

# BLACK HILLS INSTITUTE

OF GEOLOGICAL RESEARCH



## HISTORY

Once Upon A Time

## BEHIND THE CURTAIN

What Makes Us Tick

## THE FUTURE

50 More Years Of "Yes!"



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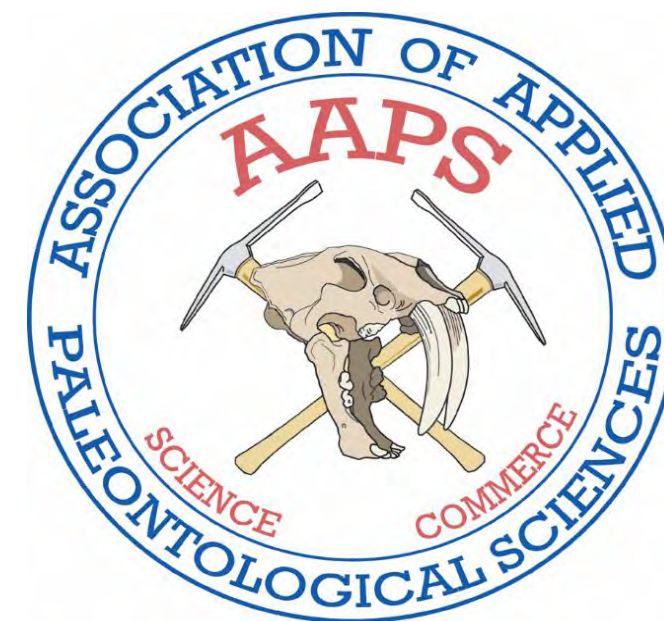
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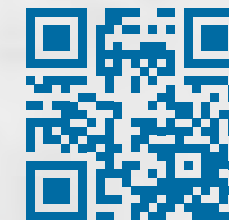
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**THANKS ALSO** to the scores of friends, collaborators, and independent contractors who have supported the work BHI has done for 50 years. Your contributions have meant the world to us. And, if any past staff names are missing from the list above, thank you, and please excuse the error. A lot has happened in 50 years—including, in 1992, the “loss” of our records!

# COMING SOON

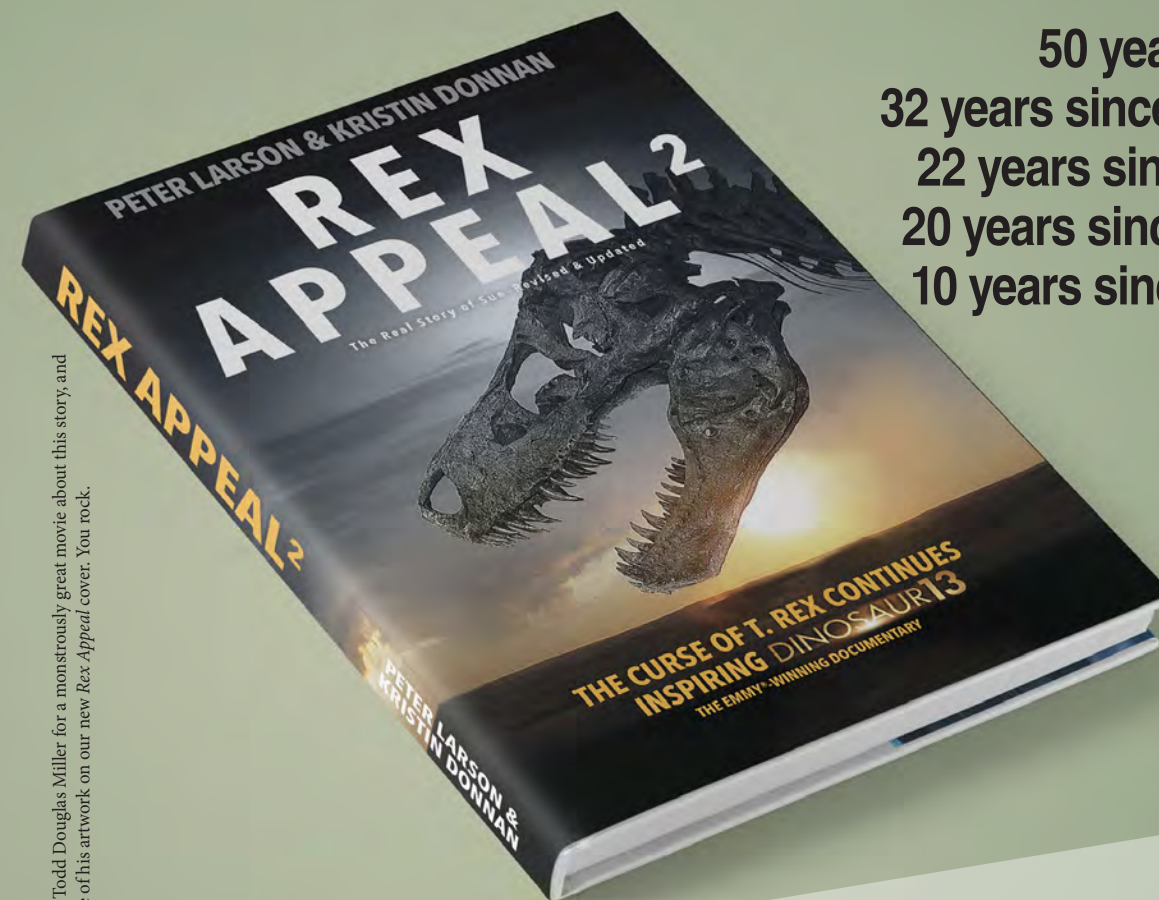
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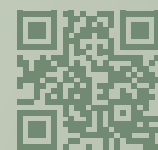
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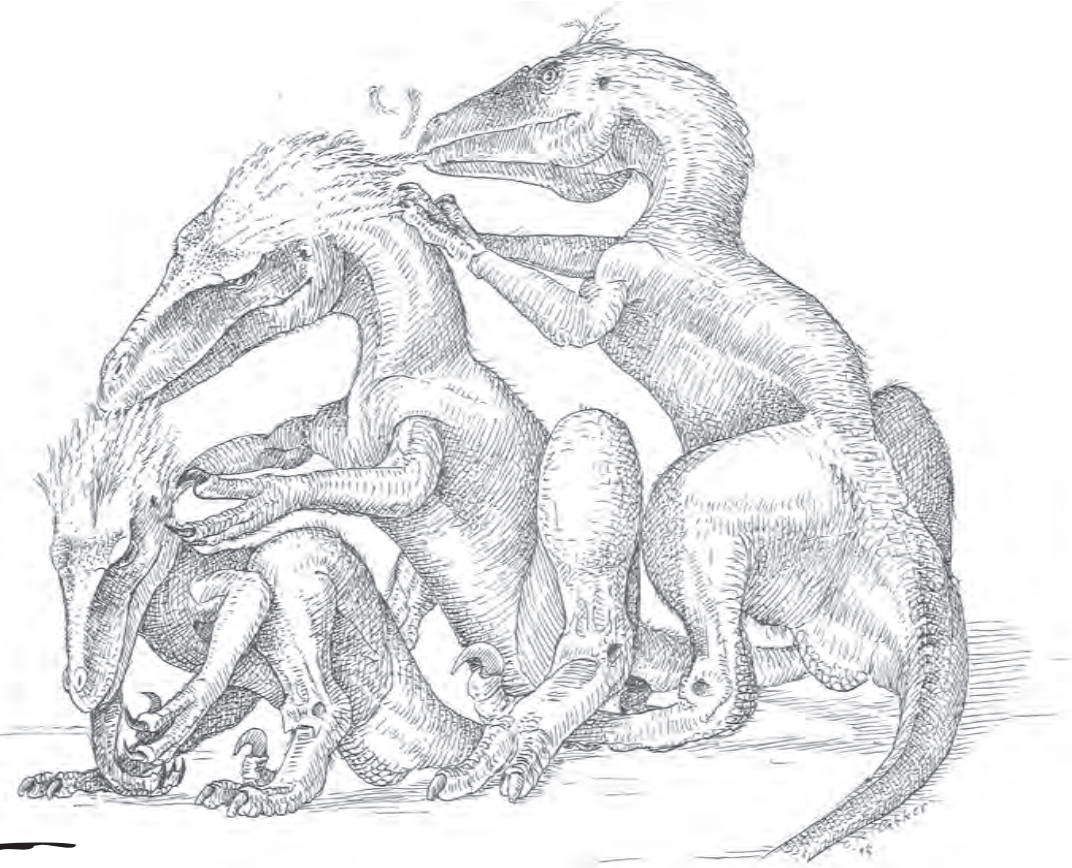
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**The venerable Bob Bakker drew this and other sketches while visiting BHI. This one depicts a Utahraptor clan grooming — “nibbling away parasitic bugs,” he says.**

Illustration © 1998  
Dr. Robert Bakker;  
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David Temple,  
Houston Museum of Natural Science.



~ *Robert T. Bakker, PhD*  
*Curator of Paleontology*  
*Houston Museum of Natural Science*

joy

is an essential element to true scholarship — and joy is what I saw the first time I visited Black Hills Institute more than 30 years ago. It was so delightful. I saw instantly that these people truly loved fossils — and not just dinosaurs, but also trilobites, and squashed fish, and even an octopus from Lebanon. I recognized educated fingerprints — the marks of scholarly and nimble-fingered people who clean bones under the microscope, scrutinize the tooth grins of jaws, or analyze minutely the zig-zag geometry of a coiled ammonite.

For me, BHI was a game changer. In one organization, we had frontline expertise in extracting fossils from the ground — and then graceful mounting of skeletons. And as a group of scholars, we could answer key technical inquiries, talk about the Darwinian architecture of skull and limbs, and analyze vertebrae, or even the skin of long-extinct critters.

I see BHI in the same tradition of Charles Hazelius Sternberg, who for more than 50 years (1876 – 1928) filled museums with magnificent skeletons. Thanks to him, and then his three sons, public museums, large and small, could present to visitors and students the riches of Deep Time. There was something spiritual about the Sternbergs. They dug fossils as holy relics that needed to speak, whether to 3rd- and 4th-grade kids or the PhD scholar.

It’s automatic. My hat goes off when people talk about Sternberg, who was mostly, maybe entirely independent of salary from museums, and held in great respect by museums and universities. When people mention BHI, I take my hat off, too. It’s a saintly place, and has filled research drawers and exhibits with superb specimens.

The spirit of Sternberg lives on in the halls of the BHI. Scores of museums display their installations; no other fossil lab has such reach. I hope you enjoy this celebration, this retrospective of the first 50 years of their work, their study, and their joy. I can’t wait to see what they do next.



# KNOWING YOUR PLACE

Statistics indicate that U.S. workers stay at a job for an average of about 4 years. And younger workers routinely change jobs even more frequently, as often as every 2.8 years.

*50 years is way more than that.*

by KRISTIN DONNAN

Statistics also show that some of the main reasons a person stays at a particular job are competitive compensation, benefits, and growth opportunities. In recent years, a thing called “work-life balance” has become particularly popular.

“Really? In some years, we didn’t even *have* compensation,” Pete Larson exclaims, “and my job has basically never changed.

I find something cool and turn them into objects that people can study or enjoy.” As the charismatic leader of Black Hills Institute of Geological Research (BHI)—a company that opened its doors initially as Black Hills Minerals, 50 years ago this January—“work-life balance” means “life is in balance when you get to work on dinosaurs.”



1980s BHI staff (at left, Pete Larson; on ladders, Neal Larson and Leon Theisen; at right, Bob Farrar) with associates and an *Edmontosaurus annectens* skeleton. BHI file photo

**“IT’S LIKE FICTION,”** Business Manager Adam Weaver says. “This company is like a dream, sort of an impossible reality that seems to have stayed alive because Pete kept saying ‘yes’ to things. He has a history of saying ‘yes’—to digging his first dinosaur, to exploring other countries, to meeting impossible deadlines—and the Institute keeps going and going and going.”

BHI is the largest private fossil company in the world. Pete and his teammate of more than 45 years, Bob Farrar, chose Hill City as their base of operation. “It’s *T. rex* country!” Pete says.

When they moved in, they brought along a Miocene elephant. Since then, they’ve worked on ten-plus *Tyrannosaurus rex* skeletons, scores of duckbills, a dozen *Triceratops*, and tens of thousands of other creatures great and small. Turtles, extinct nautilus-like ammonites, fishes, saber-toothed cats, horses, mosasaurs, birds, and creatures that look like the imaginary Loch Ness Monster.



BELOW: Storage area adjacent to collections area—as the group unpacks from a show. BHI file photo  
 AT RIGHT: Young Sharon Weaver with a *Brachiosaurus* femur at BHI's volunteer dig, early 2000s.  
 Photo provided by Dr. Weaver



**PROFESSIONAL PALEONTOLOGISTS AT THIS LEVEL**

are serious scientists who collect the record that's been preserved with the fossils in the ground. They know the direction of ancient river flows, how a creature died, the age of the sediments—and sometimes even the age, gender, and ailments of the deceased. However, all of that might not become clear until hours, weeks, or months of “preparation”—work with hand tools, brushes, and bicarbonate of soda blasters.

Some of the fossils dug by BHI crews become centerpieces in the world's most prestigious museums. And some take their place along rows and rows of shelves—in an Indiana Jones-like vault of dusty, favorite bits of history awaiting their turns. In the process of “work as usual,” the crew has discovered new species, written scientific journal articles and books, appeared in educational programs and feature documentaries, assisted government agencies in evaluating collecting practices, revolutionized how fossils are prepared and mounted, and managed volunteer dig sites—all to share their joy of adventure.

As a result, locals and visitors to the neighborhood have learned a lot about paleontology. Long-timers have also learned about

the law, because Pete and his crew have long been the subjects of international news stories—mostly thanks Pete's biggest “yes,” SUE the *T. rex*. (For more on Sue and BHI's other famous fossils, see page 32.)

**SAM FARRAR IS PART OF THE NEXT GENERATION.**

He grew up working with his dad, Bob—not realizing how unusual his dad's skill set was. When Sam was only “about eleven or twelve,” he was good enough to help with the preparation on STAN, the company's second-most-famous skeleton. Since then, Sam has only had one job. Officially, he's worked at his dad's company—now his company too—for 25 years.

Unlike Pete, Sam is not a “yes” man. He's one of a dedicated staff who balances Pete's enthusiasm with...practicality.

“Opportunities come our way—maybe something exciting, something we've never seen before. A museum wants a new display, or there's a potentially great fossil in the ground,” Sam says. “Pete says yes, and suddenly we've got a commitment. He works with a team of fixers—people who figure out how to make his dreams happen. For the

last couple of decades, I've been one of those fixers. I help ensure that these wild ventures are profitable.”

He's right. No matter how magical Pete's favorite fossils are, BHI is a private business, and one of the community's largest employers. Beyond identifying a great specimen, safely and properly collecting it, and bringing it back to life (more on transforming fossils starting on page 44)—the company also has to stay alive. Being independent is a challenge. There are no federal grants, no holidays on the beach, no private jets—and none of the growth opportunities offered by the dot-com sector. However, what staffers do get is a seat in the dirt.

**“THE INSTITUTE IS ITS OWN CATALYST,”** says Sharon Weaver, co-manager with Sam of the company's production facility—called, aptly, Rex Hall. She's also a perfect example of how fossils are contagious. “Like many kids, I became obsessed with paleontology when I was about three,” she recalls. “My parents assumed I would eventually grow out of it—but I haven't.” Sharon fell in love with the Mammoth Site in Hot Springs during a family holiday; by high school, she was splitting her summers between those mammoths and the long-necked Jurassic dinosaurs at BHI's volunteer dig in Wyoming. Nurtured by scientists at both locations, Sharon finished her doctorate in paleontology. Today, she's working with BHI's team on a museum display created from three of the very Wyoming dinosaurs she dug several years ago.

To succeed in this industry requires knowledge, talent, and true grit. In the half-century since Pete started the first iteration of this fossil and mineral company, he has rolled through waves of lean years, miles of controversy, and pristine moments of pure satisfaction. All the while, he and his “fixers” have been devoted to a single mission—to help fellow humans fall in love with science.

“That's the easy part,” Pete says. “All you need is dinosaurs!”

And vision. A vision clear enough to withstand the forces of erosion, economics, prairie winds, politics, human dynamics, and fate.

“Pete's...what's the word...eccentricity?” Sam wonders. “Whatever it is, that's why Black Hills Institute is Black Hills Institute. What Pete imagines keeps the company interesting and alive—and what we do in the lab keeps it viable.”

Whatever you call it, it's working.





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# ONCE UPON A TIME



Pete Larson with brothers John and Neal in the White River Formation, 1970s. Photo courtesy of Kirby Siber

Pete Larson grew up in a family of rockhounds—and as a child was ushered into his future profession by many mentors, starting with June Zeitner, undeniably one of the most titled and respected gem and mineral aficionados of the 20th century. Pete also received lessons in the profession from Bill and Jean Roberts, by then retired from the job of providing mineral specimens to museums and universities; later, several scientists from renowned institutions also would take Pete and his coworkers under their wings.

## **THIS BUSINESS IS NOT FOR THE FAINT OF HEART.**

It requires mentorship and commitment, and there's that not-so-small matter of getting the science right. But stepping into the marketplace is no small task. Paleontology is an esoteric, ever-changing environment—because no two specimens are alike. There is no assembly-line quality control, where thousands of identical products can be sold for the same price. Therefore, it took decades of exposure to thousands of fossils—all sizes and shapes and species, all levels of completeness, all levels of scientific and aesthetic value—for Pete to become one of the world's go-to experts in identification and valuation.

That knowledge—combined with extraordinary field skills, scientific acumen, and creative problem solving when designing skeleton poses and exhibits—allowed the company to make a name for itself. BHI became “the place museums go to shop.”

Everyone who worked here came prepackaged with curiosity, good eye-hand coordination, and a love for the past; Pete and his leadership team also exhibited a streak of independence. They had to be willing to try new things, literally go where no one

had gone before, and then step into the sales tent.

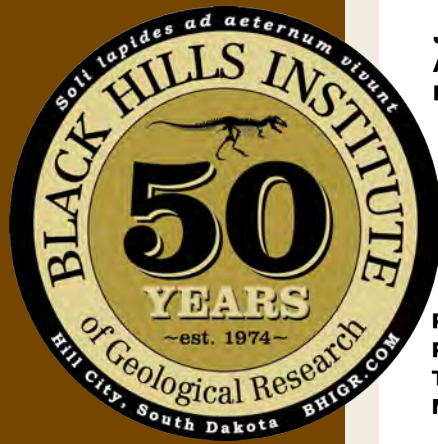
After 50 years in business, it's still surprising how excited these paleontologists get over a great fossil. They get even more excited when an exquisite specimen will be seen every year by thousands and even millions of people—although transitioning it out of hundreds of plaster jackets might take more than a year.

The process of gaining the broad skill set required to produce the highest-caliber museum displays happened thanks to endless hours in the field, lab, and library. It happened thanks to collaborations, trial and error, and being at the right place at the right time. It happened because a handful of independent scientists decided to forge their own path, and a team of talented people helped them along. It also happened because people love dinosaurs, and they go to museums to see them.

Since outlining a comprehensive history of any 50-year-old business would be impossible in a few pages (a timeline will have to suffice, page 16), we decided to highlight a few key moments in BHI's origin story. We'll begin with Pete's first-hand account of his inaugural, eye-opening exposure to the world of commercial geology and paleontology (page 18), bolstered by a few photo time capsules from those first rocky years.

It must be said that this group has experienced more ups and downs than the average company. No history of their legendary story is complete without a quick glimpse into their participation in the New Age of professional fossil collecting (page 26), plus the controversy that first put Black Hills Institute in international headlines (page 32). However, in typical BHI fashion—or, at least, in typical Pete optimism—any historical ebb or loss is energetically translated into a new beginning.





**January 1974 – Adopting of “Black Hills Minerals” (BHM) in Rapid City, SD**



**February 1974 – First sales trip to the Tucson Gem and Mineral Show**

## 1950

Summer 1956 – Peter Larson finds his first fossil

## 1960

Summer 1960 – Peter Larson and siblings open their first museum

Summer 1967 – Peter Larson collects a cycad specimen, published in the *Lapidary Journal*

1968 – Robert Farrar begins collecting fossils and minerals in Ohio

## 1970

February 1973 – First trip to see the Tucson Gem and Mineral Show

## 1974

**1975 –** Robert Farrar begins contributing to BHM

**1976 –** Excavation of mastodon skeleton, now on display at SD School of Mines

**1977 –** Founding of the Association of Applied Paleontological Suppliers, later renamed Association of Applied Paleontological Sciences

Robert Farrar and Neal Larson officially join BHM

**February 1977 –** Sale of *Archelon* skeleton to Siber & Siber, later sold to Vienna Museum of Natural History

**March 15, 1978 –** BHM incorporates as “Black Hills Institute of Geological Research, Inc.” (BHI) and moves to Hill City, SD



**September 1979 –** BHI and Siber & Siber begin excavations at the Ruth Mason Dinosaur Quarry

**1980 –** Robert Farrar becomes an owner of BHI

**July 1981 –** BHI offers first *Edmontosaurus annectens* skeleton for sale at Siber & Siber’s Sondershau

**1983 –** A second *Edmontosaurus* from the Ruth Mason Quarry is the first dinosaur sold by BHI, purchased by the Natural History Museum in Cardiff, Wales

The *Acrocantnosaurus* skeleton later called FRAN is found in Oklahoma

## 1984

**1984 –** BHI’s building expands for the first time

**1985 –** BHI and Siber & Siber begin a 6-year excavation in Peru discovering a new Family of “walrus-whales”

**1990 –** Large group of fossils from BHI goes on display at the Smithsonian Institution

**August 12, 1990 –** BHI volunteer Susan Hendrickson discovers SUE the *T. rex*

**September 1, 1990 –** SUE excavation is completed

**April 14, 1992 –** BHI begins excavation of the *T. rex* STAN, named after its discoverer Stan Sacrison

**May 14, 1992 –** Federal government raids BHI and seizes SUE

**June 1992 –** BHI sues the federal government for the return of SUE

**June 1992 –** BHI opens the Black Hills Museum of Natural History, admission free to the public

**July 12, 1993 –** BHI’s 3rd *T. rex* skeleton, DUFFY, is discovered by Stan Sacrison

**November 1993 –** Federal government brings 39-count 153-charge indictment against BHI, its owners, and others

## 1994

**January – February 1995 –** BHI owners and others undergo the longest criminal trial in SD history

**March 15, 1995 –** Jury delivers verdicts acquitting all defendants on most counts. Peter Larson, however, has two felony convictions for customs paperwork violations

**July 1995 –** Mounting of STAN is completed and debuts at Sunshine City, Japan for *Tyrannosaurus rex* exposition

**August 14, 1995 –** BHI excavates 4th *T. rex*, STEVEN, discovered by Stan Sacrison

**February 22, 1996 –** Peter Larson reports to Florence Colorado Federal Prison to serve a 24-month prison sentence followed by 24-month probation

**August 12, 1996 –** BHI excavates 5th *T. rex*, FOXY LADY, discovered by Lloyd Fox

**Fall 1996 –** BHI loses their final appeal for custody of SUE

**1997 –** *Acrocantnosaurus* FRAN is purchased by North Carolina Museum of Natural Sciences, BHI prepares fossil for display

**September 1997 –** Peter Larson is released to home confinement and later probation

**October 14, 1997 –** SUE auctioned at Sotheby’s in NYC and is purchased for the Field Museum for \$8,360,000

**April 1998 –** BHI excavates KELSEY the *Triceratops*, discovered by Arlene and Leonard Zerbst

**1999 –** The BHI museum building expands adding



**July 1999 –** BHI begins excavation at the Jurassic-age Waugh Quarry, owned by Leslie and Elaine Waugh

**November 1999 –** Peter Larson completes his probation

**April 7, 2000 –** FRAN goes on display in North Carolina

**May 17, 2000 –** SUE is exhibited at the Field Museum

**2000 –** BHI excavates 6th *T. rex*, E.D. COPE, discovered by Bucky Derflinger

**2001 –** BHI excavates 7th *T. rex*, BUCKY, discovered by Bucky Derflinger

**2002 –** BHI begins excavation of LANE the *Triceratops*, preserved with extensive skin

**May 2004 –** BHI excavates 8th *T. rex*, WYREX, discovered by Dan Wells and Don Wyrick. Excavation went “live” on “Unearthing *T. rex*” website – a first for paleontology

**June 11, 2004 –** BUCKY and KELSEY premier with *Maiasaura* and *Gorgosaurus* skeletons prepared by BHI at the Children’s Museum of Indianapolis

## 2004

**June 10-11, 2005 –** BHI hosts “100 Years of *Tyrannosaurus rex*: A Symposium”

**2008 –** Rex Hall, BHI’s production facility, expands

**2012 –** Neal Larson leaves BHI

**May 2012 –** Houston Museum of Natural Science opens new hall featuring WYREX, LANE, two *Edmontosaurus annectens*, and many cast skeletons produced by BHI

**May 27, 2013 –** BHI excavates 9th *T. rex*, TRIX, discovered by Blaine Lundstad

**Fall 2013 –** TRIX and other specimens become the center of a lawsuit (Murray v. Seversons) to determine whether fossils are part of the surface estate or mineral estate

## 2014

**2015 –** Neal Larson files a lawsuit against BHI and demands liquidation of BHI’s assets

**September 10, 2016 –** TRIX goes on exhibit at the Naturalis Biodiversity Center in Leiden, Netherlands

**2019 –** Neal Larson’s lawsuit is resolved with STAN’s bones going to Neal

**October 6, 2020 –** STAN’s skeleton sold for \$31.8 million at Christie’s in NYC

**May 22, 2020 –** Murray v. Seversons lawsuit resolved – fossils are declared surface estate and not mineral estate

## 2024

**2024 –** BHI staff celebrates 50 years in business!

**January 2024 –** EverythingPrehistoric.com goes live



**2027 –** The Black Hills Museum of Natural Science at Black Hills Institute is projected to open an expanded exhibit space



**June 2023 –** BHI directs the excavation of a *T. rex* discovered in WY

BHI launches updated website. BHIGR.com

**December 6, 2023 –** BHI purchases property for museum expansion

# Timeline



# The first big “YES,” and the Next One. and the Next.



by PETE LARSON

**PEOPLE WHO LOVE ROCKS REALLY LOVE ROCKS.** They talk about them, collect them, share them, study them, and display them. Rockhounds all over the world seek out shows so they can meet up with other rockhounds—and they stroll past rows and rows of tents or displays in convention centers. There, rocks and gemstones are admired, coveted, and bought for homes, offices, university courses, or, of course, museums.

Historically, fossils were first thought of as “curiosities,” collected by these same enthusiastic sorts of people, who came upon them while rock hunting. Fossils were bought, sold, and bartered long before they were ever studied by scientists. Today we know that fossils are not rocks per se—they almost always contain original organic and inorganic material that was part of the animal’s original skeleton and body. Their cell spaces might be filled with various minerals—especially calcite, quartz, or pyrite—so they can feel like rocks, even when the bone material is still there. But whatever their mineral content, fossils have been shown, sold, and purchased at shows, large and small, all over the world. I went to my first one while in grade school. It was a local rockhound

show with several tables covered with agates and other treasures. My first experience with an international show came when I was a student at the South Dakota School of Mines and Technology. It was February 1973.

**THE TUCSON GEM AND MINERAL SHOW** is the largest of these events in the world. Today it lasts about three weeks, and hundreds of thousands of people stroll through thousands of different vendor booths, spread across more than 50 locations. In 1973, the show was limited to only a few motels, like the Desert Inn (demolished a few years later) and the Holiday Inn (now Howard Johnson), both on what is now I-10.

Four of us geology students crammed into a Volkswagen Beetle, together with our luggage and sleeping bags—so we could sleep out in the desert and avoid hotel bills. On one hand, we were curious to see this event; on the other hand, one of my compatriots was soon to be my business partner, James (Jim) Honert, and we wanted to see what this world was all about. Mike Buswell and Dennis Murrell also piled in. We hoped we could get the lay of the land in two days.

All of us were fascinated by how cool it was that these motel rooms were filled





Photo © Layne Kennedy

by small-business owners—they had turned their sleeping rooms into temporary shops. These businesses came from around the world. In these rooms, you could buy plenty of mineral specimens and rocks, but at the time, only a few people were selling fossils. They were selling fossil fish, trilobites (arthropods, in the same group as centipedes and lobsters), and maybe a few poorly prepared fossil mammals, turtles, and ammonites.

We were kind of blown away, because we saw what was possible, and that Tucson experience became a huge part of the inspiration for starting our own business! So that entire year, while taking classes and working part-time jobs, Jim and I spent all of our free time collecting fossil and mineral specimens. We formed a company in January 1974, which we called Black Hills Minerals—a name handed down to us from a retired business owned by two of our mentors, Bill and Jean Roberts. (It wasn't until we incorporated in 1978 that we would change our company's name to Black Hills Institute of Geological Research, Inc.)

The next month, February 1974, Jim and I headed south, skipping a week's worth of class, and checked into our room at the Desert Inn. We quickly set up two tables, unpacked flats and boxes of mineral and fossil specimens, and designed our first public displays.

At night, we still had to use sleeping bags on the floor—because the bed was covered with skulls, turtles, ammonites, and minerals. Our prize specimen was an iridescent ammonite, *Placenticerias meeki*, from the Pierre Shale of South Dakota, which we had discovered on one of our collecting trips. The next morning, we tucked away our sleeping bags and looked around. We almost couldn't believe

# I was hooked on the POTENTIAL and the UNPREDICTABILITY of a business I knew would be my FUTURE.

it, but we were here—trying our hand at the business of selling.

We were at the Tucson Gem and Mineral Show.

The *Placenticerias* looked great, and it was certainly the most spectacular fossil we had brought to the show. In our minds, though, it wasn't for sale. Even at this early date, the idea of eventually opening our own museum was firmly implanted in our minds—and we had brought this specimen with us as an “advertisement,” fully intending to take it back home. We thought it was a good example of our work, and hoped it would entice people into our room. It was so beautiful, unbroken, and required no restoration. It was in such great condition, it was all real; there were no puttied or repaired areas. To prevent its sale, we put what we thought was a ridiculous price tag—\$750.00. We were certain that no one would pay such a high price.

Within fifteen minutes of throwing open our door, a French dealer named Ali Abdalah walked into our room—lured, as we had hoped, by the *Placenticerias*. He asked, “How much?”

“Seven hundred and fifty dollars,” Jim replied.

“Wait a minute,” Ali said, and he left the room. A few minutes later he was indeed back. In his hand were three brand new one-hundred-dollar bills.

“This is all I have, but it's a fair price.”

“Maybe so,” Jim said, “but the price is still seven-fifty.”

“Impossible!” This time, Ali stormed out of the room.

“I'll take it,” said a voice from the back of our room.

“Really?” I was flabbergasted.

“Yes,” said the man. “It's really beautiful.”

Just then Ali returned. “I found one more hundred-dollar bill.”

“I'm sorry,” said the other man, “I just bought it.”

It was clear that Ali was exceedingly disappointed. (Eventually, he would become a wonderful client—who fed me tripe for the first time. But that would be many years later, when I saw him in France.)

Jim and I already had discussed how we would handle the unlikely situation of someone's offering us our asking price. We had agreed that we could let the ammonite go at our astronomical number. After all, we hoped to find many more of these ammonites. So we were happy when Jim asked, “Would you like us to wrap it up for you?” We had made our first big sale.

Our customer was Bob Harris, owner of a company called The Bug House. His room was just two doors down, and he sold trilobites—extinct arthropods that look like three-lobed beetles. “Don't

move it now,” he said. “Go ahead and mark it sold, but use it to draw folks into your room.”

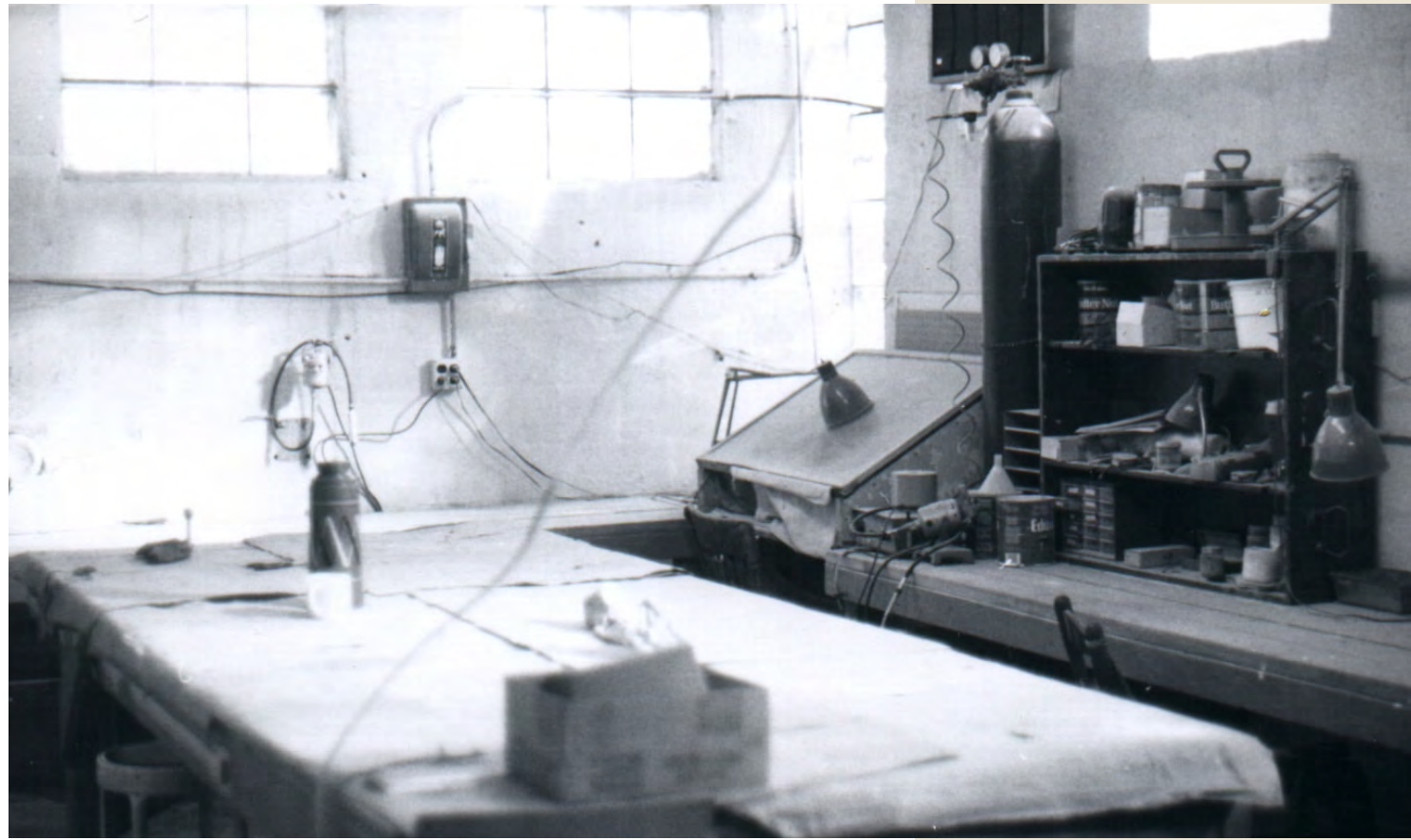
The very next day, a nice gentleman came in, introduced himself as Ed Swoboda, and started looking closely at the *Placenticerias*. He was very curious about it and asked a lot of questions. We told him all about how it was found, why we liked it so much, and why we felt it was special. We also explained that we never actually expected to sell it. A few minutes after he left, Bob Harris came in and thanked us for spending time with Ed. “Oh, by the way,” he said, “I just sold Ed your ammonite for \$2500.00!”

While some people who hear this story reflect on our naivete, or a “lost opportunity,” I was instantly energized. All at once, I learned a huge lesson about business, confirmation of Jim's and my correct analysis of quality, and an even larger appreciation for fossils.

I was hooked on the Tucson Show, and I was hooked on the potential—and the unpredictability—of a business I knew would be my future.

Over the years, we would occasionally run into Ed—who turned out to be a famous mineral collector. We could never guess whether he might fall in love with something we'd brought to sell. For me, that mystery just added to the excitement.





# There's no place like home

A year before our 1973 Tucson camping trip, we moved into the winter alligator pit at the old Reptile Gardens location in Rapid City. Thankfully, the alligators had already been rehoused at the new (now current) Reptile Gardens facility on Highway 16—so we set up camp, and the Black Hills Minerals workshop, on Skyline Drive. The location made it easy for me to dig graves at the nearby Pine Lawn Memorial Park, one of my side jobs.

We worked on our mineral collection there, and stored specimens for upcoming Tucson trips. After the 1974 selling season, and a summer of collecting, we'd actually had a run of bad luck. Maybe you could say it was the first time we put our faith in someone who let us down—in this case, a colleague ran off with a portion of our summer's collection. It was then that we met one person who would change our lives—and we would change his.

Today, Kirby Siber is a Swiss

paleontologist, commercial collector and dealer, and museum owner. Fifty years ago, he was a curious, intrepid character who by then had been in the business of rocks and fossils for about ten years. He'd heard that the Black Hills were perfectly located—fossil-rich strata were laid out in several states, in all four directions. To get oriented, Kirby wandered into the School of Mines' Museum of Geology, where he asked a whole lot of questions. There, he met none other than museum director Bill Roberts—the man who had handed down to us the name Black Hills Minerals for our business. Bill called me, we hurried down to the museum, and a lifelong friendship was born.

Kirby helped me learn about our industry, and I helped him learn how to dig fossils. Every year that we celebrate a company anniversary, he's exactly ten years ahead of us. This year, 2024, is his 60th!

“  
**What seemed like an inauspicious start led to a close friendship that continues today with the Reptile Gardens family.**  
*~ Joe Maierhauser, CEO*

PAGE 18: Early in BHI's life, the team heads back to the Tucson Show. From left, Neal Larson, Bob Farrar, John Larson, and Leon Theisen, with an associate. *BHI file photo*

PAGE 20: Another ammonite that the guys didn't want to sell; this *Sphenodiscus* remains in the collection. *Photo © Layne Kennedy*

PAGE 22: Clockwise from left: An early workshop from the Reptile Gardens location; BHI's Hill City home, in the 1980s; the Ruth Mason quarry, 1980s; the team working on a display of duckbill bones. *BHI file photos*

# Dinosaurs all around



Our first collaboration with Kirby led to a decade-long relationship with Ruth Mason, a rancher near Faith, South Dakota. Since childhood, she had spotted hundreds of exposed bones on her family's land. For years, she'd invited academic institutions to visit, hoping they could identify the dark brown specimens—but the property was too remote. She watched the bones weather away with the passing seasons. We met her when she was in her late 70s—and Kirby had a museum buyer who was looking for a dinosaur.

The Ruth Mason quarry was a duckbill dinosaur bonebed, a hodge-podge of thousands of skeletons that were disarticulated (bones that are not in their relative positions; jumbled). *Edmontosaurus annectens* are a common fossil in the Hell Creek Formation. They were plentiful, plant-eating creatures who traveled in large herds, forming a primary food group for *T. rex*. Kirby's potential buyer inspired our young company to translate our skills to big Cretaceous fauna. Although that particular sale never

came to fruition, as the museum wasn't able to raise the necessary funds, the Ruth Mason quarry would become our lifeblood for several years. We placed duckbill skeletons in museums in Wales, Ireland, The Netherlands, Japan, and the United States, and the quarry itself became a booming volunteer training center. It's fair to say that we cut our dinosaur-digging teeth there.

In 1978, Black Hills Minerals officially incorporated as Black Hills Institute of Geological Research, and we soon moved to our current location on Main Street in Hill City. Our crew traveled to Faith from 1979 through 1991, where quarry diggers dodged floods, poisonous snakes, lightning strikes, fallen trees, fires, baseball-sized hailstones, injuries—and short tempers from being “out there” too long. Bob Farrar achieved “veteran quarrier” status in 1980 after one 62-day stint. In the process, he and the rest of the crew also marveled at meteor showers and displays of northern lights.

**Quarry diggers dodged floods, poisonous snakes, lightning strikes, fallen trees, fires, baseball-sized hailstones, injuries—and short tempers from being “out there” too long.**





# Beached whales

One day in 1985, Kirby called and said, “How would you like to come to Peru to help me come collect fossil whales?” I stopped listening after the word “Peru.” Then I said yes!

Although Kirby was living there to make the acquaintance of as many of Peru’s fantastic minerals as possible, he also had met a human who broadened his horizons. The Atacama Desert is one of the driest places on earth, but Carlos Martin’s family grew olives in an oasis—where water flowed underground from the mountains, and then bubbled up to the surface. Although olives were his family’s main income, Carlos couldn’t help but notice the whales.

These were enormous fossils, which would become exposed during sandstorms; once vulnerable to the elements, they could erode in days. Carlos had reburied an excellent specimen, and he would brush off the sand for visitors. Once Kirby saw Carlos’s whale, Kirby got a permit from

the Museum of Natural History in Lima, so he could collect whale fossils. I went to help Kirby’s crew excavate one—and by 1987, we acquired our own permit. Together, Kirby’s company and BHI collected nine large baleen whales and several smaller ones, the first known walrus-whale, dwarf sperm whales, an ancestral killer whale, dolphin skulls, the largest tooth to date from the giant shark called *Otodus megalodon*, plus dinosaur egg fragments, Cretaceous mammal teeth, and the two best marine sloths from South America.

We also worked in a cool Devonian trilobite locality, in a eucalyptus grove at 13,000 feet elevation, near Lake Titicaca. And I was lucky enough to discover a LaBrea Tar Pit-style locality. As in the Ruth Mason Quarry, tar pit specimens are jumbled together; in this case, the predominant species was *Smilodon*, a saber-toothed cat. It’s highly unusual to find even two bones connected, but our

group discovered the only associated and partially articulated *Smilodon fatalis* skeleton ever collected. Which means that one skeleton was preserved, mostly intact, with many of its parts articulated, or positioned together as they were in life.

This trip, and trips we took to Peru in following years, were like an adventurous, unbelievable dream. To me, they connected us, and our duckbills and *T. rex*, to fossils all around the world.

Kirby and our company built a small, local museum to thank our Peruvian friends for sharing their knowledge—but my proudest Peruvian moment came years later. My daughter Sarah named one of my granddaughters after a whale—which, it’s no surprise, was first named after one of Kirby’s daughters.

Pete Larson, Susan Hendrickson, and Kirby Siber, excavating a whale. Kirby named Josephina. Photo provided by Kirby Siber





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Congratulations to The Black Hills Institute of Geological Research on 50 years of fossil preservation and preparation for museums, researchers and private collectors.





# MAKING waves

by ALEX RUGER & KRISTIN DONNAN

**ONE ERA OF PALEO HISTORY**, which is recounted in books, articles, and over coffee to this day, is known as the Bone Wars. In hindsight, they probably could have been predicted as a natural evolutionary outcome—something that happens when one person does something that other people wish they had done. Pete (with coauthor Kristin Donnan, who contributed to this volume), wrote in their 2002 book *Rex Appeal*:

*The world's first love affair with these real-life monsters—let's call it the Dinosaur Nascence—flourished from the last half of the 1800s to the first quarter of the 1900s. Barnum Brown's T. rexes were found then, adding to specimens of other famous dinosaurs, including the favorite Triceratops with its enormous three-horned skull and long-necked sauropods with tree-trunk legs.*

These fossils were hauled by the trainload to museums, particularly on North America's east coast, and the scientists who were writing about these discoveries began to compete. They spied on each other's dig sites, stole bones, and even buried fake assemblages of something “new,” a “missing link” of science, so that the other would steal it and take off on the wrong track.

These competitions focused on academic recognition and funding. Their arguments were ego-driven, with the goal of achieving professional stature. For this stature to be granted, the scientist with the most toys would win—and so they relied on professional collectors to find and collect fossils for them. These field experts became their trusted counterparts and colleagues, reliably collecting the great bulk of the material that eventually appeared in museums. Their role in the foundation of paleontology as we know it today is undisputed.

Decades later, Black Hills Institute, along with some other excellent commercial companies, assumed the mantle of the professionals who came before them. Except this new breed worked under their own auspices, and augmented their field skills with a more deliberate scientific approach. They mapped sites, recorded contextual site information, and began conducting research into their favorite topics. In the process, they created hybrid companies that funded their work—business and scientific—through fossil sales. Because of their frequent trips into the field, they also tended to develop excellent relationships with ranchers, thus gaining access to some of the best fossil specimens in the world.

When someone is preparing a totally cool *T. rex*, they usually talk about it. These hybrid, independent companies shared their stories in the news, and some even invited academics to collaborate on important scientific research. BHI was one of those. They talked about extinct scavengers and predators, gender, social behavior, and cannibalism. They welcomed the public into their preparation labs to see fossils in process. Go ahead, they suggested, sign the guest book. If selfies had existed then, they would have supported them.

This openness was new, and it was one of the reasons that dinosaurs enjoyed a cultural renaissance; big, amazing dinosaurs—especially *T. rex*—were making headlines.

To be fair, *Jurassic Park* didn't hurt, either.

Meanwhile, however, there was another Bone War brewing. BHI was gaining traction as a company, but also it was the poster child for commercialism. BHI's relationships with landowners had changed the game—because these professionals had started paying landowners for bones. Just as ranchers sold gravel and oil, they learned to consider their fossil resources as commodities—and suddenly, the marketplace became a player.

Some academics therefore felt boxed out of the new paradigm, priced out of the scientific market—unable to compete for a resource that used to be free. Of course, many of these same scientists had free reign to explore on federal lands.



Long before I met the Black Hills crew in person, some of my older friends called them “Latter Day Sternbergs.” The Sternberg family of Kansas are three generations of independent fossil hunters who were held to be saints by my professors at Yale in the 1960s. The Sternbergs eschewed the cap-

and-gown trappings of university training and instead learned to find and dig dinosaurs the only way it can be done—by going out to the badlands and doing it. For ninety years, beginning in the 1870s, the Sternbergs extricated lovely skeletons that filled the exhibit halls and research labs of museums all over the world. Their reward: paltry fees, but immense and vocal thanks from scientists and museum visitors.

The Black Hills crew followed the hallowed Sternberg path, supporting their researches by sale of specimens—the most important bones going to public museums. Pete and his coworkers proved to have unusual scientific generosity, always ready to contribute their hard-won specimens to joint projects, and my old professors at Yale and senior scientists at the Smithsonian worked closely with institute people. But there was another element in the community of fossil scholars, a generation of PhDs who had a caste mentality, a belief that only university scholars were entitled to dig precious fossils. I heard rumors and gossip long before I actually met the Black Hills folks, innuendos that they were “poachers and market-hunters.” I went out of my way to check the stories out, sitting in on some of the court sessions about Sue. What I saw and heard was shocking and depressing. Professors I knew well made sworn statements that were totally untrue. And yet this campaign of slander was carried out under the pious banner of “Save Our Fossils From Rustlers.”

Those terrible days are over now, thank God. But Pete did go through an ordeal that should have driven him and the institute out of the *T. rex* business. He should have dumped his childhood dreams of a *T. rex* museum and gone into a more mainstream vocation. I'm very glad he didn't.

Robert T. Bakker, PhD, in 2002



# The first professional collectors

Buying and selling fossils was a part of paleontology before paleontology was a thing. Fossil fish were sold and bartered in ancient Lebanon more than 1,000 years ago (they still are), and First Nations peoples across the globe traded small fossils for their medicine bags. When modern scientific practice emerged in the 1800s, fossils were sold to researchers, as well as to collectors who simply valued their aesthetic qualities or rarity.

Mary Anning was both one of the first paleontologists and one of the first documented sellers of fossil specimens to museums across Europe. Then, the Sternberg family made collecting into a booming business, providing North American fossils for Yale University, the American Museum of Natural History, the Royal Ontario Museum, and many other large museums. Today, a large percentage of fossils in the world's museums are still collected, prepared, and mounted by independents.

Often, there is no mention in interpretive materials of amateur or commercial paleontologists' discoveries and contributions. They are too often written out of history.



PAGE 26: STAN and Pete in Rex Hall. BHI file photo

ABOVE: Public domain painting of Mary Anning pointing at an ammonite. Painting by B. J. Donne, c. 1847, based on a 1842 portrait. Image from Wikimedia Commons

OPPOSITE PAGE: Charles H. Sternberg preparing a *Chasmosaurus belli* skull. The photo appeared in Sternberg's 1917 book, *Hunting dinosaurs in the bad lands of the Red Deer River, Alberta, Canada*. Photo from Wikimedia Commons

OPPOSITE INSET: Portrait taken by H. Cleves on 17 February, 1922. Photo provided to Researchgate.net by the San Diego Natural History Museum library archives.

PAGE 30: Pete in the White River Formation. BHI drone photo

"It's a delicate debate," Bob Bakker recently texted. "Some colleagues (not most) say private land owners must give all important fossils to approved public museums or universities, and many countries have similar laws. But this seems very unfair—PhD curators get rewarded by grants and fellowships when the scholars announce the finds. Shouldn't land owners get fair compensation for digs on private land?"

## PUBLIC LAND DEBATE

Those who were against the idea of modern-day, professional fossil collectors were concerned that the increase in the public's fascination—and demand—for fossils would cause a "fossil rush." They made the argument that fossil-rich badlands and grasslands formations might be plundered by people who didn't care about science and were just after the money that these fossils could bring. Who would protect or control public assets? Should all fossils go to public museums? Should amateur collectors—today's rockhounds, who actually find most of the best specimens—be governed in the same way as professionals? What in the world should we do?

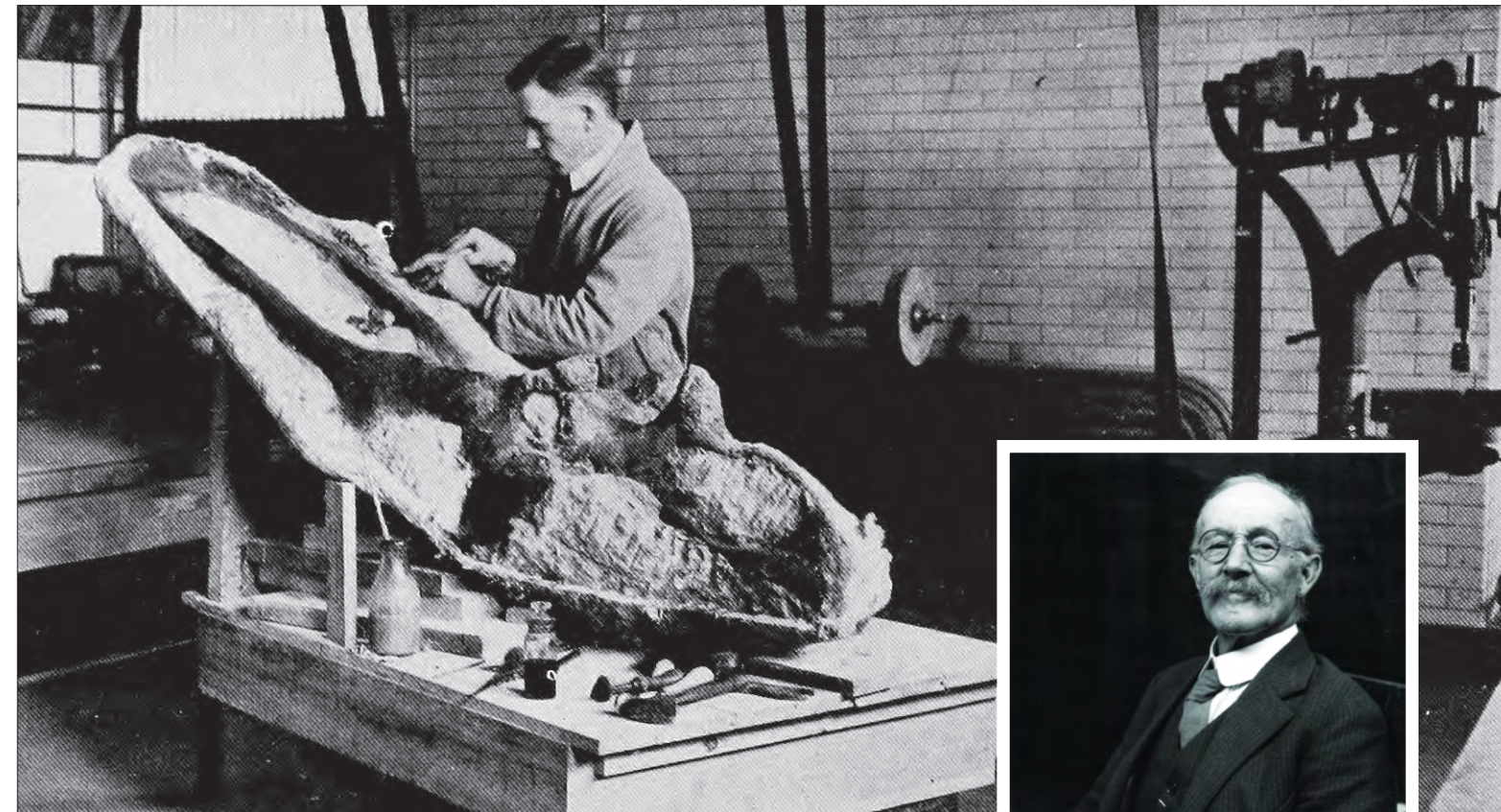
These and other valid questions were raised in a new debate, and during the 1980s and 1990s, Pete played a large role in finding answers. He was appointed to a National Academy of Sciences Committee on Paleontological Resources, convened by the US Senate, to consider how to regulate the collection of fossils on public lands. The committee also included representatives from the Corps of Engineers, the National Park Service, the Bureau of Indian Affairs, the Bureau of Land Management, and the US Forest Service.

The result of their collaboration was a comprehensive report that was unfortunately largely ignored—followed by competing legislative bills, continued disagreement, and further decades of rancor. For the Institute, it also resulted in lawsuits—because this company was seen as the ranking *Tyrannosaurus rex* factory.

When Bob Bakker wrote in 2002 that the "terrible times" were by then over, he was partly right. The most terrible of the times had passed, but BHI's position as the poster child of commercial paleontology would continue to take its toll. All these years later, we are still left with questions:

Who owns the past? Everybody? Nobody? A select few? Who should be allowed to collect and preserve it? What do we mean by a "trained" collector? Does it matter that fossils on public lands are destroyed by weather all year, every year, because there aren't enough collectors out there looking? Should a fossil belong to the state in which it was found? Should all important fossils be held in museums?

Private collections have formed the backbone of some of the greatest natural history museums in the world, and The Museum at Black Hills Institute—soon to be named the Black Hills Museum of Natural Science—is no different. This museum would not have been built without the worldwide community of dedicated commercial and amateur fossil hunters—and it abides by a very similar mission and code of ethics as public or nonprofit



museums. The idea is to preserve and maintain wonderful natural history specimens for the world to enjoy. Forever—or, as Pete says, "at least until the next zombie apocalypse." Or mass-extinction event.

Of course, some in the modern scientific community worry that money has ruined everything—that basically no commercial facility could ever act in the best interest of science. That no good can come from the private collection and sale of fossils. Legitimate commercial companies admit that every industry has its bad actors; stories circulate about thefts and illegal sales. And, of course, neutral parties—including academics who work with professional, commercial paleontologists—say that yes, there is an honest way to allow for good science and honest business, all at the same time. Let's also not forget: most museums rely upon entrance fees, and public museum curators and academic staff draw salaries often paid by tax monies.

Eventually, with the discovery, announcement, and international coverage of the largest and most complete *T. rex* ever found, SUE, BHI became the prime example for both sides of the argument. It was either the most inspirational professional company in the world, or a brazen rule-breaker (for more on SUE, see page 34).

While science and research are important, the story a fossil tells begins with its discovery. The same forces of erosion that expose these treasures, and their stories, also gradually destroy them. There are more fossils exposed right now than could possibly be collected by all fossil collectors, regardless of their affiliations, put together. So it's important that our questions are answered, that amateur and commercial fossil collectors are encouraged, and scientific inquiry is supported. In today's world, money is an inevitable part of that equation.

In the end, fossils are material, tangible objects—not just data. This means that, by virtue of the society we live in, fossils have monetary value of some kind. This monetary value is extrinsic—a physical object requires labor to produce and maintain. It's also intrinsic—a display piece becomes an insurable asset. But what about non-monetary value—to a certain culture, for example? Or educational value outside of published research? Aesthetic value? Or value related to a claim—of someone who owns the land, or someone who discovers the object? These values cannot be pushed aside simply because of ideology asserting that every specimen should be "saved for science," whatever that means. Scientific institutions contain thousands and thousands of untouched specimens, still in their field jackets, some collected more than a century ago.



There really *are* enough fossils to go around — and more are popping up every day.



### EYE ON THE BONES

Simply put, the best way to protect fossils is to collect them, and the majority of those who have made collecting their livelihood are making things better. This especially includes small museums with a focus on regional natural history—who care deeply about their local ecosystems. These are amateur fossil collectors who have their “ears to the ground,” and commercial entities who are skilled in efficient excavation and preparation of fossil specimens. Often, these groups work well together, and support one another’s efforts. History has already proved the benefits of this kind of collaboration. With a thriving commercial market, there is economic incentive for everyone to collect, preserve, and share fossils.

In the end, it’s in the interest of science to make paleontology a sustainable career, an accessible field of study, and a thriving industry. To do it, we must finally reorient our systems and institutions toward finding ways to support the broad distribution of paleontological resources—in public and private sectors.

The beauty of paleontology is that anyone can go outside, or venture into a museum, and get involved. Fossils are everywhere, allowing people from all walks of life to experience and interact with our planet’s rich history.

The history of Black Hills Institute is the history of fossil hunters, and it’s a tradition and trade that will carry on into the next generation. There really *are* enough fossils to go around—and more are popping up every day.

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# A tale of 3 REXES

by ALEX RUGER & KRISTIN DONNAN

One cannot think of dinosaurs without conjuring up the image of *Tyrannosaurus rex*, that prize fighter of antiquity with a mouthful of teeth ready to gnash and pierce and rip into its prey. Of course, science paints a different picture of the “tyrant lizard king” (that’s its name in English). Those who study these creatures interpret them in terms that are more complex, more nuanced, and, at times, more tragic.

Equally, you can’t talk about *T. rex* without mentioning Black Hills Institute of Geological Research. Digging eleven specimens in 50 years of operation would be a landmark achievement for any institution, but BHI leadership has never done anything by halves. Two of those eleven are not only the most complete, but also the most controversial, the most famous, and the most valuable. Each left a thundering footstep in BHI’s history, a footstep that also echoed in the annals of paleontology.

But today is a new day, those specimens have found new homes, and, according to the venerable Dr. Bob Bakker, BHI has used these past 50 years to “spread the joy and wisdom and puzzles of the Late Cretaceous better than any institution.” He’s referring to the Lance Formation, which dates to the end of the Cretaceous Period, about 66 million years ago, when *T. rex* ruled. With the launch of a new museum, the *T. rex* place of honor will be assumed by a third remarkable specimen. And like its caretakers, this one speaks to a hopeful future for paleontologists—and all South Dakotans.

Field paleontologists talk about their relationship with the earth—it’s what drives them. They can see bits and pieces that other people walk right past. They seem to feel what’s underground. Pete has told the Sue discovery story hundreds of times since August 12, 1990. When Susan took him to the site:

“I crawled up on the cliff face and saw three articulated vertebrae—and from that point on, I was absolutely certain that this was going to be a complete *T. rex*.”

You see his instinct about the fossil in the

video taken there, before one shovel had hit the dirt.

“We haven’t started digging or moved anything around yet. We’ve just been looking at it and taking some pictures and trying to figure out how to proceed. There’s a real mass of bones here; some are caught up in concretion, but most appear to be really excellently preserved.”

He pointed. “I believe that the tail is going that way and the skull is going this way, but we’re just going to have to dig it up and see.”



# A dinosaur named SUE

Although SUE is famous the world over, now and again her story is new to someone who isn't schooled in paleontology, or hasn't lived very long in South Dakota—or, let's face it, simply hasn't lived very long at all. The first trace of what would prove to be the biggest and best *T. rex* was small and fragmentary. Susan Hendrickson handed Pete Larson a chunk of bone, asking what it might be. His eyes lit up, because he instantly recognized the telltale honeycomb structure inside the chunk. The two raced to where Susan had found the bone. Within a couple of weeks, in August's blistering heat, a field team of just four people hand-dug thirty feet off the face of a cliff. They exposed a virtually complete skeleton, including an articulated skull.

Let's pause to truly relate to that moment. These independent paleontologists—in their thirties, making

their own way in life and business—were looking actual history in the face. It was magical, a moment every scientist wishes for.

As the skeleton still lay in the ground, the team gathered with the landowner at the site—on a private ranch within the borders of the Cheyenne River Indian Reservation—discussing the future. The landowner nodded in agreement as Pete described how “Sue,” the *T. rex* now named after Susan, would become the permanent centerpiece of the company's museum in Hill City. Pete then sealed the deal with \$5,000 and a handshake, guessing that hundreds of thousands—or more—would be spent in collecting, preparing, and mounting the fossil. At that point, in 1990, no one had ever paid so much for a fossil in its raw state.

Once excavated and jacketed, SUE traveled to Hill City, and her chief

preparator, Terry Wentz, spent months painstakingly cleaning and stabilizing the skull. Everyone knew SUE was the start of something big—but they didn't know how big.

In August 1992, there was a knock on the door. On the other side were dozens of government agents who had arrived to seize SUE. The Acting U.S. Attorney claimed that he was taking action because of his concern that BHI, as a commercial facility, was going to sell the fossil “to the highest bidder.” He implied that the company was unconcerned with SUE's scientific value, or her value to the public, both of which could be lost if she ended up in someone's living room.

The government's attention was brought to this fossil because the landowner, after all this time, had alleged that the price he had been paid had covered only permission to excavate

the specimen—not the fossil itself. Eventually, his membership in the Cheyenne River Sioux Tribe, his land's proximity to tribal land, and the fact that this parcel was held in trust by the federal government, initiated a four-way custody battle.

Of course, BHI's opinion was clear: it had paid for, excavated, and partially prepared SUE—not to mention already donating the specimen “in perpetuity” to their museum. She wasn't slated to be sold to any “bidder.” The fight was on, and Pete was about to say his most controversial “yes” ever.

BHI sued the government for the return of the fossil.

This is a long story, and it took years to unfold. It got much more complicated when the feds also initiated a criminal case—claiming that BHI had wrongfully collected fossils from public lands. And then sold them. BHI's witty and bombastic lawyer, Patrick Duffy, summarized the case this way: of the approximately one million fossils the team had excavated, the government claimed that on seven occasions, they might have been in the wrong place. On public lands that are checkerboarded across thousands of acres, without proper fencing. In a time before GPS.

What ensued was, and remains, the longest criminal court case in South Dakota history. In total, 159 counts were brought against BHI and its staff—none related to SUE. Most of the seven locality “mistakes” were not—they were location recording errors or the government had mixed up which fossil was which. Two locality charges were true mistakes, but the fossils were of no real value and had not been sold. The only troublesome convictions related to Pete's “failure to fill out forms” on two occasions. In one of those, the

government's own witnesses testified that no crime had been committed; in the other, Pete misunderstood a Customs form. Afterward, most of the jurors wondered why the case had been brought in the first place.

Meanwhile, a loophole would decide SUE's future. Although the judge ruled that BHI's purchase was valid (the money *had* been paid for the fossil), the landowner had not acquired a Department of Interior, trust-related, \$100 seller's permit before the sale. This loophole allowed the judge to void the sale of SUE to BHI—so he could return ownership to the owner, and then insist that the government oversee next steps.

Ironically, in October 1997, SUE hit the auction block with the assistance of the federal government, exactly what the U.S. Attorney's office had claimed it was trying to prevent. The starting bid of \$500,000 quickly escalated—in a blink, passing the limit of BHI supporter Stan Adelstein, who wanted to buy the fossil back for BHI—until the gavel swung and bidding concluded at \$7.6 million. Or, \$8.36 million with the auctioneer's fee. At the time, SUE was by far the most expensive fossil ever sold, and she was headed east, to Chicago.

SUE would debut in the Field Museum of Natural History on May 17, 2000. More than 10,000 people visited

the museum that day. In the decades since, millions more have gawked at her bones, wondering what this beast might have been like when she moved, what her life was like during the Cretaceous, and what killed her. A lot is said in SUE's interpretive materials about the scientific details that were first revealed and discussed by Pete and his colleagues, some from far-flung institutions. Injuries. Gender. Family groups. Both the research and SUE's charm continue; the fossil's impact cannot be understated. Still, there is no mention of Black Hills Institute in Chicago's materials.

Because of the high-profile nature of this case, more and more people went digging for dinosaurs, and especially *T. rex*. While SUE was only the thirteenth *rex* found, now more than 70 scientifically significant specimens have been discovered. If people did not see promise in prospecting for dinosaurs before SUE, then they certainly do now.

SUE also was a boon for landowners, collectors, and scientists of all kinds. You see, the more specimens that are excavated, the more we all learn—and the more everybody wins.

BHI, true to form, would go on to excavate ten more *T. rex* specimens. The second one, despite being more gracile, would leave an even bigger physical footprint.



“  
For an institution to hold the two best *T. rex* specimens ever found—at the same time—has happened only once. It happened in Hill City, South Dakota.



# AND THEN there were two

Stan Sacrison, amateur paleontologist and lifelong South Dakotan, first found the pelvis of what he knew was a large dinosaur in the summer of 1987.

He attempted to have the fossil identified by university staff, but they dismissed the find as “just another *Triceratops*.” (PS: That’s kind of a weird thing to say on two fronts. There aren’t that many *Triceratops* fossils, and wouldn’t you take a few brush swipes at it just to see how much was there?) This attitude caused the fossil to remain in the dirt for nearly five years. In the spring of 1992, Stan got in touch with Pete Larson through a mutual acquaintance. Once again, those distinct honeycombed vertebrae told the whole story: *T. rex*, and a lot of it. There was only one name for this one: STAN.

STAN took approximately 30,000 hours of preparation, from the ground to the lab to the mounting bay. When all was said and done, he stood proud as the second-most-complete *T. rex* specimen—especially notable for his nearly complete skull.

SUE’s skull was excellent, too, but it was preserved in a single block, with bones in place, as in life. Because of the solid matrix within, scientists could not “see inside.” On the other hand, STAN’s skull was scattered across the dig site. Each individual bone was well preserved, and therefore easy to study. With the right anatomical know-how, these bones could be fit precisely back into their proper life positions—thereby providing a pristine, 360-degree, inside look, like no other skull had. STAN still gives science its best look at the face of *T. rex*.

After he was prepped for display, STAN would go on tour in Japan before landing in Hill City, his home for the next twenty years. The Museum at Black Hills Institute would draw thousands of visitors annually, many making the trip to see STAN up close.



Scientists also came from around the world, and several research projects included STAN’s original fossil.

In addition, more than 65 full-scale, research-quality replica skeletons have been made by BHI staff, with more than 100 stand-alone skulls gracing museums, universities, and private collections. Because of the wide distribution of these high-quality replicas, STAN is the most studied *Tyrannosaurus* specimen ever. (See pages 38–39 for a worldwide map of STAN cast locations.)

So...now STAN is much more than a pretty face. He represents his species.

**HOWEVER, IF YOU’RE IN THE BUSINESS**, you would say: “It’s not a real *T. rex* without a lawsuit.” A quick tally ranks at least seven *rex* skeletons that have been to court—with several other the sources of threatened lawsuits. In 2012, STAN unfortunately joined the list when one BHI co-owner decided that it was time to part ways. He sought the dissolution of the

entire collection in order to receive his percentage of its value. BHI, in an attempt to save the larger museum collection and its staff’s livelihoods, had to leverage its most important, most valuable asset. Therefore, with great sadness, the staff stood by as the former co-owner took STAN to auction in October 2020, twenty-three years after SUE made the same trip.

Records were shattered again, and this time the price was exponential. No one could have guessed that the bidding for STAN would hit \$31.8 million. The buyer would remain anonymous for more than a year before the United Arab Emirates announced that STAN was to be the centerpiece of the under-construction Natural History Museum Abu Dhabi. Because BHI had retained STAN’s intellectual property, they continue to produce replicas of this specimen for museums all over the world—and a cast remains in the Museum at Black Hills Institute. Most importantly, though, the original

LEFT: A fantastically aggressive cast of STAN, mounted for the New Mexico Museum of Natural History & Science.

BELOW: Preparator Terry Wentz with STAN’s skull bones. Like an ancient puzzle, this specimen provided a wealth of “inside knowledge”

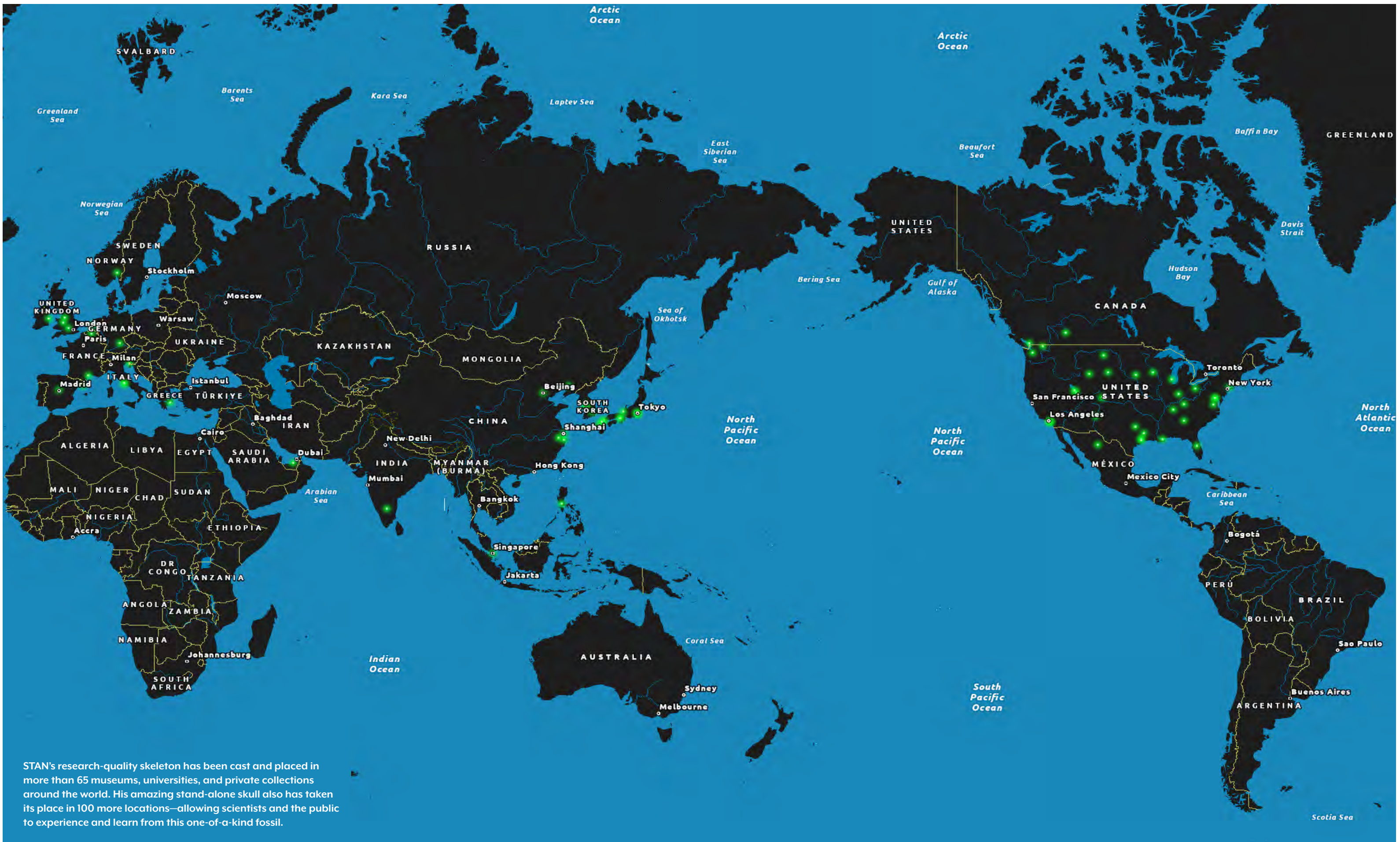
STAN took approximately 30,000 hours of preparation, from the ground to the lab to the mounting bay.



STAN will be on display in a world-class museum, available to the public and to researchers alike.

With STAN’s story in the books, we would see a second rockstar fossil emerge from the ground, spend its first chapter of life in Hill City, and get a passport for a new adventure. Again, our hometown found itself short another *T. rex*.





STAN's research-quality skeleton has been cast and placed in more than 65 museums, universities, and private collections around the world. His amazing stand-alone skull also has taken its place in 100 more locations—allowing scientists and the public to experience and learn from this one-of-a-kind fossil.



# T. rex SOUTH DAKOTA'S

Luckily, Stan Sacrison never stops kicking around Harding County. The longtime BHI collaborator, volunteer, and prairie sage found the beginnings of a second *Tyrannosaurus* specimen. With this discovery, he tied Barnum Brown—one of the most celebrated paleontologists ever, who found the first-ever specimen of *T. rex*, in 1902—as the only person to have personally discovered two.

This being the mid-90s, BHI was embroiled in the SUE-suit. So, between rounds of court proceedings, the team would find great relief in driving north through the prairie to dig the specimen. A favorite travel topic was how to name this dinosaur. At the time, Pat Duffy, the Institute's vociferous, always-camera-ready lawyer, was fighting the good fight. The team asked: What do you name a creature you wouldn't want coming after you?

The answer was obvious: DUFFY.

Crowds of volunteers visited the site, including busloads of school kids. But after a couple of weeks of digging, it was clear that the animal had died in an ancient flood plain, and its bones had been spread far and wide by river flows and predators. Digging was slow and there was a lot of space between bones—most of which were encased in mudstone “concretions,” a layer of mineralization coating each one.

**WHEN YOU KNOW THERE'S A FOSSIL THERE SOMEWHERE**, but knives and picks aren't coming up with anything, the dig isn't very fun. Not for visiting children or paleontologists. Soon, however, a couple days of steady rain put everyone out of their misery, and the dig ended for the season.

The crew returned to the site the next season, at first armed with a scientific experiment. Had it worked, fossil

digging would be a very different endeavor. Professor Bill Roggenthen, from the School of Mines in Rapid City, arrived with a Ground Penetrating Radar (GPR) machine—which he carefully ran along the dig site's top surface. Its screen indicated underground “anomalies,” density differences that he hoped meant bones, or at least concretions that might point to something other than dirt. Unfortunately, when the crew dug directly to these anomalies, the density differences didn't line up with fossils. In a mini-experiment, the team tried GPS in Duffy's mudstone locality, another Cretaceous (sandstone) site, and a Jurassic site. They struck out in all cases.

**THEIR NEXT EFFORT** was a bit more creative, and was brought to the table by expert large-equipment operator, Steve Sacrison, Stan's twin. This technology did work. Dubbed GPB—Ground Penetrating Bobcat—Steve carefully glided the skid-steer bucket's edge along the surface, shaving off one-eighth-inch layers. Crew members followed along, and could see instantly when the edge of a concretion was nicked. Amazingly, Steve could “feel” it, too, because of his keen talents with the machine. His work saved hundreds of hours with knives and picks—and spared the bones.

“You have to find each one with something, and a pick makes quite an impact,” Pete said. “This shallow scraping allowed us to target our efforts.”



After 66 million years, DUFFY finally began to rear his head from the earth. Skull bone after skull bone came out of the ground. The next season, the tooth count would come to forty, and a mostly complete skull and vertebral column would emerge. Although smaller than STAN and SUE, DUFFY is of particular scientific interest because of what he might tell us about tyrannosaur ontogeny—how an organism changes as it grows.

More than that, this specimen will cap the company's 50 years in business, taking his place as the centerpiece of the future Black Hills Museum of Natural Science.

Very few *T. rex* skeletons are exhibited in the state in which they are found, because most keystone fossils are expensive,

and therefore acquired by large museums with large budgets. Smaller museums in the American West usually can't raise the necessary funding to keep their most impressive, local specimens in their collections; therefore, only four other *T. rex* are exhibited in the state they hail from. Of these, only one is currently fully prepared and mounted.

DUFFY is the culmination of a promise that was more than three, hard-won decades in the making. At long last, Hill City will have a permanent resident-*rex*, and so will South Dakota.

ABOVE: Staff and volunteers at the DUFFY excavation site. BHI file photo



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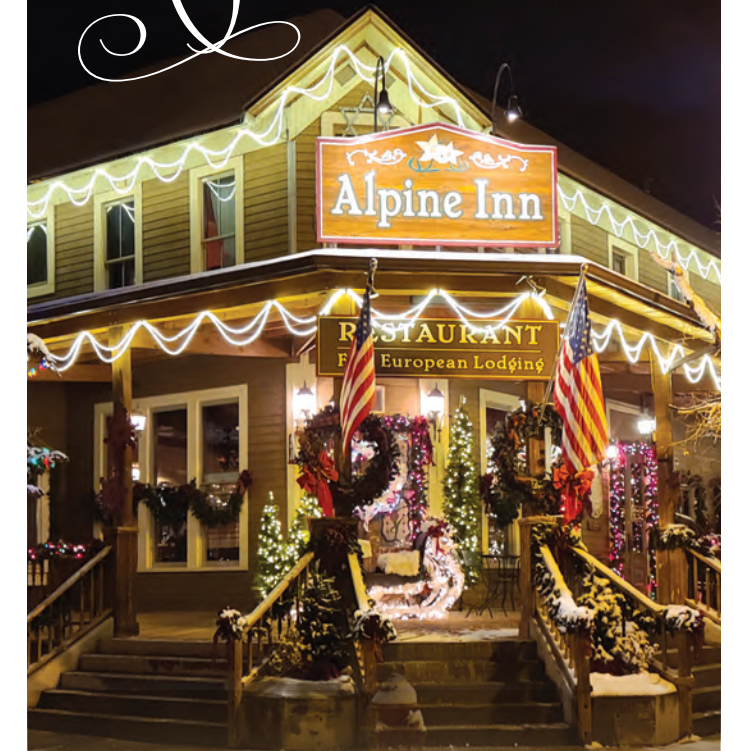
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Terry Wentz preparing the only *Acrocanthosaurus* skull in the world; the entire specimen is on permanent display at the North Carolina Museum of Natural Sciences in Raleigh. BHI file photo



# WHAT MAKES US TICK

When the four expert field crew were digging SUE's skeleton, they made a pact: when they saw evidence of each new bone, they promised not to say the word "skull." Susan Hendrickson, the fossil's discoverer, later revealed that they "didn't want to jinx it."

When Susan first took Pete Larson to the discovery site, thousands of fragments had already trickled down the cliff face, indicating that erosion had chipped off edges, bits, pieces. A digger doesn't know how much has disappeared until what's left of the fossil is uncovered. Still, Pete's intuition screamed at him; he just "felt" that the skeleton, including her amazing skull, was still tucked safely in the ground.

Is that "hope"? Experience? Intuition? Wishful thinking? All of the above? Is that what keeps field paleontologists in the field?

Yes.

"Digging a fossil feels like opening a gift—except you are the first person ever to see this thing," Pete says. "It's as if you and that ancient being are connected forever."

After an ancient being is discovered and collected, "exploration" then continues in the lab—because not everything is completely exposed and identified in the field. Bones might be broken into unidentifiable chunks or excavated in tangled blocks. Therefore, big discoveries might occur indoors, in controlled laboratory environments.

"It's exactly like putting together a giant puzzle," Sam Farrar says. "Well, it *is* a giant puzzle."

For record keeping and mapping purposes, all field jackets—whether verified or still mysterious—are carefully marked with whatever identifying information diggers have, along with the locality and date. And if the contents are still

mysterious, that "hope" is very evident in the eyes of BHI staff. "I can't tell you how many plaster jackets from various digs have 'SKULL?' written on them," says Science Communicator Alex Ruger.

Excavation is the first piece of the paleo puzzle—so in this section, Behind the Curtain, the adventure begins with a routine-collecting-weekend-that-went-a-bit-sideways story (page 46). After everyone dries off and gets back to the lab, they'll take you through the life and science of a discovered fossil (page 50)—followed by an example of how the dinosaur family tree, living creatures, art, and human imagination can enrich our collective ideas about dinosaurs (page 56).

All of this is why independent companies like BHI are so important. They shepherd these amazing creatures from their ancient burials into a second life, which can enrich and entertain us.

To be good in the field, lab, mounting bay, scientific record—and also in the marketplace—is no small feat. BHI's stock in trade is hard-earned expertise, which they strive to make evident in every specimen and cast replica and piece of research they produce.

Pete's dreams and goals in the 1970s are still in play today. It's kind of a simple recipe:

- Have fun.
- Make science accessible to everyone, and educate anyone who is interested in paleontology—other researchers and the public alike;
- Create the highest-quality specimens possible—whether for display in their own museum, other museums, private collections, or for study;
- Support the field of paleontology, with the fossils themselves and with published research papers and books;
- Oh, and have fun.

“  
**Pete sees potential everywhere he looks. A fragment could be the first bone of a whole skeleton—and sometimes it is! But this is also true with people. Within an enthusiastic school kid, there could be a future paleontologist.**

*~ Adam Weaver*



# A River Runs Through It: AN ADVENTURE IN COLLECTING

by KRISTIN DONNAN

**“Collecting fossils is a very timely process,” Pete explains. “Fossils are discovered because they’re weathering out of their entombing matrix. The forces of nature—rain, wind, freezing, thawing, even snowfall—have an effect on any fossil. Every day it’s outside is a day it moves toward destruction.”**

So that’s where it begins, in the field. The team might be called to a fossil that’s been found by someone else, or they might choose a locality to explore. That choice is based on a solid background in geology—knowing what fossils are preserved where, and why.

**DECADES AGO, I ONCE JOINED PETE AND HIS CHILDREN** on a trip to a badlands locality—a geologic formation known as *mauaises terres* in French, and *makosica* in Lakota. These rugged peaks and gullies are the result of erosion, when rivers carved away sandstones and other soft sediments from the surrounding prairies. The striking, striped formations occur in many states, and are the jewel of South Dakota’s Badlands National Park.

In this case, we were on a friend’s ranch. The Oligocene-aged deposits I saw there, and their associated fossils, have been well studied for

generations. They’re also places where lots of “fan favorites” are found—horses and saber-toothed cats and turtles.

I noticed one thing right off the bat: the recent rains that had lured us had done their job. Huge numbers of bone fragments were sprinkled across the surface. Most of the obvious specimens were land tortoises—exposed, weathered, and arranged as if each animal had eaten a firecracker.

As I walked along the gullies and up and down the cliffs, I scanned the cracked ground, looking for changes in color and texture. A bone might blend into the sediment, or be perched in plain sight, freshly eroded from the last rain. It might look like a modern deer leg; it might be the size of a pencil tip—a glassy, chocolate-brown tooth against a background of off-white clay.

I did discover a saber-toothed cat’s lower right jaw bone, but I was far outgunned by the kids’ expertise. All those years ago, now-adult Tim was nine. He held the family’s record, with some 90 found jaws of various kinds, with teeth. His 13-year-old brother, Matt, now a father of three, had excavated a museum-quality turtle. They patiently pointed out remnants of rhinoceros and oreodonts—hoofed mammals related to a camel, but which looked a bit like a sheep. Or a hog.

The ancient world must have been designed by Dr. Seuss.

Commercial people have to be generalists. They have to be good at field identification, and since they personally collect, excavate, and prepare fossils, they learn the details of the specimens. They recognize them instantly.

~ Bob Farrar







Photo © Loyie Kennedy

By then, I'd been to several fossil digs. I knew that depending on the locality and the type of fossils it contained, diggers used heavy equipment, picks and shovels, jackhammers—or the smallest of brushes and dental tools. They constructed plaster jackets reinforced with lumber, requiring pallet forks to pull them onto truck beds—or tiny plastic bags and jewelry boxes.

Field collectors relied on geology, paleontology, biology, chemistry, and physics. They mapped, measured, photographed, recorded, sampled.

They still do all of that; they also collect relevant scientific information along with the fossils, do the least possible harm to the environment, and treat landowners fairly.

I've always found something beautiful about the simplicity, the clarity, of this mission. These people walked with a familiar grace across the rocky terrain; their hands touched the earth carefully and efficiently. This family seemed completely at home.

This is a job for strong people, I thought. People with good knees and hefty shoulders and plenty of water. In thermoses. At one point, while everyone else was hunkered down, totally focused on bones, I stretched out on a gently sloping outcrop. "I feel like I've been carrying around a bunch of rocks," I said to myself.

I imagined what would happen next. These treasures—maybe a truly special scientific find, or maybe common pieces that "only a true enthusiast could love"—would be carefully unpacked and prepared in Rex Hall.

Rex Hall—a large pole barn-style building across the alley from BHI's main building—is where most of the magic still happens.

"In the lab, we learn all the details," Sam Farrar says. "You just don't know what you have until you open all the field jackets. Maybe it's a wonderful scientific specimen, but not suitable for display—or maybe it's not important, but really beautiful."

Throughout Rex Hall's preparation labs, fossils and all their associated materials are examined. They might reveal:

- **Paleoecology**—the fossil record that reveals plant and animal life, climate, and environment;
- **Behavior**—how animals lived, including what they ate, how they cared for their young, and how they interacted (e.g., mating or fighting);
- **Taphonomy**—the series of events that led to the preservation of a particular fossil, such as flooding or volcanic eruption;
- **Ontogeny**—how an individual organism changes as it grows throughout its life, which can be evident in a skeleton;
- **Osteology**—the study of bones, and how they differed and were similar among individuals in the same species—as well as among different species.

**REX HALL** contains preparation labs, welding stations, restoration rooms, 3D-scanning and -printing areas, and a molding and casting department to produce reproductions. All of the work done there aims at doing the best possible job on a given fossil—preserving as much of the original as possible, considering

its state when discovered. Some are badly broken and distorted; some are pristine. Some are only partially present; some are virtually complete.

Over the years, as I worked on projects with BHI, I would find Rex Hall to be the most interesting place on the company's campus. It seemed to me to truly represent "behind the curtain"—an entire universe of experience that happens before someone walks through any museum to admire finished, majestic specimens. What happens here fuels the scientific research, the publications, the talks, the drawers and drawers of collections.

To me, this is the real world of paleontology. But to get back to Rex Hall, the crew has to survive collecting. And my trip to the White River Formation was touch and go.

It was hot as I caught my breath, reclining on the slope. At one point, young Tim cooled off in a small waterfall.

Wait a minute.

A waterfall?

**PETE IS MORE THAN A GEOLOGIST** or a field collector; he also grew up on a ranch—in a land of agriculture. He grew up navigating wide swaths of prairie, pastures, and fields; he grew up understanding weather and road conditions.

We all knew it had rained recently. Pete knew where the irrigation ditches were, and he understood that the waterfall was a result of an overflow from the irrigation ditch. He was doing mental calculations about what this might mean for his usual access to our next stop. In his head, he said, "I think we're good." Out loud, he said, "hop in!"

We were heading for a gate just across a nearby pasture when we all noticed a telltale sparkle in the grass. It was too late by then. The entire pasture was under water.

In the world of agriculture, there are rules about courtesy, disturbing livestock, flattening grass, and leaving gates the way you found them. We had the choice of stopping for the gate or going through it to dry ground. Pete was not about to damage someone else's fence, so the four wheels of the truck sank nicely into the gumbo as we stopped. Matt dutifully opened the gate, but that did not help much.

My instinctive question was, "Who's around to pull us out?" The answer was the "come-along," a tool I hope I never again see in action. But the ditch runneth over and through and around; there was nothing to anchor the come-along. In a very matter-of-fact way, Pete said we "just" had to jack up the wheels and "build a little road." Build a little *road*?

As I crawled out of the truck and hopped from one unquashed island of grass to another, I begrudgingly noticed it was actually beautiful—and late. The sun was on its way down, and it flashed off the water, which filled in the tracks we had cut through the prairie grasses. It was also somewhat overwhelming, because everywhere I looked, this water was actually running. And because the ditch was actually letting go, the water was getting deeper. I clicked my red tennis shoes three times. Nothing.

Okay, so getting stuck is really no big deal. We've all done it. But the nearest material for a "little road" was on a bluff one-half mile away. By the time the sun sank past the horizon, all four tires were spinning helplessly on a haphazard bridge of fallen trees. We were soaked and muddy.

Tim peeled off his soggy tennis shoes and relaxed on the hood of the truck. Pete popped open the kitchen side-panel of his truck, and commenced food preparation. (I thought, how can you eat at a time like this?) Ankle-deep in water and mud, he cooked and served. Matter-of-factly, he observed: "A river runs through it."

I realize this is probably not funny to anyone else. It was not so funny to me the next day, either, when I awoke.

Paleontologists are used to carting rocks around, but I was not. During several trips to the distant rocky butte, we picked channel sandstone into packable slabs and carried them on our backs. I slid down the hill again and again, counting my steps across the prairie to the truck.

After plenty of rock had been moved, we repeated the previous night's laborious, sloppy jacking up of the wheels and created a lovely path of sandstone. Around noon, Pete drove the truck through the open gate as if we had experienced a time warp. "Nothing to see here." I passed the rest of the trip with soggy boots.

This would be the least of my experiences with BHI over the decades. Many hard rains—literal and figurative—have passed since the 1990s. Happily, soggy boots didn't deter me, and members of this team remain like family. We still write projects together—like this 50th Anniversary publication—and we're better at spotting flooded pastures.

I guess hindsight *is* 20/20.





The public face of Black Hills Institute of Geological Research is its Museum, but the heart of the operation is what happens behind the scenes—what the public typically doesn't see.

**WHEN PEOPLE THINK OF FOSSILS**, they first think of excavation. They imagine dusty, hat-wearing field workers uncovering new and fascinating objects that will soon sit behind glass walls. And they're right: good excavation is the first step, and it's crucial. But then what?

People typically do not think of the hundreds and thousands of hours spent in the "in between," the time that passes between the field and display. For every hour one spends in the field on a specimen, hundreds to thousands of hours might be required to clean, stabilize, restore, mold, cast, and prepare that specimen for display.

For all that to happen, paleontologists are constantly problem solving—often on a moment's notice. And every time, they reach for a tool. "Very few implements are specifically designed for paleontology," Pete says. "We use geology tools, archeology tools, chemistry tools, physics tools, ditch-digger tools, construction tools. And when we run across other cool objects, we can find a way to use them too."

## PREPARATION—THE CLEAN-UP



The "prep lab" is usually the first stop on a fossil's trip through BHI—whether its future is permanent display or a research drawer. Our goal is accurate, complete cleaning, repair, and stabilization, which we've learned after 50 years of exposure to a wide variety of taxa and sedimentary formations. The more we see and study, the more expertise we can apply to each fossil down the line.

Whether the specimen is a single bone that can be held in one hand or a jumble of large bones that were too closely knit to separate in the field, much of the work is still done manually.

We use chisels, hammers, X-acto® knives, and scribes, along with various types and sizes of brushes and small hand tools—and even microscopes and magnifying glasses for tiny fossils. Fine detail work of removing matrix (fine-grained sediment encasing the specimen) is also done with air scribes and air abrasive units—using mild and safe sodium bicarbonate, also known as baking soda.

Fossils are almost always cracked or broken, and stabilization is usually required throughout preparation. How much intervention each one needs depends on the condition of the fossil and our future plans for it. For example, display specimens have to be sturdy enough to be moved, mounted, and studied. After nearly 25 years of experimentation, BHI has perfected the use of several different viscosities of cyanoacrylate adhesives ("superglue") and PVA (polyvinyl acetate) to strengthen and seal fossils for the long term, from the inside out.

THE NITTY

*Gritty*

by DR. SHARON WEAVER



“I hate the sun, I hate the prairie, I hate camping, I hate rattlesnakes, and I love indoor plumbing,” says Lynn Hochstafl, BHI’s longest-standing staffer.

A third-generation Hill City resident, she joined the company in 1982. Over the years, she became an expert in fossil fish and plants, duckbill dinosaurs, and problem solving. As long as she worked indoors.



## 2

The moment people see something unique and interesting, their first instinct is to reach for it. At a museum, it’s still a first instinct—even if visitors know they shouldn’t touch. So we have to make fossils strong and resilient. They have to withstand the impacts of human nature.

Preparation challenges can come in many forms—commonly in the form of minerals present in the surrounding sediment. For example, pyrite—also known as fool’s gold—can invade the cell spaces of bones and deteriorate them. Before a pyritized fossil can be displayed, the mineral must be removed as completely as possible. Then it’s stabilized, soaked with a penetrant, and sealed. In our experience, ten years after receiving this treatment, these fossils show no additional deterioration.

## RESTORATION

Nearly all fossils, whether vertebrate or invertebrate, are missing portions when collected. Many are very incomplete, with entire bones missing from a skeleton or skull. In fact, the average “great skeleton” on display in a museum might be only 30 or 40 percent complete—and filled in with “replacement parts.”

Based on the type of fossil and how large a portion must be restored, we might sculpt missing sections from water putty, epoxy putty, glues, plastics, or any other medium that can be shaped, formed, carved, or cast. (Above, Lynn is using putty to restore a duckbill dinosaur bone.) In the wild world of paleontology, that means restorers must be well versed in a wide variety of known similar specimens, as well as the greater animal kingdom, both living and extinct.

Great restoration technicians are also artists who recognize the uniqueness of every individual specimen. That is, no two meat-eating dinosaurs are exactly alike; no two *T. rexes* are exactly alike; and no two C2 vertebrae are exactly alike. Creative solutions might come from a technician’s familiarity with many other specimens, studying scientific illustrations and photographs, and truly understanding the subtle character of the particular fossil on the table.

We also might replace a missing part with a replica bone from another specimen of similar size. Professionally created replicas are scientifically accurate, lightweight, and also themselves sculptable—so they can be customized.

## 3

## MAKING REPLICAS

Replicas can be made in several ways.

- Sculpting from scratch;
- Casting a bone from another specimen, using a variety of plastic materials; and
- 3D scanning and printing.

BHI’s team has perfected the sculpting and molding/casting processes—having created dozens of full-sized, scientifically accurate cast skeletons currently on display in museums around the world.

We usually fill silicone molds with high-quality, dense, expanding polyurethane foam. Molds can be taller and wider than a large man—and pieces are

puttied together to make their seams...well, seamless.

We’ve done this thanks to an amazing team in the lab, including Matt Seney, whose 15 years with BHI span adventures in excavation, preparation, and restoration. An animal lover—who kept more than 100 reptiles in his childhood room—he even used his molding skills to create a replica of Reptile Gardens’ beloved tortoise Methuselah.

And how long has Matt’s casting partner, Joey Rodriguez, loved paleontology? “How long have I been alive?” he replies. His family stumbled across BHI on a family holiday—and six months later, he moved to Hill City to pursue a new career, and his dream of working with fossils. His biggest moment so far? Discovering the skull of a rare *Denversaurus* while at a BHI *T. rex* dig. It doesn’t get much better than that.

~ Pete Larson

“Working here is a perfect balance between science and art. I’ve been able to do projects with animals that I never could have imagined.”

~ Matt Seney



PAGE 50: Pete Larson, Ralph Seney, and Sam Farrar put together a *Triceratops* skull puzzle. BHI file photo

LEFT: Matt Seney de-molding a cast tooth element—reproduced from one of only two existing *Brachiosaurus brancai* skulls.

INSET: *B. brancai* at the Museum of Natural History in Berlin, 2008. Photo by Gunnar Ries Amphibol; Wikimedia Commons

ABOVE: Joey Rodriguez putties seam lines of cast skull parts of *Spiclypeus*, a ceratopsid specimen named Judith. BHI file photo



# 4

## 3D SCIENCE

The team is also an “early adopter” of cutting-edge 3D applications in paleontology. We recently integrated different Artec products—the “Leo” for larger objects and the “Space Spider” for smaller ones. Digital files produced by these scanners can be used on their own for research purposes—and also to print replicas, with the Ultimaker S5 and the Modix 120Z. One great usage of 3D technology is to resize an existing bone for use in a specimen of a different size. It still might have to be modified, but the scanning and printing process is faster than molding and casting.



ABOVE: 3D printing a resized ceratopsian frill.  
OPPOSITE: Pete welding on a *T. rex* tail. He's gotten pretty good at it, after 50 years.  
BHI file photos

3D-printed bones can be customized. For example, a juvenile's humerus will reflect less detail and different contours than an adult's.

# 5

## MOUNTING

BHI stands out in our industry with innovations in designing final display specimens too. Armature—usually constructed by Pete Larson and Matt's dad, Ralph Seney—is custom-welded to follow each bone's curves. Over all, the steel supports the distinctive nature and ideal posture of each specimen. We design mounts that are easy to crate, assemble, and disassemble—they even fit through doors and are customized for the dimensions of specific rooms. They also take into consideration safety and future research.



With every mounted skeleton, we try to solve problems we've faced in past mounts. Trix, our latest *T. rex*, was our best so far—with a refined, simple, modular assembly system that fits together in a nice and tidy way.

~Sam Farrar

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art

# & SCIENCE

# THE RECONSTRUCTION OF DUFFY

by ELLA LARSON & ALEX RUGER  
Illustrations © 2023 by ELLA LARSON

## ALEX: ON PROCESS

Dinosaur science is often rigorous, data-driven work; to imagine them *alive* is an intense exercise of the imagination. Our speculations are suggested by the animals' living relatives and enriched by each new specimen that is discovered and studied. New data adds details about family trees, behaviors, sizes, relationships—and, sometimes, skin texture, feathers, and a million other bits and pieces.

Still, for the most part, we don't know what colors they were or exactly how their

muscles fleshed out their bodies. Therefore, any work of paleo-art is science fiction. Not the sci-fi of a fantastical space-opera, but the kind of science-thriller that is grounded in the unpredictability of nature.

DUFFY is a special *T. rex*—he's Black Hills Institute's *rex*, closely intertwined with the company's past and future. His sub-adult age is also important, as it adds to our scientific understanding of how tyrannosaurs grew up. For so many reasons, DUFFY had to be brought to life.

This special project required a talented, science-hippy artist who understands BHI's nerd-niche language. Luckily, Ella Larson, Pete's youngest daughter, grew up around fossils—and recently graduated from Vassar College with degrees in art and creative writing.

Luckily, she also has a passion for creature design. In the following pages, she describes her illustration process—while I act as the BHI paleontologist who fills in the research behind her work.

## ELLA: FOSSILS ARE SO FREAKIN' COOL.

If you browse through a book on natural history, you're bound to find a bunch of wild creature designs better suited for a *Star Wars* movie than planet Earth—but these things actually existed and walked/swam/slithered around like little weirdos, which brings me such joy.

I was surprised to learn how many of these illustrations are still guesses, even with all the progress paleontology has made in the past few decades. Part of the problem is that we don't have many soft tissue specimens: skin, muscles, air sacs, fat deposits, feathers—for most fossils, these have been lost to time. The best we can do is extrapolate from what we find in the modern world: things like crocodiles, monitor lizards, and ratites, the bird group that includes ostriches and emus.

It's something like solving a biological cold case. A very, very cold case. So when I had the chance to reconstruct the *Tyrannosaurus rex* named DUFFY, under the supervision and advice of Alex Ruger and others at BHI, I leapt at the opportunity—with my claws out and feathers fluffed.

It's important to note that DUFFY's skeleton is *gracile*, which means it's slimmer than the robust female skeletons. That fact would inform my drawings—as well as his pronouns. I'll refer to the specimen in the masculine.

The first and most straightforward step was tackling DUFFY's skull. All I needed to do was draw what I saw

directly, emphasizing shadows and lines between bones for clarity—keeping in mind that this fossil's features are uniquely identifiable. That is, DUFFY's bones have their own shape; several unique injuries and bumps on his jaws and face (see next page for details) tell the story of his life. All of these details contributed to a drawing that shows DUFFY himself, and not some run-of-the-mill Tyrannosaur.

Following the inside-out approach, next came the muscles. The muscle diagrams I found didn't cover anything further anterior (forward) than the jaw and neck, so I referred to images of *T. rex*'s living relatives—birds and crocodiles—to illustrate the rest.

Because birds are the closest living creatures on the *T. rex* family tree, I chose a more avian (bird-like) eye shape—which includes sclerotic rings (bony eye structures that don't appear in amphibians or mammals). However, since DUFFY didn't have a beak, and he doesn't quite fit with modern reptiles, the muscles around his nose and mouth get a little tricky—see Alex's note on dino lips.

Now for the antorbital fenestrae—openings (“windows” in Latin) in the skull below the eye sockets. There are three main hypotheses for what might have occupied that space during *T. rex*'s life: muscles (unlikely, since there aren't really moving parts inside the schnoz), air sacs, and/or the olfactory glands. Birds also have these windows—which house sinus structures and are covered with a membrane. After going through a bit of a headache trying out several different approaches, Alex and I decided on a bird-inspired membrane for DUFFY's antorbital fenestrae.



**ALEX:**  
READING THE SIGNS

Moving from the neck to the face, there are a number of interesting surfaces on the bone that might clue us into DUFFY's countenance. First and foremost are the rugose surfaces over the eye (perched upon the postorbital bone). In older individuals, these knobby osteoderms get increasingly gnarly. Trix, SUE, and MOR 900 have huge bony "eyebrows" that must have

served some display function. This is what we see in bone, but in life these structures might have been even more exaggerated. I pointed Ella in the direction of marine iguanas (*Amblyrhynchus cristatus*) who have lumpy, rugose textures on their skulls too. In life, that gnarly texture is the base of horny, armor-like scales. So we placed a thorny crown on our prince!

It's something like solving a biological cold case.  
A very, very cold case.



**ELLA:**  
SKIN

Next, we covered DUFFY with skin, scales, and a fine layer of feathers. The research of UK paleo-artist Mark Witton gives us an idea of the diversity and distribution of *Tyrannosaurus* scales, with ornamental beads on the upper jaw, and something tougher on the eyes and nose—we used growths modeled from marine iguana heads. The rest of the body shows itty-bitty, underlying "basement scales" from preserved *Tyrannosaurus* skin. If these creatures had feathers, the structures resembled primitive, hair-like down, as in the modern emu.

**ALEX:**  
EYE OF THE BEHOLDER

Artists imagine how dinosaurs might have looked based on more than imagination—they also rely on fossils that preserve some record of soft tissue along with bones. In *T. rex* and its closest relatives, there is not much direct evidence—just two Montana skeletons that preserved small samples of actual, fossilized skin. In both cases, BHI was honored to make these landmark discoveries.

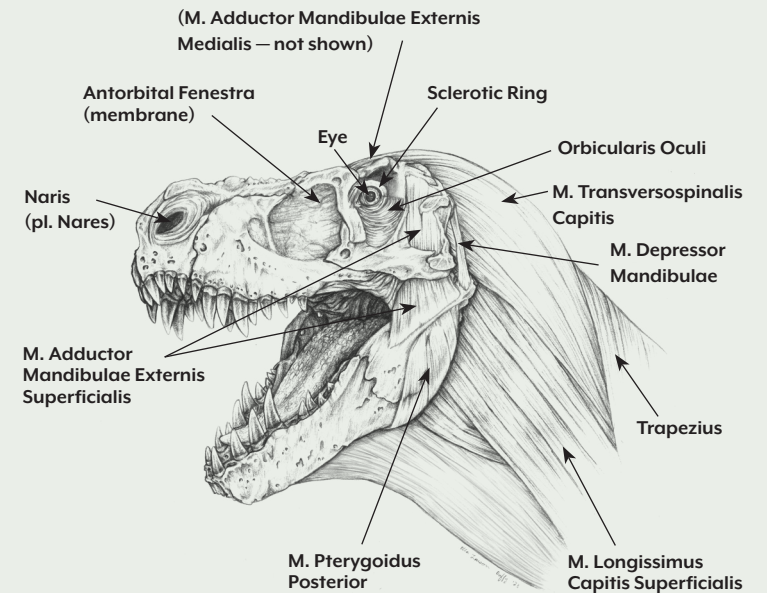
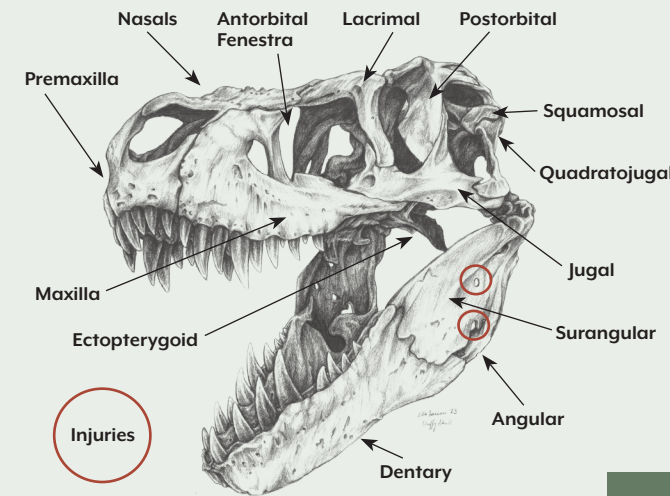
The first specimen—called Wyrex, now on display at the Houston Museum of Natural Science—made history with several tiny, slightly pebbly skin samples discovered during preparation. These give some idea of skin texture, but certainly not the big picture of the variety of textures that must have occurred across the entire body.

The second specimen is half of the Dueling Dinosaurs, a

*Nanotyrannus* found preserved with a *Triceratops*. The specimen has not been fully prepared—the North Carolina Museum of Natural Sciences will do that while it's on display—so we're not sure what else might be uncovered. However, one section of preserved skin was found—on the front of the *Nano's* right foot—when BHI was assisting its original owners to ready the specimen for sale. That skin resembled the texture found on the foot of an emu.

Other related evidence supports this scant material, including a Mongolian trackway—showing what the bottom of a *Tarborsaurus* foot looked like—and skin samples from dinosaurs further away on the family tree. With all of this in mind, I suggested that Ella use as her baselines the wrinkly, pebbly necks of tortoises and a variety of bird feet and faces.

Bones & Muscles



**ALEX:**  
LIPS OR NO LIPS?

As often occurs in the world of paleo science, the research on *T. rex* lips is contradictory, so the question remains: Did meat-eating dinosaurs have exposed teeth jutting out from a thin set of lizard-lips—as in *Jurassic Park*—or lips that covered their teeth?

One study focuses on crocodile-like facial skin—which in turn would suggest a crocodylian mouth, and protruding teeth with no lips. Another compares the thickness of tooth enamel between crocodiles and *T. rex* teeth. Tracy Ford, an

**ELLA:**  
FINISHING TOUCHES

After looking through the research, it seemed that full lips wouldn't have made much sense (à la paleo-artist Tracy Ford)—but I thought DUFFY likely would have had enough tissue to cover his gum lines. Both his nose and ears would have been low—and as for his wounds, they aren't fresh, but they're still visible. Finally came the colors. After I tried a number of combinations of varying plausibility, Alex suggested a yellow-green as a neutral base (much more realistic than my "Silly DUFFY" on the following page). As a predator (and a bird relative), he might have had some sort of pattern, possibly even brighter colors to display his lovely rugose surfaces and ornamental scales; we made these orange to better compliment his hues.

avocational paleontologist and friend of the Institute, thinks the answer lies in how the jaws fit together.

In the end, because *T. rex* sports an overbite like an alligator's—where the lower jaw fits inside the upper—I advised Ella to draw reptile-like skin covering just the root of the teeth, giving DUFFY something resembling an alligator's grin. To be sure, there is no final word in this debate—but both Ella and I felt confident that this reconstruction is within the bounds of plausibility.



he is a  
**PRETTY  
 BOY.** *yes  
 he is.*

**ELLA:  
 HEAD TO TAIL**

Next came the full-on DUFFY, head to tail, skeleton all the way to feathers (full skeleton on page 56; matching skull at right, top). I admit that here I began by tracing—ah, tracing, an artist's bane, yet oh-so helpful. For DUFFY's body, I referenced a photo of a STAN mount that was affectionately referred to as "hauling ass," and then followed the same process as his head. One difference: here I included fatty tissue, based on diagrams of birds by George A. Clark Jr. I also extended a color pattern down DUFFY's back, adding tail stripes. He has big, meaty feet too—modeled directly from Ye Olde Friend the Emu.

By this point, I thought: I've already done all this work, why not keep going? So I made another version of a scaled, feathered DUFFY, this one completely absurd (at right, below). I changed the shape of his pupils and gum line for variety, but other than that's he's a bold mishmash of Bird of Paradise, Giant Turkey, and Nightmare Skeksis (the Dark Crystal dragon-birds). Sometimes I call him "King Vulture DUFFY" (no surprise there). He's got a Wattle to End All Wattles, a Snood (yes, that is what the funny beak growth is called) of Urgh, and Gorgeous Little Feather Floodles.

He is a Pretty Boy. Yes he is.

I messed up quite a few times while illustrating him—added an extra pterygoid muscle, forgot his injuries, made his neck a li'l funky—but I hope in the end I've done this amazing creature justice. The process has increased my respect for the illustrators tenfold, and I'm now even more fond of this adorable theropod—and I had so much fun drawing him.



TOP: The more realistic version of what DUFFY might have looked like. Here, we can imagine how long-extinct bird relatives might have expressed themselves.

BOTTOM: "Silly DUFFY," in which Ella exaggerated all the most interesting (or, she says, absurd) characteristics of the creature-relatives that inspired her artistic decisions. No matter which you like better, *he is a pretty boy. Yes, he is.*

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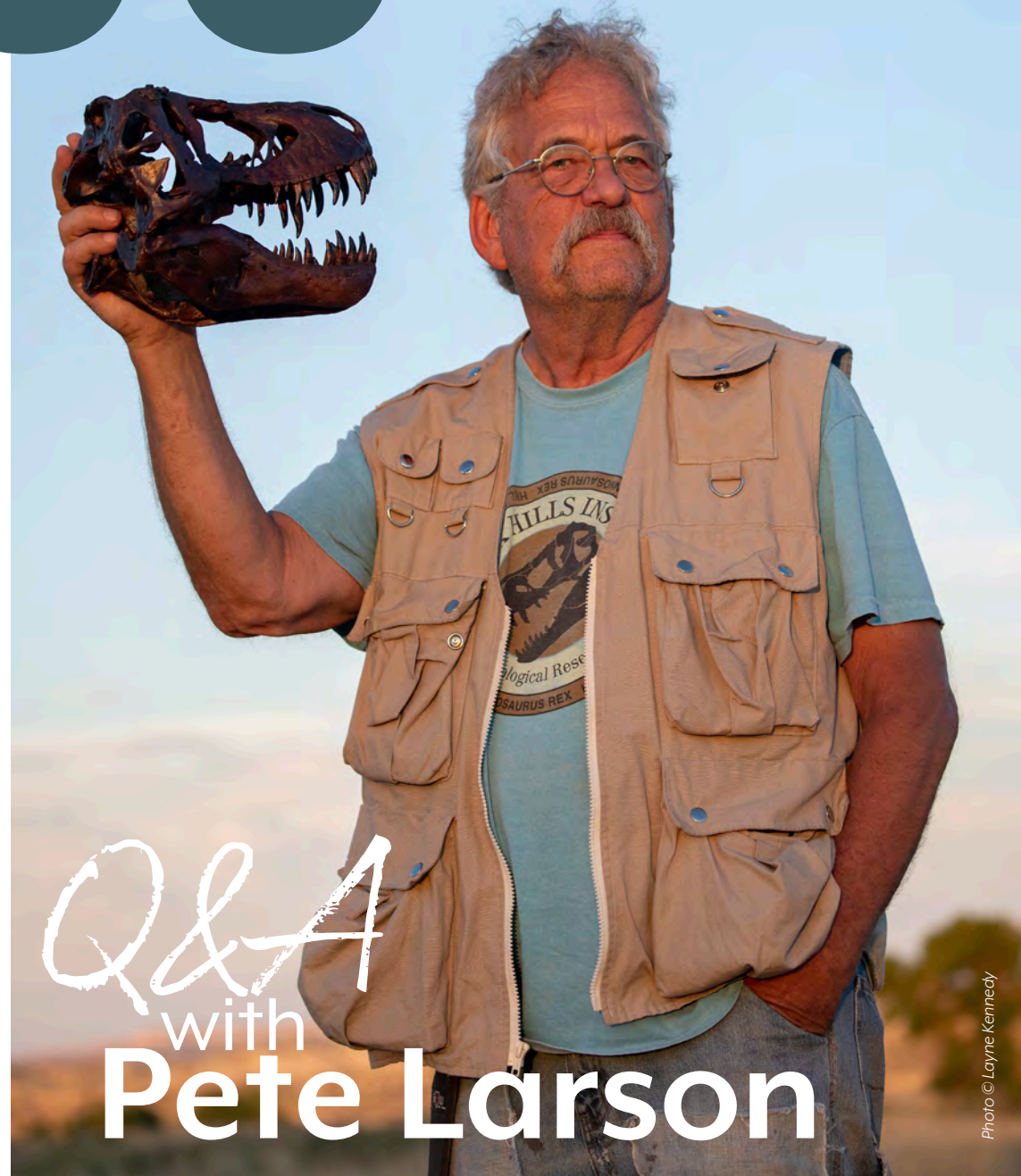
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Q&A  
with  
**Pete Larson**

Photo © Layne Kennedy

**What do you love most about this job you created for yourself?**

Let's see if I can describe it. When I look at a fossil in the ground, or in the lab, or under a microscope, it's as if I can already see it in its perfect state. It's not imagination, exactly; it's seeing beyond what's visible to the eye. I love doing something that invites anyone into an animal's past life—to make it truly visible as it once was. I guess preparation and restoration don't begin with my hands; they begin in my mind's eye.

**Why is BHI's work so top-notch?**

The advantage we have comes from seeing a whole lot of specimens in a wide range of environments. We have learned to look at fossils from a perspective beyond paleontology. We're paleontologists—and anatomists, and technicians. This combined perspective informs our work from start to finish.

I believe it also gives us a deep understanding of the dynamics of fossil preservation, the anatomy of various species, and the fossil record as a whole. It also allows us to make skeletons that are more anatomically correct. They're not just a bunch of bones strung together; you can easily imagine flesh on them. They're planting their feet and pushing off the ground. They're running or fighting. They look alive.

**Is it different to prepare specimens for academic study as compared with public display?**

Maybe a research specimen seems too fragile to place on exhibit, or it just isn't interesting to the casual viewer; in those cases, an institution might choose to keep it in the collections. But let's be clear: in the right hands, even a very fragile fossil can be carefully prepared so that its most intricate details are visible to the public. The two approaches are complementary, and both are valuable. Still, what we do best engages the most advanced techniques in our field to allow a fossil to be displayed for the public. It's protected and reinforced; it can withstand the trip to its new home, and will stand strong for decades.

**Investors ask about a company's three-year plan, or maybe their five-year plan. How far ahead are you looking?**

Fifty more years! BHI—including our current museum—is already a popular destination for both researchers and the public, and we're an important resource for museums around the world. But this important anniversary launches us into a new era. I see the company continuing to do work for other museums, but also placing our own museum more in the

forefront of our efforts. More of the objects we've collected and saved will be prepared for exhibit. And we'll be able to conduct lots more research, too.

We want to be a window to the past like no other museum has done—by looking particularly at the end of the age of dinosaurs. It was an important point in time, and it's preserved all around us. We have a unique opportunity to reconstruct that time like no one else, from the largest dinosaur in existence to the tiniest insect. You'll see creatures that watched the asteroid fall and perished because of it—or lived through it solely by chance.

**Tell us about your facilities expansion.**

Part of our anniversary involves our acquisition of the property next to our current museum. We're exploring a design for a new facility there to more generously house and display our collection—and look forward to community conversations about how our building can fit into our neighborhood. We're also building more storage next to Rex Hall—which will allow our preparation facilities to be more efficient and provide more room for collections. At the moment, our *Brachiosaurus* bones are taking up half the mounting bay!

BELOW: Artistic renderings of one potential design of the future museum expansion in Hill City. Illustrations © 2023 Michael Berglund.





How a museum “talks science”

# BRIDGING THE GAP

The first 50 years of BHI have been full of discoveries, triumphs, tragedies, growth, and scientific breakthroughs. In the next 50 years, we hope to build upon our past successes. With every breakthrough and every piece of new information about the ancient creatures we study, our responsibility grows. It’s our job to find innovative ways to share not only *what* we know, but what it *means*.

It’s been easy for Pete and his dedicated team to think about science—to spend countless hours, months, years in the field. And, as unusual as it’s been to display a wild herd of fossils in Hill City’s old gym building, the team realized its collective dream of building a fantastic, cutting-edge museum facility. Now, it’s easy to imagine busloads of children running (I mean, walking carefully) through the displays.

However, as our plans unfold to expand our museum—quadrupling our physical exhibit space—we’re also thinking about *people*. One of our first moves to get ready for the public is called Alex Ruger.

Alex, who has a broad level of education and paleontological experience, is more than a smart guy. He’s also...fun. I take a lot of joy in watching the people Alex is talking to—because you can watch them get excited with him. He’s equally engaging with children and elders—and I’ve even seen him make a teenager smile.

It became clear once we saw what Alex could do with his education and talents, that he should become our brand new Science Communicator. His role will connect our research network to the public. He’ll “connect the dots” of paleontology and education.

BHI’s staff have always been some of the most highly trained excavators and preparators in the world. In the 1970s and 80s, the company’s paleontologists hired locals with “hand skills,” like knitters and

mechanics. Their natural abilities translated to fossils.

Today, while the staff is still populated by seasoned experts who exhibit some of the best paleo skills in the world, BHI also boasts its most educated staff to date. Several staff members have earned graduate degrees in physical and natural sciences. And the company continues to participate in research projects and scientific publications.

Our museum was built upon the excitement and fascination that can only be had by discovering a new thing, finding something no one has seen before. Alex is an expert at sharing not only facts, but a greater understanding of joy that comes with the work we do. People, especially children, walk away from his presentations happier than they were before they met him, and certainly more knowledgeable as well.

Our museum’s current education program can host groups of up to 40 on scheduled tours with Alex. We have also developed some special presentations for smaller groups. For more information about educational opportunities, please email [education@bhigr.com](mailto:education@bhigr.com). And Alex will answer you personally!

**In order to share this knowledge with our visitors, Alex has to be conversant in the complexities of paleontology, geology, biology, the vast time scales of the fossil record, and the stories behind the specimens we have on display. And inherently, he understands Pete’s history of “yes.”**

by ADAM WEAVER



by PETER LARSON

It seems like only yesterday. Three other students from the School of Mines explored with me the audacious idea of starting a business. Our purpose was to take a joyful avocation and turn it into our job. Fifty years have passed, in the blink of an eye.

When I turned 70, almost two years ago, I started telling a joke that I’ve repeated ever since. “Almost a third of my life has passed,” I said, “and if we’re going to realize our dreams, we’d better get started.” A few months ago, our board of directors did just that: We made the decision to spend an extravagant amount of money to purchase a little motel next door to our main building on Main Street in Hill City. We’re expanding our museum. It’s a dream we’ve had since...forever.

This one, like all dreams, isn’t happening on its own. And while we’ve been working hard for a long time, we didn’t accomplish this on our own, either. We work hand-in-hand with the landowners who allow us access to their property. We share a passion with collectors who buy fossils and minerals from our business, and museum staff who hire us to create exhibits to grace the halls of venerable institutions, both large and small.



MY FAVORITE TIME OF DAY

# Show & Tell

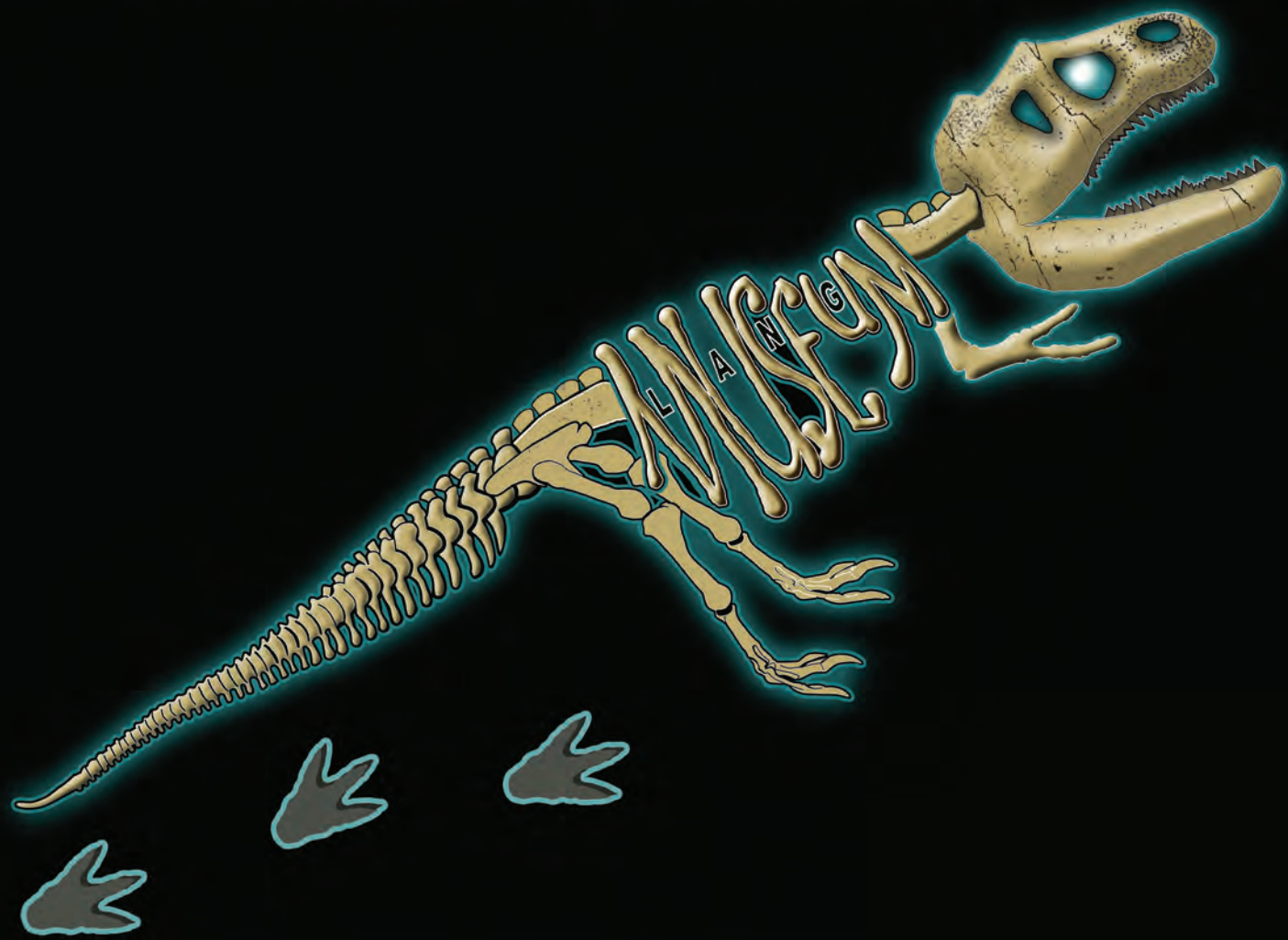
But most of all, this long-standing dream is coming true because of all the people who have worked tirelessly as BHI employees. It’s incredible to look at the list in the front of this publication—more than 200 names. These folks have shared their artistry, devotion to the work, and enduring love of fossils and minerals. Many of our preparators have become the best in the field. Their work has changed the face of paleontology. It has changed our understanding of individual characters in specific specimens and entire species; it has provided snapshots of these extinct organisms as living entities.

These workers have forged our path into the future—and they continue to touch the lives of thousands and thousands of museum visitors around the world. When I’m standing in one of those museums—next to one of our mounts—or at an active excavation, nothing gives me more pleasure than hearing a child say, “whoooooo!” That, to me, is why we do what we do.

That is pure *joy.*



The Lang Museum would like to Congratulate the Black Hills Institute of Geological Research on 50 years of passion, hard work and dedication. Inspiring adults and children all around the world, and fostering their love for science. Your contributions have been invaluable.



To Pete Larson and the staff at the Black Hills Institute: Thank you for your continued guidance and support, and most importantly your friendship.

# Here's to 50 Years

Your Friends,



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