

## *Dinosaur Wars*

### *Program Transcript*

**Narrator:** For more than a century, Americans have had a love affair with dinosaurs. Extinct for millions of years, they were barely known until giant, fossil bones were discovered in the mid-nineteenth century.

Two American scientists, Edward Drinker Cope and Othniel Charles Marsh, led the way to many of these discoveries, at the forefront of the young field of paleontology.

**Jacques Gauthier, Paleontologist:** Every iconic dinosaur every kid grows up with, *apatosaurus*, *triceratops*, *stegosaurus*, *allosaurus*, these guys went out into the American West and they found that stuff.

**Narrator:** Cope and Marsh shed light on the deep past in a way no one had ever been able to do before. They unearthed more than 130 dinosaur species and some of the first fossil evidence supporting Darwin's new theory of evolution.

**Mark Jaffe, Writer:** Unfortunately there was a more sordid element, too, which was their insatiable hatred for each other, which often just baffled and exasperated everyone around them.

**Peter Dodson, Paleontologist:** They began life as friends. Then things unraveled... and unraveled in quite a spectacular way.

**Narrator:** Cope and Marsh locked horns for decades, in one of the most bitter scientific rivalries in American history. Constantly vying for leadership in their young field, they competed ruthlessly to secure gigantic bones in the American West. They put American science on the world stage and nearly destroyed one another in the process.

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In the summer of 1868, a small group of scientists boarded a Union Pacific train for a sightseeing excursion through the heart of the newly-opened American West.

Among them was O.C. Marsh of Yale, America's first university professor of paleontology. Looking out the window, Marsh was transfixed. While his fellow passengers saw magnificent landscapes, Marsh saw much more.

Schooled in geology, he knew that great troves of prehistoric fossils could be buried in the ancient rocks. "I felt that entombed in the sandy clays," he recalled, "... there must be hidden the remains of many strange animals new to science, long waiting to be brought to life." Here was a chance to establish his reputation while working on the greatest scientific problem of the age.

Charles Darwin's revolutionary work, *On the Origin of Species*, had been published in England only a few years earlier. But Darwin despaired that little physical evidence of evolution could be found in Europe, where the heavily forested land concealed the geology underneath. The arid, open American West, Marsh was convinced, would yield the kind of fossil evidence needed to prove Darwin's theory.

**Bob Bakker, Paleontologist:** The American West is blessed by a couple of things. Number one, a long history of mountains going up. When mountains go up the, next to the foothills of the mountains are a depression, a basin. And as soon as mountains go up they start getting eroded by streams. The streams bring down sand and mud that fills up that basin at the bottom of the foothills.

That's a wonderful place to die and leave a good-looking corpse. But wait! There's another element. It's dry! It's really dry. It's drier than the Alps or the Urals. It's drier than the Caucasus. So when you could take the railroad to Wyoming, Colorado and New Mexico, you

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walk around, you'll see the rocks, naked rocks. And the rocks are full of fossils, including bones.

**Narrator:** Marsh collected little on this first trip, but like a prospector who'd just caught a glimpse of the mother lode, he vowed to return. Next time he'd bring a work party, prepared to hunt for bones in the richest fossil fields on earth.

O.C. Marsh was not the only one thinking about the deep past in 1868. In Philadelphia, at the Academy of Natural Sciences, the world's first mounted dinosaur skeleton went on display. It was called *hadrosaurus* - a creature said to have gone extinct millions of years ago, and so unlike anything in the modern world, it challenged the biblical story of creation.

Now, barely three years after the end of the Civil War, it seemed that everything in America, even the story of the prehistoric past, was up for grabs.

**Steven Conn, Historian:** Americans in the middle of the 19th century experienced two revolutions simultaneously. One, of course, is the Civil War, and that changes everything about the country politically, economically, socially. And the other is scientific.

The idea that the world hasn't always been like it is... today, in fact, where we might be standing right now was completely different ten million, 100 million, 400 million years ago, is a really powerful, fascinating, thrilling idea for people.

**Narrator:** The *hadrosaur* had been unearthed in a quarry in Haddonfield, New Jersey, and assembled by a group of scientists that included a 28-year-old Philadelphia Quaker.

Edward Drinker Cope had already made a name for himself with the discovery of the second known American dinosaur skeleton, a creature he named *Laelaps*. A self-taught prodigy, he'd been captivated by science since childhood.

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**Peter Dodson, Paleontologist:** Cope took a great interest in natural history. And at a very young age, he gained admission to the Academy of Natural Sciences, which was not open to the public in those days. And he would make drawings of *Ichthyosaurus* and *Plesiosaurs* from the time that he was nine years old. He was a brilliant fellow.

**Narrator:** Cope haunted the Academy through his teens, learning anatomy, organizing collections of fish and snakes, developing a passion for fossils.

Like his mentor Joseph Leidy, the discoverer of *hadrosaurus* and America's first paleontologist, Cope was a gentleman naturalist -- following in the footsteps of Benjamin Franklin and Thomas Jefferson, men deeply devoted to understanding the natural world.

**Steven Conn, Historian:** None of them have what we would regard as a credential or advanced training. They have no PhDs because American colleges are not granting PhDs. Cope is part of that older gentlemen's world.

**Narrator:** That fall, Cope received a letter from Professor Marsh at Yale, whom he'd befriended a few years earlier when they were both in Europe. Now the professor wanted to see the quarry where the *hadrosaur* had been found, and Cope was happy to oblige.

**Peter Dodson, Paleontologist:** Cope took Marsh on a field trip to visit the various quarry operations in southern New Jersey. And, they parted on good terms, and Marsh went back to New Haven. But after that trip, Cope's fossil supply dried up.

**Narrator:** It soon became clear why. Marsh had made a deal with the quarry owners to send any new discoveries to his lab at Yale College.

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**Mark Jaffe, Writer:** Cope was quite put out. He had taken Marsh out. He'd introduced him to people and the next thing he knows he feels, behind his back, Marsh is stealing bones from New Jersey.

**Steven Conn, Historian:** Marsh is not part of that older 19th century gentleman's world of natural science. He doesn't feel bound by those unwritten rules. He operates in an almost businesslike way, much more aggressively. He sees an opportunity in Haddonfield; he grabs it.

**Narrator:** The episode at Haddonfield cracked the veneer of Marsh and Cope's early friendship... a fracture that would deepen a few months later in Philadelphia.

Cope had been reconstructing the skeleton of a prehistoric marine reptile from a jumble of disconnected bones. He named the creature *Elasmosaurus*, and soon published an illustrated account of this unusual new species with its long tail and very short neck. It was, Cope believed, work that would propel him to the top of his field. But when Professor Marsh came to see the results, it was clear to him that Cope had misread the anatomy and put the skull on the wrong end of the skeleton.

**Jacques Gauthier, Paleontologist:** Cope puts the head on the tail. You know, Marsh was not gonna let that get by.

**Narrator:** Cope's mentor Joseph Leidy confirmed that the reconstruction was flawed. Cope tried desperately to retract the publication and cover up his mistake, but it was too late.

**Mark Jaffe, Writer:** Cope was mortified. And Marsh made sure that everyone knew that Cope had muffed the great *Elasmosaurus*.

**Narrator:** "His wounded vanity received a shock from which it has never recovered," Marsh later wrote, "and he has since been my bitter enemy."

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In the summer of 1870, Professor Marsh headed west again, leading the first scientific fossil-hunting expedition on the western frontier. The railroad now stretched all the way to California, but this was still the Wild West. Marsh and his party stayed close to military forts for provisions and protection from hostile Indians. His entourage included a crew of students from Yale College, whose families covered most of the \$15,000 cost of the expedition.

**Jacques Gauthier, Paleontologist:** When you look at the picture of them getting ready to go and they're all totally cowboied out. They're the scions of these great industrialist families, you know, who never had a cowboy hat on in their life, dressing up with chaps and spurs and John B. Stetson and you know, the whole thing. Their first guide on their first trip out there was Buffalo Bill.

**Narrator:** Marsh was a skilled self-promoter, who made sure the adventures of the Yale fossil hunters filled the pages of Harper's Monthly. They braved prairie fires, storms, and encounters with Indians. And they unearthed tons of prehistoric bones from the ancient hills. It would take months to sort through the hundreds of specimens they collected, but Marsh had already accomplished his primary goal. He had staked his claim to the fossil fields of the West. And he had no intention of sharing them with anyone.

**Steven Conn, Historian:** This is the age where the model of business is to establish a trust. And Marsh wants to create the fossil trust, using Yale as its headquarters.

**Narrator:** From Philadelphia, Edward Cope had been following Marsh's adventures with interest... and envy. He was desperate to get in on the fossil bonanza, but -- unlike Yale -- the Philadelphia Academy did not mount expeditions. It was still an association of gentleman naturalists that depended on amateurs to send in fossils.

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Cope wrote to geologist and explorer Ferdinand Hayden, who now led one of the government survey crews mapping the West. In 1872, Hayden offered to outfit a fossil hunting trip for Cope if he could get himself to Fort Bridger in Wyoming. Marsh had been there the year before and published papers on his discoveries -- a trove of fossils from the early age of mammals. Cope was sure he could do better.

**Mark Jaffe, Writer:** Even back then scientists measured themselves by publication. And it's clear to Cope that there was just great fertile material out there.

**Narrator:** But when he arrived at Fort Bridger, he found that Hayden's survey crew had already moved on, taking all the available horses and mules. Undaunted, Cope cobbled together a crew of local men, wagons and pack animals, and set out into the Bridger Basin Badlands, unaware he was being watched by Marsh's spies. When news of Cope's expedition reached New Haven, the Yale professor was furious. Cope was poaching on what Marsh considered his territory. He immediately packed up and headed west.

By chance, Joseph Leidy was bound for Wyoming as well, on a fossil hunting trip of his own. The West, it turned out, would not be big enough for the three of them.

Cope had the site to himself for a time, and the Badlands lived up to the name. He was plagued by blood-sucking gnats, bad water, fever and nightmares. Still, he worked every day from sunup until dark, looking for trails of loose bone leading to skeletons still embedded in rock. Within a few weeks, Cope realized he was not alone; that Leidy and Marsh were hunting fossils as well. And soon, they all began finding the bones of a truly bizarre creature.

**Bob Bakker, Paleontologist:** It was a fantastic beast that looked like it was made up for a... Hindu mythology! It was as big as an elephant. It had saber teeth, gigantic fangs, but it was a plant eater, but had horns, six of them in two rows. It was unbelievable.

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**Narrator:** Eager for the prized right to name a new species, each scientist rushed to be the first to get his findings into print.

Cope dashed off a quick paper by telegraph from Wyoming. Marsh did the same. But Joseph Leidy beat them both, giving him priority to name the beast: *Uintatherium robustum*. But that didn't stop Cope and Marsh. Fueled by a toxic mix of rivalry and professional greed, they continued to name new species of the same creature with very little evidence that the discoveries were unique.

**Bob Bakker, Paleontologist:** They were finding these same saber tooth Hindu monsters, and they just took a hold of their brains. They were rushing short papers into print; not well thought-out papers. Neither of them read each other's papers. Cope would name another species and Marsh would name five species. And pretty soon Cope and Marsh were ignoring Leidy's work. He was the first one in. This is what I call taxonomic carpet-bombing. There were two dozen names thrown at one species.

**Narrator:** It would take decades to untangle the mess they made at Bridger Basin. But it took no time at all for Marsh to declare war on Cope.

**Mark Jaffe, Writer:** What followed that winter and into the next spring was a relentless effort by Marsh to discredit all of Cope's names and findings.

**Narrator:** The quarrel began with legitimate questions about whether species named by Cope had already been named by Marsh.

But it quickly escalated to personal attacks in scientific journals -- accusations of fraud, false dates on papers, even theft of fossils -- a war of words like nothing ever seen before in the staid world of American science.

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**Jacques Gauthier, Paleontologist:** Let's face it - famous scientists are not successful because of their capacity to... to get along all together. Because, I mean, really, to be good and find new things, it's "I'm right, and you're wrong."

**Narrator:** Colleagues were appalled. Joseph Leidy most of all. He could see that paleontology was moving beyond the reach of gentleman naturalists. Staying in the game would require deep pockets, institutional support, and a willingness to compete with the likes of Cope and Marsh.

**Steven Conn, Historian:** Leidy is quintessentially that figure of the old natural history. He's bound by a different set of scientific ethics. He realizes that these two guys are playing a very different sort of game, operating in very different kinds of ways. I just don't think he has the stomach for it.

**Narrator:** Leidy left Cope and Marsh to fight it out in the scientific journals of the East and the fossil fields of the West.

**Steven Conn, Historian:** What Cope and Marsh see here is now a wide-open field, something that has never been done before, on a scale that has never been done before. But, the question is not, "How do we divide this up?" The question is, "How do I shut out my competitor?"

**Narrator:** Back in New Haven, Professor O.C. Marsh presided over a well-funded scientific empire, centered at the Yale College Museum, which had been founded by his millionaire uncle and benefactor, George Peabody.

**Steven Conn, Historian:** Marsh has this really quite extraordinary career at Yale. It gives him an institutional home. It doesn't pay him a salary. Which means he doesn't really have to answer to people if he doesn't want to. He's got his own money.

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**Narrator:** Marsh didn't always have money. As a boy, he lived on a farm in rural New York, with little hope or ambition.

**Mark Jaffe, Writer:** His father, Caleb Marsh, saw his son Othniel, as basically the major farm hand. And then suddenly he's plucked from obscurity by his uncle, George Peabody, and staked to an education at Andover, Yale and German universities. It was like a Horatio Alger story.

At Yale, he grew into an imposing figure with influence and connections, but few friends and no family of his own. He spent a fortune building a lavish home in New Haven, where he entertained important guests, but lived alone his entire life.

**Mark Jaffe, Writer:** It's a stunted life, I think in many ways, emotionally. And that one sees time and time again for the rest of his life.

**Narrator:** Inside the museum, Marsh earned respect but little affection. Lab assistants grumbled about slow paychecks and lack of credit for their work. The credit, they learned, always went to the Professor.

Marsh ran a secretive operation, keeping the greatest fossil collection in the world off limits to nearly everyone, even fellow scientists. He would soon make a significant exception. In August 1876, a distinguished visitor from England arrived by steamship in New York City. Thomas Henry Huxley was one of the world's most renowned scientists -- a brilliant biologist, and a passionate defender of Darwin's theory of evolution. Huxley traveled straight to the Yale College Museum, where Professor Marsh claimed to have fossil evidence that would prove Darwin right. Since his first trip west, Marsh had been piecing together the 50 million year evolution of the horse, from a fox-sized creature with four toes to the modern animal with its single hoof.

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**Mark Jaffe, Writer:** He had meticulously and compulsively collected horses so that by the time Huxley comes to visit Yale, Marsh has 33 different species of horse in three different families. And there it was, the chain, almost unbroken. And Huxley was in awe.

**Narrator:** Then Marsh brought out another fossil -- a prehistoric bird... with teeth -- something no modern bird has -- suggesting that birds arose from reptilian ancestors. Here was more support for Darwin. And more acclaim for O.C. Marsh.

**Mark Jaffe, Writer:** And Huxley said, "you are a conjurer, for whatever I ask you produce." That moment was big for both Marsh, and for Huxley, and for the theory of evolution.

**Narrator:** Darwin himself wrote Marsh an appreciative note, calling Marsh's work "the best support to the theory of evolution which has appeared within the last 20 years." Marsh's fossils were putting American science on the map.

**Steven Conn, Historian:** Americans have always felt inferior to Europeans; culturally, politically, economically. Finally, paleontology seems to be the place where we can be better than the Europeans.

**Narrator:** While Marsh basked in the glow of professional acclaim, Cope was thriving too. The death of his father left him with a sizeable inheritance. Now, he could finance his own fossil hunting expeditions, and compete with Marsh head to head.

In the summer of 1876, leaving his wife and young daughter behind in Philadelphia, Cope set out for the desolate bone fields of Montana -- just weeks after Custer's defeat at Little Big Horn.

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**Peter Dodson, Paleontologist:** And he was absolutely warned. "Don't do this. Bad idea."

**Narrator:** In the town of Fort Benton, Cope tried to hire a crew to help him in the field, but found no takers. The local men strongly advised him to carry a gun.

**Peter Dodson, Paleontologist:** But Cope was a Quaker, he was a pacifist, he didn't believe in violence. And so he wouldn't hear of it.

**Bob Bakker, Paleontologist:** Cope loved being in the field and he took risks. He would go out to the Judith River country in Montana and go hiking up these ravines where the horses nearly fell to their death. He would be warned of Lakota war parties, of Sioux warriors. He didn't care.

**Narrator:** The fossil hunting, he wrote his daughter, Julia, was very good indeed.

"We find in the high rocks there are many bones and teeth of huge fossil reptiles like *Laelaps* and *Hadrosaurus*... They were as large as elephants, but their teeth were very small, no larger than the end of my little finger..."

Cope made one discovery after another, turning out papers at a rate that would make him the most prolific author in American scientific history. Somehow, Cope could look out at the rocks and see the unfolding story of the deep past.

**Bob Bakker, Paleontologist:** He could show how you could start with an animal like *Phenacodus*, this mammal that looked a little like a sheep with the toes of a raccoon, and very reasonably evolve and tinker with the feet and the teeth and you could get a horse, you could get a rhino, you could get a tapir, you could get an antelope. He showed how small increments, Darwinian increments, could generate the whole tree of life.

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**Steven Conn, Historian:** Cope is maybe the first paleontologist who can take all of this dusty material coming up out of the ground and begin to imagine what it really looked like, how it functioned, how it moved, how it related to its natural environment. That leap of imagination, Cope was quite brilliant at.

**Narrator:** "My camp," he wrote Julia, "is on Dog Creek ten miles from the mouth... It rained two days ago and we had to stay in the tent and wagon. The creek rose very high and the water got so muddy that we had to boil it before we could drink it. Then the high, bare badlands bluffs got slippery as soap so that we could hardly hunt for fossils, but slid around and got all muddy. But the creek is down and the bluffs are dry. Now, farewell. Read and learn all thee can, for the more thee knows the more useful thee will be. So say thy loving Papa."

**Mark Jaffe, Writer:** Cope is a complicated character. He has great warmth. People who were his friends loved him. And yet on the other hand he had this irascible, thin-skinned, quick on the trigger personality. One of his Philadelphia colleagues called him a militant paleontologist. Four years had passed since the "militant paleontologist" had clashed with the Yale professor over Bridger Basin. During that time, the two rivals had barely exchanged a word. But hostilities were about to break out again over the bones of the largest creatures that ever lived.

In the spring of 1877, in the foothills above Morrison, Colorado, an amateur painter and fossil hunter and named Arthur Lakes stumbled on something astonishing.

**Bob Bakker, Paleontologist:** He comes over the Hog Back, over the sharp ridge, and he sees gigantic bones in hunks of river sandbar sediment. Bingo.

**Narrator:** In a letter to O.C. Marsh, Lakes wrote of bones "so utterly beyond anything I had ever conceived possible that I could hardly believe my eyes."

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**Bob Bakker, Paleontologist:** These vertebrae, neck bones, were a yard or more across. A single bone! And the leg bones were, you know, you couldn't wrap your arms around them they were so big.

**Narrator:** Lakes was a freelancer, looking for money for his find. He shipped a few dinosaur bones to Marsh in New Haven -- and few to Edward Cope in Philadelphia.

**Bob Bakker, Paleontologist:** As soon as the first lot arrived it was clear that these were new species, new families of species, a new slice of evolutionary time, the late Jurassic that no one had ever seen before.

**Narrator:** Marsh tried to stake his claim, putting Lakes on the payroll and sending men to Colorado to keep Cope out of the way. But it was too late; Cope already had collectors of his own harvesting similar giant bones nearby. Then Marsh learned of an even bigger find from a fossil hunter working at Como Bluff, Wyoming.

Along the base of the ridge, less than half a mile from the Union Pacific tracks, was a truly extraordinary cache of Jurassic bones. They extended for seven miles, he was told, and were by the ton. Cope and Marsh had passed Como Bluff on the train more than once. But what looked like rocks from a distance were actually chunks of fossil bone marking the greatest dinosaur graveyard the world has ever known. Again, Marsh tried to lock it up, and again, he was too late.

Cope had also heard about Como Bluff and soon opened quarries of his own. Determined to stay ahead of Cope, Marsh kept his men working straight through the winter. Arthur Lakes wrote about "finger-numbing cold... 25 to 30 degrees below zero."

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**Peter Dodson, Paleontologist:** Working in the winter just seems utter madness. Paleontologists with rare exception do not subject themselves to this sort of abuse anymore.

**Narrator:** The conditions were grueling, but the results were spectacular.

**Bob Bakker, Paleontologist:** Within a few months you had four separate digs producing hundreds of bones, dozens of skulls and skeletons of the late Jurassic. It was Jurassic Park, finally. These Jurassic critters are a world like none before, none after. The average size of a plant eater was multi-ton, five, six, seven tons. Many of the plant eaters go 100 feet, 120 feet, as big as 10 elephants, 20 elephants.

**Narrator:** The frenzied efforts of Marsh and Cope revealed a lost world... an unknown era in the history of life, 150 million years ago when the high prairie was a lush forest. Between them, Cope and Marsh discovered over a hundred types of dinosaurs, including *stegosaurus*, *allosaurus*, *apatosaurus*, *camarasaurus* -- some of the largest animals ever to walk the earth.

**Bob Bakker, Paleontologist:** These weren't just big lizards. They weren't just big cold-blooded critters, they were something else. They were full of bird-like features, mammal-like features. This was the highest level of the reptile line.

**Narrator:** The fantastic discoveries made Marsh and Cope even more protective of their quarries. Convinced his rival was stealing bones, Marsh exchanged coded telegrams with spies who kept an eye on Cope -- code named, "Jones." And most egregious of all, Marsh ordered his collectors to destroy fossils to keep them away from Cope.

**Mark Jaffe, Writer:** If you can't take the bones, smash them. Don't leave them so they could fall into somebody else's hands.

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**Narrator:** Their frantic competition for bones had pushed the two scientists to the brink. Cope's very existence tormented Marsh. He could sometimes be heard shouting, "Goddammit! I wish the Lord would take him!"

**Bob Bakker, Paleontologist:** There is a little bit of the hunt for gold in hunting for bones. And that's called the Fred C. Dobbs syndrome from Humphrey Bogart's character in *Treasure of Sierra Madre*.

**Fred C. Dobbs (Humphrey Bogart):** "...if ya know what's good for ya, ya won't monkey around with Fred C. Dobbs. "

**Bob Bakker, Paleontologist:** He wants his gold and he wants his partner's gold and he's sure that his partners are going to try to steal his gold.

**Fred C. Dobbs (Humphrey Bogart):** "You make another move toward me and I'll pull the trigger."

**Bob Bakker, Paleontologist:** And at the end he becomes murderous.

**Fred C. Dobbs (Humphrey Bogart):** "Now get your hands up. Come on, get 'em up! "

**Bob Bakker, Paleontologist:** And that happened to Cope and Marsh. There were more than enough bones for both of them. More than enough bones for a dozen more, but they kept on seeing that your win is my loss.

**Narrator:** In November 1878, in New York City, the National Academy of Sciences met under the leadership of its new president, O.C. Marsh. The Academy had been asked to advise Congress on the future of the government surveys that had been mapping the West since the end of the Civil War.

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**Mark Jaffe, Writer:** There had been multiple surveys of the West run by multiple departments of the government. There was some competition and overlap and it was felt that the surveys had to be consolidated.

**Narrator:** Cope had long been linked to the Hayden survey, best known for the exploration of what recently had been named Yellowstone National Park. Marsh joined forces with John Wesley Powell, the explorer of the Colorado River, and a leading advocate of government-sponsored scientific planning in the settlement of the West.

**Steven Conn, Historian:** Powell has a vision for how science can be used to shape the American future, especially the American West. But, in order to do that, is gonna mean an enormous expansion of the federal role in the funding of science. In order to make that case, he has to rely on Marsh, who, at this point, may well be the preeminent American scientist operating.

**Narrator:** In 1879, Congress consolidated the competing surveys into one nationwide organization. The U.S. Geological Survey would be headed by Powell, who soon appointed Marsh America's Chief Paleontologist.

O.C. Marsh was now exactly where he wanted to be. He had nearly unlimited government funding. A staff of 50 people from bone collectors to lab assistants, and a generous annual salary. He was finally in a position to get rid of his nemesis Edward Cope, once and for all.

**Steven Conn, Historian:** The surveys provide not only information, they provide a venue to get your scientific ideas out. If there are lots of different venues, then there can be lots of different voices. If there's only one venue, and it's controlled by your archenemy, it means that, that venue has just been cut off to you. This is actually where the Victorian melodrama begins.

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**Narrator:** Without government sponsorship, and with his inheritance dwindling, Cope needed money. In desperation, he invested his savings in a mining venture in New Mexico.

**Mark Jaffe, Writer:** Many of these mining companies, the only thing they're mining is investors. And for Cope it's disastrous. He loses a ton of money, going from being relatively comfortable to becoming downright poor.

**Narrator:** He applied for jobs at Princeton, the Smithsonian, even the Central Park Zoo, with no success -- and was forced to rent out the family home in Philadelphia. By 1889, Cope was separated from his wife, and living in a cramped apartment with nothing left but his beloved fossils. And if O.C. Marsh had his way, Cope would soon lose those as well.

Years earlier, Marsh had inserted language in the Survey's charter mandating that all fossils collected with government funds be turned over to the Smithsonian. He'd made a deal with Powell to keep his own collection at Yale, but he knew that Cope had no such protection.

**Timothy Rowe, Paleontologist:** Marsh said, well those things in Cope's hands have been paid for by federal dollars, so they belong to the Smithsonian. And so Marsh went to the Secretary of the Smithsonian and he said, "let's take them."

**Narrator:** Cope fought back. He produced detailed records going back twenty years proving that he'd paid for most of his collecting out of his own pocket.

**Timothy Rowe, Paleontologist:** He saved every bloody receipt. Cope is able to say, 'here's how I've spent the government money and here is how I've spent my own fortune,' which was at least ten times what the government had invested.

**Narrator:** Cope managed to hang on to his fossils, but now he wanted revenge....

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**Timothy Rowe, Paleontologist:** Cope went ballistic. I mean Cope became hysterical. Cope was, just completely went off his rocker.

**Mark Jaffe, Writer:** Over the years, Cope had been collecting bits and pieces about Marsh and Marsh's ill-doings -- what he called his Marshiana. And he finally took his Marshiana and handed them over to a freelance journalist.

**Narrator:** On a Sunday morning in 1890, the long-running feud between America's top paleontologists spilled onto the streets of New York City. In the pages of the New York Herald, Edward Cope accused O.C. Marsh of plagiarism, incompetence, and fraud spanning more than 20 years.

**Mark Jaffe, Writer:** Cope's criticisms are very scattershot, they're sort of all over the map. Maybe some that are true, maybe some that are half-truths, maybe some that are not true at all.

**Narrator:** He also accused John Wesley Powell of corruption and misuse of government funds at the U.S. Geological Survey.

**Steven Conn, Historian:** Newspapers have always loved scandals. They've always loved political scandals. But, the notion that you could turn dinosaurs into scandal is pretty new.

**Narrator:** Marsh and Powell fought back, calling Cope a liar and a thief. The public war of words dragged on for three weeks until the Herald ran out of material. But the scandal left O.C. Marsh in a vulnerable position.

In Washington, Cope's allegations of corruption at the Survey caught the attention of politicians eager to slash federal support for the institution. Under John Wesley Powell, the

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USGS had grown into an exceptionally powerful agency, one that united science and government in unprecedented ways. It was an alliance that worried many in Congress.

**Timothy Rowe, Paleontologist:** Some of the Congressmen were aghast to think that the federal government, that the United States of America, was paying more for science than any other nation in the world.

**Narrator:** They took aim at the department of paleontology, headed by Marsh, who had spent government money collecting fossils and publishing expensive books.

**Timothy Rowe, Paleontologist:** One of the pieces of work that came to the attention of Congress was a book entitled *Odontornithes*, and that means "birds with teeth."

**Narrator:** It was among Marsh's greatest scientific achievements -- some of the best fossil evidence of evolution. But to his critics, it was evidence of something else -- a waste of taxpayers' money.

**Mark Jaffe, Writer:** There's one Congressman -- Hilary Herbert from Alabama -- who just never saw any good in this science stuff. And Herbert on the floor holds up this book, what are we doing financing books about birds with teeth?

**Narrator:** Using "Birds with Teeth" as a rallying cry, Herbert turned Congress against Powell. Lawmakers cut Powell's budget in half, eliminating the department of paleontology. A terse telegram to Marsh delivered the bad news.

He immediately lost all of his survey funding and staff. He had to mortgage his house to Yale, and ask for a salary to make ends meet. Then he heard from the Smithsonian. Washington now wanted any fossils that had been paid for with survey funds.

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**Timothy Rowe, Paleontologist:** Marsh is literally buried in crates of dinosaur bones and he did not know which belonged to Yale and which belonged to the federal government. There was no catalog. Marsh had not done his accounting properly. He effectively failed the audit. And so Marsh had set this trap for Cope and inadvertently ensnared himself in it.

**Narrator:** More than 80 tons of fossils had to be shipped to Washington -- a small part of Marsh's collection, but a painful loss for a man who had jealously guarded every bone.

**Timothy Rowe, Paleontologist:** His days as being the premiere man of science, the premiere paleontologist, all that stuff was gone. He was basically finished as a man of science.

**Narrator:** The Cope-Marsh rivalry, three decades long, had cost both men dearly. And neither had much time left. By 1897, Cope's health had failed; his body now ravaged by severe kidney disease. In his room in Philadelphia, Cope was treating himself with massive amounts of morphine and belladonna, when he received an unexpected call.

A young artist named Charles Knight implored Cope to help him show the world what dinosaurs had looked like when they walked the Earth. Even though he was close to death, the scientist brought out his private notebooks to help the artist put flesh on the bones he had spent a lifetime unearthing and trying understand.

**Steven Conn, Historian:** For the better part of two weeks, Cope brings the vanished world to life -- how these creatures stood, how they walked across the landscape, what they fed on... that imaginative leap from anatomy to life. In some ways it's the last testament of this paleontologist who only has a little time left.

**Narrator:** When they were finally done, an exhausted Cope asked Knight to help him hide the notebooks under his bed. Even at the end of his life, Cope was sure that if he let down his

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guard for a minute, Marsh would steal his work. A few days later, he was found dead in his room, at age 56.

Marsh didn't last much longer. On a February night in 1899, after a dispiriting trip to the Smithsonian to resolve the fate of his collection, he walked home from the train station in a cold rain, and contracted pneumonia. He died two weeks later, a mere \$186 in his bank account. "I doubt," wrote a colleague, "whether his most intimate friends penetrated the recesses, or really, in any measure understood him." He was 67 years old.

Despite their bitter feud -- or perhaps because of it -- Edward Cope and O.C. Marsh changed the face of American science. Cope left behind a vast body of scholarship, 13,000 specimens, and a broad view of prehistoric life. Marsh left an even bigger fossil collection, including dozens of iconic dinosaurs, and some of the best evidence of evolution.

**Steven Conn, Historian:** Most American paleontological work descends from Cope and Marsh. They really do lay an extraordinary foundation for the work that will go on in the 20th century.

**Jacques Gauthier, Paleontologist:** The fact that these guys got there, took these things out of the ground and put them back where we can maintain them under these museum conditions, it's a great service to all of us. Even if, at the time they couldn't see what was at stake with this stuff, we sure can now.

**Bob Bakker, Paleontologist:** They both were called by the beauty of the big game hunt. The big game hunt in deep time, and that's a very special thing.

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