

Dinosaur Hearts and Denial

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Recently, scientists from North Carolina and Oregon discovered what was believed to be a dinosaur heart. This heart presented evidence that dinosaurs were warm-blooded and a metabolism not unlike a bird's. This discovery represented a substantial amount of support for the theory that dinosaurs were not only warm-blooded, but ancestors to modern birds as well. On the other hand, scientists who disagree with this theory have also had a look at Willo, the thescelosaur, and produced very different results. They believe that the 'heart' is nothing more than a lump of funny-shaped, but rather ordinary rock called an ironstone concretion. Both sides using various scientific forums and more ordinary media—for example, the New York Times and ABC News, presented evidence.

The discovery itself, if correct, is monumental. This proof of a heart more like a human's than a crocodile's astounded researchers in North Carolina. Mike Hammer found Willo in 1993 from the Hell Creek Formation in South Dakota (1). He and Dr. Andrew Kumitz both conducted the initial CT scans until the North Carolina Museum of Natural Sciences purchased it in 1996. At that point, Dr. Dale Russell, Dr. Reese Barrick, Dr. Paul Fisher and Dr. Michael Stoskopf of North Carolina State University began doing even more detailed research. The computerized tomography scans were done with a Picker PA 6000 scanner at 120kV potential, 320mA's, with a slice thickness of 4mm and spacing of 2mm. At that point, images were transferred to a SUN workstation and placed

in an ANALYZE-AVW to be analyzed in 3-D. This created 3-D images of what was inside the concretion (2).

The scans revealed a heart that was made up of a four-chambered design like that of a bird or mammal. There were the appropriate cavities, two separated ventricles, properly attached to what appeared to be the systemic aorta (2). This clearly resembles today's mammals and birds. All modern reptiles, except crocodiles, have a single ventricle that allows oxygenated and deoxygenated blood to mix, lowering the metabolic rate. These produces a 3-chambered heart, and crocodiles, although they have a double-chambered ventricle, also has the lower efficiency blood mixing problem (2).

The opposite viewpoint does not believe this to be a heart at all. They have labeled it a geothite, a misinterpreted concretion (3), or less politely, "a lump of mud" (2). Dr. Timothy Rowe defines a spheroidal geothite concretion as an ironstone concretion formed by near-surface oxidation of siderite concretions in shale and sandstone (3). Dr. Timothy Rowe of University of Texas at Austin and his associate Dr. Sereno of the University of Chicago have presented several reasons why it is not a heart. Most of the specific details were presented in the Science Magazine, a respected scientific forum, with Fisher *et al.* presenting their rebuttals for the denials in the article.

Firstly, soft tissue is unlikely to be preserved at all, let alone in the fluvial setting of the Hell Creek Formation (3). Fisher *et al.* responds to this by saying that cartilaginous substances, sternal ribs, costal plates and beaks have already been found in that formation (3). Rowe *et al.* also claims that the heart is merely an ironstone concretion that is often found around dinosaur bones. The response to this is that while

some concretions like that have been noticed in the formation, the nearest ones were at least several meters above Willo, but none were found in adjacent sediments. Not only that, but an ironstone formation would not have had such well-defined shapes in it, rather, it would have been lumpish without cavities. The next question Rowe *et al.* poses is that the 'heart' has several biological errors. For example, the heart itself was partially enclosing around one of the ribs. The entire piece is distorted, including the lumen, which is supposedly entirely encapsulated, but is full of iron-free silt quartz. This is unusual seeing as the entire outer 'muscles' of the heart are iron-rich. Fisher *et al.* respond to the point by saying that the distortions are due to the fact that the heart most likely rotted to some degree before permineralization. Flesh at any point would rot a bit before being completely settled and ready for fossilization. Rowe *et al.* also gives an example of another instance where an ironstone concretion had also been misinterpreted. At one point, the oldest amniotic egg was supposed to be a specimen from the Lower Permian of Texas, but was later discovered to not have the mineralogy and microstructure necessary. Fisher *et al.* rebut by stating that technology such as CT scanning has made that sort of situation much less likely to happen and the number of tests done on this particular specimen makes it even less likely.

As aforementioned, these debates have been published in various forums, even on regular news groups (4,5,6). The ABC News piece was quite a surprise. The annotated reference list will give a short description of each source and how high quality it is. There were quite a few articles on the subject, although most of them seemed to be less technical versions of what was published in science magazine. The website will have direct links to the pages; the only ones costing anything were the New York Times pieces

(4,5). All of these references were important, because once something is published in some highly technical scientific journal (2, 3) or have a news item of the week in one (7), the rest of the public will not hear about it unless aided. The North Carolina Museum of Natural Sciences began with its big exhibit being the Acrocanthosaurus; but this tiny form of Willo is overshadowing the monstrous form. Willo has its own webpage now, which works very well in answering a wide variety of questions in easy format.

The main thing is that people are being informed of these new discoveries. If not for the less technically forums, people would hear about any of this. If all that was published were technical journals, most people would have no idea of what they scientists are talking about. So while debates are important, so is the spreading of the knowledge of what these debates are about.

Both sides presented valid points on the debate of Willo's heart. The issue is still unresolved, with both sides unwavering. Although it has gotten a lot of negative publicity, heart enthusiasts believe that people will accept the idea in time. As Dr. Russell said, "We're going to hold on to the truth and see what happens in the future . . . We'll see how it all develops." (8)

References

1. www.dinoheart.org
-This website is really good for finding relatively simple facts about Willo. This is the North Carolina Museum of Natural History site and is a good source if you're not looking for intensely technical information. Rating: 3
2. P. Fisher *et al.*, Science 288, 503 (21 April 2000), "Cardiovascular Evidence for an Intermediate or Higher Metabolic Rate in an Ornithischian Dinosaur,"
<http://www.sciencemag.org/cgi/content/full/288/5465/503>
-This article is the original one published in April of 2000 in Science Magazine. This is where a lot of the criticism comes from. This article shocked a lot of people and spurred the opposition into action. This is where the fame of Willo came from. While highly technical, it is full of very good information. Rating: 4
3. T. Rowe *et al.* and P. Fisher *et al.*, Science 291, 783a (2 February 2001), "Dinosaur with a Heart of Stone—Technical Comments."
<http://www.sciencemag.org/cgi/content/full/291/5505/783a>
-This is the debating article between Rowe *et al.* and Fisher *et al.*, and while it is technical, it also presents both viewpoints in one very organized source. This is a good source to compare both viewpoints. Rating: 4 ½
4. J. Wilford, New York Times, 21 April 2000, "Scientists say they have found the heart of a dinosaur."
[http://archives.nytimes.com/plweb-cgi/fastweb?state_id=987704734&view=site&numhitsfound=56&query=%28Dinosaur%20%29%20AND%20%28Heart%29%20AND%20%2820000401%3C%3Dpdate%3C%3D20010419%29&query_rule=%28\\$query%29&query7=%28Dinosaur%20%29%20AND%20%28Heart%29&query8=using%20date%20range%20April%2001,%202000%20to%20April%2019,%202001&docid=33274&docdb=2000arc&dbname=unify&numresults=10&sorting=BYRELEVANCE&operator=AND&TemplateName=abs.tpl&setCookie=1](http://archives.nytimes.com/plweb-cgi/fastweb?state_id=987704734&view=site&numhitsfound=56&query=%28Dinosaur%20%29%20AND%20%28Heart%29%20AND%20%2820000401%3C%3Dpdate%3C%3D20010419%29&query_rule=%28$query%29&query7=%28Dinosaur%20%29%20AND%20%28Heart%29&query8=using%20date%20range%20April%2001,%202000%20to%20April%2019,%202001&docid=33274&docdb=2000arc&dbname=unify&numresults=10&sorting=BYRELEVANCE&operator=AND&TemplateName=abs.tpl&setCookie=1)
-All that could be accessed was the abstract. It seemed to be an announcement of the new discovery without getting very technical. It was another good example of how the public can be exposed to new paleontological discoveries. Rating: 3

5. J. Wilford, New York Times, 23 April 2000, "Heart of Stone"
[http://archives.nytimes.com/plweb-cgi/fastweb?state_id=987705052&view=site&docrank=10&numhitsfound=56&query=%28Dinosaur%20%29%20AND%20%28Heart%29%20AND%20%2820000401%3C%3Dpdate%3C%3D20010419%29&query_rule=%28\\$query%29&query7=%28Dinosaur%20%29%20AND%20%28Heart%29&query8=using%20date%20range%20April%2001,%202000%20to%20April%2019,%202001&docid=34069&docdb=2000arc&dbname=unify&numresults=10&starthit=10&sorting=BYRELEVANCE&operator=AND&TemplateName=abs.tmpl&setCookie=1](http://archives.nytimes.com/plweb-cgi/fastweb?state_id=987705052&view=site&docrank=10&numhitsfound=56&query=%28Dinosaur%20%29%20AND%20%28Heart%29%20AND%20%2820000401%3C%3Dpdate%3C%3D20010419%29&query_rule=%28$query%29&query7=%28Dinosaur%20%29%20AND%20%28Heart%29&query8=using%20date%20range%20April%2001,%202000%20to%20April%2019,%202001&docid=34069&docdb=2000arc&dbname=unify&numresults=10&starthit=10&sorting=BYRELEVANCE&operator=AND&TemplateName=abs.tmpl&setCookie=1)
-This was unable to be accessed online except for the leading paragraph. From the sound of the article and its leading paragraph, it merely seemed to be a public echo of the Science Magazine so that the points it made would be made again, only this time a little more publicly and less technically. Rating: 3
6. P. Recer, ABC News, 20 April 2000, "Warm-blooded? Dinosaurs may be more like mammals"
<http://abcnews.go.com/sections/science/DailyNews/dinos000420.html>
-This article was well written and entertaining to read. It was an example of how simple information was produced for the masses. Rating: 3 ½
7. R. Dalton, Nature Journal, 21 September 2000, "Doubts grow over discovery of fossilized 'dinosaur heart'
- There is no link because I received a copy of this article from Dr. Dale and was unable to access the article online. It is basic, although the article brings up some very minor points, including the criminal record of Michael Hammer. This was supposed to be some sort of evidence that the discovery was false. It didn't go into any detail at all for a scientific journal and it seemed as if the article was merely making of show of having an article on the subject. Rating: 2
8. D. Russell, 19 April 2001
-This isn't that fair for poor Dr. Russell, but I quoted him from our conversation earlier today, so I hope he doesn't mind. He is one of the key figures, so he would make a logical person to talk to.