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The Truth About Lying Stones

On 31 May 1725, Dr Johann Bartholomew Adam Beringer, Dean of the Faculty of Medicine at the University of Würzburg in Bavaria, was given three fossils that had been collected from the slopes of the local hill, Mount Eibelstadt. Two of these stones looked very much like a set of smiling worms and the third was a figure of the sun, complete with rays of light shooting out behind it. These fossils, Beringer quickly and confidently concluded, were no ordinary fossils. And, in fact, history would soon reveal that they weren't really fossils at all.

An ardent naturalist and fervent amasser of all sorts of natural curiosities, Dr Beringer employed a host of Würzburg locals as labourers to collect fossils from Eibelstadt. Over the years, he had filled his personal cabinet of curiosities with local fossils, as well as ones even more uncommon than those found in the Bavarian region. 'I acquired the rarer and choicer specimens since I could not find them in Franconia, from almost all regions of Europe,' Dr Beringer boasted in his eighteenth-century writings, 'either by buying or begging, or by the kindness of my friends and supporters.'

The story of Beringer and his not-real fossils began, then, in May 1725, when three of the 'diggers' he employed – 17-year-old Christian Zänger and the teenage brothers Niklaus and Valentin Hehn – brought the three newly discovered curiosities from Mount Eibelstadt to Beringer's door. Beringer was ecstatic. These fossils, he quickly and confidently surmised, looked so very different from the specimens that normally came

from the Eibelstadt region. (He had plenty of seashell fossils and the like, but nothing as grand as a sun with sunbeams.) Beringer called the discoveries iconoliths – lithology was the study of rocks in the eighteenth century – and encouraged his entourage of employees to systematically work the scree-filled slopes of the hill in the hopes of finding more such treasures.

Over the following summer months, Mount Eibelstadt proved to be a most productive area. Zänger, the Helm brothers and Beringer's other excavators found fossil upon fossil, marvel upon marvel. The original three turned into tens of fossils; tens of fossils turned into hundreds, and hundreds became thousands. Beringer was practically beside himself. Historical estimates suggest that by the time he published his book about the discoveries, *Lithographiae Wirceburgensis*, in the spring of 1726, he had acquired somewhere between 1,100 and 2,000 'fossil' specimens. And all the discoveries were as curiously spectacular as those first fossils.

In *Lithographiae Wirceburgensis*, Beringer reverently catalogued his burgeoning collection:

Here, representing all the kingdoms of Nature, but especially those of animals and plants, are small birds with wings either spread or folded, butterflies, pears and small coins, beetles in flight ... bees and wasps ... worms, snakes, leeches from the sea and swamp, lice, oysters, marine crabs ... frogs, toads, lizards, cankerworms, scorpions, spiders, crickets, ants, locusts, snails, shell-bearing fishes ... shellfish, spiral snails, winding shells, scallops and heretofore unknown species.

Without pausing for breath, Beringer continued:

Here were leaves, flowers, plants, and whole herbs ...
Here were clear depictions of the sun and the moon,

of stars, and of comets with their fiery tails. And lastly, as the supreme prodigy commanding the reverent admiration of myself and of my fellow examiners, were magnificent tablets engraved in Latin, Arabic and Hebrew characters with the ineffable name of Jehovah.

Short of inventorying Noah's Ark, it's hard to imagine a more complete register of life on Earth than what the slopes of Mount Eibelstadt offered to Johann Beringer. Discovering fossils that bore an uncanny resemblance to a sun with a human face, stars, entire frogs that looked rather life-like and, of course, curios that spelled out the name of God quite put something like a fossil seashell to shame. Moreover, with fossils that referenced Jehovah himself, these discoveries were not confined to the mere natural world. Beringer argued that Jehovah's name appeared on rocks as, 'light may somehow have "absorbed" the Hebrew characters from the gravestones (found nearby) and transferred them to the iconoliths of Mount Eibelstadt'.

Beringer was so set on introducing his iconoliths to the world as soon as possible that he took several shortcuts in his analysis. Truth be told, he basically skipped over any sort of study that would have been *de rigueur* in the early eighteenth century. He opted to not consult other naturalists – that is, other experts – about these strange discoveries. Nor did he create a systematic taxonomy of the fossils, or even formal descriptions of what he had discovered.

What Beringer did do, however, was to immediately begin to work on what would become his monograph, *Lithographiae Wirceburgensis*. He even commissioned 21 engraved plates that would illustrate the fossil frogs, shells, birds and comets in his collection. Detailed illustrations of specific specimens under study were an important part of communicating one's observations to one's audiences, and had been since the sixteenth-century Swiss naturalist Conrad

Gesner published *A Book on Fossil Objects, Chiefly Stones and Gems, their Shapes and Appearances* in 1565.

In addition to cataloguing the discoveries, Beringer described several theories about the origin of fossils in general – a question very much of interest to natural historians at the turn of the eighteenth century – thus inserting himself and his iconoliths squarely into active scientific debates. One of the most popular explanations put forward by naturalists was the diluvial theory, which posited that the biblical flood that ‘baptised’ the Earth drove animal and plant remains into the rocks with the torrential force of its currents and waves; in *Lithographiae*, Beringer spent several pages recounting diluvialism for his readers. Beringer also considered the spermatic theories of Edward Lhwyd and Charles Lang, which suggested that tiny sperms of seeds externally fertilised rocks and proceeded to germinate once inside the stones. He pointed out that discoveries like those from Eibelstadt could go a long way to helping resolve the debate about the origin of fossils.

Despite his unabashed enthusiasm for his trove of fossils and his commitment to his work, Beringer found the book to be hard writing. ‘I must confess that I often put down my pen, distracted and worn out as I was by the demands made on me day and night by my duties,’ he wrote in the book’s conclusion, ‘which left me scarcely more than the small hours of the night to compose a work that would be subjected to critical examination by those outside our land.’

Although Beringer never questioned the authenticity of fossil animals that smiled and spelled out the name of Jehovah, other people at the university began to talk. There were whispers that the fossils had a human rather than divine hand in their making. One of Beringer’s colleagues at the University of Würzburg, J. Ignatz Roderick, professor of geography, algebra and analysis, even carved a bit of

limestone in front of Dr Beringer showing him how easy it could be for someone in the here and now of 1725 to craft the stones, then leave them on the slopes of Mount Eibelstadt for Beringer's workers to find.

Obdurate and tenacious, Beringer remained ever faithful to his fossils. For months, he refused to be swayed by detractors like Roderick and Roderick's colleague, university librarian and privy councillor Johann Georg von Eckhart. Roderick and von Eckhart pointed to the knife marks on the rocks around the carvings, and questioned the probability of discovering something like a spider's web so perfectly preserved. Beringer took their qualms in his stride and suggested that those rumourmongers were merely jealous that they had not had his own good fortune to discover and catalogue such treasures of the natural world.

Boldly, Beringer proclaimed in *Lithographiae Wirceburgensis*, 'I have not given way [to these rumours], as the crowning work of this first edition clearly proves. Further, I shall not yield in the future. I am as determined to champion this most righteous cause, as I have been prepared to throw open this new stone collection of Franconia to the whole world.' What luck – what righteous luck! – on Beringer's part to have been the one to find, describe and publish these fossils.

Except, of course, that they weren't fossils at all and never had been. The iconoliths were fakes and, truth be told, not even particularly compelling fakes at that. Alas, Dr Johann Bartholomew Adam Beringer had been duped by a hoax from the moment he had accepted those first 'fossils' from Christian Zänger in May 1725. The perpetrators of the ruse – the eminent Professor Roderick and von Eckhart, the very colleagues who'd tried to dissuade Beringer from his belief in the fossils' authenticity – had simply thought that they'd have a good laugh at

Beringer's expense and humble him a bit, and that the matter would be quickly resolved.

Little did they know that 12 months, a plethora of fake fossils and two court appearances later, the story of Beringer's *Lügensteine* – his Lying Stones as history would be quick to call them – would prove to be anything but simple.

In the first part of the eighteenth century, fossil discoveries were relatively few and far between. While these natural curios had, of course, populated the cabinets of curiosities among the wealthy and educated since the Middle Ages, there were rather few types of specific fossils known among even eighteenth-century collectors. Fossils that showed up in naturalists' collections included the shells of molluscs (like ammonites and belemnites) and sharks' teeth (called glossopterae), as well as a plethora of corals, and plants like crinoids, echinoids and ferns. Perhaps there was the odd vertebrate bone here and there, but these skeletal bits were rare. While many naturalists ascribed these obviously sea-related curiosities to vestiges of the biblical story of Noah's flood, many scholars were interested in building even more robust explanations around fossils and had Beringer's haul been actual fossils, they would have been quite the coup for the burgeoning field of natural history.

It might require quite a bit of suspended disbelief on the part of twenty-first-century audiences to accept that Beringer didn't immediately recognise the artificial and manufactured nature of the stones – artefacts on which knife marks were amply evident, and where the artistry of the stones' carving can be most charitably described as somewhere between 'enthusiastic' and 'rudimentary'. This

begs the question of how and why Beringer was taken in by the fossils in the first place. Just what *were* fossils – legitimate fossils – to him and other eighteenth-century naturalists? And how did Beringer's curios differ?

Among Beringer's contemporary naturalists, 'fossils' had a variety of meanings, and many things were described as 'fossils' that simply would not be fossils in contemporary palaeontological parlance. Historically, many naturalists used the term exclusively to describe stones that resembled plants and animals. A few expanded the term to include what would be called archaeological finds today. The word 'fossil' came from the Latin *fossa* and simply referred to objects that had come from the ground. This could include rocks, coins and 'figured stones' that looked like plants and animals, as well as gemstones; this is certainly what comprised 'fossils' collected by seventeenth-century scholars – well before Beringer's time.

'The problem was not to decide *whether* "fossils" were organic in origin or not, but to decide *which* were the remains of organisms (or parts of them),' eminent British geologist and historian of science Martin J. S. Rudwick explains in *Earth's Deep History: How It Was Discovered and Why it Matters*. 'The question was, in which "fossils" was the resemblance to plants or animals due to their origin as part of such living beings, and in which others was any resemblance accidental or a matter of chance?'

This gets at the very question of how history, antiquity and nature act together, and how these three things were foundational in the then-developing discipline of natural history. 'Only those ['fossils'] that were truly organic in origin could be regarded as nature's own antiquities, and therefore be used to supplement, or even replace, other forms of evidence about the *history* of humanity and its terrestrial environment,' Rudwick notes. In other words, by the time Beringer was collecting his genuinely authentic

fossil seashells as well as the faux Eibelstadt artefacts, fossils were generally taken to refer to organic remains of things that were not made by humans, although the origin of fossils was still very much under debate. In 1735 – 10 years after the story of Beringer's fossils – Swedish naturalist Carl Linnaeus published the first edition of *Systema Naturae*, offering naturalists a systematic means of biological nomenclature and a method for organising the natural world. Linnaeus's classification system helped to eliminate some of the non-biotic things that Beringer (and other naturalists) classified as 'fossils', since these extraneous objects couldn't be tied to life. Scattered and eclectic though Beringer's catalogue appears, it was nominally in keeping with scientific practices of the 1720s.

Perhaps the best explanation for Beringer's 'fossils' would take them to be artefacts of a much earlier understanding of the natural world – vestiges of the sixteenth-century concept of fossils. For earlier Renaissance philosophers, the universe was a grand, straightforward hierarchy – with God at the top, followed by the angels, followed, in turn, by man, animals, plants and, finally, minerals; in short, the Great Chain of Being in which each thing is a concrete link between something above and below it. With these philosophical underpinnings, the sorts of 'fossils' that Beringer's lackeys found would have neatly and inextricably slotted into such a world view, and the fossil 'links' would have felt familiar and unexpected. The hoax fossils created by Roderick and von Eckhart would have offered Beringer fossils that were exactly what he hoped he would find, whether he consciously acknowledged it or not.

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Leaving the origin of his 'fossils' as an open question, Beringer devoted himself to publishing the Eibelstadt

specimens. At this point, in late 1725, the hoaxers began to worry about the lengths to which Beringer had bought into their scheme. Roderick and von Eckhart had put together the hoax in the first place because they found Dr Beringer to be absolutely insufferable. In their own words, he was ‘arrogant’ and ‘rather despised them all’, and they had devised a plan to salt the slopes of Mount Eibelstadt in order to bring him down a peg or two in his own estimation of himself.

Their idea was that Beringer would take a bow about his fossil-collecting prowess, eventually discern that the limestone fossils were fraudulent, then simply feel a bit foolish, once he realised that he had been filling his cabinet of curiosities with fakes – especially if Roderick and von Eckhart had the good fortune to be the ones to point out his folly. (They rather hoped he’d do this in front of someone famous, like their joint patron the Bishop and Duke of Franconia.) However, the preparations for publication of Beringer’s book indicated that he had bought into the fossils completely, and now the stakes of the prank were much higher than they had initially anticipated.

When Roderick showed how easy it would be for someone to carve stones like the very ones Beringer found, it was almost as if Roderick hoped that Beringer would pick up on the hoax – as if Roderick was spelling out the ruse for Beringer to put together. Beringer agreed with the idea in principle but refused to consider that his ‘fossils’ had been so manipulated. Sometime between May 1725 and the actual publication of his fossil treatise in 1726, Roderick and von Eckhart decided that the joke had gone quite far enough and began circulating rumours that the fossils were fake. Beringer inserted a very short, clipped and somewhat snippy chapter towards the end of *Lithographiae Wirceburgensis* that quickly dismissed the idea that these were human-made fossils, and suggested that any

claims to such were simply the result of professional jealousy and envy. A few months later, however, Beringer was backpedalling.

The exact date and circumstances of the hoax's unveiling are a little unclear. Some suggest that His Grace, the Bishop and Duke of Franconia, himself stepped into the academic melee and sorted things out, telling Beringer that the rocks weren't fossils. Others claim that Beringer realised that he'd 'been had' when he came across his own name carved in the rocks while surveying the slopes of Eibelstadt. (This is certainly the story of Beringer's Lying Stones that has been mythologised in the history of science.) Although it's impossible to know for certain how the hoax was uncovered, there is little doubt that its effects were immediate.

First and foremost, Beringer was so mortified by his error that he immediately began buying all copies of *Lithographiae Wirceburgensis* that he could get his hands on, in order to head off the possibility that someone, somewhere might actually buy the book, look at the engravings and descriptions, and conclude that Beringer was a total ignoramus for ever having thought that the carvings were real fossils. Then Beringer proceeded to take legal action against Roderick and von Eckhart.

Ostensibly, Beringer felt that the deplorable actions of both Professor J. Ignatz Roderick and Georg von Eckhart had besmirched Beringer's good name and academic integrity. He was determined that history would not remember him as a fool for being duped by the fossils. On 13 April 1726, judicial proceedings began at the Würzburg Cathedral Chapter – at the special request of Beringer – with the hopes of 'saving of his honour'. The judicial process took place over three days, with the last two hearings being held at municipal trials on 13 April and 11 June 1726.

On 13 April 1726, the court heard that Dr Beringer charged ‘certain young people of Eibelstadt’ who had purposefully brought carved, fraudulent stones to him – as well as ‘sundry others’ within the natural history collecting community – and passed them off as the real thing. Since Beringer, in turn, had argued for the stones’ authenticity, he felt that the question of his own honour was wrapped up part and parcel with the legitimacy of the Eibelstadt rocks. Documents associated with the proceedings referred to Dr Beringer as the Duke’s personal physician as well as a ‘learned dilettante’, lending a smidgen of sympathy to the question of why Roderick and von Eckhart would have found Beringer so insufferable. The court felt that Beringer made a reasonable argument and undertook his case, promising to examine those involved in the hoax as quickly as possible.

Transcripts of the court proceedings suggest that the court’s primary aim was to pin down just who had masterminded the entire affair and to what extent the ancillary characters caught up in the hoax knew what role they played in perpetrating the ruse. It quickly became clear, for example, that the ‘young diggers’ were simply pawns. They excavated the slopes, rounded up the fantastic ‘fossils’, and were eager to make a batzen or two for their efforts (court records show that the top price for finding one of the *Lügensteine* in 1725 was 22 batzen – roughly the then-equivalent of two Swiss francs). These workers simply collected what they were told to collect by the then 17-year-old Zänger.

Interrogation of the Young Diggers

[COURT]: Did any of them ever learn the art of sculpting?

[COURT]: Did they ever see in any book representations of the figures and characters found in these stones?

[COURT]: Did they ever see anyone secrete such sculptured stones on the mountain, and did they not dig up such stones?

[COURT]: Were they ever induced by Messrs. Eckhart and Roderick to sculpt stones, then to bring such stones into the city and pass them off as discovered and dug up?

The answer to all of these questions was no, and the court concluded that no fault or mischievous, malicious intent lay with the diggers. The questions that the court put to Christian Zänger were even more direct.

Interrogation of Christian Zänger

[COURT]: Where did Zänger get the 'dragon-stones', the stones on which were the Bebraic letters and others upon which the knife was used?

[COURT]: Was he not ordered by Roderick or Eckhart to deliver up diligently such stones to Beringer? To whom else were they delivered?

[COURT]: Whether Zänger does not declare that he spent entire weeks at Eckart's house grinding and making stones?

[COURT]: Did not Zänger receive from Roderick and Eckhart a little sketch of a mouse and Hebraic letters? For what purposes were these given him?

[COURT]: Did he [Zänger] ever work in alabaster? What was the figure he made of it, which he described to Eckhart and Roderick?

Zänger wasted no effort in saying that he took his orders from Herr Roderick and ferried the carved goods from Roderick's workshop to the hill slopes, and that the other diggers were simply finding them in good faith. Despite

Roderick's feeble efforts to pin the scandal on Niklaus and Valentin Hehn, the brothers came across as rather haplessly earnest.

[COURT]: Did [Niklaus Hehn] polish or carve a little, or do anything else with an instrument, or any of the stones he discovered and subsequently delivered to Dr Beringer?

[ANSWER]: He [Niklaus Hehn] never did anything to the stones, but such stones he found he delivered to Dr Beringer *as* he found them – just as he had long before brought him shell-stones.

[COURT]: Did ... Herr [Roderick] say anything further or make any other requests?

[ANSWER]: He [Roderick] said that his Grace had sent him out to discover whether they themselves [the Hehn brothers] had not carved the stones and hidden them in the mountain. To this he [Hehn] answered that they had done no such thing, for they gave out the stones as they had found them. As Roderick now saw that he could do nothing with him [Niklaus Hehn], he turned to his younger brother to ask him the same question. He also threatened to have him put into irons and getters if his brother would not admit to having carved the stones with a knife.

And so forth. The court even called an innkeeper's wife to testify about Roderick's trips to the Eibelstadt area. More questions were put to Christian Zänger on 11 June 1726, when the court threatened repercussions if it felt he wasn't being entirely truthful. It quickly became apparent that Roderick and von Eckhart had masterminded the entire escapade, and that Zänger knew very well that Roderick

was carving the ‘fossils’ in his workshop because he, himself, was leaving the stones on Eibelstadt for the Hehn brothers and others to discover. Everyone else, to all intents and purposes, it would seem, was just along for the ride.

Then, as abruptly as the hearings had begun, they ended. Four years later, by 1730, the youths and diggers disappear from the historical records, and Roderick had left Würzburg. It’s a bit unclear as to whether he left of his own accord, or was more or less run out of town; he did slink back to Würzburg to be allowed access to the city’s archive in 1735 to finish a book he was writing when the trial started. Von Eckhart died. Beringer himself continued in his university studies and medical practice, published two additional books of some academic acclaim, and spent the rest of his life hunting down errant copies of *Lithographiae Wirceburgensis* to avoid the book accidentally falling into readers’ hands.

Collecting and buying fossils is nothing new. In the centuries before and after the episode of Beringer’s Lying Stones, fossils have been imported and traded as Europe’s wealthy have curated their cabinets of curiosities. Corals, fossils and narwhal tusks were extremely popular pieces in these earliest collections, and spectacular fossils have always found a market for the discerning collector. Certainly, fossils have been bought, sold and collected in the United States for more than 200 years; at his Monticello residence, Thomas Jefferson famously kept a personal collection that included a mastodon jaw and teeth.

Part of the mystery of these natural objects comes from their inherently fragmentary nature, and that mystique certainly surrounds fossils today. A fossil forms when an organism dies and its body mineralises over millions of

years. It's rare for an entire organism to be perfectly preserved – bones can get trampled on and buried over time, and for a fossil to be captured exactly in situ, the perfect circumstances of geology, geomorphology and taphonomy need to be available. At this point, a fossil is a natural object. Whether an impression of a leaf left in eons-old mud or a dinosaur bone from the Jurassic, it's simply the result of geological processes unfolding through time.

Because of the fragmentary nature of the fossil record, the 'whole story' of an organism is not preserved, just as the 'whole organism' is rarely found. Finding a fossil means recovering the partial remains of a once-living creature from its geologic resting place; giving a fossil meaning requires that science, natural history, folklore and art come together to offer the pieces a coherent narrative. This makes fossils the Real Thing. 'What are fossils, after all,' mused French palaeontologist Pascal Tassy in an interview with historian of science Adrienne Mayor in her book, *The First Fossil Hunters*, 'if not vestiges both preserved and destroyed by time?'

The history of fossil excavation is chock-full of different ways in which researchers and amateurs alike have made these attempts to fill in the gaps in the fossil record. Sometimes this filling in is figurative, but sometimes it's literal. Sometimes a scientific hypothesis is added to round out an evolutionary narrative. At other times the gaps are reduced when a museum fills in a skeleton with copies or casts of bones that weren't recovered with the original specimen, in order to offer visitors a more complete picture of an organism. There are even times when a fossil is so full of gaps, physically and narratively, that scientists and private collectors see what they want to see. And the less scrupulous are more than happy to oblige the eager with genuinely fake fossils.

Once a fossil has been discovered it begins to take on a life of its own. A fossil's cultural cachet comes after it's been found and been given an audience, or even several audiences – be they scientific or commercial ones. It becomes scientifically significant because science is a cultural activity that happens around the fossil. At least, this is the notion of where value comes in, where value is assigned to a fossil in terms of legal and financial circles, leaving the question of a fossil's intrinsic value – be it as a luxury good or a relic of natural history – wide open.

Just as with art and antiquities, almost as soon as there was scientific and commercial interest in fossils, fakes begin to creep into collections. 'Forgers are enterprising,' historian and art crime historian Erin Thompson wryly notes in her book, *Possession: The Curious History of Collectors from Antiquity to the Present*. 'Why not be, in a field where the rewards are high and the punishments are low and unlikely to be brought to bear by buyers who are more willing to cover up embarrassing mistakes than make known the presence of forgeries in their collections?'

As early as the Middle Ages, fossil collectors worried about the authenticity of their cabinets of curiosities. For centuries, fossils have been faked in a number of ways and for a variety of reasons. The question of fake fossils – and how to ferret them out from real ones – is still very much a problem for contemporary palaeontologists, museum managers and collectors. While the Beringer case involves one of the most spectacular examples of phony fossils, there are plenty of other fakes that pop up in subsequent centuries.

Fake fossils can be created in any number of ways. Although Georg von Eckhart and J. Ignatz Roderick

carved Beringer's Lying Stones out of non-fossiliferous rock, the most historically pervasive sorts of fake fossils, however, cobble together bits and pieces of authentic fossils to create an organism that never lived in nature. These Franken-fossils, if you will, are targeted at providing an audience with exactly the fossil it wants to see. From fraudulent fossils put out into the scientific community as embarrassing hoaxes, to mashed up fossils introduced to collectors' markets to increase the likelihood of profit, most fake fossils start with some small bit of something real.

To begin with, amber-encrusted fossils have been an ever-enduring fixture in scientific and commercial circles for several centuries. 'Collectors (including professional and amateur palaeontologists) compete for acquisition of the rarest, most exceptional amber fossils. Convincing forgeries are relatively easy to make and the financial and scientific stakes can be quite high,' David Grimaldi, Alexander Shedrinsky, Andrew Ross and Norbert Baer argued in an academic journal article in 1994. 'Forgeries were presented as gifts to medieval royalty, and the problem persists today.' Although high prices make these *Jurassic Park*-like fossils some of the most lucrative to fake, they are also among the most easily scrutinised and identified.

As early as 1891, German botanist and naturalist Georg Klebs felt that there was a problem with a skeletonised lizard in the amber collection held by the Becker Museum in Germany. (The fossils were later accessioned to the Königsberg Geological Institute.) If the amber that the fossil lizard was encased in was authentic Baltic amber, it would be the oldest known example of its particular lizard taxa. Klebs conferred with his colleagues and, in 1910, published his concerns and raised the question as to whether the amber that encased the lizard was what it purported to

be. In an effort to determine whether the specimen was genuine, Klebs broke open the amber and examined the lizard. (It was then exhibited for the next 25 years in the Becker Museum, including even underwater, for reasons that are lost to history.) Tragically, the specimen was reported missing in the Second World War, and the question of the lizard in amber's authenticity is an open one. This particular piece of amber prompted other museums across the world to reassess their collections of fossils in amber.

Amber fossils can be faked in two ways. Genuine amber is so hard that it is impossible to 're-melt' it in order to encase any sort of plant or animal curiosity in it. Other types of almost amber-like resin (namely copal) are pliable and can be used to create amber-like specimens and visually, copal is practically indistinguishable from amber. It's worth emphasising that copal resin does catch biota in its stickiness, and it's common for pieces of copal to have insects, plants or animals trapped in them; the copal pieces are just not as old as their amber counterparts. These sorts of fossil fakes are cases of simple substitution – giving unsuspecting buyers something that is cheaper and easier to come across than genuine fossils in real amber.

The other method of amber fakery is much more crafty. To make these fake fossils, authentic pieces of amber are opened up, then hollowed out, and a piece of something (plant, animal, insect, whatever) is placed in the amber chamber before everything is glued back together. As improbable as it sounds, this method of creating fake fossils is spectacularly successful. In fact, one such amber fake containing a small, perfectly preserved fly duped curators and staff at the Natural History Museum in London for more than 70 years. This piece of amber had been cut in half and the corpse of a latrine fly (*Fannia*

scalaris) had been put into the little carved-out indent. The piece was neatly put back together, and for decades led scientists to think that a nineteenth-century fly had origins that stretched back over hundreds of millions of years. The fake was discovered in 1993, when then-graduate student Andrew Ross was looking at the specimen under a hot light and, to his utter horror, realised that it was melting – the glue that held the two amber pieces together was oozing a bit.

However, this type of fake isn't only produced with fossil amber. One of the most celebrated and notorious fake fossils comes from the field of palaeoanthropology – the study of human evolution.

In February 1912, antiquarian collector and country lawyer Charles Dawson uncovered fragments of a most curious fossil human ancestor in the roadside gravels of Piltdown in East Sussex, England. The fossil pieces looked like those of a hominin – a fossil human ancestor. Upon scientific analysis in the early decades of the twentieth century, the bits of skull and jaw showed a bizarre mix of anatomical characteristics – some human, some decidedly ape-like – leading dozens of researchers to conclude that the Piltdown 'fossil' was the perfect missing link between ape and human in *Homo sapiens*' family tree. The find also championed a model of evolution, researchers argued, that was very much en vogue in the early twentieth century – the hypothesis that humans' 'big brains' were the underlying driving factor in hominin evolution. (And with big brains, the scientific argument went, they were biologically endowed to create a uniquely human culture.) In the 1920s, the Piltdown discovery was touted as the earliest Englishman, and it was held up for decades as incontrovertible proof of the antiquity of ancient humanity in England, although the 'fossil' remained highly controversial outside England.

Pitldown maintained his ancestral status for just over four decades. By 1953, scientists at the Natural History Museum in London had exposed the ‘fossil’ as a hoax – a fake of the first degree. As a result of batteries of tests, using specific chemical analyses that weren’t available to science when the specimen was first discovered, researchers determined that not only was Pitldown not a missing link, it wasn’t even a real fossil. The Pitldown skull had been cobbled together from human cranial fragments dated to the Middle Ages, and paired with the jaw of a modern orang-utan, with chimp teeth stuck into the tooth sockets. Certainly, then, it’s little wonder that early twentieth-century fossil experts saw ape-like and human-like characteristics in the specimen. Pitldown remains one of the lengthiest hoaxes in the history of science and it also remains unsolved – the perpetrator has never been successfully identified, although the fossil’s discoverer, Charles Dawson, is the most likely suspect.

A short-lived counterpart to the Pitldown story occurred in May 1911, when the discovery of a ‘prehistoric human skull’ from the Devil’s Cave near Steinau, east of Frankfurt, caught the attention of German anthropologists and the media. For years, building contractor Albert Lüders had wanted to turn the Devil’s Cave into a tourist attraction. He had been drilling away to install the necessary infrastructure, and the skull was found near one of the drilling sites.

Over the following months the skull was discussed relentlessly in the media, with the German anthropologist Hermann Klaatsch championing its authenticity, and suggesting to German intelligentsia circles and newspapers that it might even have belonged to a ‘neanderthaloid’, or Neanderthal. Between mid-May and 10 August, roughly 50 articles on the topic appeared in 20 newspapers. Upon more rigorous investigation, anatomist Friedrich Heiderich

revealed the skull to be nothing more than a chimpanzee skull that had been chemically treated with potassium permanganate – to make it look older – then stashed in the Devil’s Cave. The fraudster, Wilhem Rappe, the village’s pharmacist, whose brother had brought the skull back as a gift from his travels to Cameroon, was a notorious prankster in Steinau, and he promptly ‘fessed up to the hoax. The German press had a field day raking Klaatsch and Lüdgers over the coals once their mistake was revealed. Unlike Piltdown, this ‘fossil’ didn’t have any greater impact on the study of anthropology, but the case does demonstrate that authentication of new fossils has always depended highly on the provenience of their discovery, and has done throughout history.

There is a myriad of reasons why the Piltdown hoax (and its like) was so successful. However, one of the most intriguing reasons is a rather subtle one; it was a forged fossil, but it was made from real bones. Because of researchers’ own preconceptions about evolution, anatomy and science, Piltdown was exactly what they were looking for – the ‘missing link’ between apes and humans they had predicted. Ninety years after the Piltdown hoax, another genuinely fake fossil flew through the scientific community. According to *National Geographic*, the story of this fake, *Archaeoraptor*, begins near the small village of Xiasanjiazi, in China’s northern Liaoning province. Built out of genuine fossils and very real financial expectations, it reminds us that there is still a plethora of fossils that are less than authentic.

Ever since the 1920s, the Liaoning province has been a mecca for fossil hunters and palaeontologists. Due to the region’s geology its fossils are well preserved, even including instances where dinosaur soft tissue has fossilised. In recent decades the area has become famous as a site that has produced the fossil evidence for the earliest flower,

some of the earliest mammals and the oldest intact embryo of a pterosaur, in addition to more recent discoveries of fossils of feathered dinosaurs. The region is one of the world's most prolific and significant areas for discovering fossils.

In July 1997, the story goes, a Chinese farmer found a rather rare fossil – one of a toothed, bird-like creature that had feather impressions. The farmer recognised that the bigger and more complete the fossil was, the more he would be paid for it. While academic palaeontologists often shun the practice of buying fossils from local fossil hunters, it does happen for the commercial fossil market. The farmer glued together different parts of various fossils and the result was spectacular. It sold.

In June 1998, having been smuggled out of China, the fossil was sold to an anonymous dealer. By 1998, rumours circulated through the palaeontological community that a feathered dinosaur was in the hands of a private collector, and in 1999 the fossil sold for \$80,000 at the Tucson Gem and Mineral Show to Stephen and Sylvia Czerkas, owners of the Dinosaur Museum in Blanding, Utah. (The sale was underwritten by the trustees of the Dinosaur Museum so that the fossil would be available for scientific analysis.) It was considered to be the first physical evidence of feathers on a dinosaur, indicating a common ancestor with birds.

However, the scientific community was sceptical about the fossil, as amazing as the discovery was. There was something ... 'off' about it. The fossil was refused publication in prestigious peer-reviewed journals like *Science* and *Nature*, as its provenience was particularly sketchy, and many scientists refused to work with a specimen that ran counter to international best practices for curating fossils. Concerns were also raised about whether the fossil was a single specimen or parts of multiple individuals.

In 1999, palaeontologist Tim Rowe of the University of Texas at Austin completed a detailed CT scan of the fossil as part of his work on the original team's scientific analysis. Rowe's work raised the possibility that the fossil was in reality a composite – not a single individual fossilised organism, but several stuck together. Scepticism be darned, was the Czerkas' response to Rowe's findings. The discovery was touted by *National Geographic* as a 'missing link' and was lavished with press coverage on its publication.

Further analysis of the CT scans indicated that *Archaeoraptor* was a chimera of a specimen, just as Rowe suspected. The fossil in question was actually five different individuals, from three different dinosaur species. The illegal exporters of the fossil had had a very clear sense of what would hit it big with audiences, even though many in the scientific community (including some of the original reviewers of the fossil) considered the possibility that it was a composite from the start. The fossil is regarded as a fake, although the species name *Archaeoraptor liaoningensis* remains in the scientific literature, much to the consternation of many palaeontologists who would like to simply rid themselves of the problematic taxon.

The *Archaeoraptor* fossil was a fake, to be sure, but it wasn't a fraud in the way that Piltdown or Beringer's Lying Stones were. It wasn't created to necessarily deceive its scientific audiences. Rather, it was glued together in the hopes of bringing in a better price to the discoverer, who was trying to eke out a living. (By some estimates, finding a fossil as spectacular as *Archaeoraptor* could result in a finder's fee that would be roughly equivalent to two years' salary. And subsequent excavations scientists actually did find feathered dinos in the area, bolstering the interpretation that *Archaeoraptor* offered.) While Piltdown is described as a hoax or a fraud, *Archaeoraptor* is most often described as

a composite – certainly a more compassionate category in the taxonomy of fake fossils.

There are perfectly legitimate reasons to create composites; the problem arises when the composite has a tinge of deceit about it. The scientific world was looking for a feathered dinosaur at the turn of the twenty-first century, and a feathered dinosaur was exactly what it got.

Seeing what one wants to see is one thing. But being given what one expects is the market's side of the coin. With the burgeoning commercial market, which prizes complete fossil skulls, polished teeth and impeccably prepped specimens, there's a clear set of expectations from buyers about the fossils that their money buys, and international purveyors, especially from China, are only too happy to oblige. It's clear that people will pay exorbitantly for a spectacular trophy fossil, but not so much for scrappy bits and pieces, which results in the production of more Franken-fossils – those composite fossils that lead people to think that they're authentic. This is where the worlds of fossil smuggling, legislation, law enforcement, science and the commercial fossil market are coming to a head.

It turns out that Franken-fossils aren't as rare as one might think. Because the rise of the commercial dinosaur fossil market has created even more demand for them, the scientific community is constantly honing new methods of flushing out fakes. One of the most recent developments in rooting out fake fossils comes from Thomas Kaye of the Burke Museum in Seattle. In 2015, Kaye and eight of his international colleagues published a methodology based on Laser-Stimulated Fluorescence, or LSF for short. The authors pointed to a myriad of applications for the technique within the palaeontological community, not least of which

would be an inexpensive way of sorting authentic fossils from bogus ones.

Their method is simple and, unlike CT scanning, doesn't require an immense investment of time or equipment. Their set-up involves a simple laser and a way of diffusing the light over the fossil in question. Since rocks, minerals and elements all fluoresce at different colours, when the different materials are excited by a laser beam, the fossil, rock and whatever else in there will light up as different colours, easily visible to the naked eye. 'Laser fluorescence opens the door to discovering previously unseen and unknown features in ancient fossils,' Kaye said in an interview with the Burke Museum.

The fossil parts of the rock are one colour; the resin, the plaster and the whatever else shine a different colour along the colour spectrum. With the help of a time-release digital SLR camera, images of the fluorescence pattern can be documented. The entire set-up costs something like \$500 and offers an incredibly straightforward answer to the question, 'What am I looking at, really?' The answer will usually be: a fossil. But it's so much more than 'just' a fossil. You're seeing all of how of a fossil's gaps are filled in and what unscrupulous people use to do the filling. Burke's publication offers a dramatic 'before' and 'after' series of images; his team fluoresced and photographed a *Microraptor* specimen – a genus of dinosaur with wings and feathers. The glue and resin in the specimen lit up like a constellation. One would be hard pressed to interpret that *Microraptor* fossil as anything but a composite of materials as well as an inadvertent material record of decisions made about its conservation and preservation. While composed of not-real bits it is, nevertheless, an authentic fossil.

For many caught smuggling fossils, their own cases hinge on that ambiguity – on those bits of the fossils that

aren't in fact real. They call these genuine fakes 'craft rocks', 'replicas' or 'artistic interpretations'. Phrases like these leave implicit the idea that the fossil in question is a creative endeavour, like a work of art under copyright, not an object in and of itself. Since the fossil is 'more' than just a fossil (it's had other fossil parts added to it, is a composite of multiple fossils and has had plaster and other things sculpted around it), it's no longer an excavated fossil but is an artistic work. This was one of the lines of defence that Eric Prokopi took in 2013 when he was charged with smuggling a massive *Tarbosaurus bataar* (sometimes called *Tyrannosaurus bataar*) fossil out of Mongolia via the United Kingdom and selling it on the US commercial market. The court was having none of the artistic license argument, however, and in *The United States v. One Tyrannosaurus Bataar Skeleton*, a federal judge convicted Prokopi of smuggling, sentencing him to three months in jail.

These sorts of Franken-fossils are a tricky bunch of fakes. While there were real bits and pieces of fossils in each specimen, the finished product, as it were, couldn't be scientifically named, because it wasn't, taxonomically, anything real. And this is certainly true historically – lots of fake things get names. Like Piltdown, they're made of genuine stuff, but they are fake animals. Like *Archaeoraptor*, they're assembled, composite specimens, made to sell well. And like Beringer's Lying Stones, they're sculpted works of art, carefully crafted for a purpose. They defy categorisation. Essentially, these are fossils that pander to the expectations of buyers as to what a perfect specimen 'ought' to look like. These Franken-fossils play to the market's expectations of real fossils and the legal possibilities of owning them. Although composites of fossils and casts are a longstanding tradition within the science and museum worlds of natural history, those composites don't attempt to deceive audiences, whereas Franken-fossils do.

Authenticity is irrelevant when giving audiences exactly what they didn't know they were asking for and exactly what they want. The commercial fossil market is whatever consumers want and, for many, what they actually want is something fake – something that can pass itself off as real. Piltdown and *Archaeoraptor* perfectly bookend the twentieth century's experience with fake fossils, and offer cautionary tales about seeing what we want to see. Popular media dubbed *Archaeoraptor* the 'Piltdown chicken'.

This brings us back to the story of Dr Johann Bartholomew Adam Beringer and his fake fossils. Even as early as the 1726 court proceedings, people had taken to calling Beringer's fossils *Lügensteine* – Lying Stones – and that's certainly how history has remembered them. Curiously, though, history has also created an odd sort of mythos around the story of Beringer and his fake fossils, suggesting that the entire episode was simply a rather sophomoric prank – perpetrated by his students, not his colleagues – that got out of hand. (Other tellings of the story relish casting Roderick and von Eckhart as villains, practically twirling their moustaches and capes with glee as Beringer makes a fool of himself.) For centuries, Beringer's story as the student-led prank has been told and retold, becoming a little less true every time – until the mid-twentieth century, when Beringer's court records were rediscovered in the Würzburg city archives in 1935.

The carvings themselves didn't last particularly long as genuine or authentic objects – and in all honesty, few other than Beringer counted them as such. But how they've dominated the Beringer narrative is certainly very real. It's a curious fake story that has evolved to explain fake fossils,

perhaps to cover up Beringer's very real embarrassment. 'Like all great legends, this story [Beringer's Lying Stones] has a canonical form, replete with conventional moral messages, and told without any variation in content across the centuries,' essayist and palaeontologist Stephen Jay Gould argued in *The Lying Stones of Marrakech*. 'Moreover, this standard form bears little relationship to the actual course of events as best reconstructed from available evidence.'

Today, 433 of Beringer's specimens are still in existence, scattered in 14 museum collections in Germany, the Netherlands and Britain. (Oddly, 60 more of Beringer's Lying Stones have been lost during recent years, but are technically part of the historical record, thanks to photographs.) In 1835, two of Beringer's original Lying Stones were gifted to the eminent English geologist and palaeontologist William Buckland, who it would seem wasn't quite sure what to make of the gift. The specimens at the Oxford University Museum of Natural History show boomerang-like carvings on one of the mudstone pieces, and a slug-like creature with very cute antennae on the other. When the museum's curator pulled the two of the collections I could actually see the knife-carving marks along the edge of the slug. Truth be told, when I turned over the Lying Stones to get a better look, I burst out laughing.

Despite this, the Lying Stones have become the Real Thing outside of any scientific merit. Casts of the Lying Stones pop up in a plethora of museum collections. In 1931, the Natural History Museum in London borrowed 10 Beringer specimens and created casts for its own palaeontological collections; today the museum has more modern silicon moulds of the curios. The Natural History Museum uses the real casts of fake fossils for teaching purposes and to show off the historical curiosities of the palaeo collections.

In the 1970s, Phil Powell, then assistant curator for the geological collections of the Oxford University Museum of Natural History, created moulds and casts of the Buckland specimens for a Yorkshire children's television programme (*Extraordinary!*). In 1990, the British Museum ran an exhibition dedicated to the idea and question of 'fakes', and wrote to Mr Powell to enquire about the use of the Lying Stones in the exhibition. Mr Powell's letter of 22 November 1989 states, 'We have excellent casts of the originals. Would they be acceptable in an exhibition of fakes?' The British Museum, however, was hoping for more: 'If we may we would like to borrow the original stones. This is strictly an exhibition of genuine fakes!' (The real specimens were in fact included in the exhibition, which ran from 8 March to 3 September 1990.) By the latter half of the twentieth century, fossil enthusiasts, collectors and museums could buy casts of the Oxford stones through the Educational Palaeontological Reproductions Company in Essex. The 'fossils' live on.

'Beringer's story is not just an amusing anecdote in the annals of geology, nor should it be seen as a simple story of credulity told to unwary undergraduates. Using the modern definition of a fossil as the mineralized remains of a once-living organism, Beringer's figured stones look ridiculous, clearly the work of a third-rate sculptor,' historian of science Susannah Gibson argues, championing the need for context in Beringer's story. 'But by eighteenth-century definitions, Beringer's fossils could easily have been genuine ... The whole story turned on knowing the true nature of fossils.'

As for Beringer, it's important, of course, to not judge him by the standards of today, although even by the standards of 1725 he failed spectacularly. Recall that Beringer opted not to confer with his scientific community and ignored the heavy hints about the stones' authenticity

dropped by his colleagues. His shortcomings were errors in the social doing of science, not in his understanding of what science was and how fossils factored into it.

It feels more than a bit ironic that the perpetrators' names have become almost lost to history, but their desire to humiliate Beringer has endured for the last 300 years. Beringer has indeed been humbled, just as J. Ignatz Roderick and Georg von Eckhart had hoped, and history remembers Beringer as incredibly naive and gullible – one of the earliest people to 'see what he wanted to see' and never mind the contradictory evidence.

Today, the story of Dr Beringer is regarded as one of historical irony, as the Lying Stones have become valued museum artefacts in and of themselves long after they were debunked as fossils.