

Crye Associates is redesigning combat gear for an Army of One.” Not bad for ten young civilians.

story by Urshula Barbour. Photography by Graham MacIndoe. On the third floor of an anonymous building, on the decaying grounds of the Brooklyn Navy Yard, Caleb Crye is dressing down the military. Crye, slim and pale with deep-set blue eyes more royal than navy, holds up the current U.S. combat uniform and spells out improvements he plans to make.

He knows that soldiers in Afghanistan were hampered by standard-issue brown cotton T-shirts that didn't wick moisture or dry quickly enough. Uniforms shrank when washed. Boot soles cracked or wore out after only a month or two. Fully 85 percent of the troops interviewed complained that ill-fitting, heavy helmets caused headaches, neck pain, or impaired hearing. Forty-two percent reported that the headgear collided with body armor when the soldiers lay in a prone position, meaning they were on their bellies pointing a gun and were in no mood for distraction.

The obvious solution to these woes is to design a better uniform. And the Army is doing just that with Project Scorpion, the first phase of the Future Combat Systems program to fix the potentially fatal flaws in its gear. Less obvious is the Army's choice of a designer. In 2001, Crye Associates, a 10-person studio, won a \$2.2 million contract to participate in the project. The oldest employee is 27, the youngest 23, and no one has done any time in the armed services. Even so, they are planning a comprehensive makeover of the battle dress uniform, which has not seen significant changes since the 1970s. Says Crye, the soft-spoken 27-year-old, "If we knew what we were doing it would slow us down."

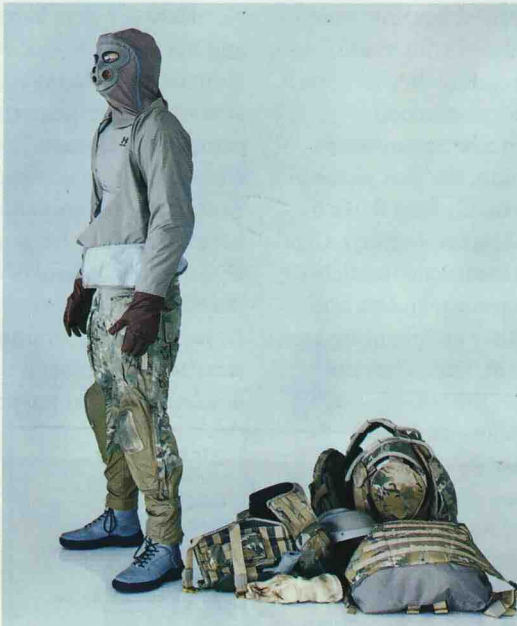
Crye has quick maneuvers on his mind because for most ground troops the real enemy is weight. Average servicemen carry 65 to 120 pounds "from the skin out," and they soon lose effectiveness when hauling a third or more of their body weight. The prototype Crye's studio designed trims 30 percent of the poundage, cutting down heat stress from body armor and load carriage equipment, and drastically reducing

the "woven mess," in his words, of overlapping shoulder straps, pack straps, slings, bandoliers, suspenders, and armored vests. Crye's uniform is not just lighter and more comfortable than standard Army issue; it's much easier to shed in an emergency. The design will also accommodate sensors to monitor the wearer for illness or injury.

How did Crye become the Dr. Atkins of the battlefield? When he and his partners, Eric Fehlberg, Gregg Thompson, and Karen Chen, launched the studio in 2000, not long after three of the foursome graduated in art or engineering from New York's Cooper Union (Chen, 26, came out of Cornell law school), they put together a list of potential clients they agreed needed a dose of reinvention. At the top were American car companies and the U.S. military. A year later, the Army issued a request for proposals for Objective Force Warrior (OFW), its first major overhaul of combat gear. When Crye Associates ran across the RFP in *Commerce Business Daily*, a publication of the U.S.

Department of Commerce, the principals got themselves invited to the briefing. (It turns out that the Army already had an eye on them because of a handheld prototype they had developed to calculate the range of mortar fire.) Crye recalls attending a presolicitation conference at the Army's Natick Soldier Center (a.k.a. Natick Labs) in Massachusetts and looking around a room at hundreds of white-haired men—representatives of multibillion-dollar defense contractors like Lockheed Martin, Raytheon, General Dynamics, and Northrop-

CRYE ASSOCIATES
ESTABLISHED: 2000
PRINCIPALS: 4
EMPLOYEES: 10
MOTTO: FORM HONORS
VISION
PROJECT BUDGET: \$2.2M



amman. Invited to make a proposal, the Crye principals came equipped with drawings and prototypes and were astute enough to say that talking to soldiers would be a first course of action if they won the contract. "They wowed us," recalls Jean-Louis "Dutch" De Gay, a systems engineer and spokesman for OFW/Natick Labs. The Army kept the studio busy with a helmet prototype until October 2001, when it awarded Crye Associates and Arthur D. Little, a longtime military contractor, the initial phase of Project Scorpion. The deliverables presentation followed in spring 2002, and shortly thereafter, Crye's uniform designs were selected for development.

Especially in typical desert conditions where temperatures can reach 120 degrees in daytime and then dip below the 40s at night, the key to battle dress is to balance protection and comfort. According to a 1997 study by the U.S. Department of Defense, soldiers wearing chemical-protective equipment of the type distributed in the first Gulf War require 10 percent more oxygen and 1.5 to 3 times longer to perform tasks than they do in lightweight regalia. Rifle marksmanship drops 15 to 19 percent, friendly fire increases from 5 to almost 20 percent, and the number of casualties sustained for every "enemy defender" killed, in military lingo, soars 75 percent.

Though these stats become less alarming the more rigorously a soldier is trained, "travel light, freeze at night" still sums up the attitude of soldiers who forgo socks and even dump food to reduce their loads. (In Afghanistan, 84 percent of the soldiers who were surveyed reported jettisoning rations.) The current Army uniform is heavier than it needs to be. As new gear is developed, the pieces are simply hung on the standard webbing like Christmas tree ornaments, rather than being integrated. In the drawn-out and sometimes tortuous development of military projects, the end products can be freighted with add-ons or "creeping featurism," as Crye describes it. In contrast, Crye's OFW uniform, which is scheduled for an advanced technical demonstration in 2006 and for field use in 2010, is heavily inspired by simple yet versatile equipment such as the canteen container, the lightweight object beloved by servicemen because it works for drinking, shaving, cooking, and eating.

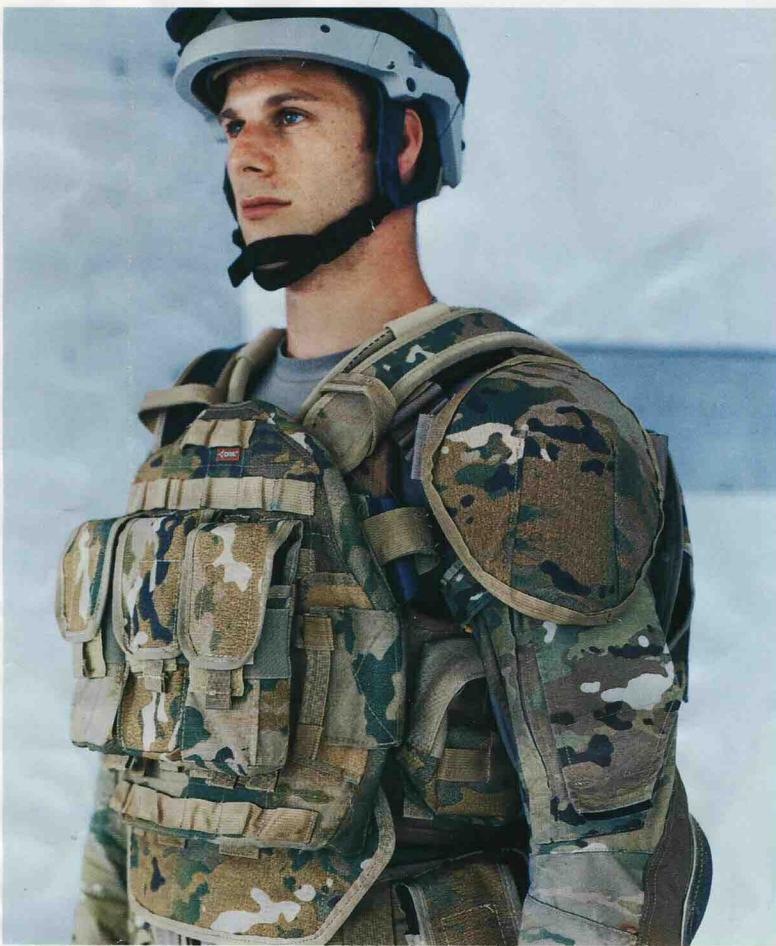
"Current Army web gear is free to swing around and bounce," says Crye Associates partner Fehlberg. "All that extra movement messes with a soldier's coordination and ends up slowing him down. Soldiers train to deal with this, and they do it well, but we wanted to make something that would naturally move with the body and not fight it."

Crye offered a "clean-sheet-of-paper approach, which has never been done [by the military] before, probably not in recent history," Fehlberg says, Crye Associates designed equipment with complementary functions. The pack, for instance, sits lower on the soldier's frame to avoid interfering with the helmet when soldiers are prone. Not only does this arrangement reduce the vulnerability of soldiers, who have to raise their torsos to avoid the collision, but it also distributes weight more efficiently. The uniform takes advantage of form-fitting, dry-weave fabrics like Under Armour, used in football and baseball uniforms to wick moisture away from the skin. The ceramic Kevlar plate combined with soft body-armor pads made of Brock USA foam is about 15 percent lighter than current armor, offers 40 percent more protection from bullets, and significantly reduces associated blunt trauma injuries. Within the armor, a jigsaw puzzle-like configuration of "stand-off" pads creates air channels that permit passive cooling or active cooling, eliminating weight that would be introduced by proposed high-tech air-conditioning and heating systems (which furthermore, like Crye's low-tech design, run the risk of breaking down). Finally,

STATE OF UNDRRESS
"TRAVEL LIGHT, FREEZE AT NIGHT" STILL SUMS UP THE ATTITUDE OF SOLDIERS WHO FORGO SOCKS AND EVEN DUMP FOOD RATIONS TO REDUCE THEIR LOADS.

opposite and below With its Project Scorpion prototype, Crye Associates completely redesigned the Army battle-dress uniform, which has not seen significant change in three decades. The fully integrated system reduces the number of elements, cutting weight by 34 percent. A chemical-protective suit remains rolled at the waist when not in use (bottom row, left) but can be slipped on in seconds (bottom row, center). The uniform is also designed for easy shedding. Says Crye of the gear his uniform will replace, "Most is individually very fast to emergency-doff, but two or three of these pieces worn together can be a devil to get out of."







opposite page, top left Crye's ballistic armor chassis replaces current body armor and web gear. A snug fit lets soldiers move freely and eliminates interference with weaponry. The camouflage pattern adapts to different environments.

opposite page, top right A single-layer lightweight wicking T-shirt designed to complement the armor keeps soldiers cool in hot weather. An armor belt takes the place of the soldier's duty belt, adding ballistic protection to the waist area and allowing more weight to be comfortably carried on the hips. Integrated elbow pads and kneepads are removable for washing; unlike the rollerblade-type protection worn by soldiers now, they do not constrict circulation.

opposite page, bottom left Zippers in combat pants provide venting and immediate access to injuries. The construction is more heavy-duty than that of traditional fatigues, in part because the uniform protects the chemsuit worn beneath it. The pack above the belt will contain a computer communications and power-management system the Army is designing.

opposite page, bottom right Crye Associates worked with Boston-based industrial-design firm Artisent to integrate helmet, goggles, and uniform. (Among other things, Artisent designs headgear for skiers, snowboarders, and lacrosse players.) Tourniquets are integrated into shirts and pants (visible as the thin, buckled strap below the soldier's name tag).

left Inside the ceramic chest plate, "standoff" pads increase ventilation, comfort, buoyancy, and bulletproofing.

Whereas fully outfitted soldiers thrashing in water can drown, the new float pads help keep the wearer afloat.

Amid fears of chemical attacks, the Crye uniform gives the military a chemsuit in one. A one-piece chemsuit can be worn as underclothing, departing from the current bulky gear that even De Gay observes makes soldiers look like the Michelin man. Made of a thin cellulose-based, impermeable membrane attached to a nylonlike outer skin, the suit allows moisture to evaporate but prevents liquids, aerosols, and vapors from penetrating. When not in use, the top remains rolled at the waist, ready to be slipped over a shirt in seconds at the first sign of trouble.

Aided by Army research, the Crye team is pushing for improvement in every direction. Because studies reveal a high degree of improvisation in the field (troops in Afghanistan reportedly added barber brushes and metal picks to their gun-cleaning kits), Crye is alert to soldiers' needs to carry gear under the worst conditions, and has identified materials for quick fixes, such as parachute cord and 100 MPH tape (the stuff SCAR drivers use to patch up racing cars during pit stops).

He and his designers also developed a camouflage pattern that will hold up in several settings. (Crye points out that seasonal changes in vegetation reduce the advantage of camouflage specific to any one terrain.) Fehlberg explains that the principles behind a more generic pattern can be found in nature: For instance, the color gradations on a cheetah's flanks and belly are shared by widely dispersed animal species. The Army tested Crye Associates' camouflage against 19 others and ranked it in the top 3 for versatility. The new fabric is designed to soil easily, the better to enhance its concealing properties. And reducing a variety of patterns to a single model not only simplifies production, logistics, and shipping, it also moves the U.S. military closer to its goal of deploying troops to any region of the world in 72 to 96 hours.

"The Army really deserves credit for defying convention because they chose industrial designers rather than engineering firms," says David Rodgers, director of Artisent, a Boston-based industrial-design firm that won a \$500,000 piece of Project Scorpion to design the helmet and is collaborating with Crye Associates to ensure that headgear is integrated with the uniform. De Gay admits to the Defense Department's reluctance to let in newcomers. "Soldiers fear change," he says. "They learn that their training saves lives on the battlefield. These guys [at Crye Associates] didn't know a single thing about soldiering. We understood it would take work on our part—it would be an investment and require time. But they have a great eye and really know the design process. What Crye brought to the table was worth it."

For his part, Crye learned early the value of direct input from soldiers. "The first systems we designed were very elaborate compared to what we ended up with," he says. "The original armored vest had a sliding hinge connection between the upper and lower torso, and this crazy accordion armor between the chest and the hips. It was cool, and the Army was interested in it, but they were skeptical. So they sent three Army Rangers to our shop to try it on. As soon as they got it on, they just took off...they ran, jumped, climbed, broke down doors. They basically told us to get rid of every linkage, hinge, and mechanism since those things were guaranteed to break. That was our first glimpse into the kind of abuse the equipment would endure."

Now that the designs have been put through crawling, shooting, and movement drills, what is left for Crye? The Army has just awarded a \$100 million contract to General Dynamics' Eagle Enterprises division for Objective Force,

FATIGUE FACTOR
THE ARMY TESTED CRYE ASSOCIATES' CAMOUFLAGE AGAINST 19 OTHERS AND RANKED IT IN THE TOP 3 FOR VERSATILITY. THE NEW FABRIC IS DESIGNED TO SOIL EASILY, THE BETTER TO ENHANCE ITS CONCEALING PROPERTIES.





a program for revamping military vehicles, communications tools, weaponry—everything but soldier-borne gear, the stuff of Objective Force Warrior, which is Crye's domain. Ultimately, Objective Force will include high-tech accessories, such as an exoskeleton, conceived as a Robocop-like frame that will allow troops to carry 300 pounds unassisted, and an electronic "mule," a small vehicle programmed to follow a soldier and haul up to 500 pounds, produce energy, and purify water. The far-reaching aim is to endow individual soldiers with the same offensive and defensive capabilities as a circa-1995 tank. Though it may sound far-fetched, such a goal is on track with the Defense Department's new philosophy of an "Army of One," which it envisions as more than simply a tagline to attract recruits. "An F-16 with legs" is how De Gay describes the mobility, survival skills, communications reach, and lethal force of the average soldier-to-be.

The task now is to integrate Crye Associates' work with that of General Dynamics, which maintains 54,000 employees against Crye Associates' 10. The ratio may be daunting, but Crye doesn't seem intimidated. Though he and his colleagues would reject any comparison to a special ops team, they have learned to maneuver quietly, quickly, and inventively.

Urshula Barbour is a principal at the New York City design studio Pure+Applied and a design instructor at the City College of New York.



above The wall of Crye Associates' studio displays various stages of prototype renderings and assorted inspirational clippings.

below Part Robocop, part Matrix, prototypes for Crye Associates' Future Warrior project look 30–40 years ahead. They feature an exoskeleton (shown here from waist down) that will allow a soldier to carry 300 pounds.

below left and opposite Despite strict human-use protocols, Crye Associates' prototypes have been tested by special ops, rangers, and marines. Crye and his crew did their own testing, sleeping overnight in the chemical gear at Fort Benning.

