

THE BOMB-PROOF, LASER-GUIDED SUPER SOLDIER OF TOMORROW

THE FUTURE IS HERE,
AND IT IS DEADLY.

HE CAN **SEE THROUGH WALLS**, HIS HELMET IS **VIDEO-CONNECTED**, AND HIS RIFLE HAS **COMPUTER PRECISION**. WE CHECK OUT THE SCIENCE (AND EXPLOSIVE POWER) BEHIND THE **TECHNOLOGY** THAT'S MAKING THE **FUTURE OF THE MILITARY** INTO HALO COME TO LIFE.

by **STINSON CARTER** illustration by **KAI LIM**

I want the soldier to think of himself as the \$6 Million Man," says Colonel Douglas Tamilio, project manager of Soldier Weapons for the U.S. Army. In case you haven't heard, the future of warfare belongs to the soldier. The Civil War was fought by armies. World War II was fought by divisions. Vietnam was fought by platoons. Operation Desert Storm was fought by brigades and the second Iraq war by

battalions. Today we fight with Small Tactical Units. And the heart of the Small Tactical Unit is the single dismounted soldier.

In Afghanistan, as in the combat zones of the foreseeable future, we will fight against highly mobile, highly adaptive enemies that blend seamlessly into their environments, whether that's a boulder-strewn mountainside or the densely populated urban jungle.

GENERATION II HELMET SENSOR

The Gen II HS provides the wearer with analysis of explosions and any other potential source of head trauma.

ENHANCED COMBAT HELMET

Made from advanced plastics rather than Kevlar, the new ECH offers 35 percent more protection than current helmets.

NETT WARRIOR

This system is designed to provide vastly increased situational awareness on the battlefield, allowing combat leaders to track the locations and health of their teams, who are viewing tactical information via helmet-mounted computer screens.

MODULAR LIGHTWEIGHT LOAD-CARRYING EQUIPMENT

A very fancy-sounding backpack, the MOLLE (rhymes with Polly) is equipped with modular patch attachments, a plastic 72 oz. hydration bladder (the tube is coming over the soldier's left shoulder) and a Tactical Assault Panel to protect the chest.



ACTIVE CAMOFLAGE

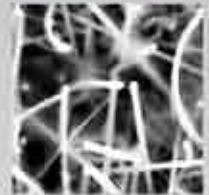
Woven optoelectric threads that change the appearance of the fabric to reflect changes in environment. Though still hypothetical at this stage, it would allow soldiers to blend right into the background, Predator-style.

BERETTA M9

The Army's standard-issue 9 mm sidearm allows for the attachment of an Integrated Laser White Light Pointer.

ASEK SURVIVAL KNIFE SYSTEM

Forged from carbon steel, with a five-inch blade, this Natick-lab-tested survival knife is equipped with a Plexiglas breaker, hammer, saw teeth, serrations, spear holes, lanyard hole, and insulated guard.



SOLAR PHOTO-VOLTAIC THREADS

Photosensitive fibers woven into the soldier's uniform that could convert solar radiation to electricity powering the Nett warrior system. Currently, the system runs on a chest-mounted battery pack.

XM25 GRENADE LAUNCHER

The XM25 Individual Airburst Weapon System (IAWS) is a computer-controlled, airburst grenade launcher, dubbed the Punisher. Several units are already in use in Afghanistan; the Army will field as many as possible in the next few years.

INTERCEPTOR BODY ARMOR

The Army's IBA is a lightweight, modular protective system that can stop bullets and fragments while providing easy maneuverability. It consists of an outer vest, ballistic plates, and attachable components for arms, groin, throat, and sides.

KNEE AND ELBOW PADS

Lightweight and super-durable, the Army's Kevlar KEPs provide dismounted soldiers with protection in case they find themselves on their knees (get your mind out of the gutter).

Our enemies are no longer soldiers in uniform, and we won't be able to defeat them with M1 tanks and F-16s—we will have to fight them with small units of technologically superior war fighters: an army of \$6 Million Men aided by robot scouts, aerial drones, and battery-powered devices able to see through walls; armed with incredibly deadly computer-equipped, laser-guided weaponry; protected with high-tech, lightweight body armor; and connected with their fellow soldiers through solar-powered, satellite-driven intel networks. It's *Halo* come to life, and it's the future of warfare.

"We've been at war for 10 years," says Marilyn Freeman, deputy assistant secretary of the Army for research and technology. "What have we learned? It's all about the soldier." Dr. Freeman has a \$2 billion annual budget and oversees 16 research, development, and engineering centers (RDECs) throughout the U.S. with more than 12,000 scientists and engineers. It is her job to make our soldiers as lethal as possible, and to make sure they get home in one piece.

Leading these efforts are a series of facilities that make Q's lab in the James Bond flicks look like Geppetto's workshop in *Pinocchio*. There's the Soldier Systems Center in Natick, Massachusetts, where everything from precision airdrop systems to sustainable shelters to fireproof uniforms to caffeinated chewing gum is developed. Or Aberdeen Proving Ground in Maryland, where satellite networks run communications for soldiers in the field and engineers continue developing portable generators and batteries that run on sugar. Or in Fort Belvoir, Virginia, where scientists are creating high-def thermal-optic sensors, unmanned mine detector robots that can locate plastic IEDs with less than a needle's worth of metal inside them, and optics that can make vehicles around you literally disappear. It may all sound like some cross between Batman, Robocop, and Captain America, but this reality is right around the corner.

"You're dominant when you're inside a vehicle. We're trying to ensure that every kid is dominant outside a vehicle," says Brigadier General Peter Fuller of Program Executive Office Soldier at Fort Belvoir. And dominance, according to PEO Soldier, boils down to awareness, survivability, and lethality.

AWARENESS

Playing Hide and Seek With the Person You Want to Kill

→ Like being in a real-life first-person-shooter game, soldiers will be able to see battle intel unfold live on their helmet- or eyewear-mounted display.

To put it simply, "think *Call of Duty* when you press pause—this is what you're going to see," says James Megliola, strategic outreach at Natick Labs, of the Army's new Nett Warrior system. All soldiers in the future will have a series of sensors feeding them constantly updated information. Says project manager Colonel Will Riggins, "The system is about knowing where you are, where your teammates are, and where the bad guys are. And then having access to information that you need at the right place at the right time."

Portable sensors can monitor vital signs and detect the sources of enemy gunfire. Unmanned ground sensors can relay data from outside the base; small unmanned ground vehicles that look like WALL-E can act as scouts; and unmanned aerial vehicles—small enough to fit in a backpack, launch by hand, and fly like remote-control airplanes—can watch from overhead. "Higher command loves this," says Megliola. "They can see what their soldiers are doing at any given time." But how does it work in a firefight? In theory this could prevent rogue units from taking matters into their own hands, a problem that surfaced in Afghanistan. "If you spot a machine gun nest, you can plot the GPS coordinates on a map and send them instantly over to your buddy who's got a 40 mm grenade launcher. He can engage the target based on my intel even if he can't see it."

ATTACK TO THE FUTURE

UNMANNED AERIAL VEHICLES

Small enough to fit in a backpack and launch by hand, these remote-control drones can send video and thermal imaging directly to the soldier on the ground.



THERMAL WEAPON SIGHT

Capable of recognizing a target day or night, the infrared-equipped TWS will enable soldiers to take out insurgents from a distance of 1,100 meters.

—> **The flow of information will be custom-tailored for each man in the squad, optimizing his ability to destroy the enemy.**

In a multiplayer shooter game, you're not looking at the entire battlefield at any given time, and you're not seeing your teammates' ammo levels and vital stats; you only see what is of immediate concern to you. This is similar to what the Army's Consumer Research/Cognitive Science Team is working on at Natick: flexible, role-based displays where the flow of data is specialized, the same way one soldier might carry a grenade launcher and another a light machine gun.

In gaming the bad guys are clearly marked. But in today's war zones you can't always tell a Taliban from a goatherd. That's where Jonathan Cohen, Ph.D., research psychologist for the Army Cognitive Science Team, comes in. "We're trying to develop algorithms of enemy behavior," he says. By breaking down enemy actions, soldiers could be able to scan a crowd and instantly recognize the subtle cues that indicate hostile or suspicious activity.

—> **X-ray vision will finally become a reality with sensors that can detect enemies through walls.**

You know that dream of every pervy adolescent, the ability to see through the wall of the girls' locker room? Well, the technology isn't far off. The Army's Sense-Through-the-Wall system works exactly as advertised—the AA-battery-powered device can look through doors, floors, ceilings, and concrete walls up to eight inches thick. It's being developed at Aberdeen Proving Ground in a "secured facility," about which Communications-Electronics Research, Development and Engineering Center engineer Dave Patel says, "There's stuff here I don't even know about." Like Superman's X-ray vision, STTW has a range of

up to 50 meters, which means you don't have to walk up to the building and hold the brick-size device against the wall; you can do it from across the street—and out of IED range. (Sadly, it can't see through bras. Yet.)

—> **Unmanned hidden cameras will work 24-7 in the enemy's backyard to find high-value targets and help take them out.**

In Jason Bourne's world, CIA agents can grab a picture from a security camera and say, "Send that over to facial recognition." Five minutes later they've got his girlfriend's high school transcripts and blood type. But that's just Hollywood. "This capability doesn't technically exist at the moment," says Benjamin Ross, an engineer working on the ICOP program (Image Capture on-the-Move Processing) at CERDEC. The reality is right now if anyone wants to take a picture to check against a biometric database, they have to be in ideal lighting, at close range, with the subject looking at the camera. "You'd have to basically be cooperating with me," says Jeff Kuderna, technical manager of the program. And there's nothing covert about a soldier taking pictures of people at point-blank range. "These terrorists are very smart. They know the area, and they'll just avoid it," says Sorin Davidovici, ICOP lead systems engineer.

The ICOP program, due in 2012, is about to change all that. "Our goal is to extend the range out to 200 meters, with variable lighting, and be able to identify a person with off-angles of their face," says Christine Chimento, ICOP's program manager. What does

"Think Call of Duty when you press pause," says software developer James Megliola. "That's what you're going to see with this new system."



it look like? Well, you won't see it. It is a covert system of two hidden cameras: one with a wide field of view that picks out any passing face within range, and another with a narrow field of view that zooms in, takes a picture, creates a template of that face using points of measurement between the eyes, nose, and mouth, and instantly checks that template against a database. If it gets a hit, so will the person in the picture.

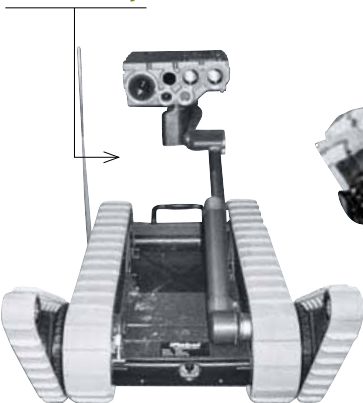
—> **Combat pilots will fly night missions**

with superhero vision...instead of by the seat of their pants.

"It's like flying in Wonder Woman's airplane," says Dr. Don Reago, the principal director for technology and counterintelligence at Fort Belvoir, where scientists are testing a new thermal-optic sensor system for vehicles and aircraft. So instead of wearing night-vision goggles and looking out the window, a helicopter's aircrew sees via external thermal sensors. "Wherever they've got their head pointed, that's what they're seeing outside the aircraft," says Mark Walters, the technical manager of ADAS (Advanced Distributed Aperture System), which is currently undergoing flight tests. "You can see through the floor, you can see through the instrument panel, you can see through the copilot sitting next to you. None of the structure of the aircraft is there anymore." This could also be mounted outside armored carriers so that when you dismount you know exactly what's waiting for you outside. Including goat turds.

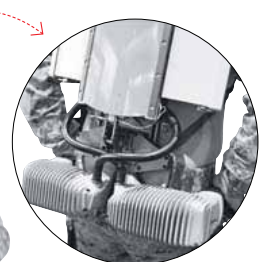
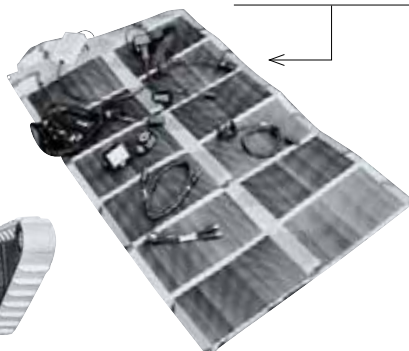
TACTICAL MOBILE ROBOT

The **SUGV** can gather battlefield reconnaissance while keeping soldiers out of harm's way.



REPPS

The **Rucksack-Enhanced Portable Power System** is a lightweight charging station that unfolds like a picnic blanket.



HULC EXOSKELETON

The **Human Universal Load Carrier** from Lockheed Martin enables soldiers to carry more than 200 pounds with little effort.

SURVIVABILITY

Extreme Fortress Makeover:
Behind-Enemy-Lines Edition

→ Frontline soldiers will build attack bases out of thin air. Literally.

If you've ever tried to set up a tent in the rain or at night (or in the rain at night), you know it's about as fun as a colonoscopy. It's the same for soldiers. But soon setting up a forward operating base will be as simple as "roll out your shelter, press a button, and airbeams able to support thousands of pounds pop up," says Clinton McAdams, mechanical engineer for the Fabric Structures Team at Natick. Call it an instant FOB. Even the lighting is incorporated. Claudia Quigley, the team leader for the Special Projects Team, says that "electro-luminescence lighting" panels make it so that "when you put the airbeam tent up, everything goes up."

In a place like Afghanistan's Kandahar Valley, the existing power grid simply can't handle the strain of our forces plugging in and sucking up their energy. Sure, we *could* drink their milk shake, but "you don't make a lot of friends stealing all their electricity and telling them you're there to help," says David Accetta, chief of public affairs at Natick. According to Accetta, a gallon of diesel fuel costs about \$400 by the time it reaches the FOB generator, not to mention the lives put at risk getting there. So with precision GPS-enabled smart airdrop systems for resupply and green power sources, the Army won't have to truck supplies and fuel through combat zones.

→ G.I. Joe will be able to fold up his power system and stuff it in his backpack...or charge it with a packet of sugar.

Today's average soldier carries 16 pounds of batteries for a typical 72-hour mission. And as soldiers' gear gets more high-tech, the

question of power becomes all the more important. CERDEC engineers have developed a lightweight foldable charging station they call REPPS. Say you're a sniper team on a recon mission. You unfold it like you would a picnic blanket and the solar panels soak up the sun's power, which mean batteries you don't have to carry.

Army researchers have also spent the past five years working on a unique recipe for a bio-battery, with a goal of creating one that you could essentially feed with a sugar packet. i.e., just a spoonful of sugar could help take the enemy down.

→ Soldiers will be battle-ready for the coldest tundra or hottest desert at the pop of a pill.

At the Doriot Climatic Chambers at Natick—which can simulate climates ranging from -70°F with 40 mph winds to 165°F with 90 percent humidity—scientists and engineers test how gear works with actual soldiers in the environments where they operate. It takes 10 days for a soldier to get used to a new climate and altitude, so the question for the future is: "How do we get them to be mission-ready quicker?" says Joshua Bulotsky, Doriot Climatic Chambers manager. "Ideally you just pop a pill and you're ready to go from a cold environment to a hot environment or from hot to cold." In fact, they're already looking into making that happen.

→ R2-D2 will be starring in the next version of *The Hurt Locker*.

Fort Belvoir houses the center for countermine operations for the U.S. Army. "A lot of the guys I'm working with have been in country two, three times over, so they've got a great feel for this stuff," says John Fasulo, who works with engineers and veteran soldiers to adapt to changes in the use of IEDs. Many of today's mines aren't made of metal, so combat engineers now carry dual-system metal detector/radars. But that still puts them too close to a potential

explosion. Cue the rise of the machines. Prototypes of a radar/metal-detecting robot that can go right up to the IED and feed radar and photographic imagery to a soldier's Toughbook laptop are already being developed, so no more *Hurt Locker* daredevil routines in the future.

→ The coming nano-revolution: soldiers will wear their sensors, power source, computer system, and ballistic protection in a supersuit.

"I measure our success in revolutionary changes, not evolutionary ones," says Professor John Joannopoulos, director of the Institute for Soldier Nanotechnologies at MIT in Cambridge, Massachusetts. The sole focus of ISN is soldier survivability, and Joannopoulos says his team has recently made significant discoveries in night vision and body armor. Discoveries that, according to him, "could have revolutionary changes in the next five years."

In the future, Joannopoulos envisions a full-body sensing device, where all the sensors that exist at the surface level in the Nett Warrior system could be integrated into the soldier's combat uniform. What can this do for the soldier? If someone sights on you with a laser, "you can tell where it came from," says Joannopoulos. "And you could use it for combat identification—shine a laser on somebody and get a signal back identifying them—or you can talk into a laser and it can communicate through the fibers and you could actually see it on a screen. You get hit by a round, you're unconscious, but the fabric detects the change in heat by the way the blood is spreading and it can get the number of wounds, the severity of the wounds, and can transmit it to a medic or a field hospital." Other technologies developed by the Army transform solar technologies into something called Powerwire, in essence solar panels that look like a strand of yarn and can be woven into the soldier's uniform. The era of the supersuit is right around the corner.

MODERN MUSKETS



XM806 MACHINE GUN

The Army's new .50-caliber machine gun is easily dismantled for speed and maneuverability.



M26 12-GAUGE M.A.S.S.

The Modular Accessory Shotgun System supplements the standard assault rifle with added lethality.

LETHALITY

All Any Soldier Needs to Increase the Pieces of His Foe

—> **Advances in technology will make the toys of the trade deadlier than ever. Bad news for the bad guys.**

The XM806 is the Army's new lightweight .50-cal machine gun. The XM2010 updates the current M110 Army sniper rifle with added range, clip-on night sights, and a sound/flash suppressor. The M26 is a new compact shotgun that you mount on the bottom of your carbine rifle and can detach as a separate shotgun.

And if you're bored with the M4, the Army has just announced a new competition in which firearms manufacturers will compete to create the next-generation Army carbine rifle. The future is going to be bloody fast, says Colonel Douglas Tamilio. "A regular infantryman will be able to look at a target 500 meters away, put his gun up, and lase it instantaneously. Then he'll get a reticle pattern and pull the trigger."

—> **Each sniper shot will be "one shot, one kill": no spotter needed.**

Thanks to breakthroughs in optical technology, sharpshooters will no longer have to think about *whether* they will hit their target, just *which* target they want to hit. DARPA, the Defense Advanced Research Projects Agency, is currently developing a little wonder it calls One-Shot, which measures the shot to a target, taking into account every variable—distance, wind, humidity, spindrift—that could affect a bullet's trajectory, and displays the exact

"We have to figure out a way to integrate all this technology and not weigh these kids down," says Brigadier General Peter Fuller.

point of aim in the shooter's scope. Similar developments are in the works for standard assault rifles, which would make a regular infantryman who fires a few hundred rounds a year as lethal as a Special Forces soldier who shoots thousands.

—> **A scope will allow you to spot an enemy 1,100 yards away on a moonless night.**

Put the latest thermal weapons sight on a sniper rifle and the bad guy 11 football fields away won't have a clue what's about to hit him, thanks to an Army software training program called ROC (recognition of combatants). That should help reduce civilian casualties, since soldiers will be able to differentiate between a farmer holding a shovel and a combatant holding an AK-47.

—> **Your new grenade launcher will take out the enemy where he hides.**

The new XM25 "smart" grenade launcher is the Army's latest game-changer, a weapon that could one day alter the face of warfare as we know it. In fact, there are five of them downrange in Afghanistan right now, hulking matte-black widowmakers that wouldn't look out of place on the Death Star.

With an internal targeting computer, a soldier simply dials in the coordinates, pushes a button, and the grenade explodes right on the bad guy's head, no matter where he is hiding. At the moment the hand-built 25 mm airburst rounds cost a whopping \$1,000 apiece, but that's dropping fast, and considering this new weapon can reduce a firefight from 15 minutes to five, it's worth it. No wonder it's been nicknamed the Punisher.

—> **Inventing the real Captain America.**

"What has changed?" asks Dr. Marilyn Freeman of the lessons we've learned from a decade at war. "It's all about the soldier now. What hasn't changed? We live in a world of persistent conflict."

As the war in Afghanistan continues, the soldiers report home with a steady stream of "capability gaps" that must be addressed. Enemies hide behind walls, we come up with the XM25. Can't get fuel up to Afghan hilltops, we make solar panels and bio-batteries. Combat engineers need to safely locate IEDs, we mount the mine detectors on robots. But with all this progress comes an increased challenge of weight and power supply. "We can't keep hanging stuff on our soldiers," says Brigadier General Peter Fuller. "We've got to figure out a way to integrate all this technology and not weigh these kids down."

Thanks to pop culture, we've been conditioned to expect a lot of this stuff from our armed forces. But only now is reality catching up with fantasy. In the world of Marvel, technology turns Steve Rogers into Captain America. In 2011 those capabilities are practically here.

Will technology be the key to ensuring our soldier is the dominant force on the battlefields of the future? As the pace of technology increases, our concept of a soldier will probably change as drastically as our concepts of telephones and mail have in the past decade. As Stephen Colbert might say, enemies of America, you're on notice. ♣



XM2010 SNIPER RIFLE

An update to the M110 Army sniper rifle, it features .300 Win-Mag rounds and clip-on night sights.



XM25 CDTE

This new grenade launcher, a.k.a. the Punisher, can reduce a firefight from 15 minutes to five.