Imagining Dinosaurs

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Abstract: There is a tendency to take mounted dinosaur skeletons at face value, as the raw data on which the science of palaeontology is founded. But the truth is that mounted dinosaur skeletons are substantially *intention-dependent*—they are *artifacts*. More importantly, I argue, they are also substantially *imagination*-dependent: their production is substantially causally reliant on preparators' creative imaginations, and their proper reception is predicated on audiences' recreative imaginations. My main goal here is to show that dinosaur skeletal mounts are plausible candidates for art-status. But, what is more, I think they *are* artworks—specifically, sculptures.

1. Introduction

I begin with a picture.

In 1866, Louis Figuier published the fifth edition of *The Earth Before the Flood* (1863),[1] a popular science text which aimed to educate children about geology and the science of prehistoric life. Of particular interest in this new edition was the addition of a lithograph by Édouard Riou (Figure 1) depicting *Archaeopteryx lithographica*, the feathered dinosaur whose skeleton was first discovered near the quarries of Solnhofen in 1861, and which was first described by Richard Owen in 1863. A feathered *Archaeopteryx* soars into the heavens at the top of the composition, while a hellish pterosaur (*Rhamphorhynchus*) takes off from a tree further down and another lounges on a marshy beach bordered by cycads and ferns and studded with starfish, feather stars, echinoids, and sea snails. A newt-like arthropod prowls the beach while a crocodilian (*Crocodilaemus robustus*) suns itself. The left flank of the composition is anchored by a forest of large conifers.

This is an entirely unremarkable—and typically uninspired—piece of early palaeoart, apart from one small detail: the *Archaeopteryx* is headless.

This is not an obvious detail. The dinosaur is small, its features difficult to make out without additional magnification. Its wings and tail are clearly feathered, which is no surprise since it is renowned as the first feathered dinosaur to be discovered. A nub between its shoulders hints at a head, but Figuier's text is unequivocal: "In the air flies the *bird of Solnhofen* (*Archaeopteryx*), which we have restored as it may have existed in life, save for its head, which was not found with the animal's other remains."[2]

Why would Figuier and Riou publish the picture of a headless animal?[3] The obvious reason is simply an abundance of caution: absent some indication of what the head might look like, they strove to minimize the picture's speculative content. And this is what is so astonishing about the picture: the desire to avoid scientific inaccuracy has led to the introduction of an *enormous* inaccuracy, since *headless*

animals cannot fly. Instead, the image effectively invites viewers to imagine the animal's head for themselves.

But even more interesting, to my mind, is the fact that focusing on the issue of *Archaeopteryx*'s head obscures the fact that *the entire image* is speculative. Nor does one need to be much of a palaeontological expert to see this; simply consider what, if any, scale was used to render the animals. The millipede-newt, for example, appears to be one-quarter the length of the crocodilian!

Archaeopteryx aside, none of this should be very surprising. Lithography, after all, is a 'manugraphic' art: it relies on someone drawing an image by hand, rather than on the 'pencil of nature'. Whereas the mechanical nature of photography is widely believed to secure a photograph's mind-independence,[4] manugraphic arts are said to ineluctably reflect their practitioners' perception and intention, since every line of the manugraph is potentially fraught with meaning. The photograph, in contrast, is simply 'transparent'.[5] On this view, artistic restorations of extinct fauna known only by their fossil remains will always be speculative, and necessarily so. But what about the skeletal remains themselves?

At first glance, it may seem that fossils are entirely intention-*independent* entities; they are, after all, the result of an entirely natural (i.e., non-intentional) causal process. This is, of course, true, but I will argue that it is *not* true of prepared and mounted skeletons, especially those of dinosaurs. Closer examination will reveal that mounts are, in fact, intention-*dependent* objects—they are artifacts. What is more, mounted dinosaur skeletons appear to be substantially *imagination-dependent* artifacts, meaning that they are good candidates for being classified as artworks. Given the ways in which we interact with them, I think it clear that they *are* artworks.

2. Imagination-dependence

What do I mean when I say that mounted dinosaur skeletons are 'imagination-dependent'? Quite simply, that the imagination is centrally involved in their production and correct appreciation.

But allow me first to outline a closely allied notion, 'intention-dependence'. To say that something is intention-dependent is to say that its existence is (necessarily) dependent on some agent's intentional action.[6] This does not mean that the agent must intend to do everything that falls under the description of some action A. So, for instance, when I intend to curl a dumbbell, I need only intend to move my arm *so*; I need not have any additional intentions concerning specific muscle fibres, action potentials, synapses, etc. Nor does it mean that I represent my intention as being *to A*; I might, for instance, intend to do something B which entails performing A as part of its satisfaction-conditions. If, for example, I intend to perform the compound exercise called a 'barbell thruster' (B), I must perform a front squat (A_1) followed by a barbell press (A_2). I can do so without ever forming the explicit intention to perform the individual component exercises (or, indeed, without even knowing that these are separate exercises). In each of these cases, we can properly describe my action as 'deliberate', and the resulting events as 'intention-dependent'. Intention-dependence distinguishes intentional action from mere 'happenings', events which simply naturally occur without any guiding minds. It also forms the basis for our distinction between artifacts and performances, on the one hand, and natural objects and events, on the other.

Similarly, to say that something is *imagination*-dependent is to say that its existence depends on some agent's act of imagination. We can distinguish two different ways in which this might be the case. On the one hand, an artifact or performance might be imagination-dependent insofar as bringing it into being required someone's substantive act of imagination. This is the case with fictional characters, who owe their existence and attributes to their author's acts of imagination, as codified in the text they produce. It is also often true of ordinary artifacts such as corkscrews, whose precise

configuration derives from somebody's inventiveness. In these cases, someone's act of imagination is a crucial component part of the causal process that brings something about. The imagination involved in such exercises is commonly glossed as 'creativity'; in the philosophical literature, it goes by the label of 'creative imagination'. It is the kind of imagination that is mobilized "when someone puts together ideas in a way that defies expectation or convention: the kind of imaginative 'leap' that leads to the creation of something valuable in art, science, or practical life."[7]

Alternately, something might be imagination-dependent insofar as its proper use or appreciation requires users or audiences to engage with it imaginatively. A novel and its characters, for example, are explicitly designed for just this kind of engagement—they are ready-made adventure machines, to borrow a phrase.[8] The whole point of fiction is to imagine the world and events in question. In this case, the imagination involved is typically called 'recreative', the kind of imagination we mobilize when recreate mental states like perception and belief for ourselves.[9] It allows us to project ourselves into a situation and think about what it is like.

Some actions and events are imagination-dependent, such as a good old-fashioned game of stumps-are-trolls, or *Dungeons & Dragons*. And so are some artifacts, especially those which we normally classify as 'art' (although not necessarily Art-with-an-A): Michelangelo's *David* (1501-4), David's *Napoleon Crossing the St. Bernard* (1801-5), Austen's *Emma* (1815), Friedkin's *The Exorcist* (1973), and so on. But it should be obvious that natural objects and events are *never* imagination-dependent in either respect. We can certainly imagine *of* clouds that they are or resemble a duck, but nobody has made them available to us for such a purpose, nor was anyone's creativity mobilized to make them.

So: we saw earlier that all artifacts and performances are intention-dependent, and all artworks are artifacts or performances, thus all artworks are intention-dependent; intention-dependence is a necessary, though not a sufficient, condition on being an artwork. That much is already universally

acknowledged in contemporary philosophy of art.[10] But I think we can expose a still finer grain: all artworks are, in fact, *imagination-dependent* artifacts or performances.

3. Art's Imagination-Dependence

Art's imagination-dependence is not a truth universally acknowledged but it is, at least, a proposition frequently entertained.[11] For most artworks, this will be a matter of their substantial investment in both creative and recreative imagination, although some may invest more heavily in one or the other. Naturalistic painted portraits such as Goya's *Portrait of the Duke of Wellington* (1812-4), for example, are not usually thought to require much imagining on the audience's part;[12] their imaginative investment is primarily creative. On the other hand, a work of conceptual art such as Piero Manzoni's *The Base of the World* (1962), a metal plinth announcing that the entire world is the artwork, strains the viewer's recreative imagination—and patience.

Historically, philosophers who may have endorsed art's imagination-dependence primarily focused on the production of art, arguing that art-making requires creativity, and creativity is intimately tied to imagination. This was true of the old imitation theory of art, for example, which reached its zenith with the Neoclassical movement in Europe. Antoine Chrysostome Quatremère de Quincy, its most prominent and sophisticated exponent, followed Johann Joachim Winckelmann in arguing that the standard of imitation given by classical works is that of *ideal* imitation, rather than the strict imitation of a particular model. In other words, what the artist imitates is not nature as it is, but rather an idealized model in their imagination; the artist must use their imagination to give themselves a model.[13] "We can see," he says, "that the ancients believed that it [the ideal] belonged to the art of making men more beautiful than they are, and that this secret consisted on the one hand of neglecting individual imitation, and on the other of being guided by the imagination, a model beauty superior to that of individuals."[14] According to Quatremère de Quincy, the ideal style of classical Greece was not

the result of artists aiming to accurately capture the forms and contours of individual real models, but rather of trying to capture the essence of the idealized figure they had imagined, thereby allowing the artist to communicate a perfection which they otherwise could never really show.[15]

When the Romantic period displaced Neoclassicism, so too did it replace verisimilitude and imitation as the standard of art. But, if anything, the imagination gained even more importance for those steeped in the Romantic ethos, according to whom artists have a special imaginative capacity (viz., 'genius') which the rest of us lack, and which gives them a special kind of insight into the world. Immanuel Kant, for one, argued that the artistic genius is someone gifted with superior powers of imagination and understanding.[16] Building on Kant's analysis of artistic genius, Arthur Schopenhauer was careful to distinguish the capacities for imagination and genius, arguing that the former is necessary for the latter since it enables the artist to see the beyond the objects which perception presents to them, and to the Platonic Ideas which animate them.[17] Vestiges of the connection between creative genius and imagination still exist today, stripped of their connection to the problematically gendered notion of 'genius'. Berys Gaut, for example, has argued that creativity is closely linked to imagination: imagination is the mental capacity upon which creativity is typically predicated.[18]

In the twentieth century, philosophers also began to take an interest in the imagination's *ontological* contributions to art-making. Some, such as Robin George Collingwood, Benedetto Croce, and Jean-Paul Sartre, argued for versions of an 'ideal theory' according to which artworks exist in the minds of their appreciators, as a kind of imaginative state which they experience when confronted with a work of art or of natural beauty.[19]

Sartre, for example, argued that aesthetic experiences are "induced dreams" in which the work is an imaginative 'analogue' of some concrete object or performance.[20] So, for example, when we hear a musical work, we do not experience it as a real thing that is temporally-extended and exists in the external world, but rather our imagination grasps the performance as an analogue of the real work; as

he puts it, "I do not hear it actually, I listen to it in the imaginary."[21] Each of us therefore experiences a slightly different work.[22] Collingwood similarly thought that all artworks are "imaginary things" which exist in audience members' minds. To gently paraphrase him, the artwork's physical manifestation is just the means by which audiences recreate for themselves the imaginary object that existed in the artist's head.[23] Unlike Sartre, however, for Collingwood there is just one work, rather than a different work in each audience member's head: the work is whatever was in the artist's imagination to begin with, and the rest of us use its physical traces to approximate it as best we can.

For these idealists, the artwork is not the individual painting, sculpture, or performance as such, but rather the imaginary object prompted by one's reflection on the material object or event. The trouble, however, lies in explaining the precise role of that material object or event, since its creation seems to be a necessary rather than a contingent component of the process of creating the work.[24] Likewise, idealism seems to implausibly preclude the possibility of genuine aesthetic disagreement, since each audience member constructs a different artwork.[25] Although this kind of idealism never really took off, it does survive today in corners of aesthetics where the works in question are widely believed to be abstract entities, such as musical works.[26]

In claiming that art is imagination-dependent, I am *not* claiming, as the idealist does, that artworks are *imaginary*, though I am happy enough to concede that some might be. I am claiming that the imagination plays an essential, not a constitutive, role in an artwork's ontological makeup. Once again, this is a claim which, though it does not draw universal assent, is at least familiar to aestheticians, if not always in so many words. We caught a glimpse of its historical popularity earlier, *via* Quatremère de Quincy and the Romantic conception of genius. Its most significant contemporary proponent, however, is Kendall Walton, who argues that most of our artworld engagement involves make-believe.[27] On Walton's model, representational artworks prescribe that we engage in particular acts of imagination; so, for example, Agatha Christie's stories prescribe that I imagine Hercule Poirot as a

small, rotund man with a splendid moustache, while David's *Napoleon Crossing the St. Bernard* (1801) prescribes that I imagine seeing the great man leading his army across the Alps atop a rearing horse. Engaging with these works means pretending—making-believe—that the content they prescribe is true. This view has found particular purchase among philosophers when it comes to our engagement with narrative fiction,[28] though decidedly less so when it comes to other art forms. One notable exception is in discussions of musical expression, where the expression of emotion in music is sometimes ascribed to an imagined 'persona'.[29]

The preceding remarks are, of necessity, just the briefest of sketches of the role philosophers have attributed to the imagination in art-making. It is safe to say that nobody would deny that art-making requires a degree of imagination or creativity, though we may disagree about the degree required and distinguish art from Art, and Art from Great Art, assigning different measures of imagination to each. This suggests that imagination-dependence is plausibly a necessary condition for art, though it is surely not sufficient. Just as the necessity of art's intention-dependence allows us to narrow the field of possible artworks from all things to just those which are artifacts or performances, so does the necessity of imagination-dependence allow us to narrow the field to those artifacts and performances which involve significant acts of imagination.

But let us return to dinosaurs. If the dinosaurs we encounter are substantively imagination-dependent, then this fact hardly guarantees that they are artworks. It does, however, open that possibility, provided we can give further details to cement their art-status. But *are* they imagination-dependent in the first place? Here, we come to the heart of the matter at hand. I trust it is obvious that manugraphic representations of dinosaurs, such as our starting *Archaeopteryx*, are imagination-dependent due to the sheer creative imagination required to generate them, even if properly assessing the finer details of that act of imagination is the purview of dedicated afficionados who know what the fossil evidence leaves under-determined. They are representations of creatures nobody has ever

seen, after all, and even if we know a great deal about their skeletal anatomy and even their ecology, that still leaves an awful lot to the imagination, starting with the creature's soft tissues and the full range of its behaviour.

But where does this leave mounted skeletons?

3. Mounting Skeletons

So far, we have seen that manugraphic restorations of dinosaurs require, at a minimum, a measure of creative imagination. In some cases, such as our headless *Archaeopteryx*, they may even invite us to mobilize our recreative imagination. But it may seem, at first glance, as though mounted skeletons are different beasts entirely: they are, after all, composed of fossil bone, and fossils are not intention-dependent, let alone imagination-dependent.

This is a mistake born of insufficient familiarity with the processes of fossil preparation and mounting. Even though fossils themselves are not intention-dependent, closer inspection of the processes of preparation and mounting shows that skeletal mounts are unquestionably artifacts. In fact, they are artifacts whose assembly requires significant creative imagination, and whose presentation and appreciation demand substantial recreative engagement on audiences' parts. Let us start with the creative side of things.

Perhaps the most important thing to understand about mounted skeletons is that the overwhelming majority of dinosaur skeletons are incomplete. This poses a problem for mounting, since audiences are not quite as impressed by headless, limbless, or tail-less skeletons as they are by the whole shebang. The reasons for this incompleteness are fairly straightforward: either the bones became dissociated, are too small and delicate to fossilize well, or they are simply too large to be reliably covered by sediment. The latter is especially true of large sauropods who, because of their unspeakable size, are less likely to have most of their remains covered by sediment before their

skeletons are disarticulated by water or scavengers.[30] For this reason, complete dinosaur tails are virtually unknown in the fossil record, leaving palaeontologists and preparators to guess at the correct number of caudal vertebrae.[31] Similarly, excessively long necks can place skulls at a significant distance from the rest of the animal's carcass, increasing its chances of disarticulation and making it extremely difficult to locate skull fragments.

It is also important to understand that many fossilized remains are not intact. Some are broken into relatively large pieces with edges that clearly fit together, and others feature a large break with lost analogues; some large bones have been pulverized into *hundreds* of tiny fragments which preparators must painstakingly glue back together;[32] still others have been flattened, warped, or twisted by geological processes. These do not supply good material for mounting; indeed, most fossilized bones are quite fragile and cannot even bear their own weight. These must then be cast from the reconstructed originals, a process which can damage the original bone. As a result, very few mounts worldwide are complete and composed primarily of bone.[33]

Finally, it is important to understand that the process of mounting a skeleton causes irreparable damage to the bones, which must have holes bored into them so that they can be pinned to a supporting scaffold.[34] It also exposes them to further damage from cleaning, dust, and light.[35]

The challenge of working with fossilized bone significantly constrains what preparators can achieve, and forces them to search for workarounds. For these reasons, most of the mounted skeletons on display are composites of bone and other materials (frequently plaster), or made entirely from casts. Missing bones are supplied either from mirror-image casts of existing bones, from other specimens, or based on analogous structures in closely related species. Even when a mount is composed primarily of bone, these bones typically come from several different individuals—usually in the same genus, if not the same species. In that case, preparators must be careful to select bones from individuals of roughly the same size and developmental stage.

To illustrate these compromises, here is Gerhardt Maier's description of one of the few mounts composed almost entirely of bone, a *Dicraeosaurus hansemanni* excavated from Tendaguru Hill, in modern-day Tanzania, and now on display in Berlin's Museum für Naturkunde:

> All missing bones for the mount (*Dicraeosaurus hansemanni)* were modeled in plaster. These included the atlas and axis, based on examples from Quarry dd, right cervical ribs 3, 4, 6, 7, 10, and part of 11, and left cervical ribs 2, 3, 6, 7, 8, and 12, as well as parts of 9, 10, and 11. The left coracoid and scapula were built of plaster, the sternal plates were modeled on examples from *Diplodocus*, the left humerus was copied from site Q11, the radius and ulna were modelled from a *Dicraeosaurus sattleri* named Skeleton O, and metacarpals I and II were replicated from originals thought to belong to *Dicraeosaurus sattleri*. The remaining elements of the manus were freely modeled. The left ilium, ischium, and pubis were reconstructed as mirror images of the right side of skeleton m. The right tibia, fibula, and astragalus were mirror images of the left side of m. All bones of the hind foot were replicated from distorted examples referred to *Dicraeosaurus hansemanni*. The phalangeal formula was that used for *Diplodocus* and *Brachiosaurus*: 2-1-1-1-1. Janensch admitted that he might have included extra vertebrae in the mount.[36]

Furthermore, because the vertebrae were distorted by geological processes the mount's spine was unnaturally curved, giving its neck a downward curve.[37]

All of this shows that mounting skeletons is not straightforward, but where does the creative imagination come in? It comes in three main stages. First, the preparation process itself is heavily reliant on preparators' imaginations to separate bone and other important structures from the rock matrix.[38] Indeed, failures of preparatory imagination can lead to the destruction of valuable evidence, such as when preparators inadvertently destroyed skin impressions from the first (and only) *Carnotaurus sastrei* skull to be discovered.[39] Second, it is on display in the ways in which preparators solve the practical problems of recreating and mounting a complete skeleton, as well as in their decisions about posing. Finally, it can be manifested in a much more hands-on manner when bones are sculpted freehand based on what is known of related species, with predictably mixed results. Consider the *Brontosaurus excelsus* mounted at the American Museum of Natural History (AMNH), which was first exhibited in 1905. At the time, no *Brontosaurus* skull had ever been found, so preparators

sculpted one based on *Camarasaurus supremus* (formerly *Morosaurus impar*), which was thought to be a closely related species. The museum did so because "filling in missing parts is essential if the skeleton is really to look like the framework of a living animal and clearly to convey the impression of a living organism."[40] A possible skull was discovered for the Carnegie Museum in 1909 which looked nothing like this sculpted head. This caused sufficient uncertainty that the Carnegie mount remained headless until 1936, when the museum followed the AMNH's lead and gave it a *Camarasaurus* head.[41]

Unfortunately, it became clear in the 1970s that *Brontosaurus* was an Apatosaurine dinosaur, and thus not at all closely related to *Camarasaurus*. This came as bad news, because the heads of an *Apatosaurus* and a *Camarasaurus* look *nothing* alike: one is long and thin, the other tall and bulky. The Carnegie Museum was the first to correct its *Brontosaurus* skull, and it did so in 1979, but the AMNH only did so in 1995, when it also corrected its mount's tail.[42] *Brontosaurus*'s saga is thus remarkably similar to the tale of Riou's *Archaeopteryx*. When we combine the highly speculative nature of *Brontosaurus*'s head with errors concerning its posture (e.g. tail-dragging) and anatomy, and the composite nature of the bones making up the mount[43] this effectively suggests that what was on display at the AMNH for ninety years was an imaginary creature not unlike Frankenstein's monster or Leibniz's unicorn. It bore little resemblance to the real creatures whose bones were exhibited under the label "*Brontosaurus excelsus*".

4. Appreciating mounts

Now that we have a finer appreciation for the work involved in preparing and mounting fossils and the role that the creative imagination plays in such work, we can turn to the public's experience of these mounts, which is where the recreative imagination comes in.

Let us begin by asking: why do museums invest so much time, money, and sheer effort in mounting dinosaur skeletons? It is not, contrary to appearances, for scientific purposes. Even though

it has been standard practice since the very beginning to subtly indicate which elements of a skeleton are not real bone, the damage done to bones in order to mount them, coupled with the liberal mixing of elements from different individuals and species and the frequent introduction of errors, makes them of at best limited value to scientists. It is, in fact, much more useful for scientists to be able to examine bones up close and from different angles—which is difficult to achieve when the bones are anchored in place dozens of feet in the air.

Instead, the whole point of mounting a skeleton is to prompt audiences to imagine the creature in real life. Practitioners themselves make no bones about it:

> [Dinosaurs] require one very important ingredient to make them truly terrifying: the human imagination. It is the mind's eye (particularly that of children) which can flesh out the dusty old dinosaur skeleton in the museum and bring it back to life.[44]

Museums go to an awful lot of trouble—and expense—to mount skeletons. To get a sense of the scale of the effort involved, consider that it took 450 hours, spread over two months, to prepare a single small cervical vertebra before it could be mounted for Berlin's Museum für Naturkunde's *Giraffatitan brancai* (formerly *Brachiosaurus brancai*) display.[45] Although a dinosaur's sheer size is certainly impressive, the point of a mount is not just to overawe us. Instead, each mount stands as a prescription to imagine its associated creature, to put flesh on its bones and imagine it interacting with its environment.

To this end, mounts are often posed in particularly evocative ways. So, for example, the Dino Kingdom 2012 exhibition in Japan featured a pair of *Yutyrannus huali* fighting for dominance, with one leaping onto another, lying on its back and kicking out at its attacker.[46] Similarly, the AMNH's Theodore Roosevelt Rotunda is dominated by a rearing *Barosaurus lentus* protecting her powerless progeny from a hungry *Allosaurus fragilis*. Indeed, museums often pair mounts with a painted backdrop, for those of us who are not quite sure how to begin to imagine them in action. This is the case, for example, at the AMNH, where paintings by Charles Knight, the *doyen* of palaeoart, accompany several

mounts. The technique is a common one, borrowed from habitat dioramas for the purpose of creating an immersive experience and "thereby glean perhaps some idea of the life which flourished so vigorously on our planet in ages past."[47] Such dioramas also typically feature animals in dynamic poses, and we have many of the same reasons to classify these as artworks as we do mounted skeletons; indeed, the main difference may just be that dioramas are more obviously artistic (and artifactual) than mounted skeletons.

As Kendall Walton would put it, dinosaur mounts are clearly props for games of make-believe: the skeleton is the real-world item we use to guide our imagination through the task of imagining what the creature must have been like when it lived, and to get a sense of the world that is gone. In Waltonian terms, the skeleton is a (real) prop which makes it fictional that an *Allosaurus* is held at bay by a *Barosaurus*, that two *Yutyrannus* are fighting, or even just that a *Giraffatitan* stands before us.

Mounted dinosaur skeletons differ from other natural history specimens when it comes to prescribing imaginings. This is because most natural history specimens are taxidermized, and although a stuffed animal is certainly artifactual, it does not mobilize the imagination in the same way. When I see a stuffed tiger, moose, or hoatzin, I am presented with a reasonable facsimile of the real thing. Comparatively little is left to the imagination, precisely because the average museum-goer is more interested in a creature's contours and surfaces than what is under the skin. Moreover, I am already relatively familiar with such animals; I do not *need* to imagine what they are like, since I already have some idea, more or less.

When it comes to a dinosaur skeleton, however, it is *I* who must make the effort of putting muscle and skin and feathers onto that bone. Moreover, these creatures are so alien compared to everything I know that I cannot hope to approximate the reality. I have comparatively few reference points for them, and so am left to my own devices. Nor am I seeing a single individual, as with most natural history specimens; I am presented with a compromise, something cobbled together from the

"best" elements of several individuals—something approaching, in the best instances, the Form of the creature's form.

With taxidermy, we typically have easy epistemic access to standards of correctness for the display—usually a living creature (e.g. tigers) or a close relative (e.g. Nicobar pigeons for the dodo, although it is worth noting that the last stuffed dodo was incinerated in 1755). But when it comes to dinosaurs, audiences have no ready-made standards to deploy, save perhaps those they have imbibed from popular culture, where conventions of depiction and market expectations trump rigorous depiction. A skeletal mount so radically under-determines the real appearance and behaviour of the living animal that audiences are left with infinite possibilities. The average gawker's imaginative engagement with a mounted dinosaur skeleton is bound to be far more extensive than her imaginative engagement with the museum's taxidermy collection. Whereas a stuffed animal's familiarity is a recipe for an admiring look or two, the dinosaur's unfamiliarity (remoteness) and the mount's under-determination of life appearance virtually guarantee that audiences will pause to engage with them imaginatively.

5. But are they art?

I argued, above, that mounted dinosaur skeletons mobilize a significant amount of creative and, especially, recreative imagination. It is because of this—and because of *how* they mobilize the imagination—that I think we should seriously entertain the proposition that they are artworks, rather than 'natural' objects (fossils) or mere scientific specimens. But it might still be objected that mounted dinosaur skeletons are rather unlike other artworks in at least one key respect: though they *do* mobilize the imagination as a matter of fact, they strive to *minimize* its contributions as a matter of course.[48] If they really *are* artworks, then this seems to suggest that they are rather unusual artworks. At its extreme, we might even take this fact to undergird a difference so profound as to be disqualifying for art-status.

After all, if museum staff could procure and display a live specimen, they would love nothing better than to do so; and, failing that, they would happily settle for a mummy with preserved skin, or a complete and articulated skeleton without a toe out of place. Mounts are only composites because, as a practical matter, fossil yields are non-ideal, and because ideal conditions of preservation are so rare that such specimens are or would be too scientifically valuable to mount. In other words, skeletal mounts seem to be the result of efforts to *reduce* creative and imaginative input as much as possible, whereas ordinary artworks seem to *encourage* that sort of engagement. If mounts are creative, it is only a byproduct of scientific ignorance.

We should be careful not to make too much of this practical difference. Some of the sting can be taken out of the objection simply by noting that mounted skeletons are *ideal*, rather than 'real', imitations of these ancient leviathans. The skeleton—composite that it is—stands as a type for the species, abstracting away from individual idiosyncrasies to give a sense of what a typical individual may have been like. As for the rest, the fact that dinosaur mounts are circumscribed by various epistemic and practical challenges does not, in itself, undermine their art-status. Indeed, there is a long tradition in art theory, going back at least as far as Adam Smith's posthumous essay, "Of the Nature of that Imitation which takes place in what are called The Imitative Arts" (1795), which locates the particular pleasure of aesthetic appreciation in precisely such attempts to overcome the practical limitations of a medium. The default view of art, at Smith's time, was that it is imitative (with the occasional exception of architecture and music), and the general belief was that imitation implies a resemblance between the artwork and whatever it depicts. But, argued Smith, the aesthetic pleasure we experience from art is not the result of perfect imitation; rather, we derive our aesthetic pleasure from the *dissimilarity* between the artwork and the object it depicts.[49] So, he says,

> In Painting, a plain surface of one kind is made to resemble, not only a plain surface of another, but all the three dimensions of a solid substance. In Statuary and Sculpture, a solid substance of one kind, is made to resemble a solid substance of another. The disparity between the object imitating, and

the object imitated, is much greater in the one art than in the other; and the pleasure arising from the imitation seems to be greater in proportion as this disparity is greater.[50]

In other words, what we appreciate is the achievement of rendering something realistically despite the limitations of a particular medium. So, for example, we appreciate the sculpture of a person more than we would someone wearing a costume because it is harder to make stone look like someone than it is to make one person look like another; and, likewise, we appreciate a painting more than a sculpture because it is harder to render the three-dimensional in two dimensions than in three.

One might also worry that the creative imagination mobilized in making dinosaur mounts is not closely tied to appreciators' recreative engagement with them, unlike with traditional artworks.[51] This is because preparators are primarily tasked with making abductive inferences about how the bones fit together and what the skeleton should look like. But when ordinary artists do their work, their creative imagination is guided in part by the recreative imagining they are hoping to elicit. So, for example, an artist preparing a natural history diorama must imagine the scene they are asking audiences to imagine, and their creative work is guided by this recreative imagining. With skeletal mounts, it seems like the recreative imagination bottoms out with the aim that audiences imagine the truth, the creature made flesh. We might say that the imaginary engagement with the mount is primarily *restorative*, rather than interactive.

But we ought not make too much of this apparent asymmetry either. First, even if it is present, it is not necessarily so: plenty of museum mounts, after all, are interactively posed. Just think of the leaping *Yutyrannus huali* exhibited at Dino Kingdom 2012, or the rearing *Barosaurus* in the AMNH's rotunda. These are dynamically-posed mounts which interact with one another to transform their associated display spaces, much as a diorama or installation does. Indeed, early exhibitions of mounted skeletons were explicitly inspired by the nascent practice of natural history dioramas.[52] But even when they are not part of *tableaux*, dinosaur mounts are frequently (if subtly) posed—usually mid-stride, as

with the world's largest mount, the *Giraffatitan brancai* that dominates the Dinosaur Hall of Berlin's Museum für Naturkunde. It is certainly true that a dynamic mount or diorama prescribes a great deal more recreative imagination than a static mount (such as the AMNH's *Brontosaurus*)—audiences are supposed to imagine this dinosaur alive *and* doing *that*, rather than simply imagining it alive. But this is just the difference between a single sculpture and an installation; the more mounts are gathered together in one space, the thicker and richer an audience's imaginative engagement with them will be since, even if the mounts are individually static, their physical proximity to one another invites—prescribes?—precisely that kind of imagining.

Museums know exactly what they are doing when they mount skeletons for display, and their aims are not strictly scientific. Following the so-called "New Museum Idea" that arose in nineteenth-century England, public museums strive to balance two separate constituencies and goals: the public, which comes for a show and stays for a story, and scientists, who use their collections for research.[53] The former bring in the funds, while the latter confer legitimacy and prestige. Dinosaur mounts were also, from the nineteenth to the mid-twentieth century, integral pieces in the prestige competition between Great Powers, who raided their colonies for fossils and raced to display the largest, most spectacular mount.[54] We can see, then, that the considerations at play here are not strictly, or even primarily, scientific. Indeed, the first museums to display mounted skeletons were particularly concerned about the potentially deleterious effect on their reputations as credible scientific institutions, given the risk of inaccuracy and the degree of individual conjecture involved in their creation.[55] In order to differentiate their offerings from those of dime museums and waxworks, they strove to achieve a balance between the spectacle and the educational potential of the mount.[56] For that reason, they expended great energy producing leaflets and painted backgrounds to guide the ignorant visitor's imagining.[57]

Finally, it is worth reiterating that the practice of mounting skeletons comes at the cost of scientific value. This is due to a number of factors, but chief among them are: (1) the composite nature of these skeletons, (2) their mix of real, reconstructed, and conjectural elements, not to mention support structures (3) the physical and chemical damage done to fossils in order to mount them, (4) the damage fossils sustain by being on display (e.g. from dust, humidity, and exposure to light), and (5) the concomitant inaccessibility of the mount's individual bones to study by researchers. But it is also worth noting that mounts are not the sort of thing that scientists count as research outputs or tools, in the same way that they would count a publication, presentation, or model.[58] Palaeontologists act in a purely advisory capacity when they are involved with mounting skeletons, while the decisions about, as well as the work of, preparation and mounting are carried out by museum preparators, many of whom have no formal scientific credentials.[59] And while it may be tempting to think of a mounted skeleton as a model, its size, fragility, composite nature, and attachment points make it an awkward research partner at best. Although palaeontologists may sometimes request that individual bones be removed from a display for examination, the effort required to do so is prohibitive. Instead, museums divide their holdings into display and study collections to facilitate scientific access to important specimens.[60] Scientists today also tend to prefer computer models when researching the biomechanical features of extinct creatures, since these can be manipulated without risk to the fossil, and because the data gleaned in this way are often more precise. Functional morphology, for example, uses an animal's skeleton to study its workings (including things like locomotion, feeding, and prey-capture). Traditionally, functional morphology was studied by physically manipulating bones at their joints, but doing so requires ready access to fossils, risks damaging them, and does not account for the effects of soft tissue anatomy. For those reasons, digital models are generally preferred for studying functional morphology.[61]

6. What kind of art are they?

So far, I have argued that mounted dinosaur skeletons are appropriate candidates for art-status. This is not a trivial claim, since at first blush they seem like paradigmatically natural objects which elicit straightforward engagement from audiences, rather than heavily imagination-dependent artifacts. Suppose you are convinced that mounts *could* be artworks. The question remains: *are* they artworks? And, if so, what *kind* of artwork are they? In what little space remains, I would like to sketch the skeleton of an answer.

I think they are sculptures. Unfortunately, the definition of sculpture has not received much philosophical attention.[62] Traditionally, the focus has been on the medium's three-dimensionality, so that sculpture is something like the art form whose appreciation requires audiences to engage with its spatial dimensions.[63] Mounted dinosaur skeletons obviously pass muster on this score, but so might any other artifact; the traditional account of sculpture does not tell us much that is specific to sculpture. More recently, philosophers have tried to draw attention to key elements of the appreciative practices associated with sculpture to fill in more of the details. David Davies (2023) has identified three key ideas in the philosophical discussion of sculpture: (1) that the concept of *touch* plays a key role in engaging with sculpture, (2) that sculpture calls on audiences to ground their imaginings in an embodied response to the work, and (3) that appreciating sculptures requires us to appreciate the ways in which they relate to their surrounding gallery space. My contention is that mounted dinosaur skeletons meet all three conditions.

First, consider the sense modality of touch. At first glance, this seems like a failure of fit since the public is not meant to touch mounted skeletons. Indeed, where real bone is used, touch is liable to damage the mount. This should not be held against mounts, however, because the public is not usually meant to touch the sculptures on display in a gallery setting, either. Still, touch *is* important to the appreciation of a skeletal mount of an extinct creature insofar as it aims to make the creature

tangible for audiences, to give it a weight and reality that images cannot. Even though visitors to a museum are forbidden to touch the mounts, it matters that they *could* do so. The bones are real, assembled, and on display; what is left of the creature is right there in front of them.[64] It is, as Carolyn Korsmeyer says, a "real old thing" which helps us to "[register] a singular thrill of proximity to something old and rare."[65] A mount's assemblage and display grants it an authenticity that illustrations lack, putting us in contact with a truly foreign past.

On the second point, we have already seen that the experience museums are trying to elicit from audiences is the awe-inspiring one of imagining the creature made flesh. For many mounts—the spectacular ones which draw the crowds—this is clearly intended to be a comparative experience, one which requires the viewer to stand next to the dead titan and feel their own fragility, insignificance, and mortality. This comparative element is explicit in public-facing talk about museums' educational mission, which often draws parallels between the extinction of the dinosaurs and the ongoing sixth mass extinction.

Finally, the third point is evident when we consider the mount's placement in the gallery space. Large and impressive mounts, for example, typically greet visitors at the entrance to a museum or wing, as with the *Barosaurus* vs. *Allosaurus* standoff in the AMNH's rotunda. Other mounts are placed against painted backgrounds showing them as they are thought to have been in life, as at Yale's Peabody Museum, creating a sort of diorama experience. But even mounts which are not used in these ways transform their associated spaces. A room stuffed to the gills with skeletal mounts is a window on a different world, and consciously so.

All this suggests that, far from being mere models or data, mounted dinosaur skeletons are the products of an appreciative practice that exploits a particular technical resource (viz., fossil bone) in order to realize certain artistic properties and values (viz., imaginative and representational ones), and which flourishes in situations of relative epistemic poverty.[66] The resulting medium-profile clearly

shares a great deal in common with sculpture, and can be found to varying degrees elsewhere in the museum, such as in natural history dioramas or even, perhaps, in taxidermy collections.

7. Conclusion

I have argued that paying closer attention to the process of mounting skeletons shows that mounts are intention- and imagination-dependent objects. They are artifacts whose process of creation mobilizes considerable creative imagination, and whose proper appreciation demands that audiences make use of their recreative capacities. We tend to take mounted dinosaur skeletons at face value, as the raw data on which the science of palaeontology is founded. In doing so we not only ignore the vast amount of creative work involved in their preparation and mounting, but we also fail to do justice to our actual engagement with them. The whole point of mounting a skeleton, after all, is to transport visitors to a lost world.

I began with a picture; allow me to end with a word. What are mounted dinosaur skeletons? Artworks.

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Fig. 156. Vue de la terre pendant la période oolithique supérieure.

1. Conifères. — 2. Cycadées et Araucarias. — 3. Fougères herbacées. — 4. Conifères. — 5. Cuninghamias. — 6. Fougères herbacées.

Fig. 1 – *Vue de la terre pendant la période oolithique supérieure*
Lithograph by Édouard Riou, in Louis Figuier (1866), *La terre avant le déluge*, Paris: Librairie de L. Hachette, p. 229.

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Endnotes

[1] My translation.

[2] Figuier (1867: 228), my translation.

[3] This *Archaeopteryx* is standardly interpreted as headless. Perhaps a more charitable interpretation is that the animal is flying away from the viewer and thus we see the back of its nubbin-head. This is not obvious, given the lateral perspective on the flying *Rhamphorhynchus* below; but even if true, we should not let this fact get in the way of a good story.

[4] See, e.g., Scruton (1981) and Mizrahi (2021).

[5] Walton (1984).

[6] The notion of intention-dependence is spelled out in greater detail in Mag Uidhir (2013) and Xhignesse (2020).

[7] Currie and Ravenscroft (2002: 9). See also Arcangeli (2022).

[8] Dundas (2015: 8).

[9] Currie and Ravenscroft (2002: 11); see also Goldman (2006), Balcerak Jackson (2016), and Arcangeli (2022).

[10] Indeed, even anti-essentialists about 'art' accept artifactuality as a necessary condition on art-making. Consider, e.g., Berys Gaut's cluster theory, whose *only* necessary condition is that the work be the product (in some sense) of an intention (2000).

[11] See Wiltsher and Meskin (2016) for an excellent overview of the role ascribed to the imagination in the philosophy of art.

[12] Walton (1973) is a notable exception.

[13] Quatremère de Quincy (1805, 12, 51).

[14] Quatremère de Quincy (1805: 13, my translation).

[15] Quatremère de Quincy (1805, 34, 46-7, my translation).

[16] Kant (2000 [1790]: §317).

[17] Schopenhauer (1818, §36).

[18] Gaut (2003: 279).

[19] Collingwood (1938), Croce (1909), and Sartre (1948: 273-82). Whether Collingwood in fact subscribed to such a theory is a matter of some dispute; see Ridley (1997).

[20] Sartre (1948: 27-30, 273-7, 281).

[21] Sartre (1948: 280).

[22] Sartre (1948: 275).

[23] Collingwood (1938: 139). The original remark concerns musical works and composers, but I take my paraphrase to be felicitous, considering his ontology of art.

[24] Wollheim (1973, 1980: 36-43).

[25] Wollheim (1973). Although some versions of idealism maintain that the work exists in the creator's imagination and is communicated to audiences via its material form—this is Ridley's (1997) reading of Collingwood, for example. See also Cox (1986) and Pearce (1988).

[26] See, e.g., Cox (1986), Pearce (1988), Dilworth (2001, 2005), Tétreault (2012), and Cray and Matheson (2017).

[27] Walton (1990).

[28] See, e.g., George Wilson (1986) on cinema, Grant Tavinor (2009) on video games, Kathleen Stock (2011) on literature, and Derek Matravers (2014) on non-fiction.

[29] See, e.g., Edward T. Cone (1974), Aaron Ridley (1995), Jerrold Levinson (2006), Roger Scruton (2009), Tom Cochrane (2010), and Jenefer Robinson and Robert Hatten (2012).

[30] Maier (2003: 322).

[31] Hone (2016: 102).

[32] The glue itself damages the bone, destroying biomolecules and their traces.

[33] Maier (2003: 248). Maier estimated six in 2003.

[34] Rieppel (2019: 211). Scaffolds are an integral part of any mount, but designed to be unobtrusive.

[35] On the surprising dangers of dust and cleaning, see Wylie (2021: 194-5).

[36] Maier (2003: 247).

[37] Maier (2003: 248).

[38] For the many and varied uses of the imagination involved in the process of preparation, see Wylie (2015) and (2021).

[39] Czerkas and Czerkas (1997).

[40] Quoted in Rieppel (2012: 474).

[41] Rieppel (2012: 476).

[42] For a more detailed treatment of this fascinating saga, see Rieppel (2012: 474-6).

[43] The real bones were taken from at least three individuals (Rieppel 2012: 477).

[44] Norman (1991: 18).

[45] Maier (2003: 105).

[46] This mount is a clear reference to Charles Knight's classic painting *Leaping Laelaps* (1897).

[47] Charles Knight, quoted in Rieppel (2019: 210). Rieppel traces the origin of this practice in his (2019) and canvasses several painting/mount pairings in his (2012).

[48] I owe this objection to a referee and an editor.

[49] Smith (1982 [1795]: 176-9).

[50] Smith (1982 [1795]: 179).

[51] My thanks to a referee for pressing this point.

[52] See Rieppel (2012: 465, 483-6).

[53] Rieppel (2019: 46); see also Nyhart (2004) and Wylie (2021: 183-4).

[54] On the prestige economy and the race for colonial fossils, see especially Maier (2003) and Rieppel (2019, esp. 4-10, 63-4, 82ff, and 107-8).

[55] See Nyhart (2004), Rieppel (2012), and Wylie (2021: 183-4).

[56] Rieppel (2019: 61-3), Nyhart (2004: 311-3).

[57] Rieppel (2019) describes a number of examples.

[58] Once again, I owe this point to a referee. Thank you.

[59] Wylie (2021: 61-2, 68-82).

[60] Rieppel (2019: 61-2).

[61] See, e.g. Naish and Barrett (2016: 92-7), Wylie (2021: 120ff), and Demuth et al. (2023).

[62] Some significant exceptions include Koed (2005), Irvin (2013), and Davies (2023).

[63] For a summary and analysis of this history, see Irvin (2013).

[64] Luckily, it is not widely known that most mounts are not, in fact, made of real bone!

[65] Korsmeyer (2016: 221).
[66] See Lopes (2014: Chs. 7-8) for how appreciative practices, technical resources, and artistic properties combine to shape an art-kind.