The discovery of evidence of the world’s oldest axe is reported by my colleagues and I in a paper published in Australian Archaeology this week.

As often happens, this announcement was the result of a surprisingly long process, and yet it has shocked some archaeologists. The response to it reveals much about the nature of archaeological argument and about the way we think about the past.

The paper reported on an axe fragment found at a site in the Kimberley region in Western Australia. It wasn't a case of the discovery being a single event, a sudden moment as the object was dug from the ground and revealed for what it was.

Instead, the "discovery" spans almost 20 years.

The story began in the 1990s, when my colleague Sue O’Connor – now Laureate Professor at ANU – excavated into the deposit. She uncovered a remarkably rich record of human activity spanning the last 50,000 years.

She retrieved thousands of artefacts and bones, and found impressively early evidence of painted art. But when she and her colleagues catalogued the artefacts, they did not recognise that one small specimen had polished surfaces.

In 2014, Sue and her PhD student, Tim Maloney, were relooking at the collection, and they spotted the polish on this object.

To archaeologists, this is like a neon light: it shouts that the object has an unusual history. As a specialist in ancient stone artefacts, I was brought into the investigation.

It was obvious on first view that this was a flake broken from the edge and a ground, or polished, axe. I have seen hundreds of similar archaeological specimens, and made them myself experimentally.

What was unusual about this one was its age. It came from the same level as a piece of charcoal that was dated to 44,000 to 49,000 years old. Thus, by association, we believe the axe fragment to be about the same age. Exciting stuff.

We knew that made this the oldest axe in the world!

A high bar

But how would we convince others of this discovery?

I set about making a detailed description of the specimen, while Tim Maloney provided me with measurements of other artefacts he had measured from the site.

I have four decades of experience, and it was really straightforward for me to describe this axe flake: it had the same edge angle as more recent Australian axes; it was made on the same material used for Australian axes; and it had the polished surfaces preserved with clear indications of the abrasion that created the edge of the axe from which it came.

Equipped with my description, we sat down and wrote a paper. We sent it off. It was sent back.

Some reviewers were not convinced the specimen was a piece of an axe. They wondered if the abrasion could have been natural and they said our photographs were not clear enough.

Disappointed, but not dismayed, the co-authors and I understood this was the job of a good reviewer; a high bar should, indeed, be set for such a significant discovery.

I corresponded with the journal editor and established what would be needed to make the case: a high resolution photograph and a demonstration that the smoothed surface must have come from an axe.

I took the piece to our new 3D digital microscope. It eventually gave me extraordinary photographs of the specimen and quantitative measurements of the roughness of the polished surfaces.

I compared the roughness indices to natural surfaces, to flaked surfaces and to the surfaces of Australian axes. I did experiments abrading the surfaces of Kimberley basalt. No surprise. The only match was the surface of other axes.

Take two

We re-submitted the paper. It was reviewed, again. We still got the same question: could the smoothness be the outer weathered surface of a cobble? The answer was no.

In fact, we had already explained in the paper how the smoothing process ground down the highpoints of other manufacturing surfaces, and so the axe was shaped all over and then ground. It couldn’t be a natural surface, and the reviewer had simply missed this point.

I don’t mind a high threshold of evidence, but I like reviewers to actually understand the paper.

But now, several reviewers began a second line of criticism. They said this was only one specimen, so how can we be sure it is real?

I am an experienced academic and I am used to the argy-bargy and politics of journal reviews, but how could I respond to this? Isn’t it to be expected that the first discovery of something will usually be a singular instance?

Of course, we would want this to be a repeatable observation, and no doubt it will be repeated as future archaeologists do further work. At heart I am a Popperian , and so I made the case to the editor that surely what counted was the quality of our demonstration that the specimen came from an axe, not the number of times an axe had been broken at the site.

I pointedly wrote to the editor saying that, if it were a more fashionable object – one pyramid, one statuette, or one hominid tooth instead of one axe fragment – it would be published to inform the discipline that it existed.

They corresponded with the reviewers, who merely suggested we go back and dig more. Going back to dig again would take years, hundreds or thousands of dollars and in the end may produce nothing. Because, perhaps, it was simply the only axe fragment in the site.

Our final approach to the editor of the journal Australian Archaeology met with a positive response. Yes, we only had one specimen, but we had demonstrated it must have come from an axe. There were no other production systems known in Australia that would create these features.

They accepted the paper.

Of course, it's possible there might be some problem with our announcement revealed in the future. But on balance, the current evidence shows our conclusion is likely to be true, and surely that's all we can ask for.

Be resilient

The announcement is significant. It reveals technological and cultural novelty and innovation in the anatomically modern humans dispersing from Africa, in the ancestors of Aboriginal people.

We have had a lot of press coverage today. Much of it good, much of it fair. And there have been some criticisms.

The BBC quoted American archaeologist, John Shea, saying :

The evidence is essentially one flake – one piece of stone out of hundreds and hundreds that they've excavated from this rock shelter site […] They would make a stronger case if they could show that similar chips with edge abrasion occurred at a greater number of sites.

Obviously, one pyramid isn't enough for some people.

Young researchers reading this can take away the obvious message: while tough reviewing is a proper part of academia publishing, many reviewers' comments may be way off the mark.

Be reflexive and self-critical, but you may also need to be resilient because dramatic discoveries can be challenging to academics and the public alike.

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Read more http://theconversation.com/the-worlds-oldest-axe-shows-the-cut-and-thrust-of-academia-59228