

SCIENCE EDUCATION AND THE WORK OF ART

Dr Maurizio Toscano
Melbourne Graduate School of Education, The University of Melbourne, Australia.

Abstract

Martin Heidegger's seminal essay, *The Origin of the Work of Art*, captures much of what is original and enduring in his philosophical offering. Although his essay takes as its subject the relationship between art, the work of art and the artist; Heidegger's inquiry covers conceptual ground that is particularly pertinent to science education. More precisely: given the ubiquity and importance of things and equipment in the science classroom, Heidegger's meticulous inquiry into the nature of 'things', 'equipment' and 'the work' offers the potential for a re-conceptualisation of science education that loosens the grip of traditional accounts.

This paper adopts the approach and conclusions put forward in Heidegger's essay in order to examine philosophically the status of things and equipment in the science classroom. While it draws upon Heidegger's inquiry into the work of art, it goes beyond his analysis by examining the relationship between science, science education and art, and the special role that science teaching plays in instantiating these connections. In doing so, the paper puts forward the claim that the 'work' of the science teacher may be conceived of as 'works of art' in the Heideggerian sense; and provides the basis for a postmodern interpretation of science education.

I. In the beginning

What better way to begin an inquiry than to set aside the very possibility of a beginning from the outset – to leap into the whirring cogs of a machine already in motion rather than to lay down each part sequentially before us in the hope that we might see the logic that once held them in their proper place. Such is the nature of the beginning of Heidegger's inquiry into the origin of the work of art, which opens by drawing our attention to the circularity inherent in the subject of his inquiry, namely the relationship between the work of art, the artist and art:

On the usual view, the work arises out of and by means of the activity of the artist. But by what and whence is the artist what he is? By the work; for to say that the work does credit to the master means that it is the work that first lets the artist emerge as the master of his art. The artist is the origin of the work. The work is the origin of the artist...In themselves and in their interrelations artist and work *are* each of them by virtue of a third thing which is prior to both, namely that which also gives artist and the work of art their names—art. (Heidegger, 1971/1935-36, p. 17)

But what advantages are there in having a beginning that is not; especially for an inquiry into the place of things, equipment and teachers in the science classroom?

Firstly, this is how any inquiry begins. For every inquiry begins as an engagement with beings already in play by virtue of their being-as-such. Even Dewey's view that inquiry begins with an experience of "perplexity, confusion, doubt, due to the fact that one is implicated in an incomplete situation whose full character is not yet determined" (Dewey 1916, p. 165); has deeply written within his references to "an incomplete situation" and to "implicated" the presupposition of a field of existence with which (and not from which) the "perplexity, confusion, doubt" is ontologically (but not causally) connected. We shall have more to say about this field of existence (or *earth* as Heidegger puts) later in relation to works in the science classroom. Nonetheless, it is worthwhile prefacing at this stage that Heidegger thinks of the tension within any inquiry as associated with the "*earth* as what both informs and resists conceptualisation" (Thomson 2011, p.79).

What we have in Heidegger's recognition of the circularity of his inquiry is a resistance to characterizing that inquiry in cause-and-effect terms. Heidegger would therefore reject the notion that experiences of "perplexity, confusion, doubt" are caused by state of affairs in the world, but would rather take them as emerging unbroken from our ongoing existence. The setting up of the *worlds* of research, inquiry, investigation and so on, only gives a specious impression that these are effects in search of causes. What this resistance to causal accounts implies for the current inquiry is that we cannot take for granted the assumptions that underpin much of science education research, which have largely adopted the causal model of scientific inquiry. Consequently, the present inquiry cannot lay causal claims or provide explanatory models. It cannot, for instance, answer as to how and why a particular thing or set of things can be employed by the science teacher to generate an increase in students' engagement with science. That such 'scientific' accounts can and do prevail has not necessarily advanced our understanding of the nature of things, equipment and the work of teachers.

In acknowledging the circularity of his inquiry, Heidegger also resists the need to terminate the inquiry. We have already explored one means of termination: an inquiry may be closed off by a terminal theoretical or explanatory account of the phenomena under investigation. The postulation of a theory of aesthetics based on abstract notions (such as beauty) as the cause of aesthetic experiences would be such a termination for an inquiry into works of art. A theory or explanatory model of 'conceptual change' may serve as the terminus of an inquiry into the works of the science classroom. An inquiry might also terminate in the works themselves. That is, in a systematic search for elements common to all teachers' work, say; instantiated, for example, in enumerations of teacher standards, competencies, dispositions and the like. "The nature of art [and we could add science education] can no more be arrived at by a derivation from higher concepts than by a collection of characteristics of actual art [educational] works" (Heidegger, 1971/1935-36, p. 18).

The preceding discussion about inquiry is not incidental to the present inquiry into the nature of things and works in the science classroom. It foregrounds not only what this paper can and cannot deliver but also underscores my commitment to entering an unresolvable circularity. My aim, although it may not always be possible, is not to treat Heidegger's inquiry as itself an object of inquiry; but rather to walk along side, walk along with Heidegger, on the path he takes in examining art, artists and their work. I shall pause to look at the questions that Heidegger points out along the way and with each step ask after their significance for science education. My inquiry therefore takes the form of an interweaving of Heidegger's inquiry and my own, preserving as far as possible the sequence of Heidegger's inquiry.¹

Before we begin the inquiry proper, I must offer some motivation for basing an inquiry into science on a work that focuses on art. While not exclusive to science teachers, much of the work of the science teacher involves and is dependent upon setting up things and equipment within the classroom for the purpose of doing and learning about science. The science teacher sets these things and equipment *to work* in the course of a demonstration or students' practical work. The things of the classroom, therefore, are in no way neutral matter, for in the work they are set to doing they stand in relation to the science teacher and science itself. This triad (science, science teacher, the works of the science teacher) draws immediate parallels with Heidegger's investigations into the origin of the work of art, which in its stead investigates the triad of art, artist and the work of art. These parallels, along with the advantages of entering a circular inquiry expounded earlier, suggest enough imbrication of art and science to enter into our present inquiry.

II. Thing and Work

Let us take a science classroom demonstration that, if unfamiliar, may be imagined or reproduced easily enough by most. A small, lit candle is set to stand vertically in a large, shallow dish of water. The candle flame whimpers a little as the teacher leans over to grab a large, clear and empty glass jam jar. The jar is taller than the candle by about three finger-widths, and its circular cross-section is as extensive as the palm of one's hand. The teacher moves the open mouth of the jar carefully towards the candle. As if trapping an insect, she encloses the candle by setting the jar over it. The candle now rests entombed by the water below it and the jar standing over and around it. The science teacher steps back to let all her students look on with wonder as the water level in the jar climbs soon after the candle is extinguished.

The candle is a thing; the pool of wax is a thing; as is the jam jar, the table and the four combined. And yet – for the science teacher, and perhaps for the students, these things are no longer mere things. In the setting up of the demonstration there seems present something in addition to the thingly character of the things; whether the things are taken separately or conjoined. Moreover, when we inquire into the demonstration it is the mysterious characteristic in addition to the things that interests us but also veils our impression of the things as such. Heidegger reminds us that we take the same stance towards works of art.

Heidegger observes:

A picture hangs on the wall like a rifle or a hat. Works of art are shipped like coal from the Ruhr and logs from the Black Forest. ... All works have this thingly character. (Heidegger, 1971/1935-36, p. 19)

Heidegger's blasphemous comparison of works of art to rifles, hats, etc., does bring to our attention the dualism we assume exists in works of art, that there is more to them than just the things they are. And he reminds us that such an assumption is often hidden in our use of the word *symbol* (drawn as it is from the Greek word *sumballein*: literally a bringing together). The work of art is symbolic in the sense that it conjoins the thing with the 'something else' that makes the thing a work of art. With this in mind we, can now read into our familiar orientation towards the works of science teachers the force of this assumption. The candle and jar are set before the students *symbolically*. But what is

symbolised? Are they now symbolic of science, a scientific concept or a model? If so, how is science, or a concept, or a model made to adhere to the jar and the candle? The question becomes all the more fraught if we ask of the science teacher who claims to be 'modelling what it means to be a scientist' how 'being a scientist' gets attached to her embodied actions. The dualism is raised and falls on the assumption of the neutrality of (what Kant called) the thing-in-itself – the thing that stands independently of all other things. So we follow Heidegger in questioning this assumption:

...it is necessary that we should know with sufficient clarity what a thing is. Only then can we say whether the art work is a thing, but a thing to which something else adheres; only then can we decide whether the work is at bottom something else and not a thing. (Heidegger, 1971/1935-36, p. 20)

If we are to understand the nature of the science teacher's works involving things, it appears we must first attend to the self-evident thingly character of the works. First we must know what counts as a thing.

Heidegger begins his inquiry into the nature of things in a rather Wittgensteinian way. He begins by considering how we use 'things' in our language games. At first, this ordinary-language project yields the worrisome conclusion that everything can be called a thing. And yet –

We hesitate even to call the deer [...] a thing. We would sooner think of a hammer as a thing...But even [this is] not [a] mere [thing]. (Heidegger, 1971/1935-36, p. 21)

Heidegger sees the need for a distinction between things and 'mere' things. Here the 'mere' tries to capture the nature of the thing that is not accompanied by something else; whether that something else is what endows works of art with artly qualities or works of science their scientific or mysterious qualities – "[s]imply a thing and nothing more" (Heidegger, 1971/1935-36, p. 22). Recall that we are asking after the thingly character of the thing to avoid its being tethered to some transcendental, metaphysical other through the dualism of symbolism.

In *The Origin of the Work of Art*, Heidegger outlines the three dominant modes of thinking about this thingly character of the thing, and finds them all wanting in ways that bring to consciousness their pernicious assumptions. For the sake of brevity we shall merely gloss Heidegger's treatment of each here.

The first interpretation of the thingness of the thing takes the "thing as the bearer of its characteristic traits" (Heidegger, 1971/1935-36, p. 24). Here is a picture of the thing as an object with its properties; or as it is traditionally characterised in philosophy, as a substance (*substantia*) and its accidents (*accidens*). In his critique of this characterisation of things, Heidegger, proffers the provocative view that it is no coincidence that our language about things takes a similar dual form – namely, the subject–predicate form. The metaphysics of this substance-accidents dualism and our language have re-enforced each other historically. Whether this is the case or not, it remains the case that such a conception (whether philosophically or linguistically) applies to all things equally, and so cannot distinguish between things and mere things.

The second mode grounds its interpretation in the sensory field: “The thing as a unity of a manifold of what is given in the sense” (Heidegger, 1971/1935-36, p. 24). Here the thing is the synthetic experience of something within the vast field of what is available to the senses. Heidegger objects to this notion on phenomenological grounds, arguing that we do not ordinarily encounter things as such assemblages of sensory input against an inconspicuous backdrop, and that when we do, it requires a particularly abstract mode of attending – to hear a sound as a particular sound is already to have lost a grip on the thingly element of the sound.

Heidegger points out that, by virtue of its abstraction and ubiquity, “the thing as bearer of its traits” distances the mere thing from us; while securing the thing in the mediated flux of our sensible experiences brings it too near. The middle ground it seems is occupied by the mode in which the thing is taken to be *formed matter*. This concept comes up to meet our intuition that things have a materiality, but also that the matter of which they are constituted has a definite form. Furthermore, this view helps distinguish things from mere things. The flame of the candle has a definite if un-shapely form that it owes to the arrangement of matter within it – the matter in the flame determines the form of the flame. In the candle the converse is true: the candle, because of the work of the candle-maker, has a form that determines the arrangement of the matter and its selection, e.g. in the selection of a wick that will not be consumed too readily in the flame. Here form and matter come together in the purpose served by the object. “Matter is the substrate and field for the artist’s formative action” (Heidegger, 1971/1935-36, p. 27): what holds for the artist’s formative act holds true for the acts of the science teacher. It is the teacher that gives to things in the science demonstration their form: a form determined by the purpose these things are to serve. “A being that falls under usefulness is always the product of a process of making. It is made as a piece of equipment for something” (Heidegger, 1971/1935-36, p.28).

What can be said so far is that the form-matter view gives us access to the equipmental character of equipment, for equipment is made from matter with a purpose that determines the form that matter takes. Equipment has something of the character of the mere thing in that it is also self-contained (a candle rests like a mere thing in a drawer as a pebble rests in a stream); but unlike the mere thing, the candle has been formed by a human. Equipment also shares its being-human-made with the work of art, and so remains “half a work” as Heidegger puts it. On the other hand, the work of art, because of its self-sufficient presence, seems less like equipment and more like the mere thing.

There may be comfort for the science teacher and the education researcher in taking the science demonstration as the use of equipment. For firstly it places tremendous significance on (or we might say reduces everything to) the intentionality of the teacher; without which the things of the science classroom would remain mere things rather than ‘scientific’ things. Secondly, it unifies all the material and agentive phenomena of the classroom under a common conception of equipmentality (or instrumentalism perhaps). The science demonstration, the classroom practical work, the PowerPoint presentation, the activity sheets, the modelling of ‘being-a-scientist’ are not just all uses of equipment, but an expression of the intentional, formative and purposeful acts of the teacher.

Although the form-matter view captures well the equipmental character of equipment, we must be cautious about applying it universally; particularly because of its all too human origins:

The matter-form structure, however, by which the being of a piece of equipment is first determined, readily presents itself as the immediately intelligible constitution of every entity, because here man himself as maker participates in the way in which the piece of equipment came into being. (Heidegger, 1971/1935-36, p. 29)

Recalling that equipment is only “half thing” and only “half work” we cannot afford to terminate our inquiry into the status of things within the totalising construct of equipment. We do not as yet have grounds for suggesting that the ontology of the classroom neither includes mere things nor works of art. Furthermore, placing undue significance on the intentionality of the teacher may preclude the possibility that students may actually have access to mere things and works of art. The intentionality of the teacher may even actively obstruct students’ access to such things, when for example the teacher forms everything into an object of science for her own ends, or when the teacher does not explain things so much as explain them away.

To leave the thing at rest in its own self, for instance, in its thing-being. What seems easier than to let a being be just the being that it is? Or does this turn out to be the most difficult of tasks...? (Heidegger, 1971/1935-36, p. 31)

The science teacher may find it difficult to let things be precisely because she encounters them as equipment. Students, on the other hand, by encountering the materials of the demonstration as something other than equipment may find this ‘letting be’ the easiest thing of all. When a student fails to see in the candle the process of combustion or the presence of innumerable molecules in agitated motion, must we blame her for being present to the thing-being of the flame? Must we blame her for not forming the flame into scientific equipment? It could be that the student is sharing in the mere thing’s refusal – its objection to instrumentalism. Could this refusal not then come to appear to the teacher or researcher like the student’s disengagement with science, her lack of interest or lack of understanding?

The unpretentious thing evades thought most stubbornly. Or can it be that this self-refusal of the mere thing, this self-contained independence, belongs precisely to the nature of the thing? (Heidegger, 1971/1935-36, p. 31-32)

There are two further points about the nature of equipment, which Heidegger famously draws from the recollection of a painting of a pair of peasant shoes by Vincent van Gogh². In reflecting on the pair of shoes in this painting, Heidegger is brought to consider the question of the usefulness of the shoes:

...must we not look out for the useful equipment in its use? The peasant woman wears her shoes in the field. Only here are they what they are. They are all the more genuinely so, the less the peasant woman thinks about the shoes while she is at work, or looks at them at all, or is even aware of them. She stands and walks in them. That is how shoes actually serve. It is in this process of the use of equipment that we must actually encounter the character of equipment (Heidegger, 1971/1935-36, p.33).

Furthermore, “This equipment belongs to the earth, and it is protected in the world of the peasant woman” (Heidegger, 1971/1935-36, p.34).

The *world* of the peasant woman is one of skilled coping with what Heidegger calls the present-to-hand: those things she encounters as part of, not apart from, her work in the field. In the field the shoes are present-to-hand; they are available to her in a way that is unmediated by thought or objective reflection. It is in their immediacy that the shoes form part of her *world*. Were she to be conscious of their being in use, they would cease to be part of this world – or as Dreyfus (1991) puts it, the shoes will have been *de-worlded*. The shoes may also be de-worlded if they cease to be useful, if say, one of the heels broke. Suddenly the shoes would become available to the woman as the equipment that they once were, as an object in need of a new world – the world of the cobbler, say. While they were in her world the shoes were allowed to be the shoes that they are; they belonged simply to a field of existence: the space of shoe-being, peasant-being, of being-there. It is the being of shoes and the peasant woman that makes available both the possibility of there being a world as such and the possibility that in such a world the beings in that world may be de-worlded or re-worlded. Heidegger calls this existential field of possibility and meaning, *earth*.

Heidegger's second point is that the equipmental character of equipment comes from its reliability. A world is sustained as long as the equipment is reliable: our worlds emerge and collapse on the presence or absence of reliability. The candle-and-jar remains for the teacher in classroom, as the shoes remain to the peasant woman in the field, as long as they are reliable, useful for their purpose. And even if the demonstration fails, even if the phenomena that the teacher wanted to demonstrate comes not to pass; her world would not necessarily collapse. In her world this failure may be part of the usefulness of the things as scientific equipment. It could be otherwise, as any novice teacher of science can attest. Moreover, it can be otherwise for the student. Is the reliability or otherwise of the equipment the same for both student and teacher? Do the students and the teacher share the same world? Indeed do we not ordinarily take the purpose of science education as an introduction to the reliability of science itself?

How did Heidegger come to understand the equipmental quality of the shoes and thereby the equipmental quality equipment?

Not by a description or explanation of a pair of shoes actually present; not by a report about the process of making shoes; and also not by the observations of the actual use of shoes occurring here and there; but only by bringing ourselves before van Gogh's painting. This painting spoke. In the vicinity of the work we were suddenly somewhere else than we usually tend to be."... "The art work let us know what shoes are in truth. (Heidegger, 1971/1935-36, p. 35)

The work of art here functioned to un-conceal the being of the shoes-as-such, but not by virtue of being a true representation of shoes, a reproduction or symbol of shoes. The Greeks called such unconcealment of beings *aletheia* (Heidegger, 1971/1935-36, p. 36), which today we translate as *truth*.

This opening up, i.e. this deconcealing, i.e. the truth of beings, happens in the work. In the art work, the truth of what is has set itself to work. Art is truth setting itself to work. What is truth itself, that it sometimes comes to pass as art? What is the setting itself to work? (Heidegger, 1971/1935-36, p. 39)

If truth is to be found in the work, then to find truth in the science classroom is to find works of art there also.

III. The Work and Truth

Having examined equipmentality we now return to the question of the work of art, for we left the work (by virtue of its self-contained self-sufficiency) much closer to the mere thing than to equipment. As Heidegger puts it:

To gain access to the work, it would be necessary to remove it from all relations to something other than itself, in order for it to stand on its own for itself alone.”...“It is precisely in great art...that the artist remains inconsequential as compared with the work, almost like a passageway that destroys itself in the creative process for the work to emerge. (Heidegger, 1971/1935-36, p. 40)

What is evident in the preceding quotation is the possibility that conceptualising the science teacher as an artist in this sense may undermine the totalizing of teacher intentionality that arises from the form-matter view. The teacher’s intentionality (we might say the teacher herself) is consumed and disappears in the crucible of artistic creation. The teacher-as-artist is no longer present as an object for students to think about, to have at hand as the ‘former of matter’. In absenting herself from the work she makes it possible for truth – as *aletheia* or unconcealment – to happen in the works of the classroom.

With this view of the work of art in mind we can appreciate all the more why it is so difficult to let the thing be the thing it *is*. This is especially so when we consider what Heidegger saw as the Modern propensity for what he called *Subjectivism*: the condition in which we as *subjects* take all things as *objects* over which we must exercise control. Built into *Subjectivism* is a subject-object dualism that hinders our capacity to experience great works of arts on their terms and not ours. *Subjectivism* can reduce works of art to objects, to tradable commodities in an art industry. It can also entangle works in aesthetics – the science of beauty – that fuels forms of connoisseurship that take works as objects controllable through economic and art theoretical discourses.

It is possible to be present to great works of art in the unmediated way that is their due, and in his essay Heidegger cites the Greek temple at Paestum³ as one example of such a great work of art. The temple was for the historic people of Hellenistic Paestum a work of art because “[b]y means of the temple, the god [was] present in the temple” (Heidegger, 1971/1935-36, p. 41).

The temple, in its standing there, first gives to things their look and to men their outlook on themselves. This view remains open as long as the work is a work, as long as the god has not fled from it”...“It is the same with the sculpture of the god...It is not a portrait whose purpose is to make it easier to realize how the god looks; rather, it is a work that lets the god himself be present and this *is* the god himself. (Heidegger, 1971/1935-36, p.43)

On Iain Thomson’s (2011) interpretation of the significance of the temple in Heidegger’s essay, the temple functions as a work of art *ontotheologically*. As the name suggests, the temple provided an historic people their *ontology*; their sense of *what is* (that is, the giving “to things their look”). The temple does so not as a representation or reproduction of something that already is, but does so rather through its self-emergence (or *phusis*). The temple as work of art also serves a *theological* role in providing an immediate way of

accessing *what matters* to the people (“their outlook on themselves”) by making their god present to them.

The world that was set up *ontotheologically* by the temple at Paestum has long since decayed and remains an irretrievable world. Were it the case that every stone of the temple remained as it was in antiquity, the temple would still cease to be the work of art that it was: the god has fled! Even if this world did not *decay*, a new theology – an a-theology perhaps – would soon enough have made the world *withdraw* itself from the work. Therefore, every historical people must inaugurate their own epoch, their own guiding and founding ontotheology, through great works of art. If the things of the science classroom function as works of art, if the science teacher loses herself in her work, then the works in the science classroom may yet tell us something of what is and what matters in our time.

What is the ontotheology of science education: what is and what matters? These are difficult philosophical questions to answer, for the site of the science classroom affords many possible worlds and every gesture and thing within it voices our ontotheology as different dialects. Nonetheless, it is a question that has been much examined, albeit (and perhaps to its detriment) more within the tradition of scientific research than that of phenomenology. What is? – Atoms and molecules are, proteins and fields are, species and genera too. The picture of the atom is a thing that by *phusis* comes to be what it is. Like the statue of the god in the temple, it is not a representation of an atom, it *is* the atom. What then is the theological in the science classroom? What matters in the science classroom is science. Science is the god whose presence is invoked by the work of the science class. Science matters to us.

And yet this is a science that serves and is served by a Subjectivism in which we use science to make controllable objects out of things. For instance, Neuroscience serves Subjectivism in materialising thought and feeling, that they might readily be controlled pharmacologically. Moreover, Neuroscience gives us late-moderns a particular “outlook on [our]selves”, for it objectifies our very subjectivity. We late-moderns are no longer subjects seeking to control objects, but mere objects like any other object that must be used as efficiently as possible. This late-modern state of double objectification in the service of efficiency is what Heidegger called *Enframing*; and it is not difficult to see how this state is instantiated in both science and scientific modes of educational research.

It is possible then to imagine the things of the science classroom, as works of art, helping establish the ontotheological grounding of Subjectivism and Enframing. If this is so, then when we find evidence for students’ rejection or disengagement with science, must we not consider whether this is a rejection of the metaphysics of our times – a world-withdrawal? Or might it instead be the case that a new ontotheological – a postmodern ontotheology perhaps – is emerging that has given young people good cause to reject science on the basis that the worlds sustained by science-as-work-of-art are in decay? If so, we may need to welcome rather than despair at students’ disinterest and rejection of science; for it may prefigure the ground for new works of art in our times. Appealing as this may be, such a call may be unacceptable for scientists, science teachers and science education researchers for whom the god of science has yet to flee their world.

We have seen thus far that the work of art sets up a world, but a world that is nonetheless subject to decay and withdrawal. Furthermore, works of art do not function to represent or reproduce *what is* and *what matters* for an historical people, but instead usher in their

ontotheology⁴. Heidegger suggests that in addition to setting up a world, works of art also set forth the *earth*.

The work of art is set forth out of the material of the work, through the process of making; but equipment too, is the consequence of making. In the case of equipment, however, the material is used up in the making. The stone mason, like the sculptor, uses stone but in the equipmental use of stone the mason uses up the stone in what he makes. The equipmentality of the stone is all the more so the more it is used up, say in its disappearance into the stone's usefulness in the wall of a cathedral. In the work of the sculptor the stone (or more properly the being of the stone) does not disappear but rather appears to us for the first time. The marble sculpture tells us anew what stone is, in the way a symphony tells us anew what sound is. Moreover, we can return to such great works of art and see the truth of stone and sound set forth from them anew. Great works of art set forth a field of being (*earth*) from which we can draw meaning without exhaustion. The marble in the sculpture and the sound in the symphony can never be used up. Yet the work of art also conceals or shelters the being of stone and sound in the work itself. The *earth* is thus also self-secluding. Like the mere thing it resists attempts to explain it away. In the science classroom the setting up of a *world* and the self-secluding setting forth of the *earth* resist our attempts to lay claim to certainty by concealing truth within the mysterious. The candle and jar demonstration sets up a world drawn from the *earth*, but in entering this world students soon discover that the earth resists our inquiry and conceals itself in the mysterious, the inexplicable.

We have here what appears to be an opposition within the work of art between the setting up of a world and the setting forth of the earth: between setting-up-as-resting and setting-forth-as-motion. We should not take this opposition as the grounds for a logical dismissal of the work thusly characterized. Instead we should, as Heidegger tells us, see this opposition of the world and earth as a striving in which world and earth are brought together in an intimate conflict that gives to each its proper character. This conflict is the happening of truth in the work of art.

But what is truth? Heidegger reminds us that:

Truth means today and has long meant the agreement or conformity of knowledge with fact. However, the fact must show itself to be fact if knowledge and the proposition that forms and expresses knowledge are to be able to conform to fact; otherwise the fact cannot be binding on the proposition. (Heidegger, 1971/1935-36, p. 51)

This correspondence (or correctness) view of truth remains dominant to the extent that we still take truth in the science classroom as the match between our claims and an observer-independent reality *out there*. Furthermore, this correspondence is taken as the basis for establishing criteria for judgment of all aspects of the science classroom. But such a view pre-supposes that facts about the state of affairs in the world have been revealed to us. This pre-suppositional revelation is what is captured by *aletheia* as unconcealment. Heidegger does not deny that we can and do talk of correspondence amongst beings, but his aim is to foreground the existential condition, *Being*, in which all beings (including correspondence) are always and already available to us. Being here tries to capture truth as the revelation that all beings *are*. Within *Being* a clearing opens in which things become revealed and simultaneously concealed. There is never one without the other, for if all could be revealed, we could never return to the earth with fresh eyes

and gather from it new meaning; and if all was concealed, there would not be the possibility of asking after beings or *Being* itself.

There are two ways in which the concealment of beings occurs that are particularly pertinent to science education. Firstly, “[b]eings refuse themselves to us down to that one and seemingly least feature which we touch upon most readily when we can say no more of beings than that they are” (Heidegger, 1971/1935-36, p.53). There is a point when a student can no longer see anything in the things (or happenings) of the science classroom except that they *are*. The things themselves have refused all attempts at representation and justification in terms of a correspondence between propositions, models or theories and a reality out there. As Wittgenstein reminds us: “If I have exhausted the justifications, I have reached bedrock and my spade is turned. Then I am inclined to say: ‘This is simply what I do’” (Wittgenstein 2001/1953, § 217). We could, therefore, see this condition not as a student’s loss of faith or understanding of science but rather as their proximity to Being.

Apart from the refusal of beings, concealment may be brought about by a dissembling, in which one thing conceals another by standing in front of it by presenting itself as the other, i.e. by simulating the other. Heidegger sees the importance of this when he writes:

If one being does not simulate another, we could not make mistakes or act mistakenly in regard to beings; we could not go astray and transgress, and especially could never overreach ourselves. (Heidegger, 1971/1935-36, p. 54)

Is this not precisely the nature of science, wherein we strive to simulate the one thing with another in order to reveal something of the world; and as a revelation made all the better by the possibility of being mistaken? What we have here, in the double concealment of refusal and dissembling, is a happening: more precisely the “happening of truth” in the “setting truth to work” of the work of art. It is in the work of art that we experience the conflict between unconcealment and the double concealment of refusal and dissemblance. Perhaps seeing the truth in science as the conflict between earth and world, between concealment and unconcealment, is preferable to viewing the happening of truth as ‘cognitive dissonance’ or ‘conceptual change’.

IV. Truth and Art

We must return to the question of the relationship between the artist and the work, for what Heidegger calls the “happening of truth” occurs in a work that, nevertheless is also made. It is a question of the making or creation of the work by the artist. Through this line of inquiry we may get closer to the creative, rather than intentional, work of the science teacher.

Heidegger begins by comparing the artist’s making with the craftsman’s making. On the surface it would seem that both the artist and the craftsman share a common commitment to craft; i.e., masterly making. Hence the Greeks took both to be *technites* (as derived from *techne*). But Heidegger is careful to point out that *Techne* does not signify crafty actions as we would imagine, but is rather a form of knowledge. As knowledge, it is a bringing forth into unconcealment. That is, the artist as *technites*, in setting forth beings, is presenting them. But unlike the craftsman, what the artist presents is the conflict between concealment and unconcealment; between the *earth* and *world*. The act of

creating differs from that of making in just this establishment of conflict *in* the work. And now we can see more clearly what is it that the science teacher creates in the science classroom – not *a* conflict, but *the* conflict. This conflict is never terminated, but if the conflict itself wins, we are granted the presence of beings-as-such.

Truth wills to be established in the work as this conflict of world and earth. The conflict is not to be resolved in a being brought forth for the purpose, nor is it merely to be housed there; the conflict, on the contrary, is started by it. (Heidegger, 1971/1935-36, p. 62)

In light of this we can see a distinction between the status of things in the science classroom as serving the discourse of correspondence, and their role as works of art in bringing forth that which “was never there before and will never come again” (Heidegger, 1971/1935-36, p. 62). Heidegger calls on us to resist the temptation to see what is new and unique in the work as a thing, and urges us instead to take this as a *Gestalt* (a figure). The artist’s work, then, is a placing of this figure. Furthermore, like the materiality of the work itself, the figure created by the artist is never used up. It continues to afford an inexhaustible source of meaning. This is the self-subsistence that the work of art enjoys that the equipment never can. This implies that when the things in the classroom are set up as works of art, students and teachers can return to them and draw endless meaning from them. When a thing is explained away by a teacher, the thing has been used up as equipment. Therein resides the danger in trying to offer totalizing explanations for things: they reduce things to mere equipment and make students vulnerable to experiences of de-worlding when such equipment fails. Moreover, *that* a piece of equipment is made soon vanishes from equipment in its use. The more reliable a piece of equipment is, the more inconspicuous the fact that it *is*. Not so for the work of art, which holds within it the creative act that brought it into being. When things assume the role of works of art in the science classroom, they are no longer expressive of the science teacher as intentional agent, but rather as acts of creation in themselves.

The work reveals to us that it is. This makes it extraordinary – uncanny. The more a work of art works the more it tells us that it is, rather than is not. This, paradoxically, takes us out of – displaces us from – the ordinary, for ordinarily we are unaware that what is, *is*.

To submit to this displacement means: to transform our accustomed ties to world and earth and henceforth to restrain all usual doing and prizing, knowing and looking, in order to stay within the truth that is happening in the work. Only the restraint of this staying lets what is created be the work that it is. This letting the work be a work we call the preserving of the work. (Heidegger, 1971/1935-36, p. 66)

Heidegger makes the crucial point that while a work of art cannot *be* without being created, it also cannot *be* without the presence of those who preserve it.

Preserving the work means: standing within the openness of being that happens in the work. This ‘standing-within’ of preservation, however, is a knowing. (Heidegger, 1971/1935-36, p. 67)

A fortiori, this is how knowing endures through the preservation of the work of art. In science students’ coming to *know* the truth, their knowing is a preserving of the works of art in the science classroom. No longer should we see knowing as a thing, a concept, or a

brain state; but rather as the existential connection with the truth happening in the work of art. Knowledge here is something very different to propositional knowledge, for it alone connects with a resolute commitment to being. It is important to note that the kind of knowing that is preserved in the work is such that the work is not a mere experience or the stimulus of an experience.

Knowledge in the manner of preserving is more than aesthetic connoisseurship. Knowing is a standing within the conflict. Heidegger's comment that "[w]hen works are offered for merely artistic enjoyment, this does not yet mean that they stand in preservation as works" (Heidegger, 1971/1935-36, p. 68), should caution us against viewing works of art in the science classroom as serving a merely instrumental role in keeping students engaged with, interested in, or entertained by science. This not only leads to as aestheticisation of the things and practices of the classroom, but it also fuels the search for causal connections between the works of art and the positive experiences of students: something we should avoid, given "[t]he working of the work does not consist in the taking effect of a cause" (Heidegger, 1971/1935-36, p. 72).

Heidegger's inquiry into the origin of work of art has taken us towards the significance of the creative process in works of art; and he rounds off this section of his inquiry by indentifying this creative process with the *poetic*.

Truth, as the clearing and concealing of what is, happens in being composed, as the poet composes a poem. *All art*, as the letting happen of the advent of the truth of what is, is, as such, *essentially poetry*. (Heidegger, 1971/1935-36, p.72)

Or, put more succinctly, "Art, as the setting-into-work of truth, is poetry" (Heidegger, 1971/1935-36, p.74).

When we think about poetry we naturally think of language, but language is more than just a system of communication, for it "alone brings what is, as something that is, into the Open for the first time" (Heidegger, 1971/1935-36, p. 73). A view of science and science education that founds itself on the premise that language is only a means of communicating, and the mere communication of truthful propositions at that, fails to live up to the poetic potential of science that happens in the works of art in the science classroom. Heidegger's claim is nothing short of a claim that works of art speak *truth* into being, that is, speak the unspeakable.

V. Conclusion – A leap to the beginning

Science teachers make use of things in their classrooms. Moreover, they set things up by way of demonstrations and practical activities, to bring something of the wonder and mystery of science to the materials they use. The path we have taken along-side Heidegger's investigations reveal that traditionally the phenomenon of using things in this way is either taken symbolically or equipmentally. From the first perspective, science teachers' use of things in the science classroom could be taken as the means of connecting the material objects to the transcendental world of scientific theories and models – here things come to symbolise scientific concepts or ideas. If the things in the classroom were instead taken as equipment, the dominant form-matter dualism would suggest that it is science teachers, as agents, that give form to the things by exercising

their intentionality. Both views are characteristic of the scientific interpretations of the status of things that dominate science education research.

The parallel this paper draws between science education and Heidegger's investigations of the origin of the work of art, suggests an alternative perspective on the work of science teachers: one that is afforded by viewing the things in the science classroom as works of art. From this viewpoint, when teachers set up things in the classroom they are neither using the things as equipment, nor letting the things be mere things. They are instead, setting things up so that, as works of art, they function firstly *ontotheologically* and secondly *aletheically*. That is, in the first case, they tell us what is and what matters, and in the second case they reveal (or more precisely un-conceal) the *being* of the things that were set up. Furthermore, the being of things (truth) is un-concealed in a way that does not exhaust the possibility of drawing new meaning from the work. This stands in contrast with the instrumental, equipmental use of things in science teaching, which is often motivated by and leads to limiting meaning. What these functions suggest is that viewing the things of the science classroom as works of art makes possible a far richer, phenomenological account of science education.

At this stage of my inquiry I want to return to its beginning, for:

A genuine beginning, as a leap, is always a head start, in which everything to come is already leaped over, even if as something disguised. The beginning already has the end latent within itself. (Heidegger, 1971/1935-36, p. 76)

At the beginning of my essay I committed myself to leaping into an inquiry that promised no end. And now all we are left with at the end is our beginning. But strangely enough, this too is how Heidegger concludes his inquiry; stating that art is a beginning that:

...always contains the undisclosed abundance of the unfamiliar and the extraordinary, which means that it also contains strife with the familiar and ordinary. Art as poetry is founding, in the ... sense of instigation of the strife of truth: founding as beginning. (Heidegger, 1971/1935-36, p. 76)

We have seen many potential beginnings for science education in walking along-side Heidegger in his inquiry. Can the re-conceptualization of science education that has emerged from the present inquiry permit us to see more clearly the dawning of a new ontotheology in new and old works of art in the science classroom? Let us leap to the beginning within Heidegger's words and see:

Art lets truth originate. Art, founding preserving, is the spring that leaps to the truth of what is, in the work. To originate something by a leap, to bring something into being from out of the source of its nature in a founding leap—this is what the word origin (German *Ursprung*, literally, primal leap) means. (Heidegger, 1971/1935-36, p. 77-78)

Notes

1. My paper takes the three main section titles of Heidegger's essay as three of its own (sections II, III, and IV, respectively).
2. Heidegger does not make it clear which of several van Gogh paintings of shoes he had in mind, but most art historians take it to be the following:
http://upload.wikimedia.org/wikipedia/commons/a/ab/Vincent_Willem_van_Gogh_118.jpg (accessed 9 June 2012)
3. An image of the temple at Paestum is available here:
http://upload.wikimedia.org/wikipedia/commons/0/05/Il_tempio_di_Era_detto_di_Nettuno_%28Paestum_1994%29.jpg (accessed 9 June 2012)
4. A detailed argument for the claim that works usher in ontotheological epochs is available in Thomson, I. (2005). *Heidegger on Ontotheology: Technology and the Politics of Education*. New York, NY: Cambridge University Press.

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