

Backstory

Some Data Is Hard to Get—
Some Data You Have to *Be* Hard to GetKevin Kit Parker^{1,2}

My second tour of duty in the Global War on Terror took me, an Army reservist, from my research and teaching at Harvard to the mountainous valleys of eastern Afghanistan. My job on this tour, working for the Center for Army Lessons Learned, was to try to understand how we were trying to rid the battlefield of improvised explosive devices, or IEDs, which were causing most of the Coalition casualties. A field-grade officer with no troops under my command, I roamed my area of operation attached to tactical units to collect data. One such group was Route Clearance Patrol 13 (RCP13), an amalgam of combat engineers, explosive specialists, and specialized teams, clearing roads of IEDs (Figure 1). On these missions, I sat strapped into its Buffalo, a motorized beast whose extraordinary size and robotic arm capabilities were designed to directly engage the explosive devices in lieu of dispatching someone to check it out themselves.

Convoing at 10 mph, the days were filled with a stressful monotony punctuated by long minutes of robotic probing of curiously placed rocks, gnarled asphalt, and bombs. It was physically more difficult than one could imagine. Saddled with body armor, ammunition, radios, water, helmets, and weapons and belted into a seat seemingly designed for someone much smaller than any of us, we scanned every inch of the road in missions lasting 10 to 15 hours. Chatter over the internal radios toggled abruptly between discussions of a twig's orientation, perhaps indicating the location of a bomb, or the rich jocularly peculiar to the kind of folk who sought this noble risk. Web, Salt, Joe, Hank, Z, and Staff Sergeant P—nicknames for soldiers hailing from Los Angeles, New Jersey, Kentucky, West Virginia, Texas, and Ohio—accepted me into their crew, and while we shared the perils of each mission, I watched them from two vantage points, both as one of them and as a detached outsider. Young soldiers on their first combat tour with an allegiance to their squad leader, Staff Sergeant (SSG) P, a grizzled, old school NCO, veteran of multiple tours in Iraq and Afghanistan, were rewarded by his attentiveness to developing their survivability and winning, either a stretch of road, a battle, or just the day.

On foot, we climbed into culverts, traipsed up and down the mountains alongside the road looking for the enemy's vantage points, and swept the valley floors on foot, stomping through chest-high wheat fields, tip-toeing along the dikes separating farming plots. We did this as carefully as one can while looking down, up, and all around under a Kevlar helmet and body armor, with an additional 30 to 40 pounds of gear, that was anything but ergonomically distributed above our waists. These missions often were done in the Tangi Valley, a lush, green divot connecting Logar and Wardak Provinces south of Kabul, known for its roadside bombs and vicious firefights.

During my first combat tour in 2002–2003 in Kandahar, I had worked the villages along the Pakistani border. I was familiar with the village cadences and the behaviors

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Figure 1. RCP 13 Conducts a Route-Clearance Mission Brief in Front of their Mine-Resistant Ambush Protected (MRAP) Vehicles, April 2009, in Logar Province, Afghanistan

of Afghans that embraced the rule of law and a civil society, those that were being bullied by the Taliban or Al Qaeda, or those whose population was thoroughly Taliban. Now, patrolling the Tangi, an ominous feeling shared between SSG P and I often preceded a gunfight. Enemy ambushes of our convoy often saw the two of us simultaneously accelerating from our seats, blowing through the vehicle roof hatches to return fire in a crazed, controlled, hyperkinetic explosion, or dismounting together to retrieve casualties or to maneuver on and engage the enemy in closer proximity. Our synchrony felt good. His soldiers, wrestling the Buffalo and their weapons to beat back an enemy, seemed to show no fear. In middle school on 9/11, these young men had joined the Army with a clear concept of what their job would be. Each of them joined to fight, to indulge an enemy's wish to engage in combat against his nation, his platoon, and his friends. They made their country's fight their own. In the face of physical and moral jeopardy, their competitiveness motivated their acceptance of the hardships I've described for nothing other than a chance to win. They were, in warrior parlance, studs.

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On March 22, 2009, I was with RCP 13 in the Tangi. We had been in a rolling gun battle since early in the morning that ended in a complex ambush, with an IED (about 500 lbs of homemade explosive, probably ammonium nitrate) flipping the Mine-Resistant Ambush Protected (MRAP) vehicle in front of us. SSG P and I had dismounted our vehicle and met another NCO from a trail vehicle moving up to assess casualties (Figure 2). A rocket-propelled grenade (RPG) round fired from the valley impacted the cliff just above our heads—a dud. Then, a few other RPGs sailed in, and it was on. In a split second, everyone opened up. At one point, I was on one knee over the body of a wounded trooper, firing around the bumper of the overturned MRAP, trying to keep the surge of Taliban or whatever other bunch of jackasses that were shooting us at bay. On all sides of us, on the cliff above us, and with ricochets off the cliff wall behind us, we were literally taking fire from five different directions.



Figure 2. The Author and Two Other Soldiers Rush forward to Assess Casualties Just Before the Enemy Initiated a Complex Ambush with Rocket-Propelled Grenades (RPGs) Hitting the Cliff above Our Heads on the Right of the Overturned MRAP

As we were exposed at the front, a medic maneuvered up to help me manage the casualties during the fire fight. I had three to manage while SSG P had started running back under fire to bring a vehicle forward to evacuate the casualties. Unmanned Aerial Vehicles (UAVs) were immediately overhead and the insurgents had fallen back into a village in the valley floor. F18s overhead couldn't get positive identification of targets, so they couldn't relieve the pressure on us by dropping ordinance. The insurgents had an egress route that protected them, moving through a village of noncombatants where our air support could not engage. UAVs from a variety of units were starting to gather in the airspace over us, under the F18s, as command posts throughout Logar and Wardak provinces tried to see what was happening. It occurred to us that, as in many a firefight in the war, everyone had a better view of who was shooting at us than we did—an extraordinary technology gap that seems almost impossible for the various DoD acquisition agencies to have not considered. We had UH-60 Blackhawk medevac helicopters en route to pick up the casualties, but with the landing zone under fire, the airspace congested with RPGs, 155 mm high explosive artillery rounds, UAVs, and the F/A-18s, the Blackhawks couldn't get in. The road was narrow and moving vehicles during the firefight was treacherous, so the platoon leader had to expose himself to play traffic cop, while three different radios squawked at him and he tried to lead his platoon. Apache helicopter gunships showed up and made strafing runs up and down the valley as the landing zone was set up by the forward controllers. While this was all going on, we were simultaneously trying to kill everybody trying to kill us and move and load casualties onto MRAPs that could not get forward of the overturned vehicles on the narrow road—a narrow road that we had already identified as booby-trapped. The MRAPs were the safest way to get the casualties back to the hastily set up helicopter landing zone (LZ), but the movement from the blasted vehicle to the MRAPs was through a space filled with lead, both theirs and ours. The 0.50 caliber machine guns and Mk-19 grenade launchers in the turrets of our vehicles were rocking, making me wonder at one point how anyone could still be alive enough to shoot at us as they shredded the valley floor.

The soldier below me was crying with considerable pain, his face having been smashed off the back of the machine gun he manned in the MRAP turret and his

leg snapped at an awful angle when the vehicle flipped, nearly grinding his head off against the rock of the cliff wall. I was on one knee, straddling him, thinking that if I got shot, I would fall on to him and shield him. Another soldier in the back of the vehicle had been sitting on the 500 lbs of homemade explosive when it went off, sending a blast wave through his body that induced compression fractures of his vertebrae. Of course, we didn't know that when we pulled him out of the wreckage. We didn't know what kind of injuries he had at all until he was leaning on me as I moved along the road between him and the majority of the insurgents, back toward another MRAP that had moved up to retrieve him. After a few steps, he screamed that he couldn't walk. As rounds zipped past us and over our heads, I let him know that not walking back was not an option anymore, and we made it to the medevac vehicle where he was pulled into the back and I returned to overturned vehicle to get another casualty.

Some data require a late night in the lab, missing an evening with friends or perhaps a family dinner. Wrestling with an experiment for days, weeks, and months on end is tough, no doubt about it. The data I collected in 2009, resulting in a classified review of how we looked for IEDs, recommendations for technologies, and detailed accounts of multiple firefights was the toughest data I have ever gathered. However, I recall it with the same euphoria I feel in the lab when my team, or myself during my training, finally gets an experiment to work. It was exhilarating. It also raised the bar considerably for what I thought was acceptable sacrifice discomfort.

After my first tour in Afghanistan when I arrived at Harvard just days off the Pakistani border, I focused on the heart. Nothing in my lab reflected my time in Afghanistan. Eventually, I started to recruit younger veterans of the Army, Navy, Air Force, and Marine Corp to work in my lab. Their training and execution were well suited to laboratory operations. After having maintained and operated satellite radios, optics on weapons systems, explosives, and other technologies we humped around the hills, maintaining a confocal microscope or a mask aligner in a clean room was not an overwhelming challenge. The presence of the veterans in the Disease Biophysics Group over the years made for something else. When one fights a war, coming home is a misnomer because you carry a part of the war tucked away inside of you. Today, in my lab, in the form of these former gunslingers, I have a reminder of the war right in my face.

After a friend of mine was wounded by an explosion with a pretty serious traumatic brain injury (TBI), I reluctantly decided to bring part of the war into my lab in a form other than just the young veteran talent we recruited. I have recounted the story before that, after my return home. I retrieved my patrol notebook from my first tour from my footlocker of combat equipment. In it, I had kept a list of everything that pissed me off in the war.

So, I decided to do a project on everything that pissed me off. One project for every problem I identified. We started first with the cell biology of blast-induced TBI (Alford et al., *Proc Natl Acad Sci USA*, 103, 12705–12710; Hemphill et al., *Neuron*, 85, 1177–1192; Grevesse et al., *Sci Rep.*, 30, 9475). We developed wound dressings inspired by a child I saw burned to death (Ahn et al., *Adv Healthc Mater.*, 7, e1701175; Ahn et al., *ACS Appl Mater Interfaces*, 11, 33535–33547; Ahn et al., *Biomaterials*, 255, 120149).

The data I collected in 2009, resulting in a classified review of how we looked for IEDs, recommendations for technologies, and detailed accounts of multiple firefights, all ambushes, from the Tangi Valley, was the toughest data I have ever gathered.

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We worked to reverse engineer the adaptive camouflage of the cuttlefish because of the jacked up, pixelated uniforms we had with a camo pattern that was terribly mismatched for the terrain we operated in (Deravi et al., *J R Soc Interface.*, *11*, 20130942). We worked with the Massachusetts State Police to apply counterinsurgency methods against criminal gangs in Springfield, MA, developing the first counterinsurgency laboratory in the world. But, despite the pain in my arthritic knees, ruptured lumbar intervertebral disc, the compression fracture of one of my thoracic vertebrae, and the numbness down both of my arms from carrying the extraordinary loads we carried in combat (between 100 and 130 lbs), I had not given much thought to about developing lighter body armor.

What motivated me was the hundreds of US soldiers who have lost all or part of their genitalia to IED blasts (Banti et al., *J Trauma Acute Care Surg.*, *80*, 131–134) The delicate anatomy of the urogenital area is poorly, if at all, protected by the Kevlar body armor we wore. The idea was to develop a para-amid fiber that could be developed as a textile fashioned as an underwear-like garment for soldiers to wear in combat. Dr. Grant Gonzalez, then an undergraduate at Harvard, took on the project after spending time working with the gangs in Springfield. Through his doctoral studies, again, in my lab, and into his postdoctoral studies, he stayed on the project until he solved it. Along the way, he developed a new method for manufacturing para-amid fibers—immersion Rotary Jet Spinning (iRJS) (Gonzalez et al., *Macromol. Mater. Eng.*, *302*, 1600365). This manufacturing system has now supported additional work in our laboratory in problems ranging from manufacturing synthetic meat to wound dressings. In this issue of *Matter*, with our collaborators at the United States Military Academy and the US Army Combat Capabilities Development Command Soldier Center, we report the ballistic and thermal protections offered by aerogels made from these para-amid fibers manufactured with iRJS (Gonzalez et al., *Matter.*, *3*, this issue).

As of this writing, our collaborating civilian scientists at the US Army Combat Capabilities Development Command Soldier Center in Natick, MA are building their own iRJS system so that they can continue this important work. As an Army officer and combat leader, my commitment to the wellbeing of my soldiers goes beyond that time with them on the battlefields of Afghanistan, and I have been grateful to have a research group that was willing to take on these projects with me. Further, taking these soldier issues back to the lab, where civilian scientists and other veterans training to be scientists and engineers can join forces to apply their knowledge and creativity, is part of fulfilling our national obligation to the gunslingers of RCP13 and those future defenders of the nation.

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