

ROCKS

by John G. Henry

History progresses by building higher and higher on the accomplishments of forebears—but how high can it go?

The huge rock spiraling into the planet's atmosphere, leaving a fiery trail in the sky as friction vaporized its outer surface, didn't know that the area where it would soon strike would millions of years hence be called Yucatan. It didn't know that its impact would vaporize countless living things, that the wave of heat and debris hurled outward by the collision would incinerate an incalculable number of other plants and creatures, or that the dust it threw skyward would create a sudden winter of long duration that would spell the doom of many species, including the dominant giant sauropods. The ecological niches opened as a result would be filled by other creatures, including one that would someday evolve toward humanity.

But the rock didn't know that, either. It was just a rock.

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Angry and getting madder by the moment, Tak glared toward Hok. The bigger Hok had just mated with the female whom Tak had wanted. Tak had no way to strike at Hok without being beaten in the fight.

Tak's hands, covered with hair like much of the rest of him, scrabbled in the soil where he crouched. One hand curled around one side of a rock. Tak stared at the rock, feeling its weight. Rocks were used to crack open nuts and the bones of animals for the marrow.

An idea came to him. Tak rushed over to Hok and swung the hand holding the rock. It struck Hok in the head and the bigger hominid fell heavily into the dirt. A friend of Hok's howled and came running toward Tak. In a panic, Tak threw the rock. It struck the arm of the other with a sickening crack and that one fell, too, screaming with pain, his arm bent at a strange angle.

The others were angry with Tak at first, but they examined the hurt done to Hok and his friend.

Some of them picked up rocks.

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Yana watched the members of her tribe scouring the ground for good rocks. She knelt near a rocky ledge, gazing at some rocks broken and split by the ice that came in the cold times. The split rocks had sharp points and edges, but were much too large to be used.

Why couldn't she do what the ice did?

Gathering up a couple of smaller rocks, she slammed them together, trying to get them to split right. A pile gradually accumulated near her, mostly of rocks broken too small to be useful. Some kinds of rocks seemed to split better than others. Her hands ached and bled from the force of her blows, but by the time others sought her out, Yana had three rocks whose rounded backs fit comfortably into her hand and whose fronts were flaked into sharp edges.

The tribe studied her work with amazement. Then the elders ordered Yana to show others how to make sharp rocks. There were animals to be felled and cut up, and other tribes sometimes tried to steal from Yana's tribe.

The sharp rocks would be useful.

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Scout eyed Hunter curiously. The other had split a heavy stick on one end and wedged a rock into it. Now Hunter was carefully wrapping strong plant fibers around the rock and stick to hold the rock in place. "What?" Scout asked.

Hunter swung the stick experimentally. "Long arm hit hard. Make arm long. Hit hard." He swung the stick again, bringing its end down on a nearby stone. The rock on the stick rang with the impact and splinters of stone flew.

Scout smiled. "Good weapon."

"Yes," Hunter agreed, looking for more rocks of the right size and shape. "Make more."

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"What?" One watched another with a long stick and a small sharp rock. "Too long," he said, pointing to the stick. "Too small," he added, pointing at the rock.

"This not club." The other finished fastening his sharp rock to the end of the long stick and jabbed at the first one with it, causing his companion to jerk away in

fright. "Like this."

The eyes of the first one lit up. "Stone on end cuts what is out of reach." He took the crude spear and jabbed at the dirt, driving the point into the soil. "Cuts deep. Deeper than club."

The inventor smiled proudly, taking back the weapon and running around excitedly. He tripped and the spear flew out of his hand, wobbling forward until it buried itself into the dirt again.

The first one bared his teeth, racing to take the weapon and throw it awkwardly, then recovering the spear and holding it up. "Stone cuts far!" he exulted.

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Sanu twirled his new weapon, then let go one end of the leather strap, setting the rock cradled inside free to fly toward the target.

Tuni's eyes widened as the rock struck a tree with so much force that bark flew and wood splintered. "Better than throwing."

"Much better," Sanu agreed. "Much better weapon."

Tuni tried a few throws, his stones going off at all angles. "It takes much practice. It needs rocks of the right size and shape."

"It's still good," Sanu insisted.

"Yes." Tuni tried another throw, imagining his tribe armed with such throwers the next time they fought the people who lived along the river. The river peoples' spears couldn't be thrown nearly as far as these new weapons would propel rocks.

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"The spearhead is too small," the woman said.

"It's not for a spear," the other woman replied. She held up a straight stick tipped with a small, sharp stone. "See. A small spear. The feathers on the end guide it as they do the birds." She picked up a long, slim wooden staff and stretched a string of animal gut from one end to the other, bowing it. Setting one end of the small spear on the gut, she drew back until the wood quivered with

tension, then let go.

The first woman watched the small, sharp rock on the front of the small spear embed itself in a nearby tree. "Good. Very good. You've made a spear truly fly."

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The maker pounded on the shiny rock. Unlike most rocks, this rock that had been dug up from beneath the ground didn't shatter when hit. Instead, it took on new shapes. Now he pounded again and again, forming the copper into the shape of a hammer with a sharp edge. He'd already found that the edges didn't stay sharp for long, but they could always be pounded sharp again.

Mounted in a wooden handle, the axe made from shiny rock worked much better than those chipped from other rocks. Set on the front of spears and arrows, it made more effective points. But the softness that let him pound the rock into shapes also prevented the rock from holding the hard edges needed in tools for hunting, building, and war. If only there were a way to make the rock harder and still form it into weapons.

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The king watched intently as his weapon-maker showed how the hot ovens melted rocks of different kinds, merging them together, the result to be molded or beaten into shapes. Finding the right rocks under ground, transporting them here, and cutting the trees to fuel the fires were labor intensive, and he had many other jobs those laborers could be doing.

"See. Here." The king eyed the very long knife with approval as the weapon-maker held up a finished bronze sword. "We can form them into these. Stronger than copper." The weapon-maker swung the sword with both hands, its edge biting into the wooden log resting nearby. "It holds the sharp edge much better, on knives or axes."

The king took the weapon, raising it to admire the keen edge and the way the sun rippled off the metal. "How strange to think the rocks we find in the earth can be remade into this." He swung it, too, imagining it biting through leather armor or shields and into the bodies of his enemies. "I need enough such weapons for all the fighters in the kingdom."

"We'll need to dig up enough copper and tin to make the bronze."

“My workers will dig.” The king gazed at the piles of raw metal nearby. “Are there other things we can dig up which when melted will make even better weapons?”

The weapons-maker scratched his head and grimaced, toeing at the rock that seemed the heaviest. “Yes, but iron is too hard. We have to learn how to melt it. It takes hotter fires than we can build. But we’ll figure it out. Someday we’ll make weapons and tools of iron.”

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“Load.” The centurion stood back as the crew of the ballista struggled to hoist a large stone into the waiting scoop at one end. The crew had already levered the arm of the siege machine back against increasing tension and then locked the arm in place while they loaded it. A huge device built of metal fittings and wooden beams, the ballista faced a barbarian fort, far enough distant that the barbarian weapons couldn’t reach it. But its projectiles could reach the barbarians.

The centurion studied the range to the enemy fortification, the size of the rock loaded into the ballista, and the direction the siege machine pointed. “Increase tension.” The crew strained to pull back the arm slightly more, then eased off with relief as the centurion nodded with satisfaction. “Let go.”

The lock was pulled loose, the ballista’s arm swung up, and the large rock hurtled toward the enemy, thrown by all the force the latest skills in human engineering could bring to bear. It struck the walls of the enemy fort, splintering massive logs.

“Prepare,” the centurion ordered, and the ballista’s crew began cranking the firing arm back down again. More rocks lay nearby, ready for hurling at the enemy. Before the sun rose much higher, the barbarian walls would be broken in several places and the centurion would be leading soldiers through those breaches to overcome the defenders.

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“What is this?” the artisan asked, examining what seemed to be a crossbow quarrel formed of metal, but with a shaft thicker than usual. “You told me you had a new weapon for soldiers to use against knights. Won’t a crossbow strong enough to shoot this be too heavy for a man to carry?”

“Watch,” his companion suggested. He tipped up a strong iron bottle with a

longish neck, a larger rounded body and a small opening near the bottom end, then carefully poured in the special powder, which would explode when brought into contact with fire. Stuffing the metal quarrel in last, he set the iron bottle into a slanted hole in the ground, facing a battered breastplate from an old suit of armor. Bending down, he set a torch's flame against the trickle of the powder coming from the hole near the back end of the bottle.

A thunderous crash was followed by a billow of smoke and flame and a second smashing sound.

The artisan stared at the armor plate, which now had a large hole punched in it. Picking up another quarrel, he stared at it. "Deadly. The force of the powder throws the quarrel harder than any bow. But why would our overlords bother with it when long bows and crossbows can do much the same?"

"Long bows and even crossbows require much practice to be skillful in aiming," his companion explained. "This is simple. Learn to load it, and anyone can use it to launch projectiles. It's the same iron we've mined for centuries, but a new way to employ it as a weapon."

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"Flints!" The sergeant stood back as the cover was lifted from the barrel. His soldiers in their bright uniform coats and cocked hats crowded around, picking up the small rocks and fitting them carefully into the mechanisms of their flintlock muskets. He inspected the weapons carefully afterward, making sure each musket was in good shape, that each soldier had a decent supply of lead balls and powder for ammunition, then reported to his officer.

The soldiers marched toward the sound and smoke of battle. They halted as they reached the crest of a ridge. On the other side of the ridge, soldiers in different colored uniforms were marching toward them.

The sergeant called out commands and the soldiers poured a measure of powder into the metal barrels of their muskets, rammed it home, added a patch and a lead ball, rammed them home, tilted the weapon and poured a small measure of powder into the firing pan, raised their weapons and pointed them in the general direction of the enemy, then at their officer's command pulled their triggers. The flints swung down, striking sparks, which ignited the powder in the firing pans, which ignited the powder in the barrels, and the muskets hurled their lead balls toward the enemy.

The sergeant was calling out the commands to load again when the enemy fired. One lead ball slammed into the sergeant's upper arm, pulverizing the bone and knocking him to the ground. He lay, his blood soaking into the rocky soil, as gouts of smoke and fire marked more lead balls being shot in volleys against each side.

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Steel-jacketed lead bullets ran on a linked belt, feeding into the machine gun as the gunner held down the trigger. A continuous stream of metal slugs tore toward the advancing enemy, smashing into them to deal death and injury. The enemy fired back, individual metal projectiles ripping past over the heads of the machine gun crew. Far above in the sky, aircraft made of steel and aluminum torn from the earth clashed with each other. From some of the aircraft, bombs fell, big steel shells filled with explosives that made them burst on impact to cast a deadly storm of jagged metal at anything nearby.

One of the attacking soldiers paused to fit a metal sphere to the muzzle of his rifle, aimed carefully, then fired. The rifle-grenade flew through the air, landing next to the machine gun, then exploded. Its fragments killed the defenders, and the attackers raced past, the machine gun now silent, its barrel still radiating heat created by the bullets that had been launched through it.

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The technician smiled as he reviewed the video. Soaring skyward in a smooth arc from the mouth of the rail gun, a glowing thread of light marked the path where a metal sabot had been hurled by linear magnetic fields at hyper-velocity. "Perfect shot."

"What's the radiant streak in the sky?" the visitor asked.

"Plasma generated by atmospheric friction. The projectile moves so fast that heat burns off its outer layers. That's not a problem since it's just solid metal."

"You don't need a warhead?" His visitor peered at the nearby display, where a thick, gleaming metal arrow rested.

"No. It's a kinetic kill weapon, like a big bullet. The energy imparted by the magnetic fields as they accelerate the round is so great that the impact by a solid projectile traveling at those velocities is enough to destroy the target." The technician made a dissatisfied face. "The main problem is getting a barrel that can

withstand the firing. Right now they wear out after only a couple of shots. But we'll get that problem licked, and then we'll be able to hit the enemy with the latest and greatest weapon we've ever come up with. It'll be unstoppable."

"You can't use countermeasures against it," the visitor agreed.

"Nope. You can't jam a rock."

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From low Earth orbit, many landmarks on the surface could easily be seen even though cloud cover screened some areas. The officer gazed through the targeting sight, increasing the magnification to pick out individual buildings and vehicles. "This is amazing. They're loading the rounds?"

His commanding officer nodded, then pulled something out of a storage compartment. In zero gravity the object had no weight, but the officer could tell from the way the other man handled it that its mass was substantial. "Here's one of the small ones." He left it hanging in the air between them.

The officer examined it, seeing a streamlined shape like a toy rocket or a trophy. "Solid metal?"

"That's right. Fin-stabilized. The targeting systems up here drop them on the right trajectories. As it falls through the atmosphere it gains energy, so it hits with a lot of force, so no warhead is needed. The launchers are spring loaded, but you could hang outside the ship and drop them by hand if you felt like throwing them at the enemy."

"A piece of metal." The officer wrapped his hand around the projectile, getting a feel for its mass. "Yet it's the latest weapon. Between ones like this and the big kinetic projectiles, we'll be able to do a lot of damage on the surface. Who needs nukes?"

"A big enough kinetic projectile can do as much damage as a nuke."

The officer frowned. "I wonder how many of these we and our opponents are going to place in orbit, and how big they'll be."

"If I were you, I'd worry more about whether we'll all end up using them."

The first officer's frown deepened. "How long until the test shot fires?"

“Five minutes. Approximately. The automated targeting system will time the drop to maximize chances for a hit. We’ll be able to watch it all the way down on infrared as the outer surface heats from friction and creates a glowing trail.”

The officer took another look at the projectile in his hand. “The culmination of millennia of human weapons development, and yet it doesn’t have any homing device or warhead or propulsion, and we can simply throw it at the enemy.”

“That’s right,” his commander agreed. “It’s just a rock.”