the sponsoring companies to use our results and put them into commercial products."

Van de Velde seems confident that technological improvements will smooth out most of today's unsightly wrinkles. One day, he says, i-Wear may be a single super-garment. A jogging suit, for example, that monitors your exercise level, then urges you to run faster by changing the music in your Walkman to something with a quicker beat or by shouting computer-generated words of encouragement.

If the prospect of telling an over-enthusiastic jogging suit to get off your back doesn't appeal, van de Velde is quick to point out that future clothing will be precisely tuned to your particular needs and sensibilities. You don't have to buy a jogging suit that shouts. You can get one that whispers. Or knows when you're in church or on holiday and don't want to be disturbed by ringing cell-phones. Such clothing could become your ally. "Suppose you're in an amusement park," says van de Velde. "Normally, you just wander around, doing whatever you happen to find." But what if your clothes knew the things that interested you and could tell you where to find them, he says. "They could maximise your chances of pleasure by gently biasing you in a certain direction, perhaps by slightly heating one shoulder or the other." Some research suggests that people gravitate unconsciously in the direction of warmth, van de Velde adds.

Tillotson at the Sensory Design Lab has a different vision: hers smells. "Smell is the least researched of the senses, but one of the most emotional and powerful," she says. "Odours drive our emotions, cause social

bonding, spur memories, influence our chemistry and lead us into temptation. So why not conjure up multi-sensorial fabrics based around the sense of smell?

"Smart-smelling clothes will sexually arouse you, boost your confidence at an interview or business meeting, enhance your appetite, uplift your mood, freshen you at work, wake you up or send you to sleep," predicts Tillotson. She is in the early stages of developing clothing that mimics the human body, pumping out various smells, possibly through microencapsulation, to reflect specific desires and circumstances. A slinky evening dress, for example, might release pheromones at the appropriate time. Maternity wear, on the other hand, could emit soothing, therapeutic aromas intended to relax the wearer and possibly assist in delivering the baby. "It could be something like a night-shirt that smells good, relieves pain and massages your back," she says.

Most of the first real-world applications of such clothing will probably be in medicine. Some hospitals already use clothing with heartbeat-detecting sensors. A European inventor has designed pyjamas that monitor a baby's position to reduce the possibility of Sudden Infant Death Syndrome. The US Army has sponsored research into garments that not only automatically radio for help when a soldier is wounded, but locate the wound, determine its severity and transmit vital signs to medical personnel. Later versions might also dispense drugs.

Alice Pentland (Alex's sister), director of the Center for Future Health at the University of Rochester, thinks smart clothes will have some very specific benefits. Lack of sensation in people with diabetes can lead to serious circulatory problems. But optical fibre fabrics could tell you when there's a pressure point that you aren't aware of, Pentland says. Sensors in the socks would pinpoint places where the pressure was strong enough to reduce the

light flow. "This causes other sensors to buzz or vibrate so that the person would know they needed to adjust the clothing," she says.

Alex Pentland at MIT goes further: "There's nothing that says we can't produce clothing that really watches out for you." Watches already monitor blood sugar levels through the chemistry of sweat. The same technology could check for chemical imbalances in your body. "Why can't the clothes then synthesise drugs on the fly? Your shirt sensors could detect low blood sugar and then produce the necessary drugs to counter it, releasing them onto the skin where they're absorbed." Pentland compares it to wearing a liver on your sleeve. "It would be like being in an Intensive Care Unit all the time, except that the doctor is your undershirt."

He expects you'll be wearing such apparel in less than 20 years. Others think sooner. Predictions get more shaky beyond that. Each year, for example, Margaret Voelker-Ferrier, an associate professor of design at the University of Cincinnati, gives her senior students an assignment: forecast future fashions based upon existing scientific developments and emerging cultural trends. "We've been doing this for some time, and so far we've been pretty much right on," says the professor.

Insulated body paint will be all the rage in 2070, the students predict. By the year 2100, they say, virtual clothing will be worn for work. But since work will be conducted at home, you'll simply program the style of clothing you want to wear on your home PC. Then you'll appear dressed when conducting business over the videophone.

Venturing outdoors will be a different matter. A century from now, Voelker-Ferrier's students say, clothing will be thin, weightless and transparent. In other words, you'll appear dressed indoors, and naked out. □

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