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# Engaging with archival texts: Performing disciplinary transgressions between Actor-Network Theory and History of Science

Aarthi Sridhar

Correspondence: A.Sridhar@uva.nl  
Present address: Amsterdam  
Institute of Social Science Research,  
University of Amsterdam,  
Amsterdam, The Netherlands

## Abstract

Disciplinary transgressions are necessary to generate newer understandings. However, such incursions are not always encouraged or acknowledged. As part of the special issue on post-structural perspectives on fisheries, this paper represents an engagement with Actor-Network Theory (ANT) while attempting to study scientific practices on fisheries in British India. Following Michel Callon's processes of translation to examine the effect of power in scientific practices of the past, I show not just the transformative promise of ANT for a study of history, but also how the act of doing history, rather, the engagement with texts as archives of actor-networks, could translate ANT.

**Keywords:** Actor-Network Theory, Archives, Fisheries, History of science, Interdisciplinarity, Postcolonial studies, STS

## Disciplinary transgressions: possibilities

Transgressions of disciplinary boundaries demand a constant calibration between adventurousness and restraint adding to the 'bittersweet symphony' of academic identity-making (Knights & Clarke 2013). The examination of these epistemic infringements allows us to examine the effects of practices that are generally termed as 'interdisciplinary'. This paper represents such a methodological excursion, undertaken as part of an ongoing doctoral project on a history of fisheries science in India. Here, I bring into conversation, practices of doing history, with epistemological insights from the distant corners of the interdisciplinary area generally known as 'science studies'. This paper forms part of a special issue of *MAST* which attempts to demonstrate the analytic worth of post-structural scholarship to concerns in fisheries (see the introduction to this special issue for examples of post-structuralist scholarship in fisheries). The paper provides a reflexive exposition of thinking *between* disciplinary boundaries by engaging a history of science with the post-structuralism inspired Actor-Network Theory, a popular approach in science studies. Examining methodological and disciplinary practices between the two fields through a micro-case of pearl fisheries management, I demonstrate a) what thinking between disciplinary boundaries does for our understanding of fisheries science in the past and b) what the effects of such disciplinary transgression are on the nature of the disciplines themselves.

The departure from disciplinary boundaries is not always a reciprocal process and is sometimes discouraged by disciplinary gatekeepers. The debates between scholars aligning within particular sub-fields of science studies and the history of science are a good example of this (Jasanoff 2000; Daston 2009; Dear & Jasanoff 2010). To characterise the relations between science studies, history of science, history and cultural anthropology, Daston evokes the analogy of unrequited love from the opening scenes to William Shakespeare's *A Midsummer Night's Dream* (Daston 2009, 798). Others argue that certain disciplinary fields do not adequately acknowledge the contributions that yet other fields have made in advancing their own development. Speaking about science and technology studies (STS), Anderson has argued that while it has gained tremendously from postcolonial scholarship, (particularly the emphasis on hybridity, heterogeneity and indeterminacy), European STS rarely acknowledges this (Anderson 2009; Anderson 2015, 652). He calls for greater engagement between the fields but asks "Can science studies participate in postcolonial analysis without changing its methods?" and, "In becoming postcolonial, how might science studies be transformed?" (ibid, 656).

Adding to Anderson's concerns, one might say that studies of fisheries in postcolonial geographies have often omitted a historicised approach and few studies examine the histories of science in fisheries through postcolonial perspectives. In this paper, I attempt to address Anderson's question regarding science studies' generative capacities for the field of fisheries but also *its own* mutability, by examining a historical instance of scientific practice around pearl fisheries during a period of British colonisation in southern India. I think through this history of scientific practices around marine molluscs with Actor-Network Theory or ANT, a popular if not controversial approach in studies of science which has been widely applied in studying science, not just in the present but also in the past (the most well-cited examples are Latour's study of Pasteurization of France (Latour 1993) and Law's study of Portuguese maritime expansion (Law 1984) and Star and Griesemer's study of the zoological collections for the Berkely museum (Star & Griesemer 1989).

Before proceeding further, it is useful to remember that ANT itself is not a singular predisposition within science studies, but is composed of a multiplicity of methods and has been known by several names (for a rough sketch of STS history see Law 2008; Asdal et al. 2007). Indeed, one of its latter-day proponents, Annemarie Mol rejects the idea that ANT is an overarching theory, preferring instead to call it a 'set of terms' and 'sensibilities' that are themselves not in search of coherence (Mol 2010). On the face of it, it appears to share conceptual ground with postcolonial sensibilities (and its call for indeterminacy) that Anderson highlights, but not in quite the same way as we shall see further ahead in the qualifications some ANT proponents impose. Mol believes that the point of ANT is not to search for stable reality, but instead to allow for a different attunement to reality by 'making visible hitherto unseen events and situations' (Mol 2010, 255). The first aim of this paper is to examine what is made visible in colonial fisheries scientific practices by thinking with, or, as Mol would say, '*doing*' ANT. The second aim is to address Anderson's question about whether ANT allows itself to be transformed in any way by engaging with postcolonial sensibilities. I begin by first locating ANT's relations to the broader field of science studies. This is followed by a brief introduction to the 'sociology of translation' – the specific version of ANT (or an ANT trail) that I follow in understanding scientific practices around molluscan fisheries in 19<sup>th</sup> century colonisation in south India. This

section pays particular attention to the encounter between practices in history and ANT. I conclude the paper with reflections on the attempt in thinking with and between disciplines.

### **Science studies and ANT**

Studies of scientific knowledge have followed profoundly divergent approaches (ANT being just one) and in such a multi-lingual epistemic space, disciplinary conversations are fraught with controversy. Studies of science in the twentieth century have produced long and trenchant debates regarding epistemological stance (and challenges to claims of epistemological validity or superiority) not just as part of the ongoing 'science wars' but even among its own practitioners. Indeed, the term 'science wars' should include not just natural scientists' trenchant criticism of the intellectual merits of social constructivist studies of science and the associated dangers of radical relativism (see Gross & Levitt 1997; Sokal & Bricmont 1998; Sokal 2008), but also the heated debates within the field of science studies.

Commenting on practices of the sub-field of sociology of scientific knowledge (SSK), particularly the reflexive and semiotic turn, Collins and Yearly (in their 1992 paper titled 'Epistemological Chicken') argue for a 'methodological relativism' understood by them as a 'rejection of any kind of foundationalism and its replacement, not by permanent revolution but by permanent insecurity' (Collins & Yearley 1992, 308). They offered a way out of epistemological indecision for scholars, claiming that searching for essential meanings of one's epistemic practices is pointless and one needed instead to look at its other side – its use. They state – "meaning and use are but two sides of a coin" and urge the social scientist to ask herself what the use of a particular epistemological tradition does for the practice of sociology or history (ibid, 308). The debate on foundationalism around Collins & Yearley's 1992 paper marked the early tensions between epistemological traditions within science studies (Callon & Latour 1992; Woolgar 1992; but see also Bloor 1999; Latour 1999). These debates can be crudely viewed as stemming from disagreements over how to do science studies between the Edinburgh and Bath schools of SSK in Britain and the numerous variants of ANT inspired by the French L'Ecole des Mines de Paris. They act as points of departure for an understanding of subjects, objects and in general, knowledge and its effects.

The contributions of the French school remain influential in science studies, and gave rise to a 'sociology of translation' as a means to understanding power. This term 'translation' was inspired by the writings of French philosopher Michel Serres, used in the works of scholars from L'Ecole des Mines de Paris (Michel Callon, Bruno Latour and others) and was generative of present-day practices known broadly as ANT. Can Mol's claim that ANT 'makes visible hitherto unforeseen events and situations' be tested in the practice of understanding science in a period of British colonisation? ANT however, did not begin with, nor stops at this claim.

### **On the ANT trail of 'translation' - principles and criteria**

To appreciate the performative aspects of ANT and observe its engagement with other disciplinary framings that deal with power and economic resources, it is useful to begin with some of its older and more provocative versions – principally, the 'sociology of translation' as popularised by Michel Callon (Callon 1984) or what Bruno Latour later

refers to as the sociology of association (Latour 2005). The principal analytical strength of this sociology of translation lies in its approach to the agency of actors and the operation of power.

Callon advocated the sociology of translation as a means of investigating how science and technology structured power relationships. In his 1984 paper, Callon examines the scientific practices around the depletion and transplantation of scallops of St. Brieuc in France. Here, he states that translation is the act of 'continuing displacement' and in observing its processes and moments, one comes to appreciate the operation of power. He identifies four moments of translation – problematisation, intersement, enrolment and mobilisation. In the *problematisation* stage, particular actors (scientists or researchers) establish themselves by a) defining both themselves and b) by defining other actors. According to Callon, the moment of problematisation involves not just the definition of one actor by another, but also that one of them set up or demands certain obligations of behaviour or action that other actors are obliged to follow in their own interests – obligatory passage points (OPP). In *intersement*, they lock-in the identities of the other actors. Through *enrolment*, they are able to further define the role of these actors in relation to other actors. In the final stage of *mobilisation*, spokespersons chosen by the scientists are able to speak for sets of collectivities successfully. Each of these stages illuminates how power operates as the "capacity of certain actors to get other actors to comply with them" (ibid, 199). But these are not stable stages and must be continually performed; rather, translations involve continuous displacements to produce enduring outcomes of power. All four moments are central to understanding the operation of power, but in this paper, I draw attention to the 'obligatory passage points,' illustrated in the empirical case that follows.

Following Callon's sociology of translation however, demands the strict adherence to a few principles that distinguish it from other forms of sociology. It demands viewing all actors impartially where there is no presumed oppressor or victim (agnosticism), using the same analytical devices or techniques to explain even contradictory views such as a scientific or a non-scientific one (generalised symmetry) and finally the inclusion of both human and non-human actors without a division between the natural and the social (free association).

Callon highlights in his paper that sociologists of science<sup>1</sup> also have a number of ways of 'stabilising' the practices of scientists (or any other 'social' entity) but rarely acknowledge the entities they themselves bring into existence (such as class, interest and so on) and then impose on the actors they study. The goal of a sociology of translation for Callon is to question society at the same time as actors, examine how actors define their identities and their "mutual margins of manoeuvre" and choices (ibid, 199).

Callon's collaborator Bruno Latour's contributions to ANT have been more popular (or infamous) than those of other ANT traditions. Following Latour's 'sociology of associations' can appear like a zero-sum game. Like Callon, Latour rejects sociological studies that start with the view that there is a stable 'social'. In effect, *doing* ANT in this manner means embarking on long and lonely uncharted trails, with only actors (or actants) and their associations for company. In this journey, he wants one to be equipped lightly, with few comforting waypoints such as the familiar sociological concepts such as 'colonisation,' 'society' or any social aggregate (class, caste, experts and so on), except if one views their 'given' natures as start points to disclose the specific associations that make such

aggregates (Latour 2005, 8). Latour's criteria for recognising or testing if an analysis merits the ANT tag, is to see if it a) problematises the actor's role, b) has no fixed direction of explanation (that can be attributed to a social force, such as capitalism/socialism etc) and c) that the analysis should 'reassemble' the social (ibid, 11). This is not a buddy sport, unless, your buddy is a fellow ANT<sup>2</sup> (preferably the most flamboyant of the species). If ANT is used merely for dispersion, deconstruction or destruction, it is not enough. Seeing how new practices, actors and concepts come into being as a 'reassembled social' in Latour's view is ANT (ibid, 11).

Despite these severe qualifications, scholars have preferred to speak of ANT as offering potential ways of enhancing communication about our world, by illustrating the use of ideas associated with it rather than to speak of it as a complete 'theory'. For example, Mansfield uses the idea of 'translation' along with that of 'assemblages' to show that quality standards around the global surimi industry are more than a set of elements, rather, they are 'outcomes of relations between elements' (natural and social) (Mansfield 2003, 11). Similarly, the idea of 'ontological multiplicity' also draws from ANT-style work, where the philosophical assumption is that an object (or actor-network) comes into existence only when it is performed (thus *doing* reality), and that by following diverse practices one encounters a multiplicity of objects—such as Mol's account of multiple atherosclerosis (Mol 2002 cited in Law 2008). While this embracing (or misappropriation) of ANT sensibilities certainly lends a more captivating storyline to ordinary sociology, ANT proponents do emphasise a strict fidelity to their 'complete' sociology (as seen in Latour's conditions or Callon's principles). Whatever ANT's intellectual genealogies, these versions of ANT appear to transform it into its own epistemological bedrock and offer resistance to *its own* translation, its continuing displacement.

Does ANT *always* resist its own translation? The serious questions raised about epistemological validity, superiority or agnosticism among the methodological variants within science studies or even ANT versions are by no means settled. In such surroundings, I now follow an ANT trail to assess what productive value it offers for scholarship that examines the workings of power in scientific activity at a time of colonisation but foregrounding this with Anderson's question regarding science studies' own mutability. This effort is further complicated by putting it into play with a particular discipline that is gradually attracting its practitioners to fisheries conferences – history. However, unlike several marine environmental historians, who are interested in past (stabilised) realities of 'nature' (such as the researchers of the History of Marine Animal Populations (HMAP) project),<sup>3</sup> the historiography I engage in is more 'social' (in the Latourian sense of examining stabilised entities) and tries to trace processes of translation involved in an instance of 'colonial' science practices.

### **A history of translations: moments with molluscs**

For ANT, an actor-network exists only in continual performance and interaction. Thus, it is possible to trace how a stabilised element (such as the idea of fish stocks, or a legal text for its preservation) came into being over a period of time by examining controversies in scientific practice and tracing displacements through the processes of translation. The controversy examined here is around the 'preservation and replenishment'<sup>4</sup> of pearl oyster beds in the waters of Gulf of Mannar, a large, sheltered marine area located between present-day southern India and Sri Lanka.

Visiting St. Brieuc, on Google Earth™, seemed a useful thing to do while reading Callon. On its two dimensional map, there are a few ways for us to compare the distant geographies of St. Brieuc and my own site of work – the Gulf of Mannar. Both appear to be somewhat sheltered shallow bays nested between a large landmass and wide open seas. Aside from these, one would need to examine scientific literature to find other stabilised terms reflecting their similarities and differences such as, salinity levels, the presence of a number of other biological and oceanographic features such as bathymetry, ocean currents, temperatures and wave actions. Similarly, sociological concepts, (not yet directly depicted on Google Earth™) have been produced since the nineteenth century that enable us to contrast, compare and speak about people and power in places as far apart as St. Brieuc and the Gulf of Mannar. Indeed, ANT has been fruitful in understanding how scientific practices between distant geographies can profoundly re-shape how we can understand the notion of space itself (Mol & Law 1994; Bear & Eden 2008).<sup>5</sup>

Besides the ‘folding of’ Euclidian geographies (Mol & Law 1994) there is an additional value in using the lens that Callon used to make sense of work at St. Brieuc in the twentieth century, to analyse archival texts on the work of experts examining the pearl banks of Ceylon, the Tinnevely coast, Burma and elsewhere between the seventeenth and nineteenth century B.C.E. It enables me to demonstrate not only what the ANT sensibility ‘makes visible,’ but also what the practice of history in turn makes visible to ANT through the ‘obligatory passage point’ of engaging with historical texts. In the following section, I demonstrate how obligations of behaviour or action are generated for anyone interested in history. For someone interested in historical work that examines practices of the State, a structured hunt at the government archives becomes an obligatory passage point. This is also a point of encounter between the disciplining practices of history and ANT, as we shall see.

### **Encountering the historical text – as both actor and obligatory passage point**

This section of the paper is devoted to the methodological practices associated with both history as well as ANT. I follow Callon’s methods to examine scientific texts associated with the management of pearl fisheries to demonstrate the analytic worth of a sociology of translation. But I do so by adopting a reflexive turn, that also focuses attention on myself as a student, tracing the obligations set up by the practice of history and historiography. Adopting this is crucial to encountering the historical text as an actor, to further subject it to Callon’s analytic of translations. Therefore, I trace first how as a student, I come to encounter historical text but also how ANT requires me to read historical text and understand the making of social context in the past.

Scholars of history often make a distinction between secondary and primary sources to categorise their empirical material. History, like sociology began much of its work in the manner of the natural sciences, with a quest for a verifiable and truthful account of the past – its context. Despite the cultural turn in history, which was attentive to the interplay between text and context and meaning in interpretations of the past, historiography cannot completely do away with context for its work. It could hold the image of a backdrop of events lightly, but cannot afford the assumption of a clean slate as ANT sometimes appears to advocate. Historians discipline themselves through a number of principles, such as being attentive to anachronism, the interpretation of multiple sources while reading texts or contextualising actors’ meanings. History-making today often relies on a combination of technologies such as those used in archaeological studies such as carbon dating or isotope

analyses, or even technologies of archival storage, restoration and retrieval. Historians are also concerned with gaps in accounts, and accumulating information that might present multiple perspectives regarding past events, often leading to crises in formal archives over the preservation of vast and fragile material. For former colonies such as India, the area covered is vast, the archival material is located in multiple sites and perhaps the India Office Records of the British Library which contain one of the largest number of administrative records, represents only a fraction of an imagined whole.

The archival records of the colonial period known as the 'British Raj' lie scattered in a large number of locations but mainly at the India Office Records now housed at the British Library in London, a much greater amount at the National Archives of India in New Delhi and for my study of the Madras Presidency, in the Madras State Archives Office, the dusty office cupboards of the Department of Fisheries of the Government of Tamil Nadu State and so on. A number of sources are still untraced or exist in regional church records or in other state archives making gap-filling style historiography a formidable exercise. Oral history records are still unavailable for some fields like fisheries and despite its popularity as a means of democratising history, collecting oral histories might not be possible in all contexts (Jessee 2011).

In examining an event of the past, the very definition of the sources of history or 'historical objects' is a moment of 'problematisation' or the inter-definition of actors. Historians contribute to the making of historical objects or actors, by a number of techniques and utterances. Thus, in order to *do* a history of the sciences around state-controlled pearl fisheries, one needs to be able to access the traces or evidences about it, often found in archival records. This by itself limits the number of actors that come into play. The 'suitable' historian must be firstly qualified to do history, convince archivists and university supervisors that one's questions merit a search in these archives and apply for the necessary grants to be able to get to these sources (other actors). Further, these sources of funding themselves are linked to particular international relations (between developing countries and developed countries), the guarantees of international scholarship agreements, arrangements between universities and governments, between business houses and charitable donations – an assemblage that I shall not explore any further here. Suffice to say that the uneven distribution and allocation of funds that enable historical practice is what makes the study of the colonial itself possible. Thus, in a rather ironic way (and a strictly non-ANT statement) the (colonial) past (responsible for this uneven distribution) re-makes both the present and the past!

Once at the archives, the student enters into a relation with the librarians' digital catalogues. The catalogue system itself becomes critical to the whole endeavour. For instance, in the year 1988 Martin Moir's *Guide to the India Office Records* (Moir 1988) was published which enabled visitors to make sense of the IOR documents, and provided one structured account of how material was arranged and could be located but also articulated the logic that determined the making of a particular record (on the basis of earlier histories of the British Raj's emerging bureaucracy). Thus, Moir's book as well as the archivists and administrators of the British Library help *problematize* the archival record or text as an actor, while simultaneously presenting obligatory passage points whilst defining their own identities as enablers of the practice of history. Given that not everything is digitised in the relatively well-funded British Library, a very large number of documents of the IOR must be physically searched within the detailed

Indexes of the Proceedings of the various departments or that of the Board of Revenue,<sup>6</sup> the student has little choice but to optimise her search through this material. Given that only ten documents can be requisitioned from the archives each day, this further structures what one can assimilate into the construction of a particular account.

This summarised account demonstrates one manner in which doing history is materially and relationally contingent i.e by the diverse yet structured ways to encounter historical sources (actors). But it also acknowledges how the engagement with archives and texts is itself an obligatory passage point (OPP) if one wants to study science in the past. Thus, what a historical method will admit as a source of history, and further, its treatment of that source (such as a text), will enable the production of historical events and actors. It is here that ANT's ability to be used as a 'historicizing method' becomes important, and my next step involves an examination of the object thus unearthed from the OPP of the archival search – the text from the archive.

### **Text as 'archives of actor-networks' – reassembling social context**

A shorthand way of recalling ANT's contribution to STS, is to state that it draws attention to how social context is assembled and attempts to reassemble it. In addition, ANT seeks actors and their networks as they are constantly being enacted or as they are 'becoming'. However, what can ANT offer to the discipline of history and in turn, what does history do for ANT? Kristin Asdal attempts to rework the contested status of a social context as a start point, and offers a way of using ANT as a historicising method. She sees social contexts as 'situations' which actively take part in enacting or in producing texts (utterances). For Asdal, this requires examining what *caused* 'becoming', or at least trying to make associations between actors clearer – establishing, one might call, a casual causality in their relations. This requires an attention to the performative aspects of texts,<sup>7</sup> or (following Law (2002) cited in Asdal 2012, 386) speech as a form of action. In my archival searches, I located several texts from the Proceedings of the Department of Revenue and Agriculture as a start point from where I proceed to understand the steps of translation, in other words, the power that *effected* this becoming. My aim while in the British Library's IOR archives was to locate *any* information that I could find on fisheries and scientific practices in the colonial period. However, tracing texts reveal associations with other texts, showing us that texts are not just actor-networks but are simultaneously associated with other texts. They reference and archive other actor-networks. This is illustrated in the following micro instance.

The IOR archives contain several documents produced in the eighteenth and nineteenth centuries, which speak about the subject of inspecting, examining and executing pearl oyster fisheries in the waters of the Gulf of Mannar in Ceylon<sup>8</sup> and in various regions under British East India Company control (and later under the administration of the British Crown). These texts offer us the chance to examine the utterances/actions of a number of entities who were in the service of the Board of Revenue and later the Government of Madras under the British Raj. A non-ANT contextual sketch might be fruitful to highlight the vast array of stabilised 'socials' that a historical narrative relies on, and to show how an ANT treatment of text can reassemble these socials. Prior historical studies (Deckla 2004; Arunachalam 1952; Athiyaman & Rajan 2004) produced using non-ANT historical methods, present us with the following social context of the region I study,

which I italicise in the following two paragraphs to distinguish it from the text that follows this, which has been examined through ANT:

#### **An assembled social context of pearl fisheries in Gulf of Mannar**

*Pearl and chank<sup>9</sup> fisheries in the waters in the Gulf of Mannar is traced to the Sangam Era and finds mention in Tamil literature of this time dating to the third century B.C.E. Pearl fisheries was an activity undertaken since then, over two millennia to eventually die out shortly after India's independence from British rule in 1947. The pearl banks of the Gulf of Mannar between present-day India and Sri Lanka were in fact a globally significant source of fine pearls. Pearling was a large-scale operation (with hundreds of boats and divers) that brought in large revenues to the kingdoms of the Chola, Chera and the Pandiyan, their local chieftains (such as the Poligar kings) and was undertaken by the skilled divers of the Parathavar fishing community but also with Muslim divers who settled here during Mughal rule (Deckla 2004). In the period of Mughal rule, the Nawab of Arcot came to administer certain areas while the Poligar Kings continued to stake their claims to a share of the pearl fisheries. Portuguese conversion of the Parathavar fishers to Catholicism in the early 16<sup>th</sup> Century B.C.E and their political influence in this region allowed them to take control of pearl fisheries here. Towards the late seventeenth century, the Dutch takeover from the Portuguese, both here and in Ceylon, resulted in repeated efforts to efficiently reap benefits from these fisheries. Finally, with the British taking control over both territories, the scientific management of pearl fisheries in this region became a full-time concern for this large-scale operation that the British Empire had invested in heavily—administratively, financially and politically (Hornell 1905).*

*Securing a continuous supply of high quality pearls from this region meant ensuring that there were no slippages and leaks, or corrupt practices in operations involving a precious commodity. But it also meant overcoming several challenges including the monitoring of officials who worked in remote locations and in hard conditions, and managing numerous 'natives'—the pearl divers, their head men, merchants and others. The 'management' of this operation necessitated the establishment of an entire administrative and expert system of men and technologies. Further, the continuous and stable supply of these resources required that the oysters themselves yield not just their treasures but also the secrets of their life cycles. This eventually led to a series of reports by experts who were appointed regularly in the British period to study these molluscs and their environments in this region between the nineteenth and early twentieth centuries.*

With this 'received / stabilised context', I will now turn to examine for the purposes of this paper just one micro instance of the association between ANT and history. The text that I selected to follow here belongs to a series of annotated Indexes to the Proceedings of the Revenue and Agricultural Department under the subject 'Fisheries' for the years between 1863 and 1891. These Indexes to the Proceedings make reference to a detailed set of other documents providing only a brief summary of their contents for some, but occasionally containing full correspondence for yet others.

In his 1984 paper, Callon identifies the marine biologists as his *primum movens* (or his start point for establishing associations and causes).<sup>10</sup> The non-ANT sketch provided earlier indicates some difficulty in establishing a strict *primum movens* to understand the operation of power, with its multiplicity of actors. In the archival documents

I obtained at the British Library in London, following the structured encounter with text, I came upon correspondence in relation to one individual who engaged in scientific practices (observations and inspections) of pearl fisheries, long before scientific activity as we recognise it today was practiced in this region. This was one of the earliest references to an official involved in pearl inspections and fisheries management that I had come across at the time of researching and writing this paper. Captain Phipps, who serendipitously appeared in catalogue searches on ‘pearls’ ‘pearl fisheries’ and ‘pearl banks’,<sup>11</sup> soon became the *lucky* person I selected to follow to understand pearl fisheries management in the 18<sup>th</sup> century, my *felix movens*. Captain Phipps, the text said, held the post of ‘Port Officer and Superintendent of the Pearl Banks at Tuticorin’ working in the district of Tinnevely of the Madras Presidency. His responsibilities, as we can glean from the records<sup>12</sup> appears to be related to conducting the pearl fisheries and overseeing this activity but also conducting surveys of the pearl banks to check if they were indeed ready for harvest.

In his report to the Collector of Tinnevely, in 1862, Captain Phipps describes the actors that he encounters in his superintending activity – numerous actors come into view from his report.<sup>13</sup> The report begins with Phipps stating that the pearl beds are ‘now well known’ (to the British officers stationed there) by their native names<sup>14</sup> and that these are located for a distance stretching 70 miles, at a depth below 8 fathoms, are comprised of rock and coral, and are located 8 miles from the shore. In speaking of the settlement of the oyster spawns, he notes that they have ‘not settled with any regularity on the same bank each year’. He also notes that between pearl banks lying at a distance of 10 miles, lie ‘several blank banks’. The assumption here is that spawning should happen randomly across any of these regions, giving the impression that all banks are somewhat identical as sites, at least for spawning. Hence, oyster spawning is said to be ‘irregular’, lending a quality of uncontrollability to the oysters themselves. Many moments of problematisation follow.

With these descriptions, follow descriptions of other actors as well. Pearl beds without spawning oysters are “barren”. Similar to the “enemies” illustrated by Callon in his paper (Callon 1984, 206), these enemies of the spawn “in this neighbourhood” are currents, absent rocks (which fail to collect sinking spawn), and sand which doesn’t allow the spawn to anchor itself. In addition, the shallow banks themselves turn into impediments. They ‘allow’ the sand to wash over them, which we know doesn’t allow spawn to anchor. Thus, in this account of elements that is today referred to as the ‘benthic ecosystem’, many actors such as the sea bed, pearl banks, the sand and the currents adjoining Tinnevely constitute themselves as an inhospitable neighbourhood for spawning oysters, and for those seeking to stock them through experiments. In this moment of interessement, Phipps seeks to further secure his allies – the oysters. Further, he implicates the “small round coral” that he found on his inspections of the blank pearl banks, which he believes dislodges the oyster, by washing against each other along with the ‘action of the sea’. In this instance of interessement, he inserts another actor between the rock and the spawn, but also fixes his own place as an observer that enables their existence. Thus, within the simultaneous moments of problematisation and interessement, the inspector of pearl banks (Superintendent Captain Phipps) establishes an obligatory passage point. In addition, his official survey reports and expert opinion on the preservation and replenishment of pearl banks to the Collector of Tinnevely constitute themselves as significant boundary objects<sup>15</sup> (Star & Griesemer 1989).

The text then introduces another actor who is simultaneously a network – the Right Honourable Sir. C. Wood, who we must presume has been linked by a chain of events to occupy a particular position, and comes into engagement with the Collector of Tinnevely, but with such a strength that the latter is prompted to act on the former's proposal for replenishment of stocks of oysters. Sir. C. Wood comes with a proposal – a method for examining the pearl beds (by numbering) and by getting oyster spawn from Ceylon to artificially establish in the pearl banks off Tinnevely. The Collector turns to the actor Phipps (an action that we must assume involves a set of associations not readily accessible in this text). Within this kind of network between actors, Phipps is compelled to respond, to this proposition and to this force, despite having just set up an obligatory passage point.

Next we see Phipps call on his 'allies' in response to this exertion of force. He cites this irregular character of his allies<sup>16</sup> (the spawning oysters) as the reason to dismiss the suggestion made by Sir. C. Wood, to adopt a system of regular numbering of the banks. Here, Phipps resorts to another firmer form of interestment, when he speaks of a 'customary' practice (he does not specify for whom this is customary) – that of the regular inspection of each pearl bank once in 2 or 3 years, with more regular inspections of Vaipaur,<sup>17</sup> Tutacorin and Trichendoor. In his opinion, this method ensures that no bank is neglected from scrutiny. Following Callon, in this description of this protocol lies another moment of problematisation, where actors come into being. In this case too, Phipps seeks to establish this method as an obligatory passage point and simultaneously his role.

Further, he counters Sir C. Wood's suggestion to stock the region with pearl oyster spawns from Ceylon since he believes that there are enough available in this region alone. Thereby, he adds another trait to our image of the spawning oyster, as being numerous and in one sense, comparable to those in Ceylon. Other descriptions of the oyster and its life-cycle follow,<sup>18</sup> and it is this additional description that leads us to settle the controversies associated with breeding oysters in this region.

#### **Prior knowledge – archives within archives**

Finally, another important set of historical actor-networks is brought into play. Phipps states that "probable causes" of the barren condition of pearl beds are on account of the "fact that the spawn from Pearl Oyster rises to the surface of the sea and at a certain age it is supposed to sink". Here, he makes a reference to a composite network – the repository of prior knowledge on oysters. This repository or 'archive of prior knowledge' as an actor-network serves as a spokesperson that establishes Phipps' identity as an erudite, scientific-minded individual but also further defines all the actors in this network – the oyster, their "irregularity" and the scientific method of inspecting them. In other words, the archive of prior knowledge *allows* Phipps to become their spokesperson, and argue his truth claims about the human and non-human actors in this instance.

What else can we make of this reference to prior knowledge? Historian of science, Lorraine Daston calls attention to a form of historical consciousness in the sciences, i.e. history *in* science (Daston 2012, 158). Referring to those sciences to which history (in particular, specimens and archiving data) is integral as the "sciences of the archive", she says that for scientists a "complex process of compilation, comparison, correction and calibration" brought together past descriptions and present experience. Thus, knowledge for Phipps, meant *his* own authoritative observations, and his understanding of

what he read elsewhere required reading and seeing – first and second hand accounts get “spliced together” (Daston 2012, 163). It is here that boundary objects emerge and an obligatory passage point is strengthened. The literature on words and things in sciences of the archive instruct us about the coming together of experience and erudition, even though the rhetoric of first-hand experience persists (*ibid*). It is this *form* of erudition that is inaccessible to fishers, lay persons and non-scientists. Access to words, instructions in academic forms of study and cognitive work thus distinguishes the scientist or the expert, but as our example above shows, there are a wide range of actions that always accompany utterances. Thus, the production of the pearl bank inspection or survey report is not merely evidence of scientific knowledge (or a contribution to sciences of the archives). Rather, it can be seen as the practice of *leaving traces* of a large number of actions (such as interactions with local divers, visits to the pearl banks, observations, collections, inspections, reading and writing) that had to be performed to make the report possible. Scientific texts from this point of view, are also archives of actor-networks. Thus, the power of the utterance or text lies not just in what it means, but also in its ability to bring to life other actor-networks.

But this text (the Index to Proceedings) does not leave us with this limited set of displacements or movements. There are wider assemblages of actor-networks that trace themselves to Phipps and his claims. The Proceedings state that the Secretary of State (Board of Revenue) was requested by the Madras Government to look into the possibility of the ‘conservancy and replenishment’ of the Pearl Banks in Tinnevely. The Government of Madras expressed that the Superintendent of the Pearl Banks – Captain Phipps, required for his work, “all available information respecting the system adopted in Europe for the stocking of Oyster Banks” including a copy of the Report by Monsieur Levicoire, Commissary of Maritime Inspections, on the operations for the breeding of oysters in the Bay of St. Beriene. An unnamed spokesperson emerges in our narrative already, who inserts M. Levicoire’s expert report along with other such scientific texts between Captain Phipps and his inspection work. We do not know from this single text whether Phipps requested these documents, or if their insertion was an action prompted from another part of the network. The new expert documents that are to be brought into this space act as boundary objects that will eventually enable the prospect of replenishing stocks of pearl oysters. Phipps, would have to use these (of his own volition or otherwise) because they demand attention not just as an archive of prior knowledge but as spokespersons. In other words, in order to make the oyster stock preservation possible, whether through replenishment, or ensuring that oyster spawn indeed anchor themselves to pearl beds, or that the inspection methods of Captain Phipps prevail, he must engage with these expert documents as boundary objects. M. Levicoire’s report itself comes into existence in this text in a reference to a letter from Mr. Vane, the late Superintendent of Pearl Fisheries in Ceylon. But that’s another story, depending on encounters with other archives of actor-networks.

In this example, I have not been able to locate how the two other moments of enrolment and mobilisation have taken place due to the absence of material immediately available in the archival collections. However, from this micro instance, we see that there are several ways in which entities constitute themselves and their own work, as obligatory passage points and create boundary objects, in a wide and indeterminate network. Star and Griesemer (1989) highlight the role of multiple entities and multiple obligatory passage points (*ibid*, 391–392) in scientific practices they examined. They

also point out (though in limited detail) that scientific publications of the archive are boundary objects which are also obligatory passage points (ibid, 396). They caution however against mistaking the 'search heuristic' of an archive as a theoretical model of the structure of the network (ibid, 396). This warning translates into practice in a very limited way, unless one examines objects and utterances outside the archive, and importantly, its silences. Reading the past between and outside of text has been central to historiography, and the experiences of working with oral histories and work on memory are good examples. For the ANT historian, these would no doubt represent other corners of the indeterminate network worthy of further exploration.

### Conclusion

What fruit has this transgression of disciplinary boundaries borne? a) Has following Callon's steps been useful in 'making things visible' for a history of fisheries science? And in the process, b) has ANT been mutable in some way on account of an engagement with post postcolonial history, at least in having to contend with newer concepts in its repertoire? Andrew Barry writes that ANT has always implied power since it implies modification, in his example of international relations and the creation of national boundaries and political situations (Barry 2013, 414).

Did my use of ANT tell me anything new about power and colonisation? ANT does signify power by modification as Barry contends, particularly if one sees it as historically repeated series of translations which enabled the creation of 'political situations' such as colonial scientific authority. This is what the scientific process entailed, in its processes of seeing, writing, recording, archiving and translating. Similar to Barry's idea of the 'political situation', we can view the colonial moment that I examined in this paper as more than a set of flattened controversies and actors with a peculiar vocabulary. It suggests *traces* of authority invested in certain actors that one encounters (these are stabilised in turn by the regular interacting micro practices of colonisation) through actions that we understand, in the *present*, as violence, rules, treaties or scientific authority. A wide set of actions were undertaken putting into operation an entire matrix of events, the assembling of the tapestry of colonisation – not taking place as one bloody-minded event, but as a series of *repeated* smaller degree operations and situations. This does not mean that the notion of colonisation disappears. Rather, ANT's insistence on looking at micro level moments of translations and following associations is able to alert us to *how* certain acts of subordination, and acts of power were performed with the impunity of colonisation. The peculiarity is its vocabulary, shorn of sociological terms associated with the 'social', thus highlighting the work done by the historian in making visible this reality.

Following Callon's steps of translation has revealed to me the micro movements or displacements necessary for the emergence of certain actors and to make some actors comply with others. One observes the processes whereby authority gets vested in scientific work but also that to stabilise authority, expertise and control over natural resources, a large amount of work is required, including that of naming, knowing, and framing, at various stages to produce stable facts about a natural resource across different geographies. One is able to see the emergence of the idea of pearl bank management not as an obvious fact but as the repeated work of a number of actor-networks through the various stages of translations.

To conclude, there is a second and final ‘use’ (to borrow Harry Collin’s suggestion) that I identify from this engagement with ANT epistemology and this has to do with what I see history as doing for ANT. Andrew Barry offered what some might consider a short cut (or even an early exit) on the ANT trail, when he said that ANT cannot be simply applied to other fields such as international relations (ibid), or at least not without, in some measure, *translating* ANT itself to the field of study. He states that national boundaries which are central to the discipline of international relations become ‘immutables’ and draws attention to the importance of historical events that assemble ‘political situations’ as an illustration of how ANT needs to translate itself to international relations. However, such ‘translation’ can be questioned when the putative ‘immutables’ such as spatial boundaries are themselves rendered fluid and foldable by practices of science that challenge topographical givens (Bear & Eden 2008; Mol & Law 1994). Do immutables remain eternally so? Do practices not hold them in place, and in perpetuity?

In order to begin appreciating the philosophical and epistemological implications of *doing* ANT, several attempts at working with it as a method were necessary. Thus, by adopting in this text, ANT as a historicising method towards approaching the Tinnelly pearl fisheries in the nineteenth century makes visible colonialism as traces of interconnected ‘situations’ whose existence is *enabled* by continuous interactions between the practices of science but also practices of history<sup>19</sup> and its encounters with indefinite actors-networks. This requires a better understanding of the archival text as a means to understanding the past and a further exploration of the idea of the ‘archive of actor-networks’. Thus, I think that ANT practices must encourage self-translation if it wishes to take seriously the text as an actor – with at least the same degree of seriousness that historians do when they encounter it as a source of their narratives. This will determine its immutability. Callon does not elaborate much on the texts that he read to make sense of the events at St. Brieuc himself and this can be a source of annoyance for historians reading Latour’s history of the Pasteurization of France. Revising this neglect in the treatment of texts is an important project, an obligatory passage point even, in which I would enlist both historians and ANT scholars. The ‘visibility’ that the concept ‘archive of actor-networks’ can lend will be made possible by further transgressions between these disciplinary fields. It is the attention to text that will enable us to make a deeper foray into understanding the politics around silences and the absences of text as well. This will be a fresh trail towards understanding not just the practices of knowledge-making in fisheries science but also the making of relations between those embedded in historical forms of erudition and those without.

## Endnotes

<sup>1</sup>An undisguised reference to the Edinburgh school that practiced the sociology of scientific knowledge.

<sup>2</sup>About the sociology of associations, in *Reassembling the Social*, Latour writes “..someone pointed out to me that the acronym A.N.T. was perfectly fit for a blind, myopic, workaholic, trail-sniffing, and collective traveler. An ant writing for other ants, this fits my project very well!” (2005; p9).

<sup>3</sup>The HMAP has received its share of criticism for being too instrumentally focused on quantifying historical marine animal populations to the neglect of social and cultural

questions that complicate our historical appreciation of fisheries in this region (Van Sittert 2005).

<sup>4</sup>These are the terms used in the records consulted for this paper.

<sup>5</sup>ANT studies have examined the topological effects of practices in science, or its effects on the idea of 'space'. Bear and Eden (2008) show how Marine Stewardship Council certification practices allow us to 'fold together' distant geographies while much earlier, Mol and Law (1994) followed the practices of doctors working on anaemia between the Netherlands and Africa, to demonstrate how social space is created not just as regions (of high and low anaemia), networks (of knowledge exchange and circulation) but also as fluid space.

<sup>6</sup>Once a reference number has been located, there is still no guarantee that the actual document will be available in the IOR archives. A subsequent search in the National Archives in New Delhi is equally a matter of chance for certain records, which may have been retained, destroyed or just become too damaged to be issued.

<sup>7</sup>Asdal sees a similarity in ANT's philosophy (of adding) and Skinner's call to approach utterances as 'unique events' and not as symbolic representations of a structure or an unacknowledged statement.

<sup>8</sup>A range of secondary sources tell us that Ceylon was earlier a Dutch Governorate and was later subject to colonization by the British. The pearl and chank fisheries of this region which were initially supervised by the Dutch were subsequently overseen by British officers.

<sup>9</sup>The chank was identified in the late 18<sup>th</sup> century documents as *Xancus pyrum* (later *Turbinella pyrum*) and the pearl oyster as *Pinctada fucata*.

<sup>10</sup>Callon's use of the term is evidently not in the same vein as Aristotle's, and indicates instead the possibility of multiple *primum movens*, in keeping with his principles of general symmetry and rejection of received contexts.

<sup>11</sup>The proceedings also record a number of other individuals (pg. Messrs James, Holman and Calyon) who were granted allowances for services they had rendered towards the Tuticorin pearl fisheries between period 1889 and 1891. However, I was unable to procure more information on their work from my archival searches in that period and could not follow any associations in relation to them. No doubt this influences the direction of the ANT trail and eclipses certain individuals while making others more prominent.

<sup>12</sup>Revenue Letter from Madras dated 23<sup>rd</sup> January, No 6 of 1863. IOR\_L\_E3\_742. I was unable to procure any information on Phipps' qualifications which no doubt earned him the credibility to gain employment as Superintendent of Pearl Fisheries for the Government of Madras, and to undertake certain actions in relation to his position in the region of Tinnevely.

<sup>13</sup>No 69, Letter from Captain Phipps to I. Silver Esquire, Collector of Tinnevely, dated 20<sup>th</sup> September 1862. We do not establish or assume any relationship here if we cannot draw on prior context or associated archival text. We merely note that he was either required to report or chose to do so without obligation.

<sup>14</sup>The knowledge of these pearl banks is by native names, suggesting that some amount of the 'making' of the beds themselves is by the native here, and this knowledge has been obtained through some means, whether by coercion, negotiation, request, it is hard to tell just from this reading. Suffice to say that attention to the situation itself suggests that the presence of the British in this space was not without a series of other context-forming associations.

<sup>15</sup>Callon does not use the concept of ‘boundary objects’ in his paper and but I use this simply to highlight the fact that not only is an obligatory passage point created in this instance, but that one can witness this moment as simultaneously producing boundary objects, a point made by Star and Griesemer (1989) as well.

<sup>16</sup>More precisely, their irregular spawning over the same banks each year, as assumed by the blank banks interspersed with full banks in the region. Thus, the lack of a discernable pattern, causes them to be labelled ‘irregular’.

<sup>17</sup>They roughly correspond to the present day names Vaipaar, Tuticorin and Thirichendur.

<sup>18</sup>The oyster as an actor may be linked in a way to a set of other actors – the spawn, the sea bed, the pearl bed, the currents, and its own negotiations of these.

<sup>19</sup>This includes both academic and non-academic practices and interactions over the topic of history, such as scholarships for studying specific topics, reserving materials, access to archives, recording particular accounts and so on.

#### Abbreviations

ANT: Actor-Network Theory; OPP: Obligatory passage points; SSK: Sociology of scientific knowledge; STS: Science and technology studies

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#### Author's information

The author is a PhD candidate examining the history of fisheries science in India. She is registered with the Amsterdam Institute of Social Science Research (AISSR), University of Amsterdam.

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#### References

- Anderson, Warwick. 2009. From subjugated knowledge to conjugated subjects: science and globalisation, or postcolonial studies of science? *Postcolonial Studies* 12(4): 389–400.
- Anderson, Warwick. 2015. Postcolonial Science Studies. In *International Encyclopedia of the Social & Behavioral Sciences*, vol. 18, 2nd ed, 652–657. <http://dx.doi.org/10.1016/B978-0-08-097086-8.85057-6>.
- Arunachalam, Sinnappah. 1952. *The History of the Pearl Fishery Coast of the Tamil Coast*. Chidambaram: Annamalai University.
- Asdal, Kristin. 2012. Contexts in Action—And the Future of the Past in STS. *Science, Technology & Human Values* 37(4): 379–403.
- Asdal, Kristin, Brita Brenna, and Ingunn Moser. 2007. The politics of interventions: a history of STS. In *Technoscience: the politics of interventions*, 7–53.
- Athiyaman, N., and Rajan, K. 2004. Traditional Pearl and Chank Diving Technique in Gulf of Mannar: A Historical and Ethnographic Study. *Indian Journal of History of Science* 39(2), 205–226.
- Barry, Andrew. 2013. The translation zone: between actor-network theory and international relations. *Millennium-Journal of International Studies* 41(3): 413–429.

- Bear, Christopher, and Sally Eden. 2008. Making space for fish: the regional, network and fluid spaces of fisheries certification. *Social & Cultural Geography* 9(5): 487–504.
- Bloor, David. 1999. Anti-Latour. *Studies in History and Philosophy of Science Part A* 30(1): 81–112.
- Callon, Michel. 1984. Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. *The Sociological Review* 32(S1): 196–233.
- Callon, Michel, and Bruno Latour. 1992. Don't throw the baby out with the bath school! A reply to Collins and Yearley. In *Science as practice and culture*, ed. A. Pickering, 343–368. Chicago: The University of Chicago Press.
- Collins, Harry and Steven Yearley. 1992. Epistemological chicken. In *Science as practice and culture*, ed. A. Pickering, 301–326. Chicago: The University of Chicago Press (1992).
- Daston, Lorraine. 2009. Science studies and the history of science. *Critical Inquiry* 35(4): 798–813.
- Daston, Lorraine. 2012. The sciences of the archive. *Osiris* 27(1): 156–187.
- Dear, Peter, and Shiela Jasanoff. 2010. Dismantling boundaries in science and technology studies. *Isis* 101(4): 759–774.
- Deckla Sr., S. 2004. *Maritime History of the Pearl Fishery Coast with Special Reference to Thoothukudi*. Tirunelveli: Doctoral dissertation, Manonmaniam Sundaranar University.
- Gross, Paul R., and Norman Levitt. 1997. *Higher superstition: The academic left and its quarrels with science*. Baltimore: JHU Press.
- Hornell, James. 1905. *Report of the Government of Madras on the Indian Pearl Fisheries in the Gulf of Mannar*. Madras: Government Press.
- Jasanoff, Sheila. 2000. Reconstructing the past, constructing the present: Can science studies and the history of science live happily ever after? *Social Studies of Science* 30(4): 621–631.
- Jessee, Erin. 2011. The limits of oral history: Ethics and methodology amid highly politicized research settings. *Oral History Review* 38(2): 287–307.
- Knights, David, and Caroline A. Clarke. 2013. It's a bittersweet symphony, this life: Fragile academic selves and insecure identities at work. *Organization Studies*. doi:10.1177/0170840613508396.
- Latour, Bruno. 1993. *The Pasteurization of France*. Cambridge: Harvard University Press.
- Latour, B. 1999. For David Bloor... Beyond: A Reply to David Bloor's 'Anti-Latour'. *Studies in History and Philosophy of Science* 30: 113–130.
- Latour, Bruno. 2005. *Reassembling the Social. An Introduction to Actor-Network-Theory*. New York: Oxford University Press.
- Law, John. 1984. On the methods of long-distance control: vessels, navigation and the Portuguese route to India. *The Sociological Review* 32(S1): 234–263.
- Law, John. 2002. *Aircraft Stories: Decentering the Object in Technoscience*. Durham: Duke University Press.
- Law, John. 2008. On sociology and STS. *The Sociological Review* 56(4): 623–649.
- Mansfield, Becky. 2003. Fish, factory trawlers, and imitation crab: the nature of quality in the seafood industry. *Journal of Rural Studies* 19(1): 9–21.
- Moir, Martin. 1988. *A General Guide to the India Office records*. London: British Library.
- Mol, Annemarie. 2002. *The Body Multiple: Ontology in Medical Practice*. Durham: Duke University Press.
- Mol, Annemarie. 2010. Actor-network theory: sensitive terms and enduring tensions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft* 50: 253–269.
- Mol, Annemarie, and John Law. 1994. Regions, networks and fluids: anaemia and social topology. *Social Studies of Science* 24(4): 641–671.
- Sokal, Alan. 2008. *Beyond the Hoax: Science, Philosophy and Culture*. Oxford-New York: Oxford University Press.
- Sokal, Alan D., and Jean Bricmont. 1998. *Intellectual impostures: postmodern philosophers' abuse of science*, xiii. London: Profile Books.
- Star, Susan Leigh, and James R. Griesemer. 1989. Institutional ecology, translations and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science* 19(3): 387–420.
- Van Sittert, Lance. 2005. The other seven tenths. *Environmental History* 10(1): 106–109.
- Woolgar, Steve. 1992. Some remarks about positionalism: A reply to Collins and Yearley. In *Science as Practice and Culture*, ed. A. Pickering, 327–342. Chicago: The University of Chicago Press.

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