

SEARCHING FOR DINOSAURS

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“ADVENTURE WITH A PURPOSE” is how I describe my trail of exploration and discovery to remote corners of our planet to unearth unknown chapters in human prehistory and scores of creatures from deep time. *Adventurous*, yes, because the exigencies of adventure form the core of exploration—the urge to seek the unknown, to go where few, if any, have ever been. *Purposeful*, too, because without discovering something new and, preferably, impactful to humankind, adventure might otherwise sum to little more than exotic travel. Adventure with a purpose, thus, is my metonym for exploration and discovery. A salient footnote here is that both *exploration* and *discovery* are driven by human curiosity, the hallmark of our species, *Homo sapiens*. Alone among the billions of species that have evolved over time on our planet, we spilled forth from Africa some one hundred thousand years ago to colonize the world in a blink of evolutionary time. So fast was our geographic exploration and so profound our technological discoveries that now the well-being of the planet itself rests in our hands. The point here being that exploration and discovery are baked into our genes.

The first question a reader may rightfully ask of a seasoned explorer-discoverer may be, “Is there much left still to explore and discover about our world and, in particular, about its past? Is the world so well connected, traversed, and digitized, and the past so mined and cherry-picked that nothing major or startling could be unearthed?” In fact, quite the contrary. We have recently entered the Golden Age of Exploration and discovery, a time when as many as fifty new dinosaurs are named every year, an era that will witness as never before exploration of the ocean depths and the visualization of the far reaches of the cosmos. In this golden age of unknown duration, discoveries will be legion, spilling out at an ever-increasing pace. Some will be mind-bending.

EXPLORATION

Exploration can require considerable grit, determination, and drive. Given that humankind has been exploring the planet for one hundred thousand years, it takes some effort to go somewhere where few have trodden

before. Sometimes advances in equipment open new horizons, such as Aqua-Lungs or manned spacecraft. In paleontology and archaeology, new gadgets have revolutionized exploration and discovery in rugged, uninhabited terrain. Satellite uplinks connect to loved ones no matter how remote the locale; GPS has revolutionized finding and relocating sites, as well returning safely to base camp; stereophotogrammetry in the field captures 3D images of new sites and finds moments after discovery; generators and electric jackhammers provide unmatched power and dexterity day or night; hand chisels have been replaced by lithium battery-powered hammer drills; and all manner of tents, shades, and dehydrated food facilitate camping in the middle of nowhere for long periods.

Requisite as well are a dozen talents that less immediately come to mind. Some of these needed talents are physical, such as an ironclad constitution that can withstand bizarre foodstuffs, a muscled body made of steel, platinum-coated nerves that can handle extreme stress, and the ability to forgo a shower for weeks at a time. Many needed talents are mental, such as an ability to overcome insurmountable hurdles, a talent for team building, a readiness to negotiate in several languages, a knack for organization, and sincere care and empathy for other human beings from very different cultures.

Another crucial talent when exploring and discovering fossils is safety management; in other words, ensuring that you and your team return sound in body and limb. This means traveling without accident across hundreds of miles of roadless, dune-obscured terrain in overloaded, beat-up vehicles, and unearthing and hauling out multiton blocks. Expeditions to remote locales in the Sahara that returned with one hundred tons of fossils in field jackets and roughly one hundred human burials were accomplished without a single broken bone, slipped disk, or rupture.

Security is the second, more subjective element of safety management. When exploring and discovering

fossils in regions known for commodity, drug, and even human trafficking, a security escort may be needed. But who is to say whether plying Saharan landscapes for a few months is any more dangerous than living for years in a city awash in firearms with an annual homicide rate topping five hundred? If, factoring in the time differential, these two situations are roughly risk equivalent, why did I arrange an escort of more than fifty armed guards on my last Saharan venture but operate alone and unarmed with my lab team at all hours of the day in Chicago?

The answer is simple. All eyes are on our high-profile operations in the Sahara. One major incident there could easily become an international headline, rather than a footnote among Chicago’s daily crises. It could not only set back years of hard work developing the nation’s patrimony, but also injure the country’s recovering tourism sector. Most of the Sahara can be likened to our Wild West two centuries ago—a vast roadless wilderness. Security is something you bring along for the ride.

DISCOVERY

Discoveries are increasing in number each year, a trend driven mainly by increasing knowledge among the world’s inhabitants. When I first traveled across the Sahara to Niger in 1990, it was possible to find a Tuareg nomad in a remote corner of the desert who had never seen an image of a dinosaur. For all some knew, dinosaurs might still be alive somewhere. A local village leader took us to a field of large sauro-pod bones protruding from the desert floor. They pertained to a ponderous sauropod dinosaur I later named *Jobaria* in honor of a beast in Tuareg legend. When asked to what these bones belonged, a village leader replied through translation, “a large camel.” Three hundred and fifty years ago, Westerners thought the same about the first bones of dinosaurs that came to light in the English countryside. They were likened



ABOVE A skeleton of the spinosaurid *Suchomimus* meets Tuareg nomads in a peace celebration in the desert over the end of a rebellion in 2000. Courtesy of Mike Hettwer.

to the largest upright animals of the day: elephants or perhaps human giants.

During the 1990s, however, most Nigeriens saw or heard about the mounted dinosaur skeletons that I installed on the museum grounds in the capital of Niamey. To the delight of children in the oasis of Agadez, I showed them *Jurassic Park*, which had debuted in 1993. The 1997 sale of a *T-rex* skeleton to the Field Museum for over \$8 million sent another message that penetrated to the world's largest desert: Fossils could be sold. On the western edge of the Sahara in Morocco, the illicit sale of dinosaur bones was already well established by 1995, when I discovered there the *T-rex*-sized skull of the predator

Carcharodontosaurus. Nearby were a few pits dug by distant villagers aiming to find and sell fossils, an illicit trade that is now the mainstay of small villages.

In northern China in the early 1990s, I discovered and named a small parrot-beaked dinosaur (*Psittacosaurus*) and a robin-sized fossil bird (*Sinornis*) from beds that soon yielded the world's first feathered dinosaur (*Sinosauropteryx*). Local farmers, who a decade earlier never gave a thought to fossils, became human moles burrowing into solid rock to supply an illicit pipeline of fossils to international dealers. Wondering if I might be a buyer, one Chinese villager slid a slab out from under his bed containing the perfect skeleton of a parrot-beaked dinosaur. But I was more interested to see

where he found it. So he took me up the valley to the opening of his handhewn tunnel. We hunched over and shuffled along his unsupported tunnel hundreds of yards deep into the belly of a mountain. “*Zhèli* (here),” he said, pointing to his subterranean site of discovery. The well-appreciated risk in this trade is getting buried alive.

On the legal side of the ledger, increased public investment has mirrored the rise of scientific and popular interest in fossils. Since 1990, new natural history museums have sprouted up not only in national and regional capitals, but also in towns and villages. In North America the largest museums are no longer on the East Coast or even in the Midwest, but rather closer to the dinosaur beds themselves in Alberta, Montana, and Utah.

Discoveries once thought to be unique or extremely rare are now understood to be more common than anyone would have predicted a generation ago. When I was a student, well-preserved dinosaur eggs were thought to be unique to a few European locales. Today, fossilized dinosaur eggs with embryonic skeletons in nesting grounds have been found on several continents. Ancient DNA, the grist for *Jurassic Park* fantasies, recently was recovered from fossil bone close to two million years in age.

The bottom line here is that today the significance of fossils from deep time is well appreciated worldwide, which, in turn, has generated more discoveries and larger numbers of paleontologists and museums than ever before. And these trends show no sign of abating anytime soon.

MODES OF DISCOVERY

Discoveries, in my years of experience, are of four kinds, in order of decreasing number: unanticipated, anticipated, quixotic, and exotic. *Unanticipated* discoveries usually far outnumber other kinds of discoveries when exploring unknown terrain. I finally had my chance to explore the Sahara on my first trip to Niger in 1990.

I had no idea what I might find when a local nomad took us to a vast graveyard of huge sauropod bones. On a later expedition to Niger's best-known dinosaur fossil area called Gadoufaoua, I arrived to find huge armored plates strewn everywhere. These belonged not to a dinosaur but to a monster crocodile (*Sarcosuchus*), which I would eventually reconstruct to find it measured forty feet in length. While collecting elsewhere in these beds, I found some peculiar fragile fossils I thought might be crab carapaces. Under the microscope back in the lab, these turned out to be the exoskeletons of a new scarab beetle. From older beds, one of my team members found what they thought might be a fossilized seed, so we collected the walnut-sized purple nodule. Under the scope back in the lab, the spherical fossil turned out to be the world's oldest turtle egg.

Anticipated discoveries are immediately recognized and met with tears and team celebration. Such is the story of my first dinosaur discovery, the skull and skeleton of the early dinosaur *Herrerasaurus*. As a newly hired professor at the University of Chicago, I had never led an expedition, much less one to a foreign land. But I felt I should start my studies of dinosaurs by trying to find the first skull and complete skeleton of an early dinosaur. So, despite a shortage of funds and any ability to speak Spanish, I headed down to Argentina in 1988 to recruit an equally young Argentine team for the task. We left town in a run-down vehicle to explore Ischigualasto, a remote and infamous fossil area in the foothills of the Andes known for its early dinosaur bones. Some days later, I chanced upon a complete skull and skeleton of the very dinosaur I had set off to discover, *Herrerasaurus*. I later dated that find at 231 million years old. When an anticipated discovery like this is realized in an instant, it can pull on the emotions. My tears flowed as the team gathered in awe over the fossil.

Quixotic discoveries, which for me number about a half dozen, are so improbable that it feels in retrospect



ABOVE Dr. Paul Sereno and Tuareg guide Dinine Alhassane dit Bido look over a burial at the Gober archaeological site in Niger in 2006. Courtesy of Mike Hettwer. **OPPOSITE** As Dan Vidal exposes more of a fossil find, Dr. Sereno guesses which part of which beast is coming to light on a 2022 expedition to Niger. Courtesy of Keith Ladzinski.

as if one was somehow directed like a guided missile to the spot of discovery. This is the story of my first fossil find in 1984, an articulated skull and skeleton of a mouse-sized mammal at the famous Flaming Cliffs in Mongolia. I had embarked on a wild, solo, eight-month trip around the world as a graduate student, intending somehow to travel across Mongolia to become the first American paleontologist to return to the Flaming Cliffs since 1923, when Roy Chapman Andrews discovered the frilled dinosaur *Protoceratops*, *Velociraptor*, dinosaur eggs, and small mammal bones there. Making that venture most improbable was the fact that the United States had yet to recognize Mongolia as an independent country. Even so, I arrived there one day on the

Trans-Siberian Railway, flew into the desert to a waiting jeep, driver, and guide, and headed out into the barren landscape. To find the famous site, we used a hunting telescope. Fifteen minutes after arriving, I scaled the first outcrop I could reach and came across the most magnificent fossil just peeking out from the orange rock surface—the skull and skeleton of the tiny mammal *Kyryptobaatar*. From the century of fossil prospecting in Mongolia that straddles my visit, no one has ever found so articulated a specimen of this kind. A similar scenario unfolded when I drove 1,500 miles from Chicago to Texas on a field trip finale for my undergraduate class on dinosaurs. After about one hour in the expansive Big Bend National Park, we came



across a horn poking out of the ground. We exposed an eight-foot-long horned dinosaur skull that was later named *Agujaceratops*. During a century of fossil prospecting in the park, it remains the only dinosaur skull ever found there.

Exotic discoveries are the rarest, but can rank as the most noteworthy of a long career. Exploration can uncover finds so strange and unexpected that their significance can easily be overlooked. Such is the story of the archaeological site Gobero in Niger. On an expedition in 2000, I was pushing my team to the limit, as it was already afternoon on our foray from our remote Saharan base camp, leaving less than enough light to return. “There. We’ll turn back there,” I announced, spotting an unusual speck of green on the horizon over a low ridge.

We crossed that ridge, which marked a fault line deep in the Earth. The spot of greenery on the opposite side, unknown to us, was the last hint of where, some 5,000 to 10,000 years ago, existed a lake teaming with six-foot perch. In a few minutes, we assembled scores of fossils on the hood of our Land Rover, realizing that we had just passed from dinosaur beds more than one hundred million years old to lake bed sediment only thousands of years old. “Just up on

that low dune, there are human skeletons all over,” said the team photographer, thrusting his digital camera our way. I led the team in single file to a remarkable scene. We stood gawking at the fossilized human skeletons peeking from the sand. Who were these people? What was the meaning of this site? We had to leave in that moment or risk stranding ourselves in the desert overnight.

My half hour at that site, however, reverberated in the back of my mind. Back in Chicago, I searched the archaeological record of the Sahara without success, looking for anything resembling what I had seen. I felt obliged to return and somehow alert archaeologists to what could be a magnificent site. Three years would pass before I had the chance to mount an expedition back to Gobero. On a short stop, we mapped hundreds of burials, recovered hundreds of artifacts, and recorded a menagerie of animals that lived during the green Sahara period.

Although I did not realize it then, Gobero had hooked me on archaeology. Fielding half a dozen expeditions over the next twenty years, my teams and I excavated over a hundred burials and recovered thousands of artifacts, calibrating all with hundreds of carbon dates. The stunning, unique picture of life in the green Sahara that emerged is a story of two successive peoples, the Kiffian and Teneanian, who lived in sedentary hunter-forager communities at Gobero for over 5,000 years. That equals the span of time from the first pyramid at Giza to today. Their sedentism, unique among prehistoric hunter-forager cultures, was sustained and anchored by freshwater springs near the fault that maintained Paleolake Gobero for millennia in a region of vacillating precipitation. Their sophisticated jewelry and ceramics and poignant burials have generated searing images from prehistory for the ages—the Stone Age Embrace, capturing the tragic deaths of a mother and two children all holding hands; Woman with Newborn, a woman holding in her arms her

newborn child; Pendant Boy, a teenager wearing a beautiful ivory pendant; and Bracelet Girl, a ten-year-old buried wearing an ivory bracelet on her upper arm.

MEANING

My route to paleontology and archaeology was circuitous. I was not a born digger like some of my colleagues, who from early childhood recall a burning desire to become a paleontologist. My performance in school was miserable until late in high school, when studio art lit a fuse of creativity. I read a dictionary, writing down each word, to score well enough on an entrance test to get into a local state university. In my

third year, on a trip to the fossil halls of the American Museum of Natural History in New York, I suddenly realized that my destiny was exploration and discovery of the past. My childhood interests in out-of-school time—collecting toads and butterflies, and exploring as far as my bicycle would take me—had come full circle.

Soon after arriving in New York to pursue a career in paleontology, however, I almost left my newfound passion because I couldn't see how unearthing the past would improve or contribute meaningfully to a better world. How could discovering new fossils impact more than just scientific research? Pursuing fossils strictly for research was not an option for me.



ABOVE Dwarfed by its ponderous size, Dr. Sereno outlines the neck of a new sauropod on the Irhazer Plain in Niger in 2108. Courtesy of Matt Irving.

Then I embarked on a career that engaged students, local communities, cities, and even entire nations with my exploration and discovery, capturing that work in fossil reconstructions, exhibits, documentaries, and plans for novel institutions. Better than any other science, paleontology fascinates children and adults the world over, and archaeology reveals our amazing past and the threads that weave our present.

My childhood exploration and discovery in out-of-school time, what educators call casual science, played a central role in my journey into science. My aim is to make pathways like that routine in South Side neighborhoods in Chicago near my university, where few teens ever imagine themselves as scientists. To make that a reality requires a novel place, a hub of casual science, a free green neighborhood destination with dinosaurs and makerlabs like none before.

I harbor a deep respect and love for the many creatures and ancient humans that my work has

brought to light in Niger, all of which one day will return to their homeland. If suitable repositories in the care of native scholars are not readied for this world-class heritage, all will eventually be lost and destroyed. New programs and collection centers must be established and museums built. Those museums ought to be green and sustainable, the first zero-energy natural history museums in the world, to house Africa's dinosaur story and the predynastic cultures of the green Sahara.

For you, the reader, I hope this essay conveys a sense of the opportunity at hand to participate in this Golden Era of Exploration and Discovery, as well as a feeling for the tenacious grit and perseverance sometimes needed to unearth new discoveries. The unending cycle of exploration and discovery that enriches our planet's amazing natural and cultural heritage is driven by innate human curiosity. It is central to who we are. ■