Excerpts from *The First Human:*
The Race to Discover Our Earliest Ancestors

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EXCERPT FROM CHAPTER NINE, A VIEW FROM AFAR

While I was reading about the Afar, it occurred to me that if a rift valley is an ideal setting for preserving fossils and artifacts, then what about *three* rift valleys intersecting in one place? What about a depressed lowland that comprises one of the largest landlocked, multiple-rift-valley structures in the world?

Jon Kalb, geologist

When Tim White gives a tour of the Afar rift of Ethiopia, he often starts from space. He is selective about who he takes with him to the moonscape of the Afar, so the only way that most people will get to see it is to watch White's slide show. In lectures to the public, White starts his virtual tour by proposing that he take the audience up on the space shuttle to show them the view of the Horn of Africa. White shows satellite images of the Afar depression, a giant triangle of land on the northeast border of Ethiopia where it abuts the Red Sea and the Gulf of Aden. It is a view White knows well—for many years during the eight-year ban on fossil hunting in Ethiopia, these space-based images were just about the only glimpses he got of the Afar. White and his coworkers studied those images during the moratorium, even working with NASA scientists to learn how to translate different colors of land in the photos into various types of ancient sediments, such as basalt and exposed sandstone. The images would later be used as navigational tools to help them target promising areas of exposed rock.

Even to the untrained eye, it is clear from the space-based images that the Afar depression is different from the land on either side. The Afar is a low-lying wedge that has sunk below high ridges of darker land on either side, like a soft spot on an infant's head. But unlike an infant's skull, where the plates of bone will eventually move together and fuse, this depression is a continental crack where giant plates of the earth's crust are still spreading apart. It is one of the rare places in the world where three plates meet in a triple rift junction—and the center does not hold, exposing a giant rift zone in between as the plates pull apart in different directions. "What you're seeing here is the Arabian plate pulling away," White tells audiences, pointing to the northwest side of the Afar depression where it abuts the Red Sea.

Over 26 million years, the movement of the plates has pushed the Afar triple junction about 160 kilometers in a northeast direction. As the Arabian plate creeps off to the north in a counterclockwise direction at a rate of about 1.6 centimeters a year, it bumps up against the Eurasian plate and scrunches the terrain at that boundary into the Zagros Mountains. The Somali plate is pulling toward the south in a clockwise motion. And the giant African (or Nubian) plate is skidding to the northwest, colliding with the European

plate, thrusting it up to create the Alps. If the plates continue on their trajectories, the Red Sea will become part of a new ocean that one day may engulf the Afar depression, though geologists debate whether the movement of the plates beneath the Afar has stalled.

The engine for all this tectonic activity is a hot spot twenty-nine hundred kilometers beneath the Afar triple junction, which is still burning a hole in the crust. A cauldron of extremely hot magma began pushing up from the earth's mantle to the surface more than 30 million years ago, forming a vast dome that stretched from Ethiopia to Yemen. At the peak of the Afro-Arabian dome was land that is now Ethiopia, which remains a high plateau and the most mountainous nation in Africa. One leading scenario for the formation of the rift zones is that molten magma pushed up under the dome, finally bursting through weak spots in the earth's crust. When the dome broke, it split along the boundaries between the plates, forming cracks that are the great rift zones, including the Afar depression and the Great Rift Valley.

Over millions of years, the energy at the hot spot has been released in a flurry of erupting volcanoes that spewed lava, ash, and rock in the rift zones. Over time, the valley floor sunk and the lava and volcanic material from the mantle oozed up onto the floor of the rift zone. As the two sides of the rift spread apart, the cooling lava spread out onto plateaus that look like ripples of sediment frozen in time. The hot spot is still fueling volcanoes that, along with tectonic movements, have inadvertently done the groundwork for White and other paleoanthropologists—they have exposed ancient sediments that would otherwise be buried, in the same way that a road crew uncovers walls of layered rock and dirt as they cut through a hillside.

The tectonic activity is not the only reason the Afar depression is the ideal place for finding fossils. "The cloud deck is important," says White, as he shows a slide of the Afar visible through banks of clouds. "You have to think about the water that comes when these clouds produce rain." The water falls down onto the giant dome and into the fissures of the rifts and the low-lying Afar depression.

The Afar, like other rift valleys, is a giant basin. Water flowing down rivers, tributaries, and drainage ditches in the rainy season is thick with dirt, rocks, and mud, which get dumped on the low-lying ground at the bottom of rift valley lakes and floodplains. The water and sediment are essential for turning bones into petrified rock, or fossils. If an extinct animal or human ancestor dies on dry land, its carcass is usually devoured by carnivores and its bones weather and decay into dust.

But if a hominid is buried quickly and gently by sediments at the shore of a lake or riverbank, for example, it might become the rare creature whose bones fossilize instead of decomposing. Once it's been buried by fine sediments, there is little oxygen, heat, or moisture to decompose the bones. In ideal circumstances, the bone doesn't disintegrate, but its organic material, such as DNA and proteins, disappears over time. The remaining spaces or pits in the bone and teeth absorb hard minerals, such as calcium and silica, which percolate slowly into the bone from water in the soil. Over time, the bone fills with hard minerals and becomes petrified, turning into stone.

While the entire eastern African rift has been called the cradle of mankind, a more apt analogy would be to call it the graveyard for humankind. Hominids ranged far beyond the Great Rift Valley, but the acidic soils in tropical forests probably disintegrated their

bones before they could fossilize, and much of the rest of the continent's surface has eroded away. By contrast, the Afar valley was a trap for fossils.

White zooms in on one of the best dumping grounds for bones in the Afar—an area of exposed sediments 150 kilometers south of the triple junction on the western margin of the Middle Awash where he and his colleagues have focused their quest. "Let's go down on the ground and see what's happening there on our trip through time," says White, as he shifts to photos taken on the ground.
