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Diffracting Digital Images in the Making

Ian Dawson, Ing-Marie Back Danielsson, Andrew Meirion Jones, Louisa Minkin and Paul Reilly

This paper presents a diffractive dialogue between ethnographic accounts of imagery, digital or computational imaging, and art and archaeology practices. It develops the notion of images in the making in the context of the digital domain, to discuss what an image is and can be today. It focuses on two digital imaging techniques developed within archaeology and cultural heritage – reflectance transformation imaging and structure from motion photogrammetry – exploring how these techniques play out in heritage and art world contexts and practices. The paper highlights digital images as unstable compositions, and explores how digital images in the making enable us to reconsider the shifting temporal character of the image, and discuss the way in which the digital image forces us to disrupt the representational assumptions bound up in the relationship between the virtual and the actual. The authors argue that the diffractive moments in these encounters between archaeology and art practice disclose the potential of digital imaging to recursively question the complex ontological composition of images and the ability of images to act and affect.

Keywords: Reflectance Transformation Imaging; Structure from Motion Photogrammetry; Ontology; Archaeology; Imagery; Art practices

Introduction

We are artists and archaeologists that teach and do research at universities and art schools. Both separately and jointly we have explored contemporary and prehistoric imagery in a variety of ways. For instance, we have studied images' changing modes of production, their unfolding characteristics and affective affordances, as well as their changing materiality over time and in various contexts. In this paper, we want to juxtapose different accounts of imagery from our disciplines, to explore and draw out new knowledge of what an image is and can be in today's digital era. Our queries are thus ontological. Does the image have an ontological history? Are images timeless or transcendent entities, or does the ontology of images change over time; does it make sense to speak of 'the image' or should we be discussing many different species of image?

The emergence of digital images has sharpened this debate. In his recent book, *Theory of the Image*, Thomas Nail¹ seems to offer a transcendent view of the image. He argues that, in their mutability, digital images offer a way of rethinking the ontology of the image from prehistory to the present day. By contrast, Vilem Flusser argues for the special character of digital images, and draws a sharp distinction between

digital or ‘technical’ images and earlier kinds of image.² Flusser offers an evolutionary sequence based on a series of developmental steps. We see a disagreement, then, about the role of digital images in a historical analysis of the image, and about the relationship of digital imaging techniques to the earliest human image making in prehistory. Should we regard digital or technical images as fundamentally different from previous image making and viewing? Rather than taking a polarised stance on one or the other of these approaches, our method is to instead diffract the analysis of ancient images and non-Western images with and through digital imaging techniques. In doing so, our primary concern is with how images are made and their processes of production, and less with the way in which they circulate, are networked or operationalised, and the possible socio-political consequences thereof.³

In the following, we present a diffractive dialogue between ethnographic and anthropological accounts of imagery, digital or computational imaging, and art and archaeology practices. With Karen Barad, we recognise that diffraction is an approach that troubles dichotomies. By working diffractively, we do not intend to offer a linear historical sequence for the image. Instead, in our view of the image, time ‘is diffracted, broken apart in different directions, non-contemporaneous with itself. Each moment is an infinite multiplicity.’⁴ To think about images and time, we begin by focusing on processes of making, reproduction and renewal in digital image production, in traditional non-Western image making and prehistory. We account for two different imaging techniques, reflectance transformation imaging (RTI) and structure from motion photogrammetry (SfM), and how these methods play out in heritage and art world contexts and practices. A case study is finally presented, where experiences of, and experimentation with, RTI results in ‘Dirty RTI’, a heterotopic mirror exposing complex temporalities and a variety of features that become embedded in both RTI processes and outcomes.

Images in the Making: Processes of Renewal

One of the earliest written accounts of image and vision is found in *De Rerum Naturum* by the Roman writer Lucretius.⁵ Building on earlier works by the Greek philosophers Democritus of Abdera and Epicurus, he describes the image as the cause of vision:

I say then that likenesses of things and their shapes are given off by things from the outermost body of things, which may be called, as it were, films or even rind, because the image bears an appearance and form like to visible that, whatever it be, from whose body it appears to be shed, ere it wanders abroad. That we may learn from this, however dull be our wits. First of all, since among things clear to see many things give off bodies, in part; either loose, scattered loosely abroad, even as wood gives off smoke and fires heat and in part more closely knit and packed together, as when now and then the grasshoppers lay aside their smooth coats in summer, and when calves at their birth give off a

caul from their outermost body, and likewise when the slippery serpent rubs off its vesture on the thorns; for often we see the brambles laden with these wind-blown spoils from snakes. And since these things come to pass, a thin image from things too must needs be given off.

In this passage Lucretius, writing between 99 and 55 BCE, underlines the dynamic cycles of renewal and rebirth involved in image making and viewing. For Lucretius, an image only becomes visible to the human eye because matter, as a 'likeness' or simulacrum in the form of a film, is given off from the image during processes of growth and replenishment. In the context of the anthropology of art, Alfred Gell draws on Lucretius to describe the way in which images may be distributed amongst a social network.⁶ Gell discusses the carved wooden Malangan idols of New Ireland, Melanesia, which are displayed before being burnt at funerals:

The Malangan carving is a skin-idol, which like the 'gossamer coats of cicadas' is distributed in quasi-material form in the memories of onlookers, who internalize the ancestral 'skin' as a new 'skin' of their own, a new skin which anticipates new 'skin' relationships with affinal partners.⁷

Indeed, we should also note that the very means by which we are able to absorb Lucretius' work today was because his words were disseminated and circulated in the Medieval and Renaissance periods through the medium of skins, as Lucretius' text was transcribed onto parchment or vellum.⁸

We now turn to other examples of image making and renewal from anthropology. One of the most celebrated examples of the renewal of images known to anthropologists is the ceremonies associated with the remaking of rock art by Indigenous Australians. Describing the repainting of Wandjina figures on rock surfaces by the Wandjina Wungurr community of the Kimberley region, Western Australia archaeologist Martin Porr notes that not only are the acts of retouching and repainting understood as not being initiated by human beings, but rather it is the 'saturated air emanating from the sun-warmed rocks that gives a new life to the painted images'.⁹ Likewise, in the Gulf of Carpentaria region, northern Australia, Amanda Kearny and colleagues note that for one traditional Yanyuwa owner of a rock art site, Tom Reilly Nawurungu, rock art images are 'not paintings but are something other than paintings: they are the Dreamings associated with this place'.¹⁰ In Indigenous Australian ontologies, images are living entities that continually undergo a process of replenishment, renewal, growth or repainting, a process in which ancestry and knowledge needs to be passed onto future generations.¹¹

In another example, discussing Orthodox Christian icons, Victor Buchli argues that:

Rather than it being an image in a modern sense, the icon is also a relic, both original and copy.¹² It is a copy because it is a reiteration of the prototype and it is a relic because haptically it has direct and physically contagious contact with the prototype, thus becoming a site of physical exchange and contagion with divine power surmounting conventional scales of time and space and producing a universality and undifferentiated presence across time and place.

In other words, the agency, or affectivity, does not rest solely in the (finished) icon. Spiritual practices are not only enacted by the viewer, because the act of making and reiteration is also an act of contemplation and worship. As iconographer Aidan Hart puts it: ‘Icons are not only manifestations of heaven to earth ... but are an offer of man to God, a priestly prayer in paint rather than word.’¹³ Barush also notes similar practices in other faiths such as the Thangka painters of Tibetan Buddhism.¹⁴

Similar processes of revitalisation can be discerned in the mark-making traditions of Neolithic Britain and Ireland (dating between 4050 and 2300 BCE). The abstract marks on Neolithic artefacts have puzzled archaeologists brought up in representational traditions of viewing. Using digital imaging techniques such as RTI and SfM, it has been possible to show that marks are often executed with an awareness of their transience and ephemerality.¹⁵ This is true whether marks are made in artefacts of chalk, such as the Folkton Drums, Yorkshire, artefacts of antler, such as the Garboldisham mace head, Norfolk, or artefacts of stone, such as the slate plaques (Figure 1) of the Isle of Man.¹⁶ Marks were not simply made – they were continually re-made. Marks are in a continual process of renewal as mark makers connected and reconnected with the materials they carved.

We have discussed a range of ways in which images renew themselves from Indigenous Australia and Byzantine icons to Neolithic Britain and Ireland. We now wish to diffractively loop back and view these non-Western image-making practices through the means of their documentation: as digital images. In her discussion of the anatomy and pathology of digital images, Louisa Minkin draws our attention to the empty core of digital models, such as those produced using SfM (Figure 2).¹⁷ She notes that ‘the surface of identification in a digital model has no thickness and contains nothing’.¹⁸ Digital models are represented by their skins. Like Lucretius’ Epicurean model of vision, we view SfM images on the basis of their outer layers or skins, as if sloughed off like snakes. These skins are formalisations of individual instances. One of the interesting things in working this way is that once you have a data set it can be compiled again and again, with different authors producing different results, each a different performance of making, assembly and refitting. A renewal. Each producing an outer skin to be viewed and intra-acted with.

SfM is an adapted and evolved version of conventional stereoscopic photogrammetry. The stereoscope was invented as early as the 1830s, and came into extensive use in America and Europe in the 1860s.¹⁹ Two near-identical analogue photos are slid into an apparatus, a stereoscope, whereby, through specific lenses, a viewer experiences a single image that appears to have depth; that is, a feature or space is rendered in three dimensions. The produced photographic image, the simulacrum, was seen as virtual reality, blurring the boundary between illusion and reality, opening up for ambiguity, disbelief and delight.²⁰ By comparison, the modern SfM technique requires multiple and overlapping photographs, instead of a single stereo pair. The overlapping digital images are needed as input to create a database of extracted features that are used in 3D reconstruction algorithms.²¹ In Figure 2, we can see that a sculpture, in the middle of the screen grab, has been viewed from a wide array of positions, that is, as if photographed by a moving sensor.

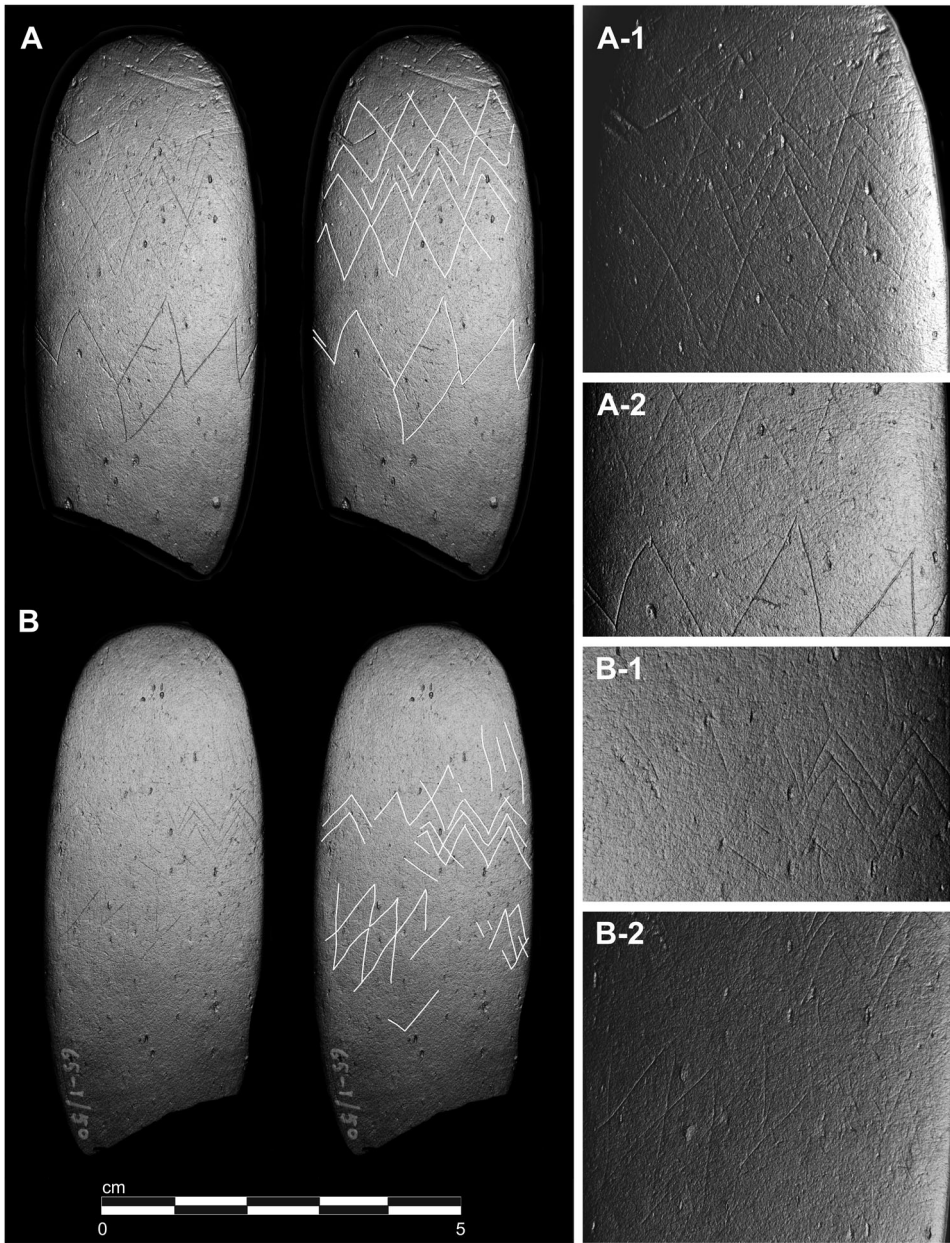


Figure 1. RTI and annotation of a Neolithic slate plaque from Ronaldsway, Isle of Man. Courtesy of Manx National Heritage.

Much as digital images made using SfM software may be recompiled afresh, so the digital images made using the RTI software patch together a single image composed from multiple images produced under different lighting conditions.²² In the RTI software, this lighting information is synthesized mathematically, which means that an examiner can analyse the image in a computer by ‘re-lighting’ the object, and enhance

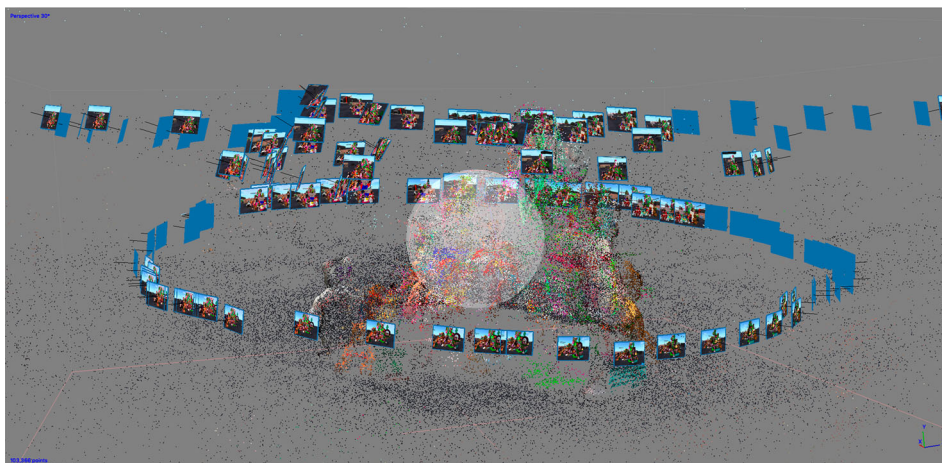


Figure 2 SfM point cloud of a virtual sculpture in process. Screen grab from Agisoft Photoscan. Louisa Minkin, 2020.

the representation of the object's surface mathematically. The manipulation of different lighting allows the digital image to be interrogated, revealing otherwise invisible aspects of surface features on archaeological objects.

This composite image, produced using RTI, enables us to reconsider images more generally. For example, Ing-Marie Back Danielsson and Andrew Meirion Jones discuss images as 'images in the making'.²³ 'Images in the making', in their definition, are conditions of possibility, a means of a 'feeling forth of future potential'.²⁴ Images are a way of assembling, of drawing together or relating, components of the world, and of providing the conditions to make these meaningful relationships visible. We can think of images and imaging as an offspring of Karen Barad's term 'mattering', in which the material world and its meaning is co-constituted by reiterative practices.²⁵

The conception of images as 'in-the-making' presents us with a very different view of images. We have moved away from an idea of the image as a stable or fixed entity. This prototypical view of images posits that, as fixed or stable entities, images can be traced or copied; it is this formulation of the image that seems to be posited by Hito Steyerl's notion of the 'poor image', an image whose prototype gradually degrades as it is repeatedly copied and circulated.²⁶ By contrast, our discussion of a series of anthropological and archaeological case studies, as well as our analysis of contemporary digital imaging techniques, leads us to view images as always in motion, as events or processes that continually emerge and unfold. We wish to underline the visual potency of images by exploring the multi-temporal character of digital imaging techniques used in an art world context.

Unfolding Digital Images

In the RTI shown previously (e.g. [Figure 1](#)), the 'subject' is isolated in a featureless bubble of spacetime. Every trace of the apparatus of imaging, photographic crews,

setting, environment and time and duration of the 'shoots' is concealed. With no reference to their makers, these digital images are rendered timeless. Sean Cubitt argues that the unacknowledged participants (Flusser's functionaries), as well as their technical forebears, are 'enslaved in technologies like the photographic apparatus' and represent an important ethical issue.²⁷ How can those enslaved in RTIs be emancipated or, at least, acknowledged? The answer, it turns out, lies in the RTI images themselves. To find it, we must first unpack them.

At first glance, RTI scenes appear settled and, perhaps, inevitable. It is commonplace to edit out the fringing shadows and the omnipresent gnomes and 'obsidian eye', that is, the highlight cue ball, those witnesses to the incidence of light.²⁸ Light scatter is minimised through black backgrounds. However, despite their apparent timelessness, in the wings of every RTI is a *mise en abyme*, an abyss from which a time dilation emerges even in the most sanitised compositions, and space, time and choices are allowed to seep back into the compiled images as soon as it is examined through an RTI viewer – a dancing penumbra, in which shadows, fading in and out of view, indicate that the set was never, and will not likely ever be, entirely static. These effects denote a form of temporal diffraction in which 'different times bleed through one another'.²⁹

Viewers can manipulate the scene by changing the surface characteristics and lighting arrangements, by making new sets of choices. Indeed, the images, and the set, are not simply still unfolding, they have become volatile and reconfigurable.³⁰ The possibility of (re)configuration,³¹ of rearticulating how the set, the crew and the apparatus are *configured*, implies that these images can, and should, be unmade and re-enacted differently. Indeed, they can be (re)cropped, edited, and recompiled from first principles at any time. Once (re)compiled, the choreography of lighting sequences will be completely recomposed to accompany the individual dexterous hand ballets that are enacted every time an (other) user interactively relights the virtual RTI subject, with swirling gestures of the mouse, to (re)saturate the visible scene with meaning-making highlights and shadows.

This volatile lighting draws our peripheral attention, causing us to glance away from the scene. Unseen, but now on the cusp of apprehensibility,³² the environment, the place and the performers on the shoot start to emerge from the shadows, and the RTI set is revealed as an extensible performative space. In fact, a record of these performative events is auto-archived as reflections on the mirrored spheres used to obtain the incidence of light in each frame of the shoot. These reflections constitute 'metapictures', that is, images that reflect on their own making and highlight the relationality of image and beholder,³³ or 'visual paradata',³⁴ describing the activities, choices and trade-offs made during the shoot: the location and articulation of the equipment, the operators and their movements. Although these metapictures are nearly always cropped out of the compiled RTI, they still lurk in the original frames used by the RTI-Builder and can therefore be reframed, reconstituted and reanalysed afresh, indefinitely or, at least, as long as technological obsolescence is mitigated by curatorial interventions.

Metapictures are well established in artistic and photographic practice. They appear as early as the fifteenth century in the paintings of Northern Renaissance

artists such as Robert Campin and Jan van Eyck.³⁵ For example, in *Portrait of Giovanni Arnolfini and His Wife*, just above the artist's now iconic signature, 'Johannes de Eyck fuit hic' (Jan van Eyck was here), is a remarkable metapicture. The painted convex mirror reflects, displaces and extends the main scene back through the painting's frame, to the position behind the Arnolfinis' witnesses, who more or less occupy the artist's apparently vacant viewpoint.³⁶ In other words, this heterotopic mirror creates a world within a world in which several contradictory or incompatible places and times can be juxtaposed and mutually transformed.³⁷

Case Study – 'Dirty RTI'

The arrangement of the *Arnolfini Wedding* discussed above provides a wonderful prototype for a subversive form of highlight RTI using a heterotopic mirror which we call 'Dirty RTI' (Figure 3). Dirty RTI exposes the complex temporalities, the local environment and the intrinsic performative aspects of more conventional RTI by also registering the practitioners and the moveable apparatus, step by step, as they work their way about the central subject to record it. In other words, they become embedded in the RTI processes and outcomes.³⁸

This image (Figure 3) is a frame from a compiled Dirty RTI working session in Dawson's studio. The ostensible 'subject' is the tall sculpture in the centre of the scene. A mobile light source, consisting of a halogen lamp, was moved around the



Figure 3. Dirty RTI performance in a plastic studio. Paul Reilly/Ian Dawson 2020.

set by Dawson, dragging an extension cable around with him and moving miscellaneous objects as he traversed the space in darkness. The mirrored surface of the convex security dome on the rear wall provides the highlight reference in each shot. The shoot was conducted remotely via a laptop by Reilly, who directed Dawson on how and where to illuminate the column through the call and recorded the scene at these selected positions by using screen grabs from the video conference screen. The subsequent PTM file charts Dawson's movements, bearing the light on a pole, and drawing the electrical power cable across and through the scene screen. The mirrored trace of Dawson's performance in the *mise en abyme* between the image capture device and the mirror is also attached as an embedded metapicture on the security dome. The main image and the embedded metaimage diffract the interlaced temporalities of the performance. Each individual shot was not an evenly spaced moment where matter was tracked regularly. Rather, the properties that come to matter were re(con)figured in the very making/marking of time. Each new shot had to be negotiated and configured, and thus contributed uniquely to this diffractive 'image in the making'.

When all the frames in this shoot are brought together, they reveal a world-making in which both we and the things around us emerge as vibrant matter that is continually *in formation*.³⁹ The crew (in the studio and in the remote observation station), the apparatus, the ostensibly central subject matter and the studio are all 'enfolded participants in matters iterative becoming'.⁴⁰ This Dirty RTI image is a refusal by the makers to be self-erased and holds the decisions and gestures of its making within itself, and so acknowledges the material in-formation that is often discarded within editing protocols and processes. In this case, they are central to forming this image, putting into stark contrast those many other images of art, archaeology and cultural heritage which choose to brush away the footprints and the fingerprints of the image maker(s).

Conclusion

The partiality of a singular viewpoint is diversified by contemporary imaging technology. Our eyes are opened to other wavelengths. We add more sensory structures to the optic. The technology itself is intrinsically transdisciplinary, as it is built and modelled by experts and fans from an array of disciplines. Tasks here are collective, and information resides in the overlap. Pixel matching and image stacking are characteristic assembly techniques of contemporary data capture. Information is imbricated like the scales of a fish. Drop a photogrammetric model into the Unity game engine, and every constituent image is produced as a camera. Data capture produces new objects. Informatic forms may be physicalised in print or animated with game engine physics – given qualities, properties, scripts. How does the workflow of physically rendered new content figure new ontologies? In digital spaces, as in indigenous thinking, object hierarchies are situational, and membership in a given class is ambivalent and unpredictable. Can these new data objects be useful in parsing the complexities of emotions, for feeling out inconsistent realities?

This is a sentient zone, characterised by animacy and fluidity between conventionally fixed Western categorisations. We have unsettled objects and counter-images. Forget the game of animal/vegetable/mineral. Instead, think the poem object language of Paul Celan (1920–1970). He deals in petrified oaths, dayblind dice, seed-sense. Think about the parasympathetic nervous system of exchange: mis-stimulation, cross-sensory stimulation. The photic sneeze of the transdisciplinary. In this space we expose what Martin Luther King Jr gloriously called ‘creative maladjustment’.⁴¹

Issues of cultural heritage are seeping from its conventional institutions – museums and archives – into hybrid forms: both a popular culture fascinated with *Horrible Histories* and *Time Team* romance (*Horrible Histories* and *Time Team* are popular British TV programmes on the subject of history and archaeology), and academic and artistic sites of contemporary practice that may intervene in socio-political systems of representation, the vortex of necropolitics.⁴²

Can digital models be considered as proto-objects, overwriting the record? A kind of level violation characterised as posthuman? What movements come to bear in activating new forms of an object in digital spaces, the buffer zones where we may destabilise paradigms? We get motion-sick in VR, accounted for as a disjunction between vision and balance. The nausea induced is symptomatic of the body voiding out poison. Spatial disorientation, hallucination and dissociation are all symptoms of neurotoxins, reminding of the kill or cure therapeutics of the Pharmakon. If this space of disassociation is concomitant with the loosening of secure disciplinary, biological and ontological perimeters, we see the need to work through the separation of senses that makes us unsettled, and produce together better models for embodied virtuality as faculties for dream, imagination and knowledge exchange.

We argue then for a re-envisioning of digital images, not as sources for the wholesale rethinking of images,⁴³ nor as markers of a new evolutionary stage of visual interaction,⁴⁴ but as mutable sites of intra-action. Digital images, particularly those produced using techniques like RTI and SfM, are overlapping multi-temporal, multi-agential and multi-spectral places of contestation, dialogue and change.

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