

The Faintest of Traces: Objects and the Self-Organization of Social Assemblages

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In *Being and Time* Heidegger writes,

The ready-to-hand is not grasped theoretically at all, nor is it itself the sort of thing that circumspection takes proximally as a circumspective theme. The peculiarity of what is proximally ready-to-hand is that, in its readiness to hand, it must, as it were, *withdraw* [my emphasis] in order to be ready-to-hand quite authentically.¹

In *Anti-Oedipus*, Deleuze and Guattari remark,

...we cannot tell from the mere taste of wheat who grew it; the product give us no hint as to the system and relations of production.²

Between Heidegger and Deleuze and Guattari, we encounter two ways in which objects withdraw. In the case of Heidegger, the tools we use withdraw and disappear as we use them. As I compose this talk the keyboard upon which I type disappears from view, becoming invisible. It falls into the background as my thought is directed at the themes animating this paper. As I cook a meal, I attend not to the utensils with which I cook, but to the mixture of herbs, garlic, onions, and tomatoes I mix together in the pan. The wooden spatula with which I mix this enticing concoction falls from view.

By contrast, in the case of Deleuze and Guattari, it is not the objects with which I deal that withdraw from view, but rather the system through which these objects are produced. Deleuze and Guattari are here alluding to one crucial dimension of Marx's concept of commodity fetishism. As a consequence of this form of withdrawal, commodities become what Marx called "social hieroglyphs"³, such that "...definite social relation[s] between men...

¹ Martin Heidegger, *Being and Time*, p. 99.

² Gilles Deleuze and Felix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia*, p. 24.

³ Karl Marx, *Capital*, p. 167.

assume... the fantastic form of a relation between things.”⁴ The hieroglyph is a mysterious figure whose meaning is uncertain and which is quite different than it might initially appear. As I cook this herb pasta, I have little to no knowledge of how these herbs and vegetables were grown, what agribusiness produced them, who harvested them, their working conditions, wages, and legal status, how they arrived at the farmer’s market where I bought them, and so on. All of these relations disappear from view. I believe that I am merely relating to the bulb of garlic, oblivious to the fact that this bulb of garlic is the embodiment of all sorts of social relations pertaining to how the garlic was produced. Here Marx is somewhat misleading, for it is not just that that bulb of garlic disguises the social system of production, thereby disguising social relations, but that it also disguises all sorts of machinic relations used to produce the garlic. None of this is directly given in the sensuous being of the garlic.

But it is not just the way in which a bulb of garlic is produced that withdraws from view. It is also the means by which various social relations are produced that withdraw from view. Just as we go to a grocery store and see various vegetables, meats, etc., without knowing how they were produced, we see that other groups of people live in particular ways and under particular circumstances, that certain groups relate in particular ways, that men, women, and different ethnicities enjoy different statuses, and so on without discerning how things came to be this way. The processes of production by which these social patterns or collectives came to be are largely invisible.

This Janus-faced phenomenon of withdrawal poses a daunting challenge for social analysis. Because production and use withdraw, these dimensions often disappear from the archive, failing to be inscribed alongside those other things that are recorded. The archive, that

⁴ *Ibid.*, p. 165.

reservoir of written and recorded documents that scholars such as ourselves draw upon to produce other documents, tends to be a record of what people believed, how they experienced the world, signs, ideologies, the *results* of scientific research, the applications of technologies, beliefs about the nature of the social world in which people lived, myths, history, narratives and so on. Because the tools that we use and the manner in which things and social assemblages were produced withdraw, there is a tendency for them to leave only the faintest of traces within the archive. In the material realm, bubbling with machines, technologies, techniques, animals, natural resources, geographical topographies, and microbes tend to disappear or get erased.

This phenomenon of withdrawal and the nature of the archive has profound consequences for our analysis of social assemblages. As students of the humanities, social theorists and social scientists we seek, among other things, to understand the social assemblages within which we are enmeshed and that we find in the world about us. Much of this investigative work consists in careful archival research through which we strive to produce an archaeology of social assemblages. The withdrawal of objects and the manner in which objects and social assemblages are produced withdraw from the archive leaving only a trace of their existence. This tends to systematically invite a form of social analysis that treats ideas, beliefs, signifiers, ideologies, narratives, norms, morals, laws, and beliefs as the glue that holds the social together. We thereby miss the role that nonhuman objects play as glue.

As Latour argues in *We Have Never Been Modern*, the modernist constitution is one in which the world is divided into the social and human world governed by relations of *meaning*, and the physical or natural world composed of physical objects governed by brute cause and effect relations.⁵ Here it is said that we do bad natural science if we allow meaning to intervene

⁵ Bruno Latour, *We Have Never Been Modern*, 1993.

in our investigations, while we do bad social science and humanities work if we allow the world of physical objects to intervene in our investigations. These two worlds are supposed to be rigorously kept apart, as the social and human world is governed by meaning.

However, as we set about our investigative work, we quickly encounter problems. Drawing a concept from Foucault's *Archaeology of Knowledge*, we readily recognize that social assemblages are characterized by a degree of regularity. While certainly social relations are constantly undergoing various mutations and re-alignments, we note that they have a stability as well. In the order of time we note that certain class stratifications, certain links between groups and institutions, certain social entities like nations, various identities, and so on are relatively enduring. From the standpoint of the second law of thermodynamics or entropy, we also note that there is no *necessary* reason that human persons and bodies should be regular in this way. Indeed, we're surprised that so many social relations are so durable. Why don't they fly apart, becoming disordered over time, in the way that gas particles distribute themselves randomly throughout a chamber?

The modernist constitution tells us to look to the domain of meaning—signs, norms, laws, narratives, myths, ideologies, signifiers, etc. —to account for this durability. Yet I believe, if we're honest with ourselves, we immediately become aware of the inadequacy of this glue the moment we step into the classroom. Among our students, we certainly encounter meanings in abundance. What is remarkable about the abundance of meaning we encounter in the classroom, however, is just how *different* these meanings are. To be sure, there are certain patterns and repetitions of meaning among our students, yet their systems of meaning are quite diverse. This is reflective of the diversity characterizing the domain of social assemblages in general, up to and including scholars such as ourselves. As many of us have experienced, it is easier to build or

engineer pigs that fly—especially at Georgia Tech --than to get two or more academics to agree on anything.

Faced with this, our perplexity increases with respect to the specter of entropy, for confronted with this proliferation of meaning we wonder how this alone could ever provide the glue necessary to generate the regularities we encounter in social assemblages. Clearly the domain of meaning must be an important component of social assemblages, yet it cannot be the entire story.

Something is missing. In his essay “Where are the Missing Masses?”, Latour marks the void of these components in sociology. As Latour writes,

According to some physicists there is not enough mass in the universe to balance the accounts that cosmologists make of it. They are looking everywhere for the "missing mass" that could add up to the nice expected total. It is the same with sociologists. They are constantly looking, somewhat desperately, for social links sturdy enough to tie all of us together or for moral laws that would be inflexible enough to make us behave properly. When adding up social ties it does not balance. Soft human and weak moralities are all sociologists can get. The society they try to recompose with bodies and norms constantly crumble. Something is missing... Where can they find it?... To balance our accounts of society we simply have to turn our attention away from humans and look at non-humans.⁶

According to Latour, the missing masses that haunt our analysis of social assemblages are nonhumans. Nonhumans refer to entities as diverse as the various technologies that inhabit our world, natural resources, geography, weather patterns, media, animals, information technologies, microbes, stars, texts in their sheer materiality, infrastructures like roads and fiber optic cables, and a host of other entities besides. These entities that leave the faintest of traces in the archive are, according to Latour, an important component, an important glue, contributing to the regularity of social relations.

⁶ Bruno Latour, “Where are the Missing Masses? Sociology of a Door”, 1992, <http://www.bruno-latour.fr/articles/article/050.html>.

My thesis-- following theorists such as Isabelle Stengers, Bruno Latour, Andrew Pickering, Donna Haraway, Ian Hacking, and Karen Barad --is that these nonhumans play a key role in the genesis of social assemblages. Here I must proceed with care, for the point is not that we should reject discussions of the domain of meaning, but rather that our analysis of social assemblages should adopt a multi-dimensional approach that simultaneously investigates the imbrications of the symbolic, the material, and the phenomenological in the formation of social assemblages. Karen Barad describes this framework well under the title of “agential realism” in her book *Meeting the Universe Halfway*. As Barad puts it, “...agential realism takes account of the fact that the forces at work in the materialization of bodies are not only social, and the bodies produced are not all human. Crucially... agential realism clarifies the nature of the causal relationship between discursive practices and material phenomena.”⁷ While I have some quibbles with Barad’s ontology, I wholeheartedly embrace her project of thinking the imbrication of the discursive (what I would call the semiotic, representational, or domain of meaning) and the material. The point is not to replace the domain of meaning proposed by the modernist constitution with the domain of nonhuman entities and physical causality, but to think the interrelations of these domains.

This point can be clarified with respect to a modified version of Lacan’s famous Borromean knots.⁸ Lacan first introduced the Borromean knot in Seminar 19, during the years of 1971-72. A Borromean knot is composed of three interlocking rings such that if any one ring is cut, the other two rings fall away. He labels the three rings “imaginary”, “symbolic”, and “real”. The signification of these terms is not important for my purposes here. Lacan was interested in

⁷ Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, pp. 33 – 34.

⁸ Jacques Lacan, Seminar XIX, *Ou Pire*, 1971 – 72.

modeling the interrelation of those domains of the world that structure subjectivity. The Borromean knot allowed him to investigate how these domains are linked together, how they overlap, and how they can come undone, as a way of situating the various symptoms, interpersonal relations, and structures of subjectivity and desire that appear in the psychoanalytic clinic.

Here I would like to modify Lacan's Borromean knot somewhat, labeling one ring the symbolic, another the phenomenological, and the third the material. These three circles would, in turn, be encompassed by a third circle entitled "the real". By encompassing all three domains in the circle of the real, I am emphasizing the flat ontology I've developed elsewhere in my book *The Democracy of Objects*.⁹ Flat ontology seeks to place the heterogeneity of entities that populate our world on equal ontological footing. In other words, it refuses to reduce the domain of the symbolic to the material, nor to reduce the material to a construction of the cultural. Instead, it strives to think the interaction of these domains, treating them all as being equally real. Flat ontology thus claims that 1) entities are real at all levels of scale, and 2) that entities come in a variety of different flavors or types. Thus, for example, a neutrino is no more real than a corporation, and a tree is no more real than a fictional text. All are entities that genuinely circulate in the world and produce effects.

With this modified version of the Borromean knot it is my hope that diverse branches of theory can be integrated and thought together. Thus, under the circle of the material we are able to mobilize the work of Friedrich Kittler, Walter Ong, Marshall McLuhan, Bruno Latour, Andrew Pickering, and Bernard Stiegler in the domain of science, media, and technology studies insofar as all of these theorists investigate the materiality of technologies and mediums and how

⁹ Levi R. Bryant, *The Democracy of Objects*, forthcoming.

they influence social relations. Here we would also find materialist historians such as Fernand Braudel, Karl Marx, and Jared Diamond. In the domain of the symbolic we could draw on theoretical work such as that developed by thinkers such as Foucault, Derrida, Butler, Kenneth Burke, Lacan, Judith Butler, Zizek, Ian Hacking, and so on. Finally, the domain of the phenomenological allows us to integrate the phenomenologists, ethnologists such as Jakob von Uexkull, technological phenomenologists like Ian Bogost in his *Alien Phenomenology*, and systems and autopoietic theorists such as Niklas Luhmann, Maturana and Varela, and the cyberneticians.

The point, however, is not to simply embrace all of these diverse domains, but to instead investigate how they interpenetrate and interact, influencing one another so as to produce the social assemblages that populate our world. The Borromean knot allows us to think overlaps between the different domains and their tensions as in, for example, the case of technologies where we have an overlap between the symbolic and the material in the form of blueprints and material embodiments, patent laws, etc. Similarly it allows us to investigate those moments where one domain outpaces another domain. Thus, for example, it could be said that during the Enlightenment the domain of the symbolic outpaced the domain of the material insofar as a revolution took place in how we *think* the nature of social relations and the world (especially in the case of the famous *philosophes*), while material conditions, institutions, and production remained largely the same (for a time, at least). By contrast, in our own time, the material transformations wrought by technology, communications technologies, and shifts towards globalization seem to outpace the domain of the symbolic and how symbolic social relations are structured. In Egypt last week we witnessed a revolutionary transformation in the symbolic, but it remains to be seen whether the material domain of Egyptian economy (40% of the population

lives on less than two dollars a day) and institutions will be brought in line with this symbolic transformation.

If science, media, and technology studies in the humanities and social sciences ought to be privileged sites of investigation, then this is because they are not marginal subfields, but rather plumb the depths of the interaction between the material, symbolic, and phenomenological. If this is the case, then it is because the objects of these investigations ineluctably guide the researcher to the analysis of the imbrication of the material, symbolic, and phenomenological in the genesis of social assemblages. What science, media, and technology studies reveal is the key role material agencies play in bringing human persons and bodies together in particular ways, and how material agencies are interrelated with the symbolic and the phenomenological.

In the last half of this talk I would like to provide a case study of what I'm alluding to, drawing on the example of the IceCube Neutrino Observatory at the South Pole. It would take me too far afield to give a detailed discussion of the imbrication of the symbolic, the material, and the phenomenological here, so instead I would like to draw attention to the key role played by material and nonhuman entities in the self-organization of the IceCube social assemblage or. In recent years, physicists have increasingly turned their interests towards the investigation of neutrinos. Neutrinos are tiny elementary particles that generally move near the speed of light and that have a neutral electric charge. Physicists are especially interested in high energy neutrinos produced as a result of gamma ray bursts, supernovas, and black holes.¹⁰ These types of neutrinos, in their turn, will teach physicists about dark matter and energy which is thought to account for roughly 96% of the universe's mass. Back in the late 60s and 70s, Vera Rubin began

¹⁰ *IceCube Neutrino Observatory*, "Frequently Asked Questions", <http://www.icecube.wisc.edu/info/faq.php>.

doing research on the orbit of stars at the outer edge of galaxies. As Rubin recounts it, she was searching for a research project that would allow her to pursue her interest in the movement of stars and galaxies. At the time, Rubin was a new mother completing a PhD in astronomy where women were often discouraged from participating (in high school one of her advisers had told her that it was “okay” for her to go to college but that she should stay away from the sciences). She was looking for a research topic that would both fit with her life and allow her to finish her degree.¹¹ Research on the angular motion of stars at the edge of galaxies seemed to be a good fit.

Her research would come to shake the entire world of physics, revealing how little we know. Much to her surprise she discovered that stars on the outer edge of galaxies were orbiting at rates too fast to be possible given the observable mass of galaxies. It was observations such as these that led astronomers to hypothesize the existence of dark matter and energy to account for the missing mass required to account for this surprising motion. Neutrinos, in their turn, would play a role in demonstrating the existence of dark matter and energy, helping us to learn about the strange properties of this type of matter.

The great difficulty is that because neutrinos have a neutral electric charge they pass right through more familiar forms of matter, only rarely producing effects. At this very moments neutrinos are streaming through our body with a facility greater than that we experience walking through a morning mist. At the level of theory, physics predicts the existence of these particles, yet we now encounter two problems: First, given that our instruments are composed of forms of matter neutrinos seldom interact with, how can we detect them? Second, because strongly interacting particles are also constantly raining down upon the earth and because these particles do produce readily observable effects in matter, how do we distinguish neutrino-events from

¹¹ *Most of the Universe is Missing*, BBC Documentary.

more familiar particle-events? If we're not able to do this, of course, then we will be unable to demonstrate the existence of neutrinos predicted by physics or study them.

Here it is worth noting that these strange qualities of neutrinos perfectly exemplify the ontology of objects I develop elsewhere under the title of “onticology”. As I first outline in my article “The Ontic Principle”¹², and later in detail in my forthcoming book *The Democracy of Objects*, onticology is the ontological thesis that the world is composed of objects.¹³ Deeply indebted to the object-oriented ontology of Graham Harman¹⁴, onticology proposes a flat ontology in which objects exist irreducibly at all levels of scale and where objects are withdrawn from one another such that they only relate to one another selectively. Here we encounter a third form of withdrawal that I call “ontological withdrawal”. The neutrino is a prototypical example of an object insofar as it is seldom able to interact with most other objects, thereby indicating the manner in which it is withdrawn. In my view, neutrinos teach us what is true of all objects. Now this is not merely a shameless attempt to plug my work and motivate you to read it—though it's that as well—but rather these principles of onticology draw attention to an important point. If it is true that objects are withdrawn from one another, that they do not directly touch, then it follows that objects do not arrive *pre-related*, but rather relations must be *forged*. It is here that discussions of neutrinos become important, for as scientists strive to forge relations with neutrinos so that they might also forge relations with what is taking place in the core of the sun, gamma ray bursts, supernovas, and, above all, dark matter, we discover that a number of *other* relations are forged in this process that are social in nature. Here the neutrino functions as a sort of parable, a sort of prototypical example, for the role that nonhuman objects play in the

¹² Levi R. Bryant, “The Ontic Principle: Outline of an Object-Oriented Ontology”, in *The Speculative Turn*.

¹³ Levi R. Bryant, *The Democracy of Objects*.

¹⁴ Cf. Graham Harman, *Guerrilla Metaphysics*.

self-organization of social assemblages. For in the case of neutrinos, we discover that not only does our attempt to forge a relation with these elusive entities generate certain very specific social relations, we also discover that a number of other nonhuman entities appear in the course of striving to forge these relations, bringing humans together in very particular ways.

Before proceeding to discuss the role of these nonhumans within the ring of materiality and the role they play in the genesis of social relations, let's first take a brief look at the circles of the symbolic and the phenomenological. As science, media, and technology theorists, what would we investigate under the heading of the symbolic and phenomenological when approaching the IceCube Neutrino Observatory? Under the heading of the symbolic, of course, we would first note that it is theories that predict the existence of neutrinos and dark matter. It is these theories that propel scientists to do experimental work seeking to verify the existence of these things. Here too we would find Foucault's famous *epistemes* or discursive structures guiding scientific research, as well as Kuhn's paradigms. In *A Realist Theory of Science*, Roy Bhaskar draws attention to the fact that scientists must be formed or *produced*, or that human beings must go through an educational process, a sort of subjectivization, that transforms the nature of their perception, how they pose questions, the concepts they work with, and so on.¹⁵ Investigating this formation of scientists, we might draw on Ian Hacking's concept of "interactive kinds" as developed in *The Social Construction of What?*¹⁶ An interactive kind is a category under which those subsumed by the category interact with the category, modifying their behavior and thought processes in all sorts of ways. If, for example, someone is going through psychotherapy and is told that he is an obsessional, this might lead him to do all sorts of research, leading him to either contest this categorization, embrace it and emulate it, or leading his family

¹⁵ Roy Bhaskar, *A Realist Theory of Science*, 2008.

¹⁶ Ian Hacking, *The Social Construction of What?*, 2000.

and employers to treat him differently. This is one reason that psychoanalysts, as opposed to psychotherapists, do not reveal diagnoses to their patients. In the case of scientists, there exists a whole universe of interactive kinds that the developing scientist internalizes so as to participate in her field. As we saw in the case of Vera Rubin, she contested the implicit this that only men are to participate in the hard sciences. As a result of this, she has, over the course of her career, become a passionate advocate for women in science and also talks around the world encouraging girls and young women to pursue the sciences. Within the symbolic we would also find the role played by ideology, the culture wars, and abstract economic relations.

In the domain of the phenomenological, by contrast, we encounter questions pertaining to the manner in which scientists encounter the world around them, as well as all the conundrums revolving around producing phenomena that allow us to detect what is essentially beyond the domain of the phenomenological as in the case of neutrinos that cannot be directly experienced. However, the domain of the phenomenological extends well beyond this. In *A Foray Into the Worlds of Animals and Humans*, Jakob von Uexkull has taught us how to investigate animal experience.¹⁷ What Uexkull shows is the selective way in which organisms relate to entities independent of them. I see no reason that we can't generalize this thesis to objects in general, whether animate or inanimate. All objects relate to the world about them selectively, such that they can only be perturbed in specific ways. This plays a significant role in how entities can relate. We have already seen this in the case of neutrinos, where its neutral charge prevents it from interacting with other forms of matter. The same would be true with technologies that can only receive selective inputs from the world. Likewise, following the sociologist Niklas Luhmann, we can explore the manner in which social systems are selectively open to their

¹⁷ Jakob von Uexkull, *A Foray Into the Worlds of Animals and Humans*, 2010.

environment such that only certain environmental events produce information for the internal functioning of these systems. Under the domain of phenomenology, we would thus explore how various types of objects are selectively open to their environment and how this affords and constrains certain possibilities for assemblages.

Returning to the domain of materiality, how, then, are relations forged with neutrinos? Earlier I noted that in those rare instances where neutrinos do interact with other forms of matter they are nonetheless difficult to detect because more familiar particles also produce events leaving us unable to distinguish neutrino events from events produced by other particles. To solve this problem, scientists have built neutrino observatories deep under ground. By locating these observatories underground, the earth functions as a shield against other cosmic particles. The idea is that strongly interacting particles are filtered out by the intervening before they reach the sensors of the observatory. Scientists can then be assured that these events are produced by neutrinos. These observatories, in their turn, require great amounts of very clear and pure water allowing photo-sensors to detect the bursts of light produced in those rare instances where neutrinos interact with atoms of water. However, here we encounter another problem. As it turns out, engineering chambers large enough to contain the requisite amounts of water proves very difficult. There has been some success with water-based observatories as in the case of the Homestake Observatory located deep in a mine in South Dakota, but researchers are now pursuing larger observatories.

To mitigate this problem, scientists began the construction of a neutrino observatory in the South Pole during the season of 2004/2005 and completed building in December of 2010. If the South Pole proves promising solution, then this is because it contains ice that is kilometers thick. Ice deep beneath the surface tends to be extremely pure due to the pressure of the ice

above that eradicates light distorting air bubbles. Here, then, nature provides scientists with vast amounts of water in frozen form, perfect for detecting neutrino events.

Before proceeding, it is worthwhile to note that without noticing it we have already stumbled upon one social dimension of this research. Social relations do not merely pertain to content, meaning, norms, and so on, but also have a *geographical site*. They are located in time and space and forge their relations from this site. We can raise two questions at this point: First, why is it that social relations occur at this particular space and time? Second, what exigencies does this time and space place upon social relations, leading to the genesis of further social relations? Here spatio-temporality should be thought topological in terms of structure of connectivity among humans and nonhumans.

With respect to our first question, the South Pole becomes the site of these social relations because of the peculiar features of neutrinos and the challenges posed by engineering and the water needed to detect neutrinos. Scientists are brought to this particular site in pursuit of the elusive neutrino. This site proves to be a privileged point for gathering together these scientists. However, due to the unique features of the site, additional social relations are autocatalytically generated, drawing together yet other humans, nonhumans, and institutions. In other words, the unique features of the South Pole generate a set of *problems* that pull together other persons, institutions, businesses, entities, and nations not immediately involved in the scientific project of detecting neutrinos. Relations grow from the site.

To illustrate this point, let's first look at some of the mechanics of the observatory. The complete observatory is one square kilometer and consists of light sensitive sensors sunk 2.5 kilometers beneath the ice at regular intervals. The holes for the sensors are drilled with superheated water, which requires energy to be produced. In fact, the drilling of each hole

requires 20,000 liters of jet fuel .¹⁸ Where does this fuel come from? After all, the South Pole does not have jet fuel stations on every corner, so how does this fuel, used both to run the station and drill the holes, arrive there? Here we encounter the genesis of another social relation. Few outfits are equipped to deliver jet fuel, especially in the amounts required to keep the IceCube project running. As it turns out, the fuel is flown in by U.S. Military cargo planes. We thus encounter another social link being forged between humans due to the exigencies posed by the environment of the South Pole and the nature of the neutrino research project.

Evelyn Malkus of the IceCube Research Project has shared a number of relations of this sort in email discussions with me. The scientists that conduct their research at the IceCube observatory are transported, along with their supplies, to the city of Christ Church in New Zealand by the New York Air National Guard. From there, they are transported to the McMurdo Station, a New Zealand island capable of sustaining 1,258 people. McMurdo is the launching point for both the scientists of the IceCube Observatory and the supplies for the station. Due to its proximity to Antarctica, the ocean surrounding the island freezes over every year—sometimes as far out as eighty miles with ice as thick as six feet—requiring U.S. Coast Guard ice breakers to cut a channel through the ice so that supply ships can get through to service McMurdo and military cargo planes can bring supplies to the IceCube Observatory. Finally, supplies are provided for the observatory by Raytheon Polar Services, which is a Colorado based company that services Antarctic expeditions.

Throughout the foregoing I have tried to provide the barest sketch of the role played by materiality in the genesis of social relations. There is far more to be discussed here, so I have only been able to allude to the richness of these relations and the problems posed by the

¹⁸ *Ibid.*

exigencies of detecting neutrinos in the environment of the South Pole. The material relations underlying the functioning of the IceCube observatory are far more intricate than I've discussed here. I have not, for example, discussed the economic relations that sustain the project, consisting of 242 million dollars from the National Science Foundation as well as 30 million dollars from Germany and Sweden. Moreover, I have only barely touched on the dimension of phenomenology through a discussion of how neutrinos interact with other forms of matter, completely ignoring the phenomenological self-experience of the scientists involved in the project. Finally, I have not discussed the symbolic dimension of the project, involving theories, ideology, beliefs, interests, power and all the rest. A complete analysis would investigate the interpenetration of all these domains, and how they interact and modify one another as these relations unfold. For example, the textbooks on the dynamics of ice theorized that ice one kilometer beneath the surface would be clear and without ice bubbles due to the great pressure produced by the ice above. However, as scientists began to drill they discovered that this was not at all the case and such ice was not found until the drills reached 2 kilometers and beyond.¹⁹ This is a beautiful example of the dynamic Andrew Pickering describes in *The Mangle of Practice*, where the performative dimension of science engaging with the world encounters resistances that lead to the modification of theory. Science, too, grows from the site. Here we can imagine all sorts of new theoretical work pertaining to ice arising as a result of this encounter with the South Pole. Here there is no base/superstructure relation, but rather a complex interaction with all three domains playing a lateral role with respect to one another such that sometimes the symbolic takes the upper hand, sometimes the phenomenological, and sometimes the material. A complete analysis would explore these interactions in all three domains.

¹⁹ *Ibid.*

Nonetheless, because of the exigencies posed by the nonhuman entities with which the scientists of the IceCube Observatory are dealing a network of humans, institutions, nations, businesses, technologies, cities, and natural entities are brought together in a unique way. A particular social assemblage is generated that could not have been anticipated in advance and that is deeply wedded to technological, environmental, and scientific demands. When we begin looking at the details of this network, we discover that the beliefs, theories, ideologies, and so on are not enough to account for how and why the scientists live in IceCube as they do, but rather that we must also look at the role played by materiality in the genesis of this form of life or social organization. It is this network that tends to withdraw from view in the archive.

This network should be thought of as a web in a process of becoming. The metaphor of a web is particularly fortuitous because it implies a sticky network that draws or gather entities together. If there is a certain inertia to social relations, then this is not simply because of the ideologies in which humans are enmeshed—though clearly these are central components as well—but also because of the material relations in which people are enmeshed. This inertia is like the space-time curvature described by Einstein in his theory of gravity, insofar as it draws humans and nonhumans together in patterned relations. These material relations contribute to structuring social relations in particular ways by virtue of the manner in which we are dependent upon them. A scientist at the IceCube Observatory might be deeply critical of U.S. foreign policy, but is dependent upon the military to provide the supplies she needs to both live and conduct her work in the South Pole. As a consequence, changing beliefs, while a necessary condition for social change, cannot be a sufficient condition. Material relations must be changed as well. This requires the political theorist to attend to the domain of materiality and how humans and material entities are linked together in self-sustaining and self-reinforcing networks.

The difficulty is that due to withdrawal these networks are very difficult to discern and track. In our investigations of science and technology, there is a tendency for our attention to be drawn to the beliefs and texts produced by the scientists themselves, treating these as what embody social relations. The extra-representational or extra-semiotic tends to withdraw from the archive. Yet these extra-representational and extra-semiotic elements are where many of the social relations as well as their reasons are to be found. To discover these relations it's necessary to develop a form of theoretical vision similar to that required when looking at Holbein's painting entitled *The Ambassadors* made famous by Lacan where one has to "look away" so as to discern the strange floating skull in the foreground. The point is not to ignore the reports of the scientists and how they describe their work and social relations, but rather to constantly shuttle back and forth between these three rings to see how they interact and relate to one another.

The sort of research I'm proposing here—already suggested by many working in the fields of science, media, and technology studies—can be taken in a variety of different directions. We can explore how sciences and technologies are generative of particular social assemblages as I've attempted to do here. We can take up the mantle of the critical theorist, exploring how these social assemblages are complicit in certain power structures, economy, and ideology. We can explore the relations between these social assemblages arising from scientific work and broader social assemblages outside the sciences. But above all, I believe that case studies such as the IceCube Observatory provide us insight into the nature of social assemblages in general, drawing our attention to the role played by material exigencies in how humans come to relate to one another in uniquely patterned ways.