Proteus and the Digital: Scalar Transformations of Seawater’s Materiality in Ocean Animations

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Abstract
This article analyzes the discursive and conceptual equation of the ocean and the database. Considering how the chemical and vital properties of seawater serve to transform what is ‘stored’, the language of flow and fluidity is inadequate to describe what seawater actually does to things – it encrusts them, rusts them, adheres burgeoning life-forms to them. Seawater asks us to rethink terrestrial notions of the archive or database as informed by the language of earth and sediment, and instead consider the ocean-as-database in terms of seawater’s capacity for protean transformation. We also need to consider the scale at which we are looking at seawater; the protean properties of seawater are meaningful at a macro scale, but on increasingly microscopic scales, multiple processes of abstraction make seawater commensurate with digitality. The author considers the stakes of focusing on different scales of seawater and its materiality, taking as her examples two different data visualizations/animations: Google Ocean (scaling the ocean down to the size of a computer screen) and ATLAS in silico (scaling ocean microbial genomic data up to the size of a projection, or cluster of computer screens). She concludes by asking, how might a theory of media evolve from the materiality of seawater differently on macro and micro scales?

Keywords
aesthetics, data visualization, database, digital animation, environment, materiality, media ecology, mapping, oceans

Introduction
Imagine a theory of media that proceeds from Ariel’s song in Shakespeare’s The Tempest (I.2.396–401):

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Full fathom five thy father lies;  
Of his bones are coral made;  
Those are pearls that were his eyes:  
Nothing of him that doth fade,  
But doth suffer a sea change  
Into something rich and strange.

On a literal level the song is about transformation over preservation; it describes Ferdinand’s supposedly drowned father, whose body has sunk about 30 feet into the ocean (five fathoms) after being shipwrecked during Prospero’s storm. Although his father is actually alive and well, Ariel’s song misleads Ferdinand into imagining his father’s watery grave. Ariel aestheticizes the drowned-body as becoming treasure, nearly taking the form of a blazon, attentive to not the whole body but its parts: eyes, bones, and their magical and protean transformation. Seawater itself does not change, but is itself the transformative and creative element that reconfigures sunken objects like the body of Ferdinand’s father, an origin lost at sea. ‘The sea-change instead captures the force, physical and metaphorical, of salt-water transfiguring flesh’ (Mentz, 2009: 8). Seawater asks us to rethink terrestrial notions of the archive as informed by the language of earth and sediment, and instead consider the ocean in terms of seawater’s capacity for protean transformation (see Figure 1).

Even though the metaphor ‘information is water’ pervades discussions of information technology (e.g. data flows, one surfs the web), the chemical materiality of seawater present in life and in Ariel’s song is largely missing from animations of the ocean in digital media. Here, I use the term ‘animation’ in its older and broader sense of that which ‘brings to life’, rather than a more specific definition of anime/animation as based on a particular kind of technology or machine (Lamarre, 2009). For example, Google Ocean is an animation to the extent that it simulates movement through the ocean; the artwork ATLAS in silico animates blue particles (representing unique protein sequences) into fluid dynamic equations. Many other digital animations imagine seawater as a generic ‘fluid’ rendered transparent like air, a passive medium of frictionless navigation without any

![Figure 1](image_url). Underwater sculpture from the installation ‘Vicissitudes’. Taylor’s sculptures evoke Ariel’s ‘sea-change’ aesthetic in which seawater participates as co-sculptor. Installations such as ‘Vicissitudes’ change over time as larval organisms in seawater such as tunicates, algae, sponges, and worms attach to and grow on their surfaces. © 2013 Jason de Caires Taylor / ARS, NY / DACS, London. Reproduced with permission from ARS.
of the chemical properties that make it such a powerful agent of transfiguration in life and in the imagination (Helmreich, 2010). They also tend to depict the ocean (or its microcosm, the aquarium) as spatial ‘containers’, expanses in which to fill objects rather than the lived space of the ocean that philosopher Michel Serres (1983), referencing Jules Michelet, has described as ‘the soup’.

In scaling the global ocean down to the size of our computer screen, or scaling seawater up to the point where microbial DNA is tangible, we need to think about the ideological and pedagogical stakes of forgetting the materiality of what we are scaling, and how seawater’s materiality changes with scale. As examples, I look at Google Ocean (which scales the ocean down to the size of a computer screen) and the collaborative art installation ATLAS in silico (which scales microbial genomic data up to the size of a projection or cluster of computer screens), asking: in what ways is seawater’s specific materiality lost along the way? Conversely, what might be added or gained by exercises in scaling the ocean? What is a meaningful scale at which to consider seawater? Finally, how might a medium-specific theory of media proceed from the materiality of seawater such that it considers data as forms in an enlivening and transformative milieu? 

**Contexts for a sea-change in database logic**

Literalizing the metaphor that ‘the ocean is a database’ (a structured set of data held in a computer) can be misleading because it neglects the different scales at which the ocean can be animated with life. Take for example Grahame Weinbren’s article, ‘Ocean, database, recut’, which collapses the differences between database and ocean, already considered an informational archive. Published in the edited volume *Database Aesthetics* (Vesna, 2007), Weinbren’s article celebrates the ‘multilinear’ structure of databases over the ‘linear’ structure of most print-based narratives and cinema. Using the fantastical ocean moon (a literal sea of stories) in Salman Rushdie’s novel *Haroun and the Sea of Stories* (1991) as a conceptual example, Weinbren (2007: 66) argues that Rushdie’s ocean ‘fulfills two basic criteria of the database: (1) it is composed of smaller elements, the story currents; and (2) it can be traversed in a multiplicity of ways’. Here, ‘the elements of the Ocean database are stories’, where, metaphorically, ‘the swimming user affects the narrative currents and their meaning’, much like choose-your-own-adventure narratives (p. 69).

This presumes commensurability between three mediums: seawater, narrative and the digital. Whereas in *The Tempest* it is the seawater that changes the immersed human, for Weinbren, the ‘swimming user’ is the one that changes the ‘water’ of narrative currents and stories. This inverts a conception of agency, making the user the creative force of organization, rather than the environment of seawater that we see in *The Tempest*. Instead of animating seawater’s transfigurative materiality, Weinbren’s argument focuses on the structural richness of databases as storytelling structures, where the ocean serves as a convenient conceptual figure or metaphor. This modifies Lev Manovich’s (2002) oft-cited argument that database and narrative are mutually exclusive, instead suggesting something more along the lines of Gilbert Simondon’s philosophy – that the database is a sort of ‘pre-individual’ reserve from which narratives might individuate in relation to user choices. Not explicitly tied to an ecological agenda, Weinbren focuses on how the database aesthetic opens more expressive possibilities for interactivity and narrative structure, in which databases present a new way of generating experiential knowledge through the user’s non-linear interactions with the data.

A third ‘basic criterion’ of the database that goes unmentioned in Weinbren’s argument is this: that data persist over time in a stable archive that is identical over repeated viewings; we design digital storage to last as long as possible. Although Wendy Chun (2008) has convincingly shown how information in digital storage does not last for ever, but has a material life-span, the *telos* of database design is for long and stable life that, while practical, does not reflect the materiality of
seawater. Thus if the ocean is our model for the database, this third criterion needs to be rethought. Seawater itself chemically and vivaciously changes submerged macro scale objects, rusting, encrusting, and growing polyps of coral, tunicates, sponges and other free-floating larvae on sunken objects. With the open-system of the ocean, objects do not persist in their original state, but change over time through their immersion in seawater, perhaps like Plato’s sea god Glaucus in *The Republic* (1991[1968]) whose original body image cannot be extrapolated because of its long transformation underwater.3 Seawater changes what it touches (see Figure 1). If seawater is our model, then the stories in Weinbren’s database would change each other during circulation before a storyteller could draw on them. This is a point that would be clarified by thinking medium specifically with seawater.

The stakes for considering the persistence or decay of objects are both ideological and pedagogical, digital animations (video games, computer animations) often obfuscate lived ecologies. For example, in Nintendo Wii’s *Endless Ocean*, fish do not age or die. Although the game renders light underwater in a very convincing way, it does not integrate principles of change underwater that might modify the landscape, distribution of organisms, growth of organisms. Granted these would be complicated to render, the game nonetheless promotes the conception of fish-as-commodities, collectible and domesticated, and underwater landscapes as unthreatened, stable places. As media theorist Alenda Chang (2012: 15) writes, video games have the potential to model more meaningful ecologies: ‘We need game environments that respond to human agency and yet seem to possess life independent of player actions: this would constitute a radical but constructive decentering.’ With modifications, Wii’s *Endless Ocean* has the potential to model an ecologically responsive game environment that takes into consideration principles of protean change that are vital to seawater’s materiality.

This article furthers the practice of thinking materially with seawater, making visible the sedimentary logic of the database through considering the medium-specificity of seawater. Thinking with seawater on a macro scale challenges the specific idea of information parsed atomistically as ‘bits and bytes’ in an archive designed to prolong the integrity and duration of inscribed data, given that seawater transforms what exists within it. Yet if we consider seawater on a micro scale, its materiality changes: instead of principles of protean change and transfiguration, we see more of a logic of exchange. This pushes our conceptions of media to the limits, asking us to critique not only ‘medium-specifically’ (Hayles, 2002), developing a specific critical vocabulary for non-print media, but also ‘medium-specifically’.4 What I term ‘medium-specific theory’ requires that we attend to (1) the environmental conditions of concepts like ‘information’, and (2) changes in material scale, for at the level of molecules and proteins (as in the artwork ATLAS *in silico*), abstraction makes possible the commensurability of seawater and digitality. Thinking medium-specifically with seawater means going beyond the broader turn towards ‘oceanic studies’ (*Proceedings of the Modern Language Association* [PMLA]: May 2010) or the ‘Blue Humanities’ (Baucom, 1999; Cohen, 2012; Mentz, 2009; Steinberg, 2001), which shift critical inquiry from the confines of continents to material and historical networks across ocean basins. Beyond this, seawater can function as a ‘theory machine’ (Helmreich, 2011), a medium whose specificity asks us to reconsider how we conceptualize the materiality of the archive, instantiated in the environment or in a silicon database. In the following sections, I look at how data visualizations/animations render the materiality of the ocean across macro and micro scales, and how matters of scale determine seawater’s relation to database logic.

**Zooming out: Google Ocean**

In the beginning, there was Google Earth.5 How the Earth got its Ocean goes like this: while at a press conference in Spain in 2006, renowned ocean scientist and National Geographic ‘Explorer in Residence’, Sylvia Earle, told the creators of Google Earth that their project was missing something:
... I had a chance publicly to say how much I love Google Earth. ‘My children, my grandchildren think it is great to see their backyard, fly through the Grand Canyon, visit other countries,’ I said. ‘But, John, when are you going to finish it? You should call Google Earth ‘Google Dirt’. What about the ¾ of the planet that is blue? 6

This conversation launched an endeavor to extend Google Earth’s mapping features to the ocean. Earle worked with Google’s team to add an ‘explore the ocean layer’ to Google Earth in 2009, which suggests that the foundation for Google Ocean is a mapping technology originally developed for visualizing land.7 A ‘layer’ is a set of data superimposed on the base map of Google Earth, and it can be turned on or off depending on what the viewer wants to see. Google ocean is a kind of meta-layer, and within it are other sub-layers of data sets that include ARKive: Endangered Ocean Species; Explore the Oceans; Shipwrecks; Census of Marine Life; Cousteau Ocean World; Marine Protected Areas; Dead Zones; Animal Tracking; National Geographic; and Water Sports. Clicking on the icon for one of these layers brings up a textbox that might include information, photographs, video, or animations on the map itself.

Google Ocean is a good first step towards the goal of making the ocean not a space ‘outside’ society but a lived space ‘of’ society (Steinberg, 2001). The types of ecological relation that Google Ocean enables, its flexibility traversing scales from the local to the global, suggest what Ursula Heise (2008) calls ‘eco-cosmopolitanism’, a way of experiencing an immersive connection between self and distant places. However, analyzing the visual rhetoric of Google Ocean asks that we go beyond celebrating its technological sublimity. Google Ocean facilitates a particular ‘distribution of the sensible’, a term I borrow from Jacques Rancière, which describes ‘the system of self-evident facts of sense perception that simultaneously discloses the existence of something in common and the delimitations that define the respective parts and positions in it’ (Rancière, 2004: 12). In Google Ocean, the map is what the community of viewers has ‘in common’, positioning each viewer as a satellite able to gaze down onto different parts of the world. This viewpoint has been called the ‘Archimedian standpoint’, ‘bomb’s eye view’, or ‘world-target’ (Arendt, 1998[1958; Chow: 2006; Virilio, 2006[1977]), denoting a particular position of power, and a way of seeing the whole world as if from the perspective of a projectile bomb or an orbiting, unearthly satellite.

Google Ocean’s ‘normative point of view’ – the scale and location in which the application opens – involves a blank ocean with uniformly blue coloration and land as varyingly yellow, green, white and brown. The ideological dimensions of such visual choices stand out when contrasted with more mischievous maps, such as one that reverses the normative colours – the land is uniformly blue, and the ocean basins textured with yellow, green, white and brown.8 Colours train us where to look for details, such as changes in elevation, focusing our attention in a way that predetermines what ‘matters’. The gently textured blueness of the ocean in Google Ocean’s normative view connotes blankness, which is both the prerequisite imaginary for the extension of empire and a socially constructed choice of representation. As Philip Steinberg (2001: 107) writes in The Social Construction of the Ocean, the ‘blankness’ of the ocean in maps historically emerged:

By the early 17th century, maps featuring sea monsters representing marine nature and ships representing social activity that transpired in the arena of ocean-space began to be replaced by maps portraying a grid over an essentially featureless ocean.

Both the blankness and the iconography of sea monsters and ships are abstractions and specific choices of representation that participate in different constructions of the ocean as a place either open to extensions of empire, or already populated with a mélange of occupants.
However, if we zoom into a sea-level view, we see a variety of detail added in ‘layers’ such as National Geographic, Shipwrecks, Census of Marine Life, Sports, and others. The hypermediacy of the layers – the way they embed a combination of text, images, video and animation – functions much like the iconography of pre-17th-century maps and their sea monsters. These annotations at sea-level view offer an interactive counter-logic to the normative view of Google Earth (see Figure 2). For example, in the layer ‘Animal Tracking’ (see Figure 3) you can see the route that a tagged marine animal swam (fin whale, humpback whale, great white shark, sea lion) from a satellite perspective, and then click ‘play’ to see an animation of the animal’s route as if from its own perspective. This approximates a kind of ‘crittercam’ point of view through compounded eyes – the viewers’, the animal’s, and the camera’s – although without partial glimpses of the animal’s body you usually get in crittercam footage and without experiencing the opacity or friction of seawater (Haraway, 2007: 250). Instead the animal itself is invisible, signified only by its movements, taking you along an automated path as in Google Streetview. The only traces of the animal are its satellite coordinates at particular moments in time which, depending on their frequency and direction, can lead to either a smooth route (as with the fin whale) or an incredibly dizzying, zig-zag motion (as with the great white shark).9

The productive tension in scale between global and sea-level in ‘Animal Tracking’ involves both machine and animal points of view, where machines enable and constrain the possible subject positions we might occupy in relation to the global map. The point of view is not entirely disembodied, but cybernetic, one that takes place in the machinic Umwelt (a term that Jacob von Uexküll uses to indicate ‘perceptual worlds’) of satellite technologies. Like an aquarium, Google’s ocean stands apart from the comfortably dry viewer. It is this structure as a discrete container that makes
the aquarium so very compatible with the logic of the database. Distinguishing between narrative and database, Katherine Hayles (2012: 177) discusses how relational databases require ‘self-containment’ or in technical literature, self-description: ‘A database is said to be self-describing because its user does not need to go outside the database to see what it contains.’ Strategies of containment make aquariums and databases equally possible.

However shifts in scale do not enable Google Ocean to incorporate elements of seawater’s specific materiality, or what I discussed earlier as the specific principles of chemical change and vitality that challenge the possibility of any stable data. As we zoom into Google’s ocean we meet no resistance, but see and hover clearly as if through perfectly clear air. Yet perhaps it is not even air. As Helmreich (2011: 1225) observes, Google Ocean does not model gravity; the world is rendered weightless and transparent, with ‘many watery materialities missing’. In fact, we might say that Google Ocean is aesthetically more terrestrial than oceanic, specifically through two things: how it renders oceanic space as a kind of Cartesian ‘container’ (its aquarium aesthetic of viewing) and through its terrestrial logic of sedimentation, which we can see in the ‘layer’ aesthetic. The ‘layers’ are part of the Cartesian rendering of space, able to turn on or off content in a way that doesn’t affect the base map. The ‘container’ metaphor of ocean space is apparent through the transparent atmosphere and water (‘street view’ underwater is clear, although not programmed to see much besides blue).

Because Google Ocean structures viewing relations in aquarium terms – a transparent screen/glass separating observer from observed, framed by a rectangular window – we can say the sensible is not simply distributed from user to globe, but scaled in such a way as to erase the materiality of seawater: its opacity, viscosity, its chemical and vital properties. Google Ocean also forecloses...
the perception of change over time, offering instead a static snapshot of seemingly immortal waters. One seeming exception where the snapshot indicates a process beyond itself is the layer called ‘Dead Zones’. Oceanic ‘dead zones’ are a common name for hypoxia, which indicates decreased amounts of dissolved oxygen in the water. The ‘Dead Zones’ layer uses icons of dead fish to annotate the larger map, indicating that a particular bay, harbor, or area of the sea lacks the amount of dissolved oxygen necessary to support sealife. Just as ‘Animal Tracking’ gestures beyond the map through reference to the absence of an animal body, ‘Dead Zones’ uses an icon to indicate the absence of many bodies, over a marked but unbounded space. Although the icon of the dead fish stands in for a process (deoxygenation), the process is not temporally marked with a start date anywhere, figuring as yet another example of how Google Ocean’s layers have not adequately dealt with change over time.

Thinking with seawater in relation to global mapping projects like Google Earth/Ocean is especially poignant when thinking about climate change and the rapid coral bleaching in response to ocean acidification. If the ocean’s features do not change over time in our digital representations/animations of them, then we risk believing in an idealized form of nature that is invulnerable to the actual environmental changes happening at a variety of temporalities, a situation Rob Nixon (2011) has compellingly written about in *Slow Violence and the Environmentalism of the Poor*. Slow violence describes the scale of environmental changes such as glacier melt, sea level rise, and toxic chemical leaching that, because of their slow scale, are not easily perceived as violence to people, yet are due to anthropogenic effects interacting with natural processes. A more ecologically and timely instantiation of Google Ocean might find a way to animate the ocean in such a way that scales ‘slow violence’ to human perception.

**Zooming in: ATLAS in silico**

Google Ocean is one of many interactive data visualizations of the ocean that seeks to seamlessly link the real ocean with its digital replica, a cybernetic articulation that appears intensified in new projects such as the remote underwater observatory NEPTUNE. Located off the coast of Canada, NEPTUNE includes collections of sensors that broadcast information about currents, temperature, and other data to scientists on shore. ‘We’re the world’s first regional-scale underwater observatory network that plugs directly into the internet. People everywhere can “surf the seafloor”, while ocean scientists run deep-water experiments from labs and universities all around the world.’ NEPTUNE’s networks represent ‘a vision of the sea as a space that can be remotely monitored and managed. Ocean and cyberspace … woven together’ (Helmreich, 2009: 241). Seeking to expand NEPTUNE into an even bigger project, John Delaney (2010) has given a recent TED talk entitled ‘Wiring an interactive ocean’, and revealed plans to increase the underwater sensory laboratory and add drones that would carry samples of deep-sea sediment to scientists on land.

The next data visualization I turn to, ATLAS in silico, does not simply translate the ocean into a digital database, as Google Ocean and NEPTUNE do; it performs the conceptual inverse by considering the ocean as already a natural database of the genetic material of marine microbes. This biopolitical figuration considers seawater as a kind of biotechnical soup, first abstracted down to its informatic solute (microbes), and then abstracted again down to only part of the microbes (fragments of protein sequences). One project that illustrates the viewpoint that the ocean is always already a database is the Moorea Biocode Project, which seeks to establish ‘a library of genetic markers and physical identifiers for every species of plant, animal, and fungi on the island of Moorea’, an island in French Polynesia. Referred to in one article as ‘Moorea’s Ark’, the endeavor participates in a long tradition of taking the island as an isolated site for both preservation and experimentation (Deloughrey, 2013). In dystopic speculative fiction like Paolo Bacigalupi’s *The
*Windup Girl* (2010) and Margaret Atwood’s *MaddAddam* trilogy (2013), the genetic database is a treasure that holds the key to both restoring lost species and making designer organisms.

**ATLAS in silico** draws on a dataset gathered by J Craig Venter, who pioneered the human genome project. Sailing on his personal yacht Sorcerer II, Venter and four other scientists circumnavigated the globe collecting data (microbes filtered from hundreds of litres of ocean water) from the mid-latitudes for the purpose of genetically sequencing and cataloguing microbes. Though critiqued by marine microbiologists for ‘random sampling’ rather than developing a set of standards for sampling that specify times, depths, and seasonality (Helmreich, 2009), the data collected by Venter’s expedition have been made available on two databases: the Community Cyberinfrastructure for Advanced Marine microbial Ecology Research and Analysis (CAMERA), an online resource for marine metagenomics, and UCSD’s division of the California Institute for Telecommunications and Informational Technology (Calit2). A collaborative group of artists and scientists at UCSD worked with Venter’s data to create the next visualization I discuss, **ATLAS in silico**.

Whereas Google Ocean scales down the totality of the ocean into an interactive map, **ATLAS in silico** scales the very small (protein fragments) up to a human-perceivable size. Visually, **ATLAS in silico** looks like the deep sea: imagine bright blue freeways of data particles streaming across an inked black background, an immersive environment that creates the feeling of space exploration. These particles each stand for ‘one data record describing a unique protein sequence from the GOS [global ocean survey] data’. Particles are also referred to as ‘open-reading frames’ (ORFs), the predicted amino acid (protein) sequences of their DNA (West et al., 2009a). Each particle circulates in a broad, three-dimensional flow. These particles, ‘when brought in to close proximity by participants become luminous three-dimensional objects that reveal their story in multiple layers of information that intertwine biology, with its social, environmental and metadata contexts’ such as salinity and the depth at which they were collected (see Figure 4). The ‘life-size rendering’ of the genetic information into a symbolic body (‘shape grammar’) is adjusted to a scale and size that we can view, interpret, and manipulate for the purpose of detecting patterns in the data (West et al., 2009a; see Figure 5).

Through both visual and audio feedback (of sounds that relate to viewer position and selected content), **ATLAS in silico** allows for haptic interactivity, putting abstract microbial genomic data in relation to a human scale. The collaborators write that these data can be played with by a human participant, allowing for ‘an open-ended auditory data-mining process in hopes of revealing unknown or unpredicted features through the formation of emergent patterns’ (Großmann et al., 2008). **ATLAS in silico** not only shifts the scale of the microbes ‘up’ to human size, but also reciprocally shifts the human down to the scale of (predicted) protein sequences. This is one of the poetic effects of juxtaposing human and DNA fragment: not only to render intelligible the microscopic, but to speculatively allow human viewers to imagine themselves immersed in the world of microbes (West et al., 2009b).

It would seem that **ATLAS in silico** presents an innovative and engaged example of thinking with the materiality of seawater, largely due to its choice of life forms (microbes). Microbes have the capacity to not only pass on genes to their progeny, but also to laterally transfer genes to each other on occasion, making them ideal candidates for transcription into an atlas. In *Alien Ocean*, Helmreich (2009) pays attention to the way that marine microbes are viewed as ‘living machines’, or ‘living data’. Here, marine microbes are fragmented and articulated in terms of being almost purely information, manipulable by humans with a variety of research agendas concerning the origin, evolution, and replication of life. It would be tempting to say that **ATLAS in silico** represents a way of thinking through the fluidity of microbial genetic information as it is shared in the ocean, as available and constantly circulating within microbe populations themselves.
However, ATLAS focuses on a very specific materiality: not the materiality of seawater as a whole with its composite chemical and biological properties, but that of microbial genomic material. ATLAS *in silico*’s microbes have undergone multiple ‘transductions’ (Helmreich, 2009) or material conversions from seawater, to a ship, to shotgun-sequenced DNA fragments, to information in a database, to ‘shape grammar’ in the final artwork (West et al., 2009b). Like the view of the whole earth in Google, our access to the microbial genomic data is not direct, but transformed across scales, mediums and

![Figure 4. User interacting with ATLAS in silico. Each particle in the stream is a fragment of Global Ocean Survey data, represented by ‘shape grammar’ (middle image) that the user can zoom into, along with information about where the data was collected. © Ruth West. Reproduced with permission from Ruth West.](image-url)
technologies of intelligibility. Yet this practice is not only a matter of transduction, but also a matter of erasure of the bodies of the microbes, whose genetic data have been ‘liquefied’ by the process of sequencing, thus artificially creating a new abstract space and place for contemplation and play with information re-embodied in randomly generated ‘shape grammars’. ATLAS \textit{in silico} ‘inverts’ the bodies of marine microbes, turning their bodies inside-out so that their genomic material may be abstractly represented as the small blue dots circulating in the installation, which can be examined more closely to view patterns in the other data associated with them. This literalizes the idea that seawater contains information, and through its abstractions, it both reveals and conceals the microbe.

What ATLAS \textit{in silico} does teach is that the scale of ‘data’ matters for thinking materially with water. Both ATLAS \textit{in silico}’s abstraction of a microbial ‘gene pool’ from seawater and its micro scale allow for a conceptual commensurability between ocean and digitality. This poetics works because at the microscopic level, seawater does not demonstrate the same properties as it does on a macroscopic level (encrusting and transfiguring large objects) that we see in \textit{The Tempest}, or in the sculptural work of Jason de Caires Taylor. With microbial DNA fragments, change is conceived of not as transfiguration, but as rearrangement. These two factors – abstraction and scaling down – are what make the logic of digitality commensurate with seawater’s abstracted materiality. The DNA fragments are still preserved, but they have been scaled down to units of exchange that cannot be ‘transfigured’ by seawater in the same way large objects can (like Ferdinand’s father in \textit{The Tempest});
instead, participants can interactively recombine them. If atlases ‘simultaneously assume the existence of and call into being communities of observers who see the same things in the same ways’ (Daston and Galison, 2010: 27), then ATLAS in silico promotes a specific community of viewers who see microbial life as always already informatic. Our consideration of ATLAS in silico’s aquatic materiality also depends on whether we consider the DNA fragments as part of the ‘water’ or as ‘solute’, that is suspended in seawater. What is seawater, what is sediment? In the installation itself, fluid dynamics equations animate the movement of the blue dots, and one could argue that they are more of the precipitate rather than the water itself. It also raises a follow-up question: is information atomistic, akin to a stream of sand, or does it belong to its fluid suspension?

Yet abstraction also allows us to see material connections; if we consider the micro scale, we see that one of the substances linking microbial bodies with the digital technologies is the element silicon. Viewed in this way, ATLAS in silico suggests a radical experimentation with the materiality of seawater through its meta-reflection on the substance of silicon, an element widely present in the internal structures of diatoms. In his famous ‘Gaia hypothesis’, James Lovelock (2000[1979]) discusses how the sea is dominated by protista such as algae and plankton. Diatoms are a type of algae with skeletal walls made of silica. The skeletons of diatoms are made of opal,

… a special gem-like form of silicon dioxide, usually known as silica, the main constituent of sand and quartz. Silicon is one of the most abundant elements in the Earth’s crust; most rocks, from clay to basalt, contain it in combined form. It is not generally considered of importance in biology – there is little silicon in us or in anything we eat – but it is a key element in the life of the sea. (Lovelock, 2000[1979]: 94)

In an ironic (siliconic?) turn of fate, the microbes (reduced to genomic data) are now reincarnated in new silicon avatars: the array of computers and LCD screens. ATLAS in silico is the end of a journey from silicon to silicon.

A crucial difference between the fluidity of microbial genetic information in ‘the wild’, so to speak, and in ATLAS in silico is that ATLAS puts the human at the centre of the installation. Just like Grahame Weinbren’s ‘swimming user’, the user of ATLAS in silico selects, organizes, and finds patterns within a database. Unlike actual seawater, the data in the database itself do not autonomously recombine and evolve on their own, but constitute a set of building blocks for future observers to play with. The protean force of seawater is instead frozen in place, and the transfigurative properties of seawater are simply not in play. Although ATLAS in silico uses fluid dynamics equations, this only models a generic fluidity; it does not represent a truly protean aesthetic of engaging the chemical force of seawater.

I turn to one final example to distinguish between ocean and database, the Artificial life (A-Life) installations Tierra and A-Volve, that seem to offer a way of thinking of the digital as a kind of seawater. In Thomas Ray’s Tierra, computer scientists strive to ‘evolve’ self-replicating algorithms inside computer memory, involving processes of both growth and rearrangement. A-Life takes the computer as a world in which simplistic, virtual creatures may emerge, compete with each other for resources (memory space for replication), and eventually die out according to a separate series of algorithms, or rules of the virtual world. Separate algorithms constitute the virtual ‘creatures’ that are regarded by some people as mere simulation, and by others as an instantiation of real life itself. As Sarah Kember (2003: 518) writes, the computer figures as a virtual ocean of life: ‘The RAM [Random Access Memory] of the virtual computer is referred to as the “soup” in which the machine codes or “self-replicating” algorithms “live” as “creatures”’. Helmreich (2000: 107) compares the experience of visiting an A-Life conference and moving from one simulation to the next as similar to strolling, ‘from one tank to another at a sea life museum’. Here the computer functions as a womb-like ocean, a matrix in both reproductive and computational senses
of the term. Silicon substitutes for seawater, and it would be tempting to say that code functions as both environment and organism. Yet the environment is precisely what has been elided; inside the computers hosting A-Life, the only ‘environmental’ factors are other organisms, continuing to propagate their internal structure. Rather than the direct kind of environmental shaping we see with seawater, A-Life avoids the question of milieu by focusing primarily on the internal generation of form; the ‘soup’ of code is merely metaphorical.

Conclusion: Proteus and the digital

The conclusion I draw from this comparative study of Google Ocean alongside ATLAS in silico is that scale matters for thinking materially with seawater in ocean animations. On a macro scale, seawater’s materiality is both a creative and destructive force that sometimes reorganizes, sometimes diffuses, sometimes grows on what it touches, a principle that artists like David Gatten and Jason de Caires Taylor have taken advantage of in their material artwork. Such a principle is missing from Google Ocean: other layers such as Shipwrecks, Census of Marine Life, ARKive and National Geographic employ a sedimentary logic of accumulation such that you can always return to the objects, marked, at any time of day or after any duration of time – they will still be there. In other words, form does not follow content: while it is a valuable educational tool that may provoke interest and wonder in the general public, Google shows the ocean at the expense of employing any properties of the seawater itself. The same disjunction between form and content occurs on the micro scale of ATLAS in silico, where a mirroring of form and content is made possible through abstractions (for instance, taking microbes out of seawater, and protein fragments out of the microbes). These abstractions enable a picture of an ocean that is compatible with the logic of exchange and digitality. But because such abstractions are always negotiated, explored, arranged and played with by a human user, ATLAS in silico shares more with Weinbren’s database aesthetics than with the creative autonomy of seawater itself.

To return to my question at the beginning of this article: how might a theory of media proceed from Ariel’s song in The Tempest, working from a premise of object transformation rather than stasis? I have approached this through analyses of Google Ocean and ATLAS in silico, which take the material conditions of the ocean environment as a premise from which to rethink traditional categories of analysis, such as archive and database. Seawater’s protean aesthetic offers a way of thinking about seawater as a distributed, creative force, a force that questions our terrestrial assumptions about agency and the ‘material’ of history as solid and static, rather than turbulent, soluble, life-giving. Ariel’s sea-change calls for a theory of media to contemplate amidst the melting archives of glaciers, the acidification of oceans and the global rise of the seas.

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Notes

1. Both ‘media’ and ‘milieu’ have long intellectual histories. For ‘media’, I consider Stefan Helmreich’s (2009: 32) definition of media as ‘substances, channels, or instruments through which forms of action
are propagated’ and also John Guillory’s (2010: 357) connection of media with distance: ‘the enabling condition of mediation is the interposition of distance (spatial, temporal, or even notional) between the terminal poles of the communication process (these can be persons but also now machines, even persons and machines).’ For ‘milieu’, I draw on Georges Canguilhem (2001: 6–31), who varyingly describes milieu as a ‘fluid intermediary’, ‘environment of the living’ and ‘perceptual environment’. I use the term here to indicate that whatever is ‘stored’ in the ocean contributes to the broader ocean-as-environment, possibly impacting other stored material.

2. For more on database aesthetics, see Manovich (2002), Hayles (2012) and Vesna (2007).
4. Although Clement Greenberg has written of the ‘medium specificity’ of the art object, I use the term differently to consider how the ocean environment changes the conditions of knowledge production and thought. For Greenberg’s definition of medium specificity, see: http://csmt.uchicago.edu/glossary2004/specificity.htm (accessed January 2014).
5. Keyhole, the company that created the mapping technology, was acquired by Google in 2004 and its flagship product became Google Earth.
7. Even visualizations of the land can be misleading; because Google Earth is composed of many satellite photographs taken over time, any moving objects such as ships or cars are seen dotted across Google’s earth.
9. For these tracks to be meaningful, one would need to combine a study of the animal’s movements along with a clear understanding of the tracking technology itself, of when it was possible to broadcast locational data, in addition to other contexts involving seasons, currents, and the movements of food sources.
10. Gísli Pálsson (1998) leverages a similar critique against fisheries scientists in ‘The birth of the aquarium: The political ecology of Icelandic fishing’, where treating the ocean as an aquarium or manageable space brackets out the observer from the thing observed.
14. Stefan Helmreich (2009: 99) rather poetically notes the equation of database and microbial genomic data: ‘If the sea was once a chaotic and cosmic amnion, an archive of life primeval and life to come, those pasts and futures nowadays read more like a mix-and-match database than a straightforward, stratigraphic archaeological record.’
18. Initially, CAMERA is making available all the metagenomic data being collected by the J. Craig Venter Institute’s Sorcerer II Global Ocean Sampling (GOS) expeditions, which have sampled microbial communities around the globe, plus 150 new full genome maps of ocean microbes. The initial incarnation of CAMERA also includes two other data sets: a large-scale metagenomic survey of marine viral organisms collected from sites around the North American continent by Forest Rohwer and his research team at San Diego State University and a vertical profile of marine microbial communities collected at the Hawaii Ocean Time-Series (HOTS) station ALOHA by Ed DeLong and his research team at MIT. (quoted from

Also see CAMERA website, available at: http://camera.calit2.net/ (accessed August 2013).
20. The reason the sequences are ‘predicted’ is because of Venter’s method of ‘shot-gun’ sequencing that relies on algorithmically assembling millions of DNA fragments into amino acid sequences.
22. Protists are only one type of ocean microbe. Other ocean microbes include archaea, bacteria, fungi and viruses.
23. For a more detailed discussion of Tierra see Chapter 9 in How We Became Posthuman (Hayles, 1999), and Christa Sommerer and Laurent Mignonnet’s ‘Art as a living process’, available at: http://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w05/somm_mign.htm (accessed June 2013).
24. For example, see David Gatten’s experimental film piece ‘What the Water Said’, or Jason de Caires Taylor’s underwater sculptures like ‘Vicissitudes’ and ‘Silent Evolution’.

References


**Author biography**

Melody Jue is a PhD Candidate in the Program in Literature at Duke University. She is writing a dissertation entitled ‘Wild blue media: Aquatic displacement as critical method’, which calls for a radical overhaul of critical practices and contemporary media theory. These practices have largely operated under a terrestrial bias, or unreflective use of concepts and reading practices that assume the observer is comfortably positioned on dry land. Drawing influence from feminist science studies and constructivism, which both critique objectivity and emphasize the relation between embodiment and knowledge production, ‘Wild blue media’ develops a ‘medium-specific philosophy’ responsive to seawater.