‘The Last of the earth’s frontiers’: Sealab, the Aquanaut, and the US Navy’s battle against the sub-marine

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Declaration of Authorship

I, Rachael Squire, hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Signed: ___Rachael Squire_______

Date: __________9.5.17________

Contents

Abstract

From 1957-1969, at the height of the Cold War, the US Navy in conjunction with the Office of Naval Research conducted a series of pioneering experiments designed to enable ‘man’ to live and work for extended periods of time beneath the sea. Led by Capt. Dr George Bond, the projects (Project Genesis, Sealab I, Sealab II, and Sealab III) involved sending teams of divers, or ‘aquanauts’ as they were known, to live in hyperbaric chambers and undersea habitats positioned at various depths for days and weeks at a time. Whilst the gaze of publics and scholars were often pointed to Outer Space, we see here an extraordinary demonstration of a Cold War belief that humans should not be constrained by their terrestrial roots.

This thesis engages with this set of case studies to make a number of interventions in geographical scholarship. The first attends to literature on the intersections of science, the military, and technology during the Cold War, arguing that novel insights can be produced into this complex at the bottom of the sea. The second deals with questions surrounding temporality, embodiment, technology, and volume in relation to the constructs of territory, terrain, and the elemental. In the third instance it draws on literature from cultural geography, anthropology, and sociology to argue for geopolitical practices that are more open to experimentation and playfulness. Finally, the thesis concludes by offering the framework of ‘extreme geographies’ as a means of furthering engagements with ‘hostile’ spaces within the field of political geography scholarship and beyond.

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List of abbreviations

DDC	Deck Decompression Chamber
NEDU	(US) Navy Experimental Diving Unit
NMMF	National Marine Mammal Foundation
ONR	Office of Naval Research
PADI	Professional Association of Diving Instructors
PTC	Personnel Transfer Capsule
UCSD	University of California, San Diego
UNCLOS	United Nations Convention on the Law of the Sea

Preface

Charting a course: From the Bay of Gibraltar to La Jolla Submarine Canyon

Far from the coasts of La Jolla and Florida, the beginnings of this project can be found in the unlikely setting of the Bay of Gibraltar. Following on from my Masters research exploring the role of various elements in the sovereignty dispute over the British Overseas Territory (see Squire 2016a), I began to look into the geopolitics of sub-marine life around the small landmass. I had already briefly explored the unfurling of a Spanish flag by Spanish divers over a sunken artificial reef near the border and briefly alluded to the role of resources including fish and the water itself in sparking tensions. Looking back through time to the Second World War and Buster Crabb (aka Lionel Crabb) came to provide the initial stimulus for the project.

Cited as one of the inspirations for Ian Fleming's James Bond adventure *Thunderball* (BBC News 2015), Crabb was stationed at Gibraltar during the Second World War with the Royal Navy. He became a pioneering member of the Navy's new experimental diving unit tasked with removing unexploded limpet mines attached to the hulls of Allied vessels. With rudimentary equipment, little diving knowledge, and team members who could not swim, this was no easy task. Crabb, however, made a name for himself as an extremely skilled diver and technician gaining him the nickname 'Buster' after the American swimmer and action hero Buster Crabbe. Crabb's career continued well into the Cold War until his disappearance in 1956 which remains shrouded in mystery and conspiracy after his headless and handless body washed up in Chichester a year later. Whether he defected, was kidnapped by Soviets or killed underwater after being caught planting a mine on a Soviet warship is unknown but his death prompted a great deal of speculation and geopolitical intrigue.

Crabb, and more broadly, the figure of the 'diver' fascinated me. The idea of geopolitical events playing out through the body, unknown and unseen by those on the surface was something I wanted to learn more about and it took me next to the Diving Museum in Gosport, Portsmouth. Aware that Crabb's last posting was in Portsmouth, and keen to find out more, I headed to the museum upon completion of my Masters research. It was an intriguing place. Set within a battery constructed in the 1860's against the threat of a

French invasion, the museum is run by volunteers – many of whom are former military or commercial divers. Whilst the museum wasn't yet open when I arrived, the sea crashing in and out over the road and a selection of diving bells on the lawn outside reassured me that I was in the right place. Upon opening, I descended a few steps into the battery to be greeted by the smell of wetsuits and to find myself immersed in a cave like environment filled with diving equipment old and new. Mannequins sporting various forms of breathing equipment, posters and signs detailing the exploits of the likes of Buster Crabb, an early helium descrambler highlighting the effects of saturation diving on the human voice, and the rebreather used in the 1965 James Bond film *Thunderball* were all on display.

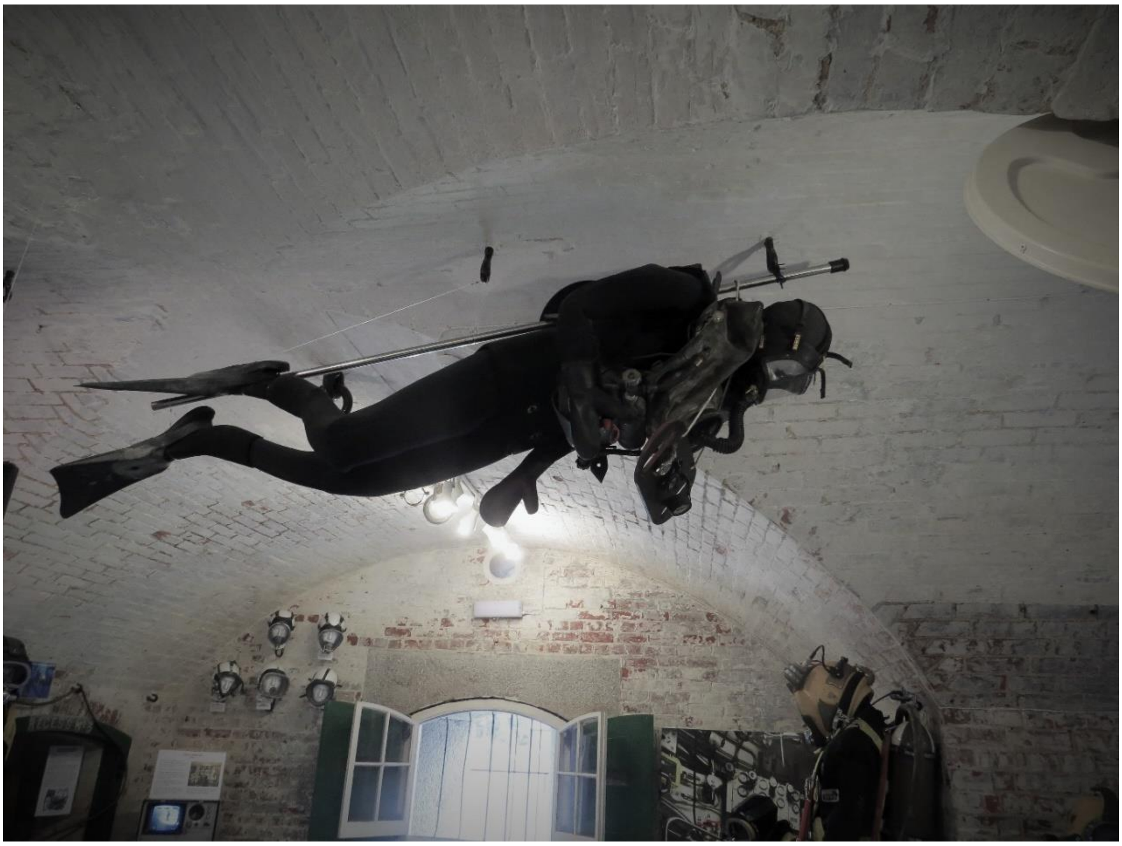


Figure 1: A 'diver' looming large on the ceiling of the Diving Museum (photo by author)

Figure 2: An example of the displays at the museum featuring mannequins bound to various pieces of equipment and diving technology (photo by author).

In addition to general information about the evolution of certain pieces of equipment and diving techniques and technologies, there were also small country specific displays on the likes of Russia and the USA (see Figure 3 below). Both were far from being comprehensive but the USA display became one of my first introductions to the case studies around which this thesis centres – Sealab I, II, and III. As you can see from the image below, each experiment was described only in a short paragraph but it was enough to capture my interest and intrigue. Contained within these short lines was a narrative of human beings living under the water for extended periods, undersea habitats, and trained dolphins – all of which sounded like they should have been with the James Bond memorabilia rather than in an exhibit on diving history.

Figure 3: The ‘USA’ exhibit at the museum and my introduction to Sealab (photo by author).

As I made my way around the museum the volunteers proved to extremely helpful and informative. In the process, they opened up a number of additional questions for me to think about. As one volunteer, Dusty, a former frogman and submariner, spoke to me about his experiences, much of it revolved around the body. He recalled divers having to swim continuously around a lake for long periods of time for endurance and the importance of building oxygen tolerance with men selected on their ability to withstand oxygen poisoning. Another volunteer and former diver, John, described how diving was ‘like another planet – you feel like superman, it’s like flying’. A number of the volunteers were hard of hearing, evidenced through hearing aids and the elevated volume of the conversations we had. Hearing and ear problems are, as I was told, one of the many embodied consequences of a working life spent underwater. There was a corporeality and hapticality to their experiences that I had not thought about before and after the visit, I made a note which suggested ‘using Sealab as a way of exploring the geopolitics of underwater inhabitation, diving, and the intersection between nature and military (the body, air, animals e.g. dolphins)’.

Looking back at my notes nearly three years later, and this happens to be quite an accurate description of what I ended up doing but there were a number of detours along the way which saw my focus on Buster Crabb fall along the wayside. His life and work are well documented and whilst his death is surrounded in mystery and conspiracy, there was little I could add to his biography. Unsure of the feasibility or practicalities of researching Sealab, I considered exploring the intersections between diving, the body, the sea, and the military in the UK Cold War context. In the process I spent a summer at the National Archives in Kew working my way through various Admiralty reports from the Experimental Diving Unit during the 1960s. Whilst I may come back to these at some point, Sealab remained a captivating prospect and it was one that I wanted to pursue further. Alongside my time at Kew I was sending initial emails and conducting preliminary online research about key sites, spaces, and people involved in the Sealab projects. A number of reports and films produced by the US Navy were available via online archives and I digested them with interest. I finally put the documents from Kew to one side after receiving positive responses from people with extensive knowledge on Sealab in Florida – also home to the Man in the Sea Museum, and San Diego – home to Scripps Institute of Oceanography and the site of Sealab II in La Jolla Submarine canyon. My focus, as the following chapter's detail, then fell wholly on the many wonderful, complex, and at times troubling narratives and geographical questions that unfolded alongside the Sealab experiments and the US Navy's extraordinary attempts to live and work on the seafloor.

The Sealab Prayer

Almighty God, who declared through Holy Scripture that man would one day acquire dominion over the seas, and the creatures therein, grant that this day fulfilment of thy work is at hand.

To the brave and dedicated men who have committed themselves to this project, grant Thine unending watch and safeguarding care in all the many hours of their life under the sea.

Give unusual wisdom to those of us topside who might somehow control their work and safety as they perform their duties below. And when their work and Thy will together be done, grant us all a safe and worthy respite from our labours for a time to come.

We ask all this in the name of Jesus Christ our Lord.

Amen.

George Bond (1965, Sealab II)

Chapter 1

Introducing Sealab

> 'And perhaps there are those who pause at the miracle of travel into space and beneath the sea… For this is an age of wonder. It will produce in the bigger perspective of time, new Columbus' and Magellans' that men will remember when our own age of exploration is history…Sealab 1 is part of that adventure. A beginning part in our own times.'
>
> (US Navy 1964)

1.0 Introduction

During the Cold War, the US Navy placed great importance on calculating, administering and speculating on and about the volume of the sea (Oreskes 2003). For military planners and civilian scientists funded by agencies such as the United States Office of Naval Research (ONR), the sea was a three dimensional space in which the enemy could prowl unseen in nuclear-powered submarines cloaked by the matter of water and ice and capable of wreaking havoc on land and from the air. Yet the sea also captured the strategic-technical imagination of those in the US government and military for other reasons. Beyond the water column, the seabed itself became the focus of international legal practitioners (Collis and Dodds 2008). The 1958 Convention on the Continental Shelf, one of four conventions negotiated at the first United Nations Conference on the Law of the Sea, (UNCLOS I) codified the rules of international law, its architects concluding, as US President Truman had done in 1945, that coastal states should have control over the resources in these submerged and subterranean spaces (Truman 1945, UN 1958). Looming large was the prospect of gaining access to great untapped resources, food sources and minerals beneath the sea—this for 'the benefit of all mankind' (O'Neal *et al*. 1965: i).

It was within this Cold War context of subterfuge, uncertainties and unknown possibilities that the US Navy (hereon referred to as 'the Navy') and associated governmental administrations increasingly sought to penetrate the surface of the sea to better understand a potentially resource rich and strategic operating environment. Perhaps less well known, is that this sub-marine imperative did not end at moving or extracting resources through the water column, but involved a number of experimental projects to test the feasibility of living, with the help of an undersea habitat, for prolonged periods of time without need to return to the surface. In the words of the US Navy (1966) 'Men have begun to go down to the sea…not to play within it, but to dwell, to live for a while'.

There was a sense of urgency and purpose after the tragic loss of the Navy's lead nuclear submarine, the USS *Thresher* in 1963 along with 117 lives on board. According to Sealab protagonist Captain Doctor George Bond (1993:1), it brought about a 'sudden recognition' of the need for deep diving, underwater search and rescue capabilities, and salvage operations at depth. Under the leadership of George Bond, Bob Workman and Captain

Walter Mazzone, and after a prolonged period of experimentation in hyperbaric chambers during Project Genesis, the US Navy, along with scientists, oceanographers and engineers set about constructing the first Sealab underwater habitat (see Figure 4).

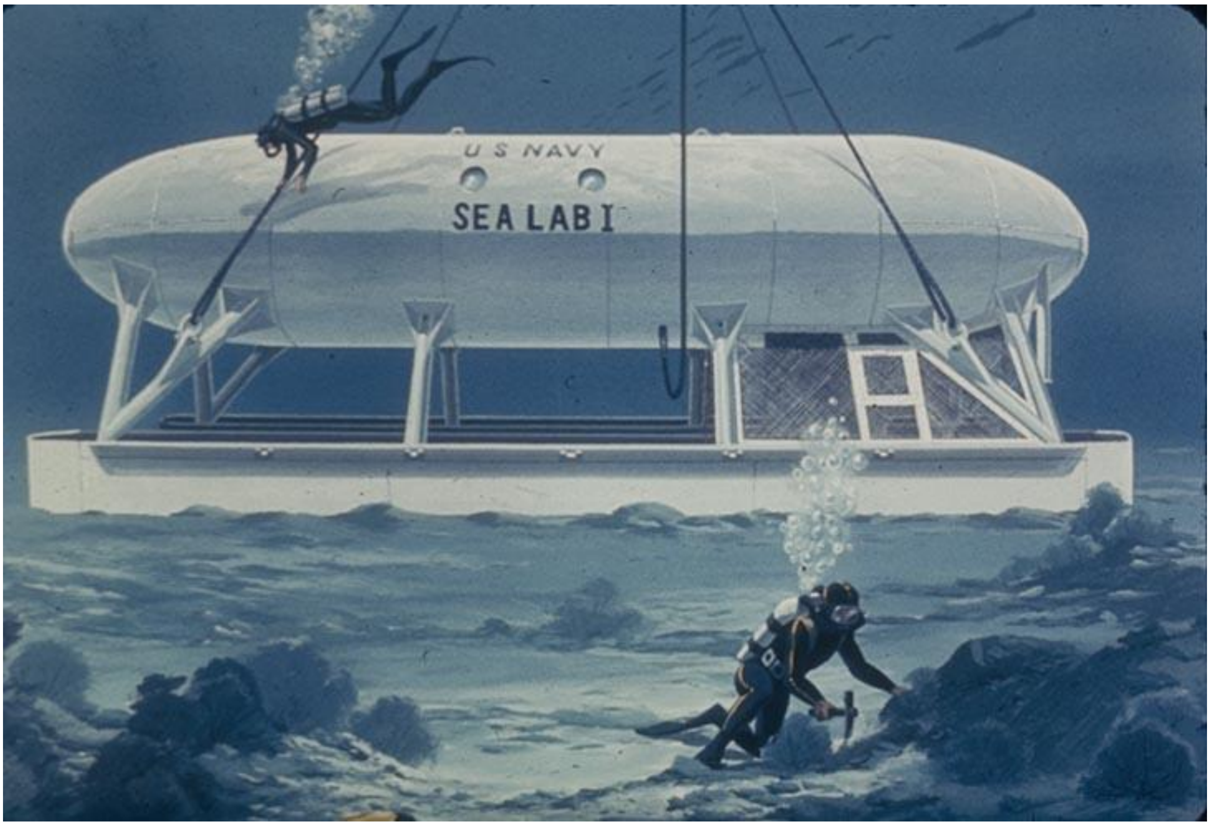


Figure 4: An artist's impression of Sealab I on the seafloor (Man in the Sea Museum, date not known but circa 1964).

With a budget of $150,000[1] and with parts stolen from military facilities, Bond and his team of engineers successfully made Sealab I sea worthy and it was lowered, with the help of pressurised gas, to the sea floor off the Bermudan coast to provide a space for four men (or aquanauts as they were known) to live and work 58m under the sea for three weeks (Barth 2000). The water surrounding Sealab II was held at bay by the pressure of the air within the habitat meaning that the men could move relatively seamlessly from the breathable atmosphere of the habitat to the sea outside without the need for doors or hatches. Much to the disappointment of the aquanauts and personnel on the surface, the project was

[1] This was the budget at the time of the experiment and would equate to approximately $1.2 million today.

suspended after 11 days due to an impending hurricane which would have made it difficult for the support station to safely interact with the habitat whilst beneath, the rising and falling waves made it a challenge to maintain the necessary pressure inside. It did, however, demonstrate, as the Navy (1966) stated, that 'the deep dark sea is a lot more interesting if you can make man a free agent not just for a few minutes but for a few days…for a man that endures, a man that simply is, is triumph enough 190ft down'. After the success of the first experiment, Sealab II was set into motion. Rather than utilise the clear and warm conditions of Bermuda's sea, the aquanauts this time were to face a much more challenging environment on the continental shelf appurtenant to the US Pacific Ocean Coastline (ONR 1967). The experiment set about pushing the boundaries set by its predecessor by sending aquanauts to live and work at a depth of 62m, one mile off Scripps pier at La Jolla, California. Three ten man aquanaut teams spent 15 days each living and working at the pressure of the sea floor, whilst NASA astronaut Scott Carpenter lived for 30 days, in what the ONR described as 'a pioneer effort to support human life and useful activity in the earth's most hostile environment' (1967:3).

The stated aims of Sealab II were multiple and indicative of the 'new role of science as the centrepiece of national security' (Hamblin 2002:20). In addition to increasing the US's 'capability to attack many significant oceanographic problems', the second Sealab endeavour sought to better the Navy's ability 'to live and to perform useful work under the sea' including salvage and rescue operations for sunken submarines, downed aircraft and atomic weapons; to make the sea 'yield some of its secrets' on undersea weather systems; to expand the capabilities of the military on the continental shelf; and to test the feasibility of enrolling a trained dolphin into the project (ONR 1967:17). In light of the 1958 Continental Shelf Convention, the Navy also made numerous references to both exploring and exploiting this area, the sea and sea floor becoming a space capable of saving man[2] with its 'treasure trove of resources', 'food supply for the proliferating human race', and wealth of minerals (US Navy 1966). 'Knowledge of the oceans is more than a matter of curiosity' stated the Navy (1966), 'our very survival may hinge upon it' and more importantly, 'knowledge is strength, a step in progress towards the essential strategic goals

[2] I use the term 'man' knowingly. Not only does this thesis refer to the 'Man in the Sea Program' but military diving is highly gendered

of the future which will require increasing utilisation of the vast oceanic areas for our security'. Covertly, there was another aim – to acquire the capability to lock divers in and out of submarines at depth for covert and clandestine operations.

Training and preparations were well underway for Sealab III, scheduled to be 185m down in 1968. It was to be the longest and deepest submersion with experiments in underwater construction, continued physiological studies and an expansion of the marine mammal program. Whilst the Navy (1968) described the project as a 'major milestone in our progress into the deep ocean', the project ended tragically. The habitat – an adapted Sealab II – leaked profusely as it was lowered. Once on the sea floor, the leaks continued and aquanauts Bob Barth and Berry Cannon were sent down to open the habitat and plug it from the inside. On both the first and second attempt they could not open the hatch due to the pressure differentials and the second ended fatally for Cannon. He died in the water from carbon dioxide poisoning – it was later established that his diving rig was missing baralyme, a substance used to absorb the poisonous gas.

Notwithstanding their tragic end, the projects had successfully established a diving technique (see chapters 4 and 5) that would enable 'man' to inhabit the deep and it continues to be used today with a wide range of applications. As a prime example, the Aquarius Reef Base, an underwater laboratory in Florida positioned 19m on the sea floor, has been utilised by scientists who live for up to two weeks at a time under the sea to conduct oceanographic research, NASA and European Space Agency astronauts who test techniques, technology, and equipment before it is used in Outer Space, and the US Navy who continue to develop their underwater capabilities. The oil and gas industry and any work requiring deep diving for prolonged periods also make used of the diving technique, known as saturation diving, established during the Sealab experiments to maintain the world's extensive underwater energy infrastructure.

In the following paragraphs I will outline some of the empirical and conceptual opportunities that open up in the study of the Sealab experiments, before finally offering an outline of the chapters to follow.

1.1 Empirical and conceptual opportunities

> 'If the question of human interaction with nature is fundamental to geographical scholarship, it is startling that so little attention had been paid to the military dimensions on of this relationship - to wars on geography' (Farish 2006:192).

Before outlining the key conceptual opportunities and contributions made possible through an engagement with Sealab, it is worth noting the empirical novelty of the case study and its subsequent capacity to add further depth and richness to our understandings of the Cold War. The Cold War itself is far from understudied. There is a wide range of literature dealing with multiple aspects of this prolonged period of geopolitical tension and upheaval. This scholarship is far reaching and includes work on popular geopolitics to explore the role of propaganda, mass communication, and the forging of national identity (Sharp 1993, Carruthers 1998, Dodds 2005, Leab 2006 Dittmer and Dodds 2008, Kinney 2013); Outer Space (Sage 2008, 2009, 2014, Gorman and O'Leary 2007) and the Polar Regions (Farish 2006, 2010, Lackenbauer and Farish 2007, Petersen 2013) to better understand the role of extreme environments and the framing of nature as 'an oppositional object, or more specifically, a force to be overcome' (Farish 2006:192); reflections on the role of science and the International Geophysical Year in forging international cooperation (Powell 2008a, Howkins 2008); and the eclectic, countercultural and 'groovy' scientific practices that characterised a particularly colourful period in American history (Kasier and McCray 2016) to name but a few.

Yet within this diverse, and at times whacky and unconventional landscape of spaces and practices, Sealab has remained relatively unaccounted for in academic scholarship and wider public discourse. Indeed Ben Hellwarth, author of one of the only journalistic accounts of the projects, noted without surprise that the 50th anniversary of Sealab came and passed in 2014 'with scarcely a tweet' (Hellwarth 2014). In spite of the significance of the projects, both in the development of certain techniques and technologies and in the shaping of public imaginaries at the time, detailed accounts of the geographies, geopolitics, and wider significance of the experiments are remarkably absent. Empirically then, Sealab represents an opportunity to add further colour texture, shape, and form to Cold War discourse, whilst also contributing to the wide range of scholarship on the intersections of the military, science, and technology during this time period. Simultaneously, it represents a series of moments through which to better understand how the Cold War played out under the sea beyond the traditional vectors of submarines, surveillance, and resource extraction. It provides what Steinberg (2009:490) might describe as an opportunity to work 'from behind the lines' or what Vermeulen (2015) might describe as an opportunity to go behind, beyond, beneath and inside the mediator of the 'surface'. In doing so, we are better able to account for the ways in which the Navy sought to 'attack' nature and the hostile environment of the sub-marine. Moreover, it offers an in depth account (both literally and figuratively) of multiple practices – from the considerations of territory construction in an un-earthly space, to the effects of isolation and disconnection on human psychology and physiology, to the role of animals and non-human life in shaping and resisting geopolitical endeavours.

Empirically within this temporal frame, we might also consider the role of Sealab in complicating the construction of the Cold War hero. Framed as 'warriors' by aquanaut Bob Barth (7 February 2016, Mr Barth's home), the aquanauts in many ways conformed to the archetype 'hero' of the time. Their bodies were conditioned, their minds trained to approach their work with the cool, calm headed rationality that was seemingly beyond the reach of women, and they partook in what Dean (2001) would refer to as volunteer heroism – whereby the 'man' voluntarily places himself in a context that could be both harmful and life threatening. Simultaneously, however, their bodies also succumbed to the environment of the water and the undersea habitat which was extremely humid. They suffered from ear infections, bacteriological problems, and skin rashes. Their bodies were infected and besieged by the mico-organisms thriving in this hostile and unusual setting. At the same time, they were also required to perform tasks associated with the feminine, domestic sphere. Whilst Anderson (2009) argues that in a military context, tasks such as a cooking and cleaning become an extension of the masculine practices of training and discipline – practices that are legitimised and maintained by strict hierarchical obedience – the undersea setting works to challenge this assumption. Far from being obedient, the men at times showed little regard for the chain of command, they expressed wishes for more autonomy, and swore at their superiors on the surface. The physical distance between the surface and the seafloor served as a mediating volume – a volume that came to distinguish between surfaces dwellers and sea dwellers. The masculinity of the men was confirmed and reinforced not in obedience, but by their ability to break new ground, to pioneer 'home' in a hostile surround in a seemingly civilised fashion.

Underpinned by this rich empirical setting, there are three key conceptual opportunities that emerge through the Sealab experiments and which are reflected upon in this thesis. Often, it is at the extremes that knowledge can be created for more mainstream applications, as is the case here.

1. **Territory and Terrain**

The first and perhaps most prominent examples of this are the ideas surrounding territory and terrain that are generated through Sealab. The Sealab experiments (and their predecessor Project Genesis) offer examples of territory-making in the extreme and in grappling with a terrain away from the two dimensional surface of land. Considering also the environmental context of the deep sea and novel insights can be gained. As Hannigan (2016) highlights, the official definition of the 'deep sea' is usually said to start at a depth of 200m, the break point between the continental shelf and the continental slope. When the word 'deep' is used in this thesis it is not in reference to this definition. Rather it is used to highlight activity that breaks the sea's surface and where the body can be immersed. As Brekke (1997:39) asserts, the 'deep' is a human and imagined construct as well as a physical state and it to this interpretation that I lean towards in order to account for the array of activity taking place beneath the surface of the sea that may not meet the scientific designation of 'depth'.

To begin with the concept of territory, one of the key themes that emerges through this thesis is that of temporality. The framing of the projects involve moving along a temporal axis from explorers such as Columbus, to the early American settlers in the Western Frontier right the way through to future projections of living and dwelling beneath the sea. At the same time, these temporal imaginaries are intersected with practices that disrupt this linear path. Routines and structured daily rhythms became crucial parts of the project and were perhaps even more significant in an environment where there is no indication of the daily cycle – as aquanaut Bob Barth told me (7 February 2016, Mr Barth's home), 'the sun goes out when you're down there'. Simultaneously, the seafloor and surrounding water column had their own non-linear rhythms that disrupted the ability of those topside to determine the precise location of the habitat. Whilst geographical scholarship has established that territory is a processual and constantly unfolding construct (Elden 2013b), there are perhaps other less linear considerations in territory construction that warrant further attention. Secondly, as will be explored in Chapter 5, the Sealab projects (and other territorialising endeavours in extreme spaces) are premised on the intersections between technology, elements (such as air and water) the bodies of the humans and animals inhabiting the environment and scientific interventions. Drawing on the work of Donna Haraway and others, I deploy the term 'cyborg territory' to provide a means to unpack and interrogate the geopolitical implications of these intersections as various elements, technologies, and bodies collide.

We might also think here about the role of the 'animal' in territorial practices. As chapter 6 explores, the voluminous environment in which the Sealab projects were set were filled with life. The animals in question already had their own territorial practices and mechanisms before the habitats arrived. When the habitats did submerge, the impact was significant. As Clarke et al. (1967:1388) note on the Sealab II habitat, the 'effects of the presence of Sealab II on the biota of the site was almost immediate'. It became surrounded by stinging scorpion fish, plankton swarmed around the lights which in turn attracted their predators, white croakers. Simultaneously, anchovies rotted having 'infiltrated' the Personnel Transfer Capsule whilst in Sealab III sea urchins threatened to 'invade'. Within political geography scholarship, territory is conceptualised as a predominantly human endevaour, yet Sealab demonstrates that animals and non-human life forms have significant implications for the practice and conduct of territory. In simple terms, they were there first, and had the capacity to both be co-opted into and undermine the intentions of the US Navy.

Inherently tied to questions of territory is that of terrain. Unlike territory, terrain is yet to be critically interrogated by geographers. It is all too often taken to simply refer to the lie, or the formation, of a landscape and the associated strategic and military considerations associated with traversing or moving through the space in question. The Sealab projects unsettle this assumption. Throughout the experiments the operating environment was far from being a surface to traverse. Whilst the seafloor had its own contours, heights and depths, peaks and troughs, it was also lifted and suspended in the water column. It acted as a curtain of sorts, obscuring the vision of the aquanauts and contributing to a sense of disorientation. Moreover, the water was cold, it was dark, it acted on the bodies of those dwelling within it. Terrain emerges here as a three dimensional construct and one that should be uprooted from its etymological roots on 'terra'. Taking this one step further, it is argued that terrain could also be re-orientated towards the body (both human and non-human). Throughout the projects the bodies of the aquanauts and of the sea life they were engaging with were brought under the microscope, mapped, and monitored to establish their relationship with the external environment. They emerged with their own morphologies, sedimentation rates, flows, circulations, and rhythms that were brought under regimes associated with territory construction. Terrain is materialised in relation to the body and the body emerges as a further volume through which and in which territorialising regimes are extended.

2. The Elemental

The Sealab experiments also provide opportunities to think through aspects of the 'elemental'. As an increasingly salient concept within geography (See McCormack 2015, Adey 2015, Squire 2016), elemental geographies offer opportunities to re-think and re-conceptualise the agency and materialities of substances such as air, water, fire, and ice that might otherwise be taken for granted. By engaging with Sealab through an elemental lens, we see how substances such as air can be made malleable, their molecular and chemical formation altered to enable humans to 'dwell' on the sea floor. It was mixed, 'scrubbed', contained and put to work for the agenda of territorial expansion. Within this framework, certain elements such as helium emerge as protagonists, their chemical specificities both enabling sub-marine inhabitation whilst simultaneously interacting with the body to produce both wanted and unwanted, damaging affects. Air emerges here as a substance that is both malleable and containable whilst also remaining excessive with its capacity to escape and imbricate itself deeply within the structures of the body.

One of the key mechanisms for containing and manipulating various airs was the hyperbaric chamber. The chamber stands as an important geopolitical and geographical space within the projects, serving as a testing a ground, an environment in which the aquanauts were brought under certain calculated and experimental regimes of corporeal governance, and a space that acted as an analogue for the pressures of the deep sea. Capable of taking the body to great depths (and indeed heights) whilst stationary, the chamber provides a microcosm for how certain verticalities and depths impact the human body whilst also demonstrating the significance of analogue spaces more generally in the recreation of extreme (often experimental) conditions.

3. Methodological reflections

The final conceptual opportunity I want to reflect on is methodological. I described above how Sealab offered opportunities to get behind the lines, to immerse via the bodies of the aquanauts in the sub-marine with all of its complexity and nuance. Methodologically too this was something that I wanted to achieve and I sought to do so my making body a test site of sorts and immersing myself in a range of environments from learning to dive in cold and dark water, to inhabiting a hyperbaric chamber and spending a short amount of time in an undersea habitat. Not only was this significant in gaining an embodied understanding of my subject matter, in learning the language of diving, and in building rapport with my research community but it enabled me to physically 'move with and be moved by the phenomena' that I 'attempted to draw into view' (Meyers 2012:177). This perhaps gained significance when thinking through the concept of 'cyborg territories'. In many ways, in donning SCUBA gear I was myself becoming a cyborg of sorts in a mixing of technology, the body, and an external environment. At the same time, my body – the body of a researcher- was also significant as I conducted interviews and inhabited certain spaces such as the US Navy Experimental Diving Unit. My gender and appearance became significant in my interactions with a number of individuals, highlighting the importance of factors such as apparent youthfulness, size, and gender in the research process. There is a wider point here about how we, as geopolitical researchers, engage with our subject matter. The body and immersive methodologies, I argue, could take a more central position in the practice of geopolitical research and researchers could perhaps be made more vulnerable and open to new experiences, dwellings, and elemental surrounds (see Squire 2017).

1.2 Thesis overview

Before engaging with the literature underpinning the projects, the thesis begins with a short interlude at the end of this chapter entitled 'People and Projects' which is designed to provide the reader with a reference point for the key actors that surface throughout the following pages. The actors have been selected based both on their contribution to the projects, but also largely on their presence in the archival material collated during the research process at the Man in the Sea Museum, Florida and the Scripps Institute of Oceanography archives held at the University of California, San Diego.

Moving forward, chapters 2 and 3 set the scene with the conceptual and methodological underpinnings of the thesis. Chapter 2 seeks to trace how Geography has grappled with a range of issues in and on the sea. In doing so, it traces fluctuating interest in the sea as a space of geographical enquiry, from early geographers such as Mackinder and Vaughan Cornish to present day writings by the likes of Kimberley Peters (2010) and Philip Steinberg (1999, 2001). It then moves to identify three key areas of intervention to address the lack of 'depth' and the absence of bodies (both human and non-human) in the volume of the sea. It ends by tying these loose ends together by drawing on the elemental as a means to engage with the sea and the bodies that inhabit it at multiple scales. Chapter 3 moves to consider the methods and methodologies operationalised during the research process. It critically engages with my use of interviews and archives whilst also addressing the significance of the question 'do you dive?' It is in this chapter that central themes surrounding embodiment (and the significance of my own body) emerge and it concludes by suggesting that the researcher's body could have a more central role to play in the cultivation of creative research and practice in political geography.

Chapters 4, 5, and 6 are dedicated to the analysis of the empirical material and follow a number of theoretically informed trajectories through the unfolding of Sealab from Project Genesis to Sealab III. Chapter 4 addresses the imaginaries and practices that facilitated the establishment of the projects. Through the protagonist of Captain George Bond, it explores the frontiering and homesteading imperatives that drive the US Navy forward to their ‘manifest destiny’ beneath the sea. Of course, there were practicalities to consider in making this density a reality and I therefore turn to the elemental challenges associated with seafloor living such as the shifting silt and identifying an appropriate location for the habitats. Finally the chapter explores the practices of ‘home’ beneath the sea and the construct of the ‘sea dweller’. Each section is cut through with the Cold War social politics of the time and it offers a number of conclusions pertaining to gender and the constructs of home, territory, and terrain beneath the sea.

Whilst chapter 4 deals with the social, cultural, and political context that shaped the projects and the aquanaut’s engagements with their surroundings, Chapter 5 addresses the elemental surround in which they were immersed and peels back the context of Chapter 4 to address the significance of the physiology and minute inner workings of the aquanauts. It begins by moving back in time slightly to Project Genesis to establish the importance of the space of the hyperbaric chamber. It is through this construct that ideas surrounding the malleability of air(s) is explored. Living and working in these unnatural spaces has significant embodied consequences and the second half of the chapter explores how these were made manifest on the human body. The chapter concludes by reflecting on key themes including the notion of ‘cyborg territory’ and the unsettling of the sanitised figure of the Cold War Hero.

The final empirical chapter dwells on a number of different kinds of bodies. Moving beyond the human, Chapter 6 explores the roles of animals – from Tuffy the dolphin right the way down the food chain to microscopic planktonic life forms drifting through the seas volume. It demonstrates how practices of domination and domestication were extended and mapped onto various animals and non-human life whilst also illustrating how this was not a straight forward endeavour. Humans are at once both superior and inferior to their animal counterparts and dolphins, fish, and sea urchins each played a role in both undermining and shaping the Sealab projects. In doing so, they demonstrate the significance of non-human life forms in the practices of territory construction in voluminous spaces.

Throughout the preceding chapters certain themes and concepts emerge and remerge. By way of conclusion, chapter 7 ties these together by reflecting on gender and the construct of the Cold War Hero, the concepts of territory and terrain, ideas surrounding the engineering of the elemental, and the methodological interventions made in both the practice and writing of the thesis. The chapter suggests areas of further research and concludes by suggesting the framework of ‘extreme geographies’ for engaging with spaces that are hostile to human inhabitation in a world that may become ever more extreme.

1.3 People and projects: a glossary of the key actors in Sealab

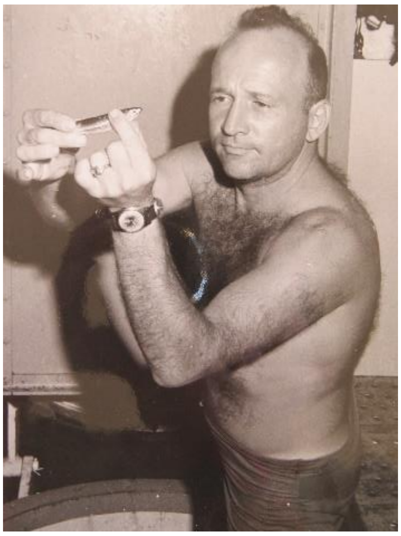
'Certain individuals, although perhaps not always the expected ones, float through the chapters' (Farish 2010:xxiv)

Both Farish (2010) and Kasier and McCray (2016:5) suggest that 'certain charismatic individuals' often provided the pivot around which Cold War science orbited. Sealab was no exception to this. Whilst, broadly speaking, there are too many actors and agents to mention, there were a number of audacious and experimental individuals who were significant in the Sealab endeavours, the records of which have been instrumental in writing this thesis. These individuals, both human and non-human 'float through the chapters' (Farish 2010:xxiv) and the following pages are designed to provide a brief and easy reference point to better understand both the context of Sealab and the oft cited names that will appear and reappear in the forthcoming chapters. In addition to understanding individual actors (both human and non-human), the 'Projects' section of this short chapter will also provide a brief synopsis of the experiments from Genesis to Sealab III.

Name: Captain Dr George Bond (also known as Papa Topside)
Role in Genesis and Sealab: Principal investigator

Background: Originally a GP from North Carolina, Bond joined the Navy in 1953 and qualified as a Diving Submarine and Medical Officer. In 1958 he transferred to the Naval Medical Research laboratory where he completed a record 52 second, 302ft buoyant ascent from an escape trunk of a submarine. He, along with Cyril Tuckfield, established the feasibility of deep submarine escape. In 1964, he became the Principal Investigator of Project Genesis and later, the Sealab projects. He is now widely revered in the military professional diving community as the 'father of saturation diving'.

Bond died in 1983 but chronicled his experiences of Sealab in diaries, newsletters, official logs, and letters, the original copies of which were utilised in this thesis (Image courtesy of Kevin Hardy).

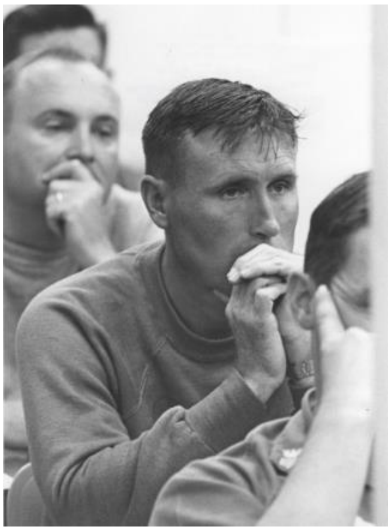


Name: Bob Barth

Role in Genesis and Sealab: Navy diver and Aquanaut, Bob Barth was the only diver to take part in every stage of the Sealab program from Genesis (where he looked after the experimental goats and served as test a subject himself) to Sealab III (where he made the last and fatal dive with Berry Cannon). He was a trusted and experienced member of Bond's team.

Background: Barth met George Bond whilst serving as a submarine escape instructor. He is one of the few surviving aquanauts and participated as an interviewee. His book 'Sea Dwellers' was also an important resource.

Image courtesy of the Man in the Sea Museum, Florida



Name: Berry Cannon

Role in Sealab: Aquanaut in Sealab II and III. Cannon tragically died in Sealab III as he and Bob Barth attempted to open the habitat on the sea floor. It was later found that the substance used to absorb carbon dioxide (baralyme) was missing from his rig.

Background: Cannon was a civilian electrical engineer at the US Navy Mine Defence Laboratory.

Cannon's wife, Mary Lou Cannon has donated many of the documents from his time in Sealab to the Man in the Sea Museum and to a curator in San Diego. This includes his personal journal from his time in Sealab II.

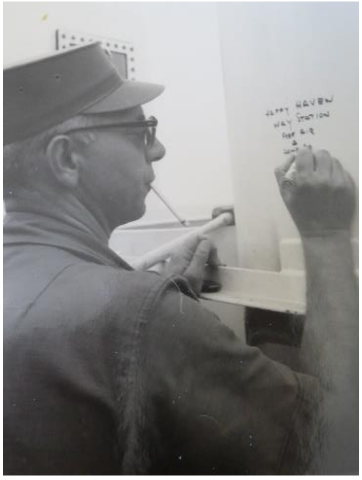
Image courtesy of Kevin Hardy

Name: Scott Carpenter

Role in Sealab: Aquanaut in Sealab II. A motorcycle accident prevented his participation in Sealab I and a misdiagnosed case of decompression sickness curtailed his participation in Sealab III

Background: Scott began his career as an American Naval Officer before becoming an astronaut and being selected for NASA's Project Mercury in 1959. He became the second American to orbit the earth. He was also the first astronaut to become an aquanaut and staged the first telephone call from the bottom of the sea in Sealab II to the Gemini mission in outer space.

Scott attracted a significant amount of media attention with a host of newspaper articles written about him and by him, speeches, and reports that are available to study (Image Courtesy of Kevin Hardy).



Name: Captain Walt Mazzone

Role in Sealab: Physiological control officer. Mazzone and Bond alternated watches throughout the experiments

Background: Mazzone was a decorated WW2 submariner. He left the Navy to complete a Pharmacy degree before re-joining to work with Bond on Sealab I, II, and III. A number of the diving techniques and parameters he established are still in use today.

Records of his 'watches' are readily accessible as are his contributions to numerous Sealab reports.

Image courtesy of the Man in the Sea Museum, Florida

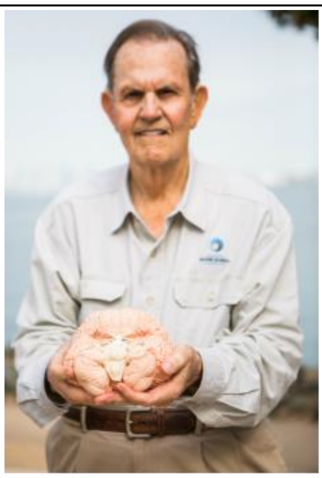
Name: Earl Murray

Role in Sealab: Oceanographer and aquanaut in Sealab II.

Background: Murray was a research associate and lab technician at the Scripps Institute of Oceanography from 1952-1977. He had expertise in deep diving and underwater photographer. He worked with both Jacques Cousteau and George Bond during his career.

Murray's exploits in Sealab are well documented in the Scripps archives. Materials include his personal journal, official log, letters and photographs.

Image courtesy of the Scripps archives, UCSD



Name: Dr Sam Ridgway

Role in Sealab: Dr Ridgway was responsible for the care of Tuffy the dolphin in Sealab II, and the dolphins and sea lions of Sealab III.

Background: As a Vetinarary doctor, Ridgway became one of the founding practitioners in the US Navy's Marine Mammal Program and was involved in the capture and acquisition of Tuffy the dolphin. Dr Ridgway continues to work for the Program and undertake dolphin research today.

Dr Ridgway was an interviewee and has also recorded his experiences with Tuffy in 'The Dolphin Doctor' (1982).

Image The Marine Mammal Foundation

Name: Tuffy (a.k.a. 'Tuff' guy)

Species: Bottlenose dolphin (Tursiops Truncatus)

Role in Sealab: Tuffy was trained during Sealab II and III to rescue lost divers and to deliver mail, tools, and other small objects.

Background: Tuffy was caught from the Gulf of Mexico and conscripted to the US Navy's Marine Mammal Program. He was known for his volatile demeanour and independent streak, as well as for the 'battle scars' on his body thought to be the result of shark attacks.

Image courtesy of the Scripps archives, UCSD

Projects

Project Genesis

Led by: Dr George Bond, Dr Robert Workman

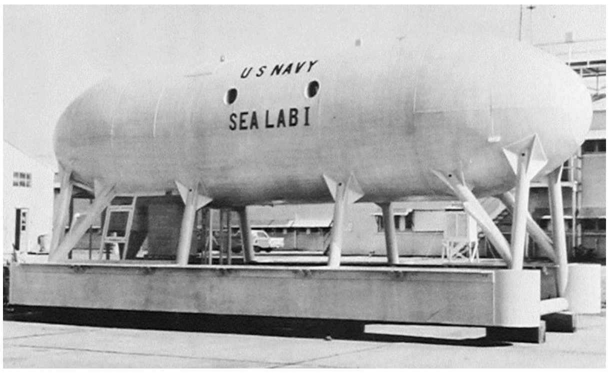
Date and location: 1957- 1962. Various hyperbaric chambers at Naval facilities including the Navy Experimental Diving Unit.

Depth and duration: Various depths (and heights) were reached -40,000 ft -200ft deep

Purpose: To ascertain whether a ‘man’ can breathe an artificial air mixture at depth and to establish the feasibility of saturation diving.

Phases: 5 phases (A-E). Phases A and B were on animals, C was conducted at ambient pressure, D and E were conducted at pressure.

Findings: Man can successfully live and conduct useful work in am artificial atmosphere at pressure for prolonged periods of time with one decompression at the end.



Sealab I

Led by: Dr George Bond, Captain Walt Mazzone **Date and location:** 1964, waters off the coast of Bermuda

Depth and duration: 58m (192 feet of sea water), 11 days (the project was suspended due to an impending hurricane).

Purpose: To test the results of project Genesis in favourable open water conditions. The clear and warm water off Bermuda provided relative thermal comfort and high levels of visibility.

Phases: One team of four men for 11 days.

Findings: Sealab I confirmed that the results of Project Genesis were viable in open water.

Sealab II

Led by: Dr George Bond, Captain Walt Mazzone

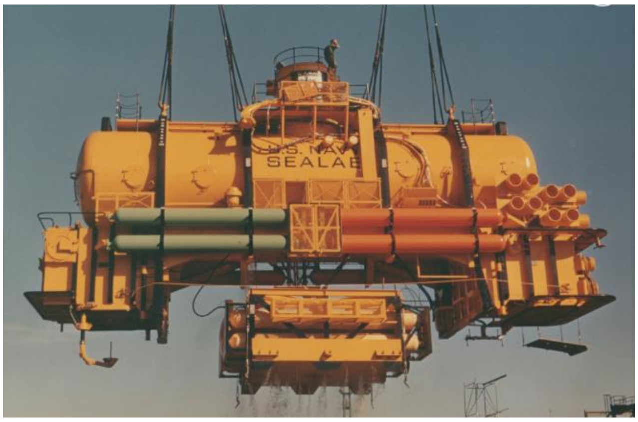
Date: 1965, one mile off the coast of Scripps Institute of Oceanography, La Jolla, California on the US continental shelf.

Depth and duration: 62m (205 feet of sea water), 45 days

Phases: Three teams spent 15 days each on the seafloor. A number of aquanauts took part in both Team 1 and 3 and Scott Carpenter spent 30 consecutive days on the sea floor.

Purpose: Among many stated aims, Sealab II sought to extend the results of Sealab I in less favourable conditions more akin to likely operating environments, to conduct rigorous physiological and psychological testing, to conduct oceanographic studies, and to test equipment and operating procedures for undersea work.

Findings: ‘Man’ can live and work at depth in unfavourable conditions, paving the way for future saturation projects.



Sealab III

Led by:

Date: 1968-69

Depth and duration: 185m (610fsw) but was never inhabited – it leaked air at an unsustainable rate so Bob Barth and Berry Cannon were sent to fix it. Berry Cannon died in the process due to an equipment oversight and the project was terminated.

Phases: The program consisted of numerous training phases including underwater construction, sedimentation control, marine mammal work, and salvage procedures. 5 teams of 9 divers were scheduled to spend 12 days each in the habitat

Purpose: To push the limits of the Sealab II, to further the establish feasibility of underwater construction, marine mammal work, and

Findings: This was the end of the Sealab program but the technique of saturation diving has been widely utilised in militaries, for research purposes, and commercially in the oil and gas industry.

Chapter 2

Geography in and on the sea: towards an elemental geopolitics of the sub-marine

> 'The sea is everything. It covers seven-tenths of the terrestrial globe. Its breath is pure and life-giving' (Verne 1869:58).

2.0 Introduction

Drawing on four 'bodies' of literature (see Figure 5), this chapter seeks to address a number of lacunae within the burgeoning literature on the space of the sea within human geography. It identifies a point of intervention at the intersection between scholarship on the sea, territory and volume, the body, and the non-human – themes that are cut through by the geopolitical context of the cold war and particular actors such as scientists and their funding institutions. Put otherwise, it deploys areas of literature that have previously not been brought into 'conversation' with one another to explore the geopolitical questions that arise at the centre of the diagram where bodies, water, and elements and questions relating to territorial volumes collide

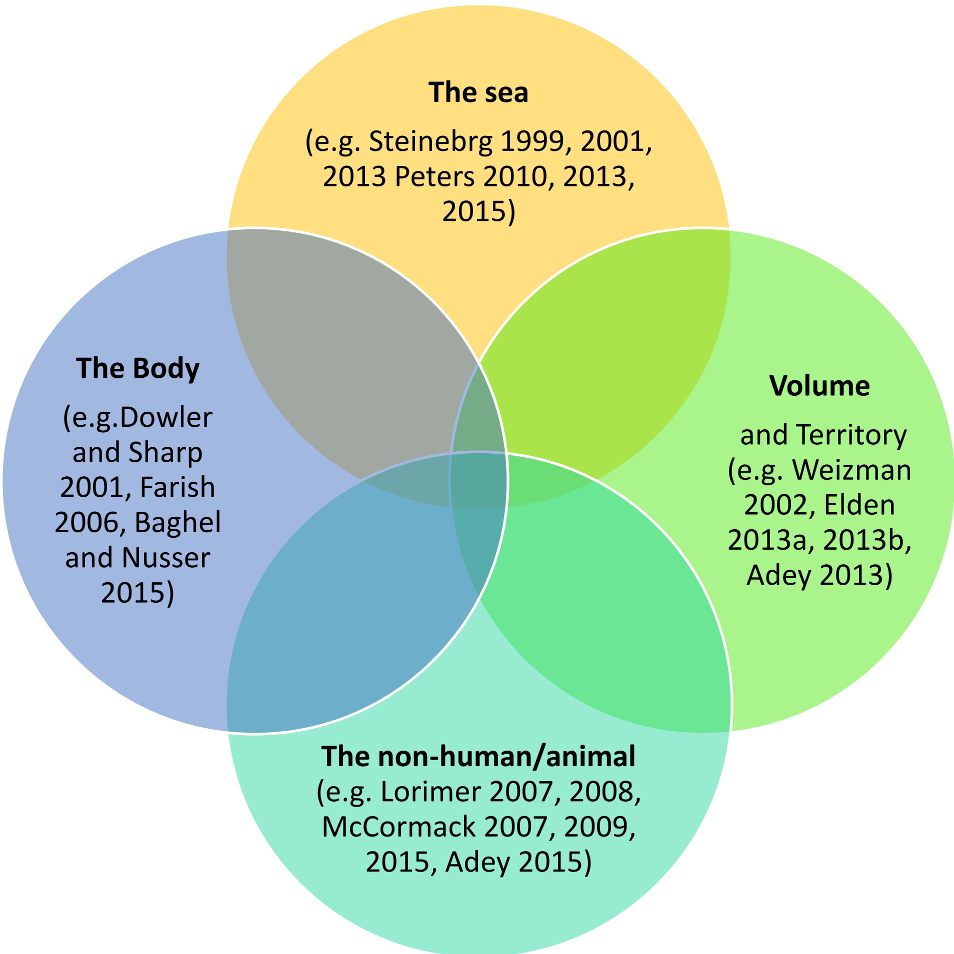


Figure 5: Interlocking and mutually informing spheres of literature

The chapter begins by tracing the re-emergence of the sea over the last two decades into the forefront of geographical writing. In order to do so, it looks back to historical work on the sea and charts a path to current engagements with ocean space in cultural and geopolitical geographical literature. The sea, as Colville et al. (2015:99) highlight, 'needs to be understood as a space which was imagined in all its physical dimensions throughout history'. The study of, and engagement with the sea as a material space is not a new phenomenon. As will be explored, it has always involved a negotiation of the 'sea as a three-dimensional landscape' (*ibid*). The chapter then moves on to identify three key sites of intervention within current scholarship. The first deals with ideas pertaining to volume and depth (see Elden 2013). Thus far scholarship on territorial volumes has remained tied to ideas of verticality, leaving the theoretical and empirical richness of 'depth' as an immersive and inherently voluminous space relatively unaccounted for. The second point of intervention lies with the human body. In order to better understand attempts to master depth in geopolitics, the body must be made a protagonist given the central role it has played in a number of geopolitical exploits (such as in Sealab, oceanography, underwater surveillance, and in the emergence of the offshore oil and gas industry). The final point of intervention lies with the non-human. Whilst animal geographies are flourishing in cultural and social sub-disciplines, political geography is yet to really take seriously the role of animals in human attempts to grapple with and ultimately conquer extreme environments such as the sub-marine. The concluding section of the chapter seeks to suggest a framework through which these interlocking themes and ideas can be better interrogated. It does so by drawing on the work of John Protevi (2009), Isla Forsyth (2013), and Derek McCormack (2015) to foreground the elemental and molecular – thus providing a common thread from which to explore the wider geopolitical implications of 'man's' exploits beneath the waves.

2.1 The sea in Geography

Tracing the geographies of the sea is no easy task. Like the matter of the water itself, interest in oceanic space has shifted, changed, mutated, and come and gone over the years. Whilst human geography has recently re-discovered the sea as a space worthy of exploration, the oceans have long been present, albeit in different ways in the minds of geographers and those shaping geographical thought. Driven by the imperatives of science, exploration, and geopolitical ambition, knowledge of the sea has been wrought by a large and diffuse range of actors and agents (Livingstone 1992, Driver 2001). As Lambert et al. (2006:487) and Rozwadowski (2005) highlight, early explorers, navigators, fishermen, whalers, undersea cable layers, hydrographers, cartographers, and coastal communities have all been instrumental in the production of maritime knowledges[3]. Notwithstanding the wealth of knowledge present in sea communities around the world, for the West, the 19th Century was particularly productive, 'witnessing a dramatic increase in awareness of the open ocean as a workplace, a leisure area, a stage for adventure, and a natural environment' (Rozwadowski 2005:4). Increasing literacy rates during this time in the Global North only increased awareness of the complexity of the sea as imaginations were projected from land and into the deep (Rozwadowski 2005). The 'unsettled frontier' (Driver 2001:2) between these imaginaries and practices is where geography lay. As Driver (2001:3) highlights geographers increasingly began to describe their discipline as one of synthesis – drawing together a wide range of knowledge to construct understandings about space and place. Similarly, as Powell (2008b:548) highlights in his work on the Arctic, 'geography has never agreed upon coalescing paradigms or intellectual boundaries', rather, broad themes 'such as an appreciation for the importance of spatiality…hold together an otherwise disparate community of practitioners'. Within this community of practitioners, different understandings of geography and geographical practice existed and actors such as field scientists emerged in Powell's research as central to the construction of a geographical imaginary of the Canadian Arctic. In revealing some of the 'hidden geographies revealed around the boundaries of geographical science' (559), Powell and Driver work to re-introduce actors into geography that are often forgotten 'through the retrospective delineation of disciplinary cartographies' (549) and in doing so, the diversity of ways that the sea is lived on and with and cross-cutting issues such as gender, class, race, and sexuality are revealed (Lambert et al 2006).

Despite recent assertions that we have recently seen a 'maritime turn' in human geography (Psuty et al. 2003), we are perhaps instead seeing a re-turn to the ocean. To provide some illustrative examples of early engagements with the sea, the work of geographer Halford

[3] See Rozwadowski (2005) for a rich and full account of this with specific reference to the sea.

Mackinder is a good starting point. Famous for his theorising of the 'heartland' and 'geographical pivot of history', Mackinder made the seas the protagonist in *Britain and the British Seas* (1902). For Mackinder, Britain's defence, economy, and imperial ambitions were defined by its relationship to the water – to the surrounding seas, internal waterways, plains, and (geo)physical history. He was also interested in depth and the sea floor, outlining the significance of the 'submarine platform', or the continental shelf to British naval exploits. He sought to visualise the sea floor, bringing the depths to the surface and marvelling at the 'long mountain range' and 'forest clad slopes' that lay beneath the water's surface (1902:26). Far from an absence, the sea was at the centre of an isolationist geopolitics, a vital actor in preserving Britain's social organisation, modern commerce, productivity and resources. Moreover, the sea was thought to be a determining factor in Britain's defence with the 'whole course of future history' dependent on 'whether Old Britain' would have enough 'virility and imagination to withstand all challenge of her naval supremacy' (309). Indicative of a belief in the 19th Century that the ocean 'was an important place and natural site for the exercise of military, technological, and scientific power' (Rozwadowski 2005:10), the sea along with its character and motion emerge through Mackinder's writing as a central feature of the geographic imaginary.

Moving away from this reading of the sea that renders the water a space that has 'aided and abetted the furthering of national interest', bowing to the 'will of an island nation's military prowess' (Colville et al 2015:98), the geographer Vaughan Cornish further hints at the potential richness of the sea as a space within geography. Whilst *Waves of the Sea and other Waves* (1912) is primarily a scientific piece wherein Cornish meticulously and scientifically analyses the size and speed of ocean waves, the introduction to the piece is telling:

> 'Most of us have felt the fascination of a wave. The waves of the sea, which are the prototype of all the phenomena which we now call waves, are perhaps the most fascinating of all. Great as is the beauty of their form, the mystery of their motion is the greater charm. For while they move they live and have a being, which, like our own, is but momentarily associated with the matter of which they are formed. The wave preserves its individuality, its recognisable though not unchanging form, its energy, partly active, partly in reserve whilst its material substance is constantly

rejected and renewed. Of all manifestations of the inorganic world it is most like a living being' (Cornish 1912:7).

The manner in which Cornish introduces his work is incredibly lyrical and poetic; it goes beyond scientism or legalism and is indicative of a subject matter that cannot be fully grasped and analysed through calculation and hard scientific or legal practices. It perhaps also represents a tension within geography when writing about the sea. On the one hand, Cornish attempts to bring the sea under the remit of the scientific, all seeing and knowing eye – the result of 15 years of research, and on the other, he cannot resist the temptation to romanticise the wave, to compare it to the human experience and marvel in its 'beauty' and 'charm'. Whilst there are clearly vital physical geographies to study, there is also a distinctly human element to this that cannot be captured through man made cartographic striations, lines, demarcations, and ascriptions. Similarly, Maury's (1855) *Physical geography of the Sea* captures some of its affectual nature. Describing it as a sublime 'majestic' space, Maury sought to 'collect the experience of every navigator as to the winds and currents of the ocean, to discuss his observations upon them and then to present the world with the results on charts for the improvement of commerce in navigation' (1855:v). Far from drawing lines across the sea, Maury wanted charts to show 'the experience of each master as to the winds and currents'. The object of 'this little book' he wrote, 'is to show the present state, and from time to time, the progress of this new and beautiful system of research' to 'present the gleanings from this new field in a manner that may be interesting and instructive to all, whether old or young, ashore or afloat, who desire a closer look into the 'wonders of the great deep' or a better knowledge as to its winds, its adaptations, or its physical geography' (xv). In other words, this scientific treatise sought to capture the 'agencies' (33) of the sea, how they were physically experienced by navigators and sailors, and how the ocean moved and flowed[4].

Moving forward in time and the work of political and legal geographer, Martin Glassner (1968), offers a further intervention. Away from the sublime affectual resonances and military imperatives described above, Glassner called for a 'new generation of political

[4] Seafarers, for example, used drifting bottles as a means to understand currents. The bottles, writes Muary, acted as 'mute little navigators' (28).

geographers and others' to 'plunge into' the 'relatively new and absolutely exciting and rewarding field' of the political geography of the sea. Glassner (1986b:5) writing 'shortly after the signing of the United Nations Convention on the Law of the Sea, at the beginning of a period of rapid, far-reaching and unpredictable changes in man's uses of the marine environment and their regulation', sought to provide a background and framework from which this new generation could work. Premised on the belief that the Law of the Sea and related maritime matters deserved 'much greater attention from political geographers' than they had received (Glassner 1986b:6), he aimed to initiate a 'new political geography of the sea' centred upon emerging legal regimes. For Glassner and others writing in his special issue, the legal and geopolitical were synonymous. The new law of the sea equated to the new political geography of the sea:

> The term 'political geography of the sea' encompasses essentially those aspects of the Law of the Sea that have a spatial or territorial component; that is, many of the same topics which on land have long engaged political geographers but transferred to the marine environment' (Glassner 1986b:7).

The papers deal with the legal through studies of economic zones (Nanda 1986), the law of the sea (Abrahamsson 1986) and, amongst other issues, the delineation of maritime boundaries (Alexander 1986). Lines are drawn across the sea's surface, it is striated, and demarcated for geopolitical gain (for a more recent example see Bar-Noi 2015).

In spite of the historic centrality of the sea within geography it became somewhat side-lined in the 1990s. The advent of space travel which made visible the earth for the first time, air travel which made traversing the sea extremely manageable, and increasingly urbanised populations removing the sea from everyday experience, perhaps contributed to a form of sea blindness. Denis Cosgrove's paper on the significance of Earthrise and Photo 22727 is perhaps indicative of this shift. Initially the water in the earth photographs are central. Cosgrove writes of how 'the atmospheric haze, the cloud forms, and the colours produce a watery image of almost tearful intensity' (1994: 278). He describes the water in the clouds, the intensity as tearful, the blue is at the forefront. Yet far from focusing on the 'aqueous', Cosgrove inadvertently shifts his focus to the spaces being bridged by air travel with the sea acting merely as distance to be superseded. The images, whilst very 'blue' in their appearance, served as visual signifiers for one accessible world wherein space and time collapse as the sea is travelled over to somewhere more meaningful. As Cosgrove highlights, for airlines in the 1940s and 50s, the presence of the sea only served to demonstrate the scope of route systems, their sheer scale of operations, and their ability to pass over vast swathes of water to land. In a 'world of total connectivity' the sea is a space of pure distance to be superseded; 'connectivity itself functions to dematerialise the connector, the space in between' (Connery 2006:497). In spite of the historical literature, for scholars such as Steinberg (1999:368), Cosgrove's paper is perhaps indicative of how the sea became, in human geography at least, a 'forgotten portion of the planet' (Steinberg 1999:368).

Steinberg argues that this neglect occurred, in part, because 'the decline of sea travel and dependence on supplies has removed the sea from the realm of everyday experience' (Steinberg 1999:367), thus becoming a constitutive 'outside to landedness' (Connery 2001:77). The emphasis placed upon ownership and settlement in social formation 'and the meaning imbued in terrestrial environment' writes Jackson (1995:87), working to confine geographers to 'the interpretation and analysis of expressions and representations of land-based places and spaces' (88). Whilst the sea is obviously still vital to our existence; we fish in it, ship across it, extract resources through it, the vast volumes of the earth's oceans were represented by scholars such as Schmitt (2003) as the 'perfect and absolute blank'. Ocean space was annihilated in a bid to cross it quicker and to remove resources through its watery matter without paying attention to the matter through which these materials and objects move. The sea is, for Schmitt, a place without geography, and a space outside of geographical inquiry. It is not surprising, writes Connery (2006:497) that humanity, an overwhelmingly terrestrial species, should have terrestrial forms of thought, 'forms that in the encounter with the maritime would find a scene of negation, radical otherness, or utopian or dystopian release'.

As has been elucidated, conceptualisations that frame the sea as being somehow absent from geography are historically problematic and much can be gained from acknowledging earlier and more diverse contributions to maritime geographies. Moreover, when one considers the infinite, multi-faceted, and incredibly complex geographies of the sea, the assertion that the sea is absent from 'geography' lacks complexity. In a synthesising discipline, the silence on sea geographies perhaps reflects a lack of dialogue and exchange with the array of geographical actors that produce maritime knowledge, and a need to decolonise understandings of the ocean. For thousands of years the sea has been central to the geographical imaginaries of people who live and dwell by and on the sea. Nomadic communities in Southeast Asia are a prime example. The first European reporting on this way of life came with Magellan's crew (Nimmo 1968) but communities such as the Bajau have long live on and with the sea, generating a nuanced and complex understanding of the water, the life within it, and how to read its surface and depths for navigational, hunting and skin diving purposes – they live a life 'closely interlinked with the ocean' (Abrahamsson and Schagatay 2014:171), producing valuable geographical knowledge in the process[5]. Similarly, as Deloughrey (2017:35) highlights, in the context of the Caribbean, the ocean has long been understood as an important material entity. The enormity of transoceanic history of slavery and indenture have created an aesthetics that imaginatively populates the sea in an act of regional historiography and ancestral memory. The Atlantic has come to be understood as an unmarked graveyard, an 'oceanic archive' of the atrocities of the slave trade. We might also think here about the centrality of the sea in different geographic traditions. How have geographers beyond the UK and the US dealt with the sea in their research and writing?

Notwithstanding the above, claims of 'absence' have served as a powerful driver of a renewed engagement with the diverse range of geographies that take place on water. Indeed, in the last two decades, as part of a 'broader re-imagining of the spatial character and co-ordinates of human history and culture' the 'aqueous' element of the earth has been increasingly emphasised. It is now widely acknowledged that a terra-centric approach neglects the important role of watery spaces in processes related to landed life (Peters 2014, Lambert et al. 2006; Peters 2010; Steinberg 2001), an awareness that has become increasingly important in light of pressing and transformative global climatic and environmental changes. As Steinberg (1997:367) asserts land and sea are constructed through linked dynamics and whilst it 'may not be as markable as terra firma' (2013:160-

[5] In 2004, for example, Moken 'Sea Nomads' in Thailand alerted local communities to an impending Tsunami having noticed a sudden change in sea level. The Moken were widely acknowledged for saving the lives of those in the area as an entire village was swept away (Arunotai 2008:73).

161) ‘it has consistently been striated and zoned throughout the centuries, making some activities permissible for some actors and others not.’

As such, geographers are increasingly seeking to re-engage with and re-characterise the sea with scholars such as Peters, Lambert et al., Anderson, Spence, Lehman and many others capitalising on the ‘intellectually rich fodder that awaits other geographers who wish to venture offshore, where 71% of “place and space” exist’[6] (Wright 1999:437). Far from existing outside of state territory as a mere surface or connecting space to be erased, the sea is again re-emerging in geographical scholarship as a space that, like land, ‘shapes and is shaped by a host of physical and social processes’ (Steinberg 2009:490). As Mackinder, Maury, and Vaughan-Cornish and communities such as the Bajau have long realised, Anderson and Peters (2014:3) remind us that ‘our world is a water world’. Indeed, as Jones (2011:2287) highlights, satellite images‘ taken from centrally above the Pacific ocean are startling because the whole `earth' appears blue, with just a few fringes of land peeping over the circular horizon’ (Jones 2011:2287).

Foregrounding the sea’s materiality has proved to be a productive means of pushing against and resisting the conceptualisations, such as those put forward by Cosgrove and Glassner in their respective sub-fields, that both de-materialise and de-characterise the sea. Human geography is ‘afloat’ with an increasingly diverse range of scholarship encompassing the ‘relationalities and materialities that transcend typical human-non-human, wet-dry boundaries’ (Spence 2014:203). Lambert et al. (2006) for example, highlight how the oceans themselves (rather than just human activity on the ocean) warrant further attention whilst Peters (2010: 1265) explores how ‘three-dimensional, fluid and liquid’, undulating surfaces, textures, currents and substance of the water impact the ‘contemporary and social uses of the space’. Peters does this by engaging with the pirate radio ship, *Radio Caroline*, exploring how the seas’ materiality interacts with the ship, broadcasters, and listeners. The boat, for example, drifts and changes direction at the whim of the waves, the broadcasters suffer from sea sickness, get disorientated and experience a sense of excitement at what the sea might throw at them next. The listeners are in turn exposed to the sea through intermittent radio signals, sounds, and atmospheres travelling from the

[6] When the earth is considered as a three dimensional sphere rather than merely a circular crust this reduces to 0.12%.

ship through the air to their radios. These interventions, as Spence (2014:204) highlights, are increasingly relational, ‘concerned less about the agency of discrete entities, and more about the relational processes within and between them’. This is perhaps illustrated in the work of Anderson (2012:27, 2014) in his analysis of the ‘relational sensibility of surfing’ and his phenomenological experience kayaking, or in Bremner’s (2014) work on the agency of the sea in confounding the search effort for the missing Malaysian Airlines flight, MH170. Steinberg (2013) also focuses on the ocean’s materiality. The oceans should, according to Steinberg, be understood as ‘physical entities: as wet, mobile, dynamic, deep, dark spaces that are characterised by complex movements and interdependencies of water molecules, minerals, and non-human biota as well as humans and their ships’ (Steinberg 2013:159). From this perspective, the underlying material nature of the earth’s vast waters must be understood as ‘emergent with, and not merely as an underlying context for human activity’. For Steinberg, it is the mobile nature of the ocean that makes it a productive space of inquiry within geography. ‘The complexity of the ocean as a mobile space whose very essence is constituted by its fluidity and that thereby is central to the flows of modern society’ (2013:159)– the mobility of the sea takes centre stage here, utilised as a space from which to explore the flows and mobilities that make social and cultural life.

To interpret and analyse the seas from this perspective, ‘movement, instead of being subsequent to geography, is geography’, the world constituted by mobility and movement without a stable grid of places or coordinates (Steinberg 2013:160). This ontology is drawn, in part, from oceanography and Langrangian fluid dynamics wherein oceanographers trace the paths of ‘floaters’ that travel through the seas. As they move, the sea is made known through their mobility (Steinberg 2013:161). Similarly, Steinberg suggests that through the movement of the sea itself, we can begin to interrogate the circulations that take place on and in it whether that be the ideas, people, commodities, and ships that move across its surface or the fish that swim beneath the surface. In other words, the sea becomes the ‘object of our focus not because it is a space that facilitates movement, but because it is a space that is constituted by and constitutive of movement’ (Steinberg 2013:165). Incorporating the seas’ motions and materialities in the ways described above offers the potential to further unlock ‘human geography from its land bias’, to ask all kinds of interesting questions about the world we live in' (Lambert et al. 2006:406), and to revise conceptualisations of the sea as an empty space.

Lehman (2013b), for example, seeks to 'enliven the ocean as an actor' that exercises agency in her analysis of a community living along the coast of Eastern Sri Lanka post 2004 Tsunami (2013b). Far from isolating the sea from her study, Lehman enrols it in a network of human and nonhuman actors as an entity with its own agency, and 'aliveness' that dynamically shapes reality and exerts a direct influence on the lives of those who fish in it, live by it, and rely on it for their daily existence. The sea emerges through Lehman's work as more than an empty 'stage for human drama': it acts, conceals, transforms, rebels, cooperates, and (mis)-behaves in 'myriad ways that are highly influential and not entirely predictable' (2013b:497). In behaving as 'actor and network', Lehman argues that the ocean serves as a nexus for relations and discourses on power, politics and security, and in doing so, allows greater insight into the various and interrelated forces of conflict, disaster, environmental change, and the racial, gender, class experiences of those who live (sometimes precariously) at these intersections. Notwithstanding the valuable interventions proffered by the contributions mentioned throughout this chapter, there remain a number of lacunae in academic engagements with the sea in contemporary human geography, and indeed in contemproary political geography. The following sections of this chapter will begin to address a number of these, and in particular ask questions of how to take seriously the depths of the sea (not merely the surface) and how to incorporate discourse on the body (human and non-human), the elemental, and questions of scale within this seemingly uninhabitable space.

2.2 Depth, bodies, and submarine life

> 'If we consider in the appearance of things only that which is intelligible to us, then we would be at best partially sighted. At worse, we would bring a frame of reference to bear on a material world that is a hindrance to the very possibilities of intelligibility of that difference' (Yusoff 2014:43)

2.2.1 Bringing depth to volume

The 'global political space' '*across*' which geopolitical meanings and identities are constructed, was, for Toal and Dalby (1998 see also Agnew 1998) very much a land based affair. In a world 'of perpetual speed and motion, convulsed by globalization, saturated by information, and entranced by ephemeral media spectacles and hyperbole', Toal and Dalby situated geopolitics as a discipline concerned with stark boundary making practices. In this conceptual framework, 'diverse places' are converted into a unitary internal space with boundaries and an established 'outside' against which identity is formed. In other words, critical geopolitics was characterised by boundary drawing practices that are made manifest '*across* the landscapes of the state' (4). As Toal and Dalby (1998:3) assert, the geopolitical imagination:

> 'is certainly at work in the projecting of a visual order of space, usually in the form of cartographic surveys and national atlases, *across* an uneven and broken landscape that is being territorialized with lines delimiting administrative provinces and an official inside and outside' (emphasis added).

Recent work on territory by scholars including Stuart Elden has suggested that ideas of 'territory as bounded spaces with control exercised within them is at a best a partial definition that needs to be challenged' (Elden 2013b, 2014). For Elden, this might be achieved conceptually by conceiving of territory as a process rather than an outcome, 'as something continually made and remade, as dynamic' or a mode of operating that produces a 'mutable and fluid' construct' (Elden 2013b:330). This might also be achieved by rethinking the very spaces of territory. In the above quotations from Toal and Dalby, the word 'across' (marked in italics) is used numerous times. Clearly, when writing their text, the surface was privileged and territory, and the spaces of the political, were understood as sites that exist on a two dimensional plane on which people move across rather than under or over. From this perspective geopolitics is constructed on a grounded surface that is understood along the horizontal x-axis and airspace, subterranean infrastructure, and volumes such as water columns are less well accounted for.

Recent scholarship by Weizman (2002), Elden (2013) and others, has recast territory, challenging the flat, terra centric bias that has characterised political geographic scholarship. Their research demonstrates that geopolitics does not take place across the flat, two dimensional plane traditionally associated with sovereign spaces and in doing so, brought spaces, materials, and objects that had otherwise evaded scholarly attention into the frame (see also Clark and Jones 2016). Weizman's (2002) work is indicative of this paradigmatic shift, bringing volume to geopolitics through an exploration of territory and sovereignty in Israel and the West Bank. This protracted, highly volatile territorial contest could not simply be mapped in the atlases and cartographic surveys to which Toal and Dalby refer (see above). As an example, the Palestinian Authority was granted control over isolated territorial 'islands' but Israel retained control over their airspace and the sub-terrain beneath - spaces that cannot be represented or interrogated within a traditional, two dimensional geopolitical framework. On the contrary, within this 'politics of verticality' Weizman's analysis moves from the hills and valleys of the West Bank, to the politics of water and sewage, to subterranean infrastructure and archaeology beneath the ground, to the control over airspace. As it does so, the two dimensional territorial construct is unravelled, engulfed by three dimensional volume, and layered with 'strategic, religious, and political strata'. Elden (2013) uses Weizman's territorial critique as a platform through which to re-focus on ideas of height and depth. With particular reference to the subterranean tunnel infrastructure in Israel and the West Bank, Elden explores how territorial sovereignty and security extend along the horizontal and vertical axes. Moving discussions on territory 'into the atmospheric heights and geologic depths of the earth' (Clark 2013b:49) Elden concludes that we need to think about volume and through volume, rather than simply through the vertical to grapple with the complexities of territory, power and security.

The emphasis on the heights and depths of political geography, and a recognition that the social, cultural, and political practices that make legible the reality of the world politics take place beyond the earth's surface, has prompted a number of interventions that deal with geopolitics beyond terra firma. The air, in particular, has proved a fruitful space for highlighting vertical expressions of power in and through the air, for example via surveillance mechanisms and a police presence (Neocleous 2013, Williams 2010, 2011, Gregory 2011, Graham and Lucy 2013); but also that the air can be a politicised substance in and of itself (Adey 2015b).

These discussions however, are yet to percolate down in a meaningful way into the depths of the sea. It is important to note here that when I used the term, 'depth' I do not simply mean a downward extension of the vertical. Rather, I am referring to an immersive condition whereby the water becomes in and of itself a distinct three dimensional volume that can be inhabited as well as theorised (see Deloughrey 2017). One might argue that even the labels 'undersea' and sub-marine' used throughout this thesis for conceptual clarity, have the effect of framing the sea as inherently superficial. In other words, the surface is the starting point of analysis – to engage with depth is to move beyond the surface space rather than taking the deep volume as being a significant starting point in and of itself. 'It is often remarked that the sea is less explored that the moon' but, as Yusoff (2014:44) writes, this is perhaps unsurprising given that the moon is a visible surface. Unlike the sea, with its 'modes of illumination' the moon becomes 'that which we can see' and therefore engage with. The depths of the sea however are somewhat more recalcitrant and resistant to the human gaze.

While recent geographical scholarship embraces the surface of the sea through surfers, kayaks and ships, the geographies of the deep remain relatively unaccounted for. The sea has remained predominantly as something to move on (not under), look across, drift across – a space 'over which man explores and colonises and trades' (Semple 1911:294 in Steinberg 1999:368). This being said there are some exceptions to this that demonstrate how the sea column and floor have been pivotal to geopolitics. Dodds and Nuttall (2016), for example demonstrate how the imperative to think with and through the volume of water (albeit sometimes in its frozen form) has been pivotal in understanding the so called 'scramble for the poles'. The Cold war provides their temporal frame here and it is one that is also useful for interrogating the role of depth and the intersection of science, oceanography, and the military at sea beyond the Polar Regions.

Historians have undertaken a great deal of work to interrogate the multifarious ways in which the geophysical properties of the ocean and military collided during the Cold War (Oreskes 2003). During this time period, militaries were embroiled in a concerted effort to 'see' beneath the sea (Turchetti and Roberts 2014). In a significant surveillance transformation, human communications formed but a small part of the data gathered by state actors. The oceans, sky, celestial space, the surface and the interior of the earth were all subject to extensive and strategic surveillance; as Turchetti and Roberts (2014:2) assert 'gathering information from enemies was inextricably linked to gathering information about the earth from the beginning of the Cold War'. Rather than being understood as a discrete activity linked to concrete state aims, they call for surveillance to be conceptualised during this time period as a more general imperative to understand and control both the earth and its inhabitants. An enormous influx of state funds to the geosciences in the 1950s and 60s enabled this to take place with significant results; knowledge on the circulation of jet streams and ocean currents, for example, contributed to antiaircraft defence, whilst concerns over Soviet submarine activity were countered by vast investments in oceanography (Hamblin 2002). As Hamblin highlights, Admiral Arleigh Burke felt that scientific research was an essential component of America's national defence strategy and necessary to 'subdue the ocean environment, to make it a manageable and even advantageous battlespace' (Hamblin 1992:15). Arguably, writes Hamblin, oceanography in the US owes its existence as a 'mature discipline to financial and logistical assistance from the Navy' and the formation of the Office of Naval Research (ONR). The relationship between oceanographers and Navy personnel was symbiotic with the Cold War geopolitical context having a 'decisive influence in configuring a new understanding of the terraqueous globe' (Deloughrey 2017:32). According to Hamblin (1992:3), the oceanographers wanted to conduct research and the Navy 'wished to know everything there was to know about its own workplace – the sea environment'. The military applications of the data remained classified – even to the scientists, so many simply pursued their own ideas with the navy using the research as it saw fit and to provide constant operational information for defence systems. Information garnered by Woods Hole Oceanographic Institution on underwater acoustics, for example, proved vital for the operation of US submarines. On the other hand, however, the scientific community was divided between researchers who relied on Navy funding and those who refused to do so and thus had to rely on less advanced and less expensive oceanographic techniques (Hamblin 2002:4). The Navy, then, wielded great power over the production of oceanic knowledge during the Cold War and the elemental science of the seas became not only assimilated into the 'highest levels of national security and foreign policy planning' but a prime carrier of the American flag (Doel 2003:636, see also Oreskes 2003).

Engagements with the elemental aspects and the *geo*politics of sea space clearly feature strongly in historical and military accounts of the Cold War. Military services claimed to need an understanding of, 'and an ability to predict and even to control the environments' in which they operated and this required quenching an intense 'thirst for geophysics intelligence' (Doel 2003:638). This being said, they are very particular engagements with the submarine environment that were mediated through technology and calculation. We also see this measured, calculated approach in Hannigan's (2016) account of *The Geopolitics of Deep Oceans*. The ocean, according to Hannigan, 'is divided up and classified both vertically and horizontally'. Drawing on Elden's (2013) work, he states that the ocean must be conceptualised as a volume to avoid 'the trap of treating geopolitics as a flat discourse' yet in not attending to critical engagements with Elden's work, Hannigan perhaps inadvertently overlooks that which would enrich our understandings of depth. For example, Hannigan approaches the topic entirely from a policy discourse perspective. Using this framework, he interrogates the 'deep' through four key concepts: oceanic frontiers, governing the abyss, sovereignty games, and saving the ocean. Whilst there is great scope within these four categories, his analysis falls short of really 'deepening' our understanding of sub-surface geopolitics. This is primarily because, like Glassner (1986) and Steinberg's early interventions (1999), his methods are inherently tied to the surface. Policy documents engage with the sea as a space on which to write over or 'striate' (Deleuze and Guattari 1987) wherein the geographic gaze extends across the sea from land rather than inhabiting the sea itself. As an example, whilst it is not depicted, Hannigan refers to the legal delineations pictured below (2016:4, see also Dodds and Nuttall 2016:42). The continental shelf, EEZ, contiguous zone, and high seas are lines that extend outwards over an empty, lifeless, motionless water column. This raises some interesting questions. What, for example exists between and beneath these lines? How do the lines stretching over the surface affect the space beneath? How does the geographic imagination function in the blank space with its associated pressures and viscosities? These are questions that will be addressed in the coming chapters as the two dimensional legal gaze is disrupted and challenged by various bodies and materials.

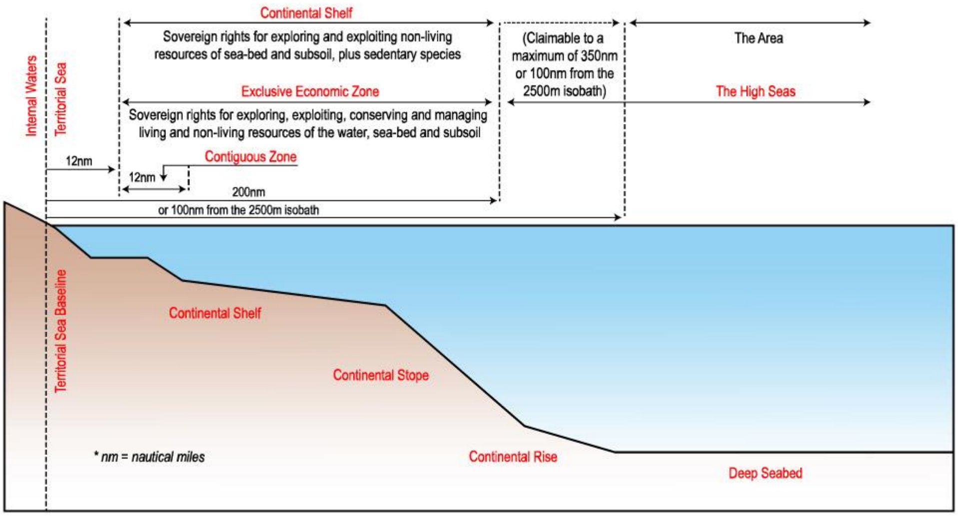
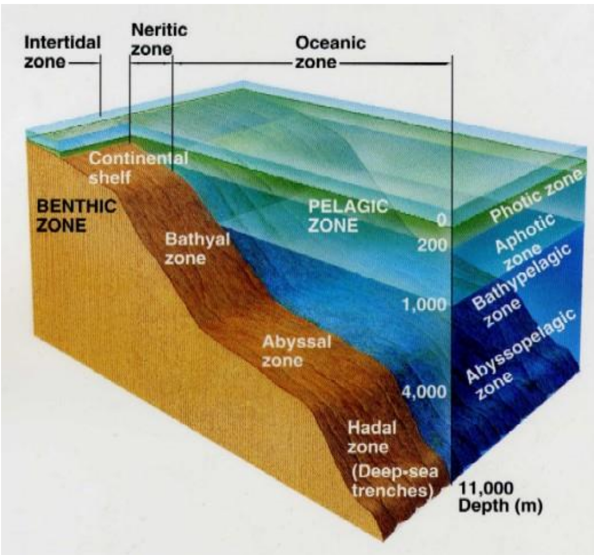


Figure 6: legal boundaries extending from the coast to the High Seas – the sea itself is simply blank space (source Fisheries and Oceans Canada, http://dfo-mpo.gc.ca/science/hydrography-hydrographie/UNCLOS/index-eng.html).



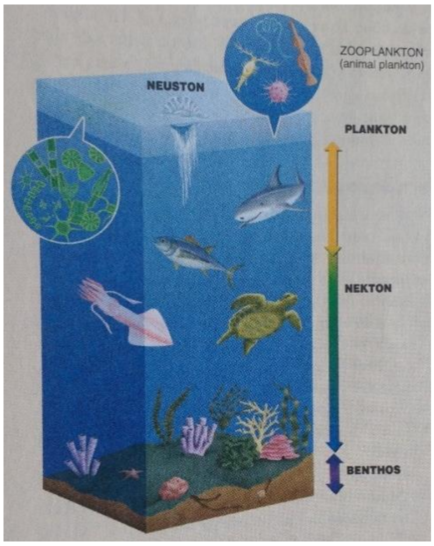


Figure 7 (le): Filling in the blanks: Basic ocean zones ranging from the Abyssal to the Pelagic (Shreeves 2005:2-7) Figure 8 (right): Depth and marine organisms (plankton live on the surface, nekton live in the water column and bethnic organisms on the sea floor) (Shreeves 2005:2-7).

Figure 6 differs markedly from the representations in Figures 7 and 8 which details different portions of the water column. Depth is given character by different layers[7] and defined by phenomenon such as light penetration and the water's ability to sustain different life forms. The image was originally found in the PADI recreational diving encyclopaedia (Alexander 2005:6-7) which, whilst not an academic source, highlights the different ways that the water column can be characterised when your starting point is one of immersion in the sea itself rather than gazing along lines extending from land. As Rozwasowski highlights, this could be extended one step further were these categorisations to be less structured, more fluid, and better able to acknowledge the ways in which human understandings of 'undersea' have changed over time in reference to 'human ability to survive in an environment otherwise hostile to humans' (2010:522). Furthermore, understandings of the sea as an operating environment and beyond could perhaps be enriched by incorporating other approaches to volume. Indeed, one of the key criticisms of Elden's (2013) paper on territorial volume was that it is pre-occupied with the calculable, the measured, the geometric as opposed to the immersive, the affective, and the embodied (Adey 2013a). In other words, Adey argues that we need to engage with the 'things', the bodies, and the atmospheres that fill volumes and that shape human experiences within voluminous spaces. Unlike air, the sea has perhaps been overlooked as a space where lived, embodied experiences and experiments take place because of the practical challenges of conducting research beneath the waves. We read, for example, of military landscapes (Woodward 2014) but rarely do we read within geography of military seascapes – or even sub-seascapes.

This is perhaps in part due to assertions that frame the sea is largely 'inhospitable, detached from shore, physically unstable, immensely deep and uninhabitable' (Steinberg 1999:369). This is clearly true in many instances, it risks masking the wide range of human and non-human embodied encounters that take place beneath the sea's surface. In physical geography and oceanography, for example, Wright (1999:429) acknowledges that whilst the fundamental limitation of conducting scientific research in submersibles is the 'human component', 'man' remains a valuable and necessary element of deep sea investigate capability. The ability to see and experience the deep is an important aspect of undersea knowledge production with submersibles such as the Alvin (a three person submersible owned by the US Navy and used by Woods Hole Institute of Oceanography) pivotal in establishing theories of continental drift and plate tectonics (Wright 1999). Whilst Hannigan (2016) alludes to the Alvin and other submersibles, embodied experiences remain largely absent from his account except, somewhat ironically, from the front cover (see Figure 2) which depicts divers unveiling the American flag underwater – an image that in itself powerfully demonstrates the need to engage with this space beyond discourse. Similarly, in Rozwadowski's account of *Ocean Depths*, the human body remains largely absent. 'The vastness of the sea, in all three dimensions' writes Rozwadowksi (2010:521), 'impedes meaningful scientific knowledge based on direct personal experience and demands, instead, systematic sampling using standardised instruments'. Engaging with the body *and* the sea would give new insight into studies of 'depth' as it is experienced, and as knowledge is wrought by scientists and physiologists about the 'deep' in order that it might be inhabited.

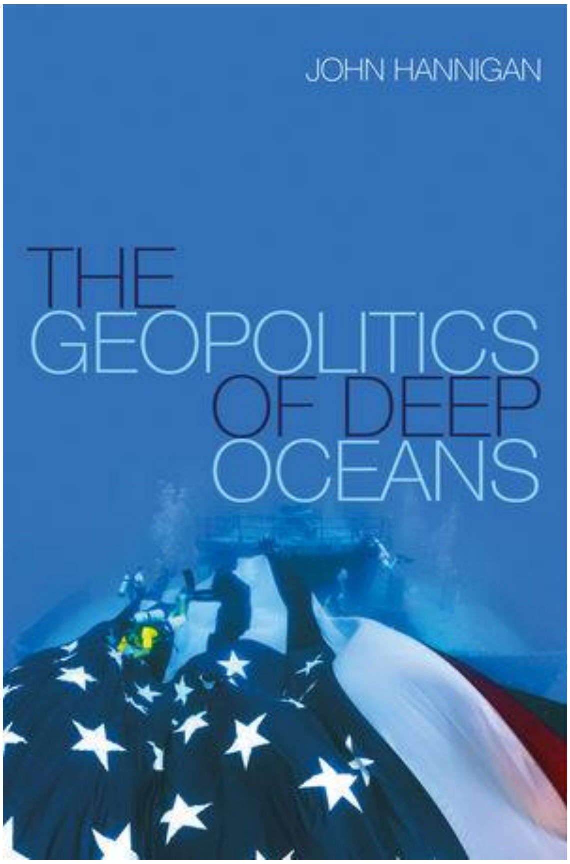


Figure 9: The front cover of Hannigan's (2016) book – the bodies on the front cover are left in 'no man's land' once the page is turned.

There is also something to be said here about the natural draw of the sea to 'man'. Numerous scholarly interventions refer to the sea as the element from which the human race emerged, citing our ancestors as the reason that humans today remain fascinated with the sub-marine. Peter Sloterdijk (in ten Bos 2009:74), long concerned with the spheres and volumes of human habitation (from womb to globe) goes as far as to describe the human being as a 'moving animal which longs to change elements', a creature yearning to break free from the mono-elemental (in Ten Bos 2009:74). Almost 2,000 years ago, Greek geographer Strabo too alluded to the intricate and slightly mysterious relationship between man and sea writing that 'we are in a certain sense amphibious, not exclusively connected with the land but with the sea as well (cited in Steinberg 1999:368). As Helmreich (2010:49) highlights, poets such as Byron and Shelley 'celebrated the sea as a seductive substance with which we humans might seek to merge, dissolving our bodies into the nourishing matrix of life itself…recognising that an oceanic past swims through our most intimate substances: our blood, sweat, and tears'. This sentiment is echoed by Sylvia Earle who writes that 'our origins are there (in the sea), reflected in the briny solution coursing through our veins' (15).

We see this innate connection made manifest in imaginative constructs of undersea-space. Le Du Blayo (2014:167) for example highlights that in many comic books, characters move seamlessly from one element to another; they are amphibious, capable of living in both air and water, where 'the limit between the terrestrial and the underwater worlds disappears'. *20,000 Leagues Under the Sea* by Jules Verne is another oft cited example of man forsaking land to, as the quotes below demonstrate, reside in the mysterious, desolate yet abundant, emotive space of the sea[8]:

> 'The sea is only the embodiment of a supernatural and wonderful existence. It is nothing but love and emotion; it is the 'Living Infinite'...The globe began with sea, so to speak; and who knows if it will not end with it? In it is supreme tranquillity' (Verne 1869:52).
>
> 'The sea is everything. It covers seven-tenths of the terrestrial globe. Its breath is pure and life-giving. It is an immense desert place where man is never lonely, for he senses the weaving of creation on every hand. It is the physical embodiment of a supernatural existence' (Verne 1869:58).

[8] There is clearly scope here for a popular geopolitics of the sub-marine. This is something that warrants further attention but is beyond the scope of this thesis

Whilst the likes of Verne's *Nautilus* have remained confined to his book, we might look to the practice of diving[9] to explore this intricate and seemingly otherworldly interaction between 'man' and sea. Already in these two short extracts we these intersections come through strongly. The sea, like a human body, is described as having 'breath', it is a 'physical embodiment' – 'nothing but love and emotion'. Verne may not be a geographer but he was fulfilling a geographic function in the construction of the 'deep' and the interweaving of the human body with a body of water. Geography, with its concern for space and place both at land and on sea is well placed to address the significance of these imaginaries. Social and cultural geographers such as Straughan (2012) and Merchant (2011a, 2011b, 2014) have already undertaken work to establish the importance of embodied encounters with undersea space. The diving body is, as Merchant suggests, 'an understudied topic of research within geography' (2011:134, see also Straughan 2012) and there is much to be gained by rectifying this.

The underwater seascape, like land, comes into being through practice by drawing variably on 'embodied, material and discursive domains' (Macpherson, 2010: 6 in Merchant 2011a). The seascape according to Macpherson is no longer considered 'an inert background or setting for human action, nor is it understood as solely a pictorial or discursive form of representation'. If this is to be reconciled in academic discourse, then the novel characteristics of undersea space (its temperatures, textures, viscosity, atmosphere etc) must be understood (Merchant 2011). Straughan (2012:19) contributes to this discussion by engaging with the sense of 'touch' in the aquatic world and exploring how scuba diving brings together 'the distal and the proximate' to facilitate the 're-centering of the self. For Straughan, undersea space can function as a therapeutic landscape, one that can instil a sense of wellbeing and calm for the body moving through it. Helmreich (2007:624), on the other hand, describes how the water can disorientate. Merchant (2011a:216) too points to a sense of otherness instilled by the 'dense water world' writing that:

> 'Surely the point of modifying one's body, with prosthetic dive equipment, is to adapt to and explore an 'other' world, to one's self? Isn't the point to observe the

[9] Here I am referring to the practice of scuba diving or diving with an artificial supply of air.

sea's spectacle, to learn about creatures and seascapes that are far removed aesthetically and biologically from those of the land?' (Merchant 2011b:54).

For Merchant, the diver is introduced to a 'different way of being' (rather than simply seeing) to the everyday spaces of land. Similarly Lambert et al. (2006:484) describe the sense of 'detachment from ordinary life' provided by the sea. Mediated by diving technologies, the body's senses will alter; things will appear larger and closer through the water; directions and sources of sound will be difficult to establish as sound-waves move faster through the water than in the air - all affecting the ways in which the water is experienced by tourists. Straughan and Merchant have been extremely successful in taking sea geographies beyond surface. Their interventions deal with the body as it immersed in water and the social, cultural, embodied implications of this yet, there is certainly a geo-political dimension that has been neglected. The lack of attention afforded to these dynamics may be because it is a space that is sometimes understood as 'an uninteresting abyss', as something 'outside of state territory' with attributes that 'deter permanent, sedentary habituation' (Steinberg 1999:369).

2.2.2 The Body in Geopolitics

'Contemporary geo-scientific visualisation drains the oceans dry, eradicating the play of the motion and mutability to which the watery gives rise, shining the light of reason into its dark spaces in order to produce virtual landscapes , as scenic as they are scientific over which the disembodied eye may roam unhindered' (Lee 2014:14).

Whilst engaging with the body would enrich understandings of depth, or the sub surface environment, the body is also a productive site of analysis in its own right. As Simonsen (2000:7) highlights, geographies of the body have become the subject of a rapidly expanding literature. In political geography this shift has been championed by feminist scholars seeking to introduce questions of scale into geopolitical thinking. In questioning the dominance of male state-state international relations, geographers such as Jo Sharp and Lorraine Dowler have sought to shine a light on the 'hidden and insidious workings of power' that may occur in everyday life, in unexpected places and spaces, and which work in and through the body (Dowler and Sharp 2001: 167). A feminist geopolitics is, according to Dowler and Sharp (*ibid*), 'an embodied position where different scales of analysis come together' and a paradigm through which to challenge disembodied 'spectator' theories of knowledge that have long pervaded geopolitical discourse (Dowler and Sharp 2001:166).

Contrary to the disembodied writings of Toal (1998), Dowler and Sharp argue that geography has been enriched by an appreciation of the ways in which phenomenon, such as international relations, are affected by and reflected in embodied practices and lived social relations. Rather than conceptualise the body as a mere surface for geographical and discursive inscription, this position asserts that bodies are important sites in their own right. This does not come at the expense of discourse or representational modes of analysis, rather it is to interrogate geographical phenomenon with greater attunement to actual lived practice (Dowler and Sharp 2001:169). At the same, write Dowler and Sharp (172), the impacts of the movement of global geopolitical discourses onto individual bodies need to be examined (see also Dodds 2014).

Whilst Dowler and Sharp are concerned with the voices and bodies on the margins of geopolitics (such as women and differently abled bodies), we might also turn to the work of Matthew Farish to understand the purchase of interrogating at the bodily scale within the discipline. Farish (2006) explores the confluence of science and military strategy in the 'hostile' frontier environment of the Arctic during the Cold War. The US military in Farish's study sought to catalogue and comprehend the 'liabilities of the arctic terrain' in order to overcome, harness, and transform it to enable 'man to work with the cold rather than against it' (2006:184). This process involved constant study and experimentation to adapt 'men' to the Arctic's demands with bodies and machines closely coupled in an intimate and intricate relationship between body, environment, and technology. The 'national scale' writes Farish (2006:177) 'must be placed next to the finer perspectives of military bodies' as individuals became the focus of attempts to overcome the Arctic. Physicality was clearly important here but so too was the 'conditioning of minds…the key to Arctic survival was a state of calm rationality' with psychology encompassed under the umbrella of geopolitics.[10]

Like the Arctic environment itself, the body became in these military research programs 'a category, a vessel through which ideas of arctic geography could be expressed' – it was, like the location it inhabited, *extreme'* (Farish 2006:191 emphasis in original). Farish (2013) also highlights how the bodies of indigenous Alaskans were caught up in this process precisely because they were seem to be living so successfully in the extreme cold. Their bodies, writes Farish (2013:5) 'collectively comprised a medical mystery that if deciphered would aid troops in Alaska'. The body here became its own three dimensional volume to be understood with military scientists and medical professionals enrolled to peel back the border of the skin and answer physiological questions. Military objectives and the landscapes of military occupation came to be experienced at personal scales (Woodward 2014) - the military gaze over the landscape finding expression through the physiology of those who lived, moved, and worked there and a mastery of the Arctic landscape achieved at scales from the body to the environment (Farish 2006).

Foucault's conceptualisation of biopower and Agamben's understandings of bare life are useful here in honing in on this bodily scale as a site of intrigue and interrogation within political geography. Whilst biopower is a term that morphs and mutates as it is drawn into connection with theorists, issues, sites, and concerns, it can broadly be defined as a mechanism through which to understand how 'life has become the 'object target' for specific techniques and technologies of power' (Foucault 1978: 142-3 in Anderson 2012:28). Under a biopolitical regime, the ultimate expression of power over legal subjects is no longer death. On the contrary, 'ultimate domination' is concerned with mastery over living beings at the level of 'life itself'. The referent object of power thus becomes the living being (or the life contained within the body) and interventions from the state might aim to optimise or manipulate this life, or a population of lives, often against some form of threat

[10] It is worth noting at this point that the psychological is an under represented feature of embodiment within critical geopolitics and is worthy or further interrogation. How, for example, were minds trained and conditioned alongside bodies to withstand the pressures of a 'hostile' environment?

(Anderson 2012:30). Natural life, or bios (the form of living) becomes incorporated into the 'mechanisms and calculations of state power' and 'the species and individual as a simple living body become what is at stake in a society's political strategies (Agamben 1998:3).

Drawing on Foucault and discussions on biopolitics, Agamben furthers this line of thought to incorporate the entry of 'Zoe' (the simple act of living as opposed to the form of living) 'into the sphere of the polis' (Agamben 1998:4). This is the politicisation of bare life and it is a form of power that necessitates and legitimates total domination as is powerfully illustrated in Agamben's case study of the concentration camp. For Agamben, Nazism provides an example of a 'properly biopolitical' movement wherein natural life was made the exemplary place of sovereign decision (129). The bodies of individual prisoners became subsumed and incorporated into a regime that stripped the 'Zoe', leaving a body that could be experimented on, tortured, killed, and dissected. We might also use this case study to draw attention to the spaces in which these atrocities occurred –as with Farish's work scientific sites and labs were key. In May 1941, for example, a German doctor who had been working on rescue operations from high altitudes contacted Himmler asking for three professional criminals to experiment on. A compression chamber was installed at Dachau for the versuchpersonen (human guinea pigs) and a number of bodies became subjects. A 37 year old Jewish man was one such body and he was subjected to the equivalent pressure of 12,000m of altitude. After 10-30 minutes he had died, his body subsequently dissected. The extremes of the concentration camp, however, are not a pre-requisite for the power politics of bare life to unfold. In the US in the 1920's, 'people held in US prisons on death row were infected with malaria plasmodia in an attempt to find an antidote to plaudism' (Agamben 1998:156). Similarly, during the Second World War, inmates of the Statesville Penitentiary were 'were made into reservoirs' for malaria and 'food sources for mosquitos' whilst being treated with experimental drugs, often with 'vicious side effects' (Comfort 2009:1). In this instance, the inmates became heavily involved in the research project, 'recording data on one another, administering malarious mosquito bites and experimental drugs to one another, and helping decide who was admitted to the project and who became eligible for early parole as a result of his participation'. The post Second World War, early Cold War era, became the 'heyday of human experimentation in America' – plutonium was injected into people by the military to study the biological effects of radiation, soldiers were subjected to poisonous gases, and the list could go on. Typically using prisoners or conscientious objectors as subjects, the US military and government believed that ‘human experimentation is not only desirable, but necessary in the study of many of the problems of war medicine which confront us’ (Comfort 2009:6). The state, life and the body became powerfully intertwined during this time period as sovereignty was exercised not merely over a given population but over the minute, bodily workings taking place beneath the skin.

These noteworthy interventions have been successful in drawing the geographer’s gaze toward the body in order to better understand the ways in which power and sovereignty circulate and are embodied. Yet understandings of power and the body remain tied to terra firma. When the geographic gaze ventures off land and beneath the sea, it is often a ‘disembodied eye’ that brings knowledge to the surface. In neglecting the body, the nuanced information garnered on land through feminist and biopolitical discourse is lost. The water becomes a space that lurks at the ‘edge of the picture’ (Woodward 2005:731), a space that technology may pass through but which bodies are unaffected by. One only has to turn to popular culture, or to legendary military divers such as Buster Crabb (see preface) to appreciate that power is exerted through the body in the sea by states and militaries. Questions then remain about how this takes place. How, for example, does the sea itself prevent, enable, or constrain the military body in the sea? How have bodies been experimented on to understand how depth and pressure work on and beneath the skin? What are the legacies of diving innovation in contemporary geopolitics? In seeking answers to these questions we can begin to give a body to the ‘disembodied eye’ that roams beneath the sea and begin to construct ‘knowings’ that no longer ‘rely on the work of the proxy’ (such as sonar and scientific visualisations) (Yusoff 2014:47). Rather than ‘draining the oceans dry’ (Lee 2014:14) as the quote at the beginning of this section suggests, understanding the immersed body might be a productive means of reintroducing water and garnering new perspectives. Places and spaces are, after all, ‘never simply given’ but constructed through phenomenological experience, embodied practice and particular sets of ‘strategies and apparatuses’ (Clark 2013: 2827-2828).

2.2.3 Nonhuman bodies

More broadly, geographers are increasingly questioning how humans and non-humans relate (Peters 2012, Hobson 2007). As highlighted by Bear (2010), following the work of Wolch and Emel (1995) there has been a burgeoning literature on animal geographies. Inspired, in part, by Latour's Actor-Network Theory, the primary aim of such an intervention was to dislodge the assumption that animals are 'little more than a background to human society'. On the contrary, Hodgetts and Lorimer (2015:286) suggest that animals matter as political and ethical subjects and that attending to the 'spatial behaviours of all animals (and other nonhumans) provides what Lulka terms, a 'thicker' sense of the Earth'. As Hodgetts and Lorimer (ibid) suggest, animal geographers assert that a focus on animal geographies can 'tell us something about us' as humans. Hobson (2007:251) too seeks to bring animals into the fold of political geography. Rather than conceptualise animals as objects of resource struggles, she argues that they are part of and not incidental to 'specific political configurations' as subjects that enabled a 'broader conceptualisation of the how the 'political' is constituted'. According to Hobson, the reason for this is two-fold. Firstly, 'animals are already subjects of, and subject to political practices (through trade, consumption, regulation etc)', and second, Hobson suggests that 'animals can be considered affective political subjects' that play a vital role in the formation of the 'dynamic systems and processes that constitute the natural world'. In acknowledging and engaging with the boundaries and fluidities between the human and the non-human animal, a political animal geography would be well placed to explore the processes, practices, and specificities of the 'diverse modalities of power at play' (Hobson 2007:257). Writing some nine years after Hobson, Srinivasan (2016:76) comments that there remains a lack of attention on the political in animal geographies.

In addition to a lack of the political, much of the focus within this sub-discipline of geography has attended to life on land. Yet, as Lambert et al. (2006) have argued, in order to understand maritime spaces then maritime scholars must also consider the role of non-human actants in shaping the sea. There is a need to look 'beyond obvious' and visible 'marine features to more obscured uses and life at sea: …animals, fish, and underwater worlds' (Peters 2010:1267). Bear and Eden (2008) have gone some way in filling this lacuna in their exploration of the relationship between humans, the sea, and fish through the various spatialities of the Marine Stewardship Council. Fish, by their very nature are hard to regulate – they move and in doing so defy human made boundaries. Attending to these recalcitrant animals and their impact on man-made regulatory systems 'reminds us that geographies of the sea could be further enhanced by exploring not only what happens on the surface of the water, but also beneath' (Bear and Eden 2008:490). Encompassing 'animals and sea life as objects of study' clearly has great potential (487) and Bear further demonstrates this in his study urging geographers to take *individual* animals seriously as part of an 'ongoing project of studying the intertwining of human and non-human lives' (2010:300). As Bear highlights, this does not mean that these encounters are easy either in 'practice or in interpretation' but to leave them unaccounted for runs the risk of 'leaving lives beyond direct encounter invisible – especially it might be argued, when these lives are lived in spaces away from direct human gaze, such as in the deep ocean' or 'non-airy spaces' (2010:297-300).

As evidenced by Buller's (2013, 2014, 2016) series of reflections in *Progress in Human Geography,* animal geographies are 'blossoming into a vibrant and diverse sub-field of cultural geography' (Hodgetts and Lorimer 2015:291), accounting for moral landscapes, animal rights, domestication, an inclusion and exclusion across a variety of sites from zoos to urban environments (see Collard 2012). Alongside this has been the emergence of a political approach to animal geographies – largely in discourse concerned with animal rights and the animal as a political subject (Milligan 2015[11]), but also an approach to animal studies that frames military or service animals as 'tools' of warfare (Cudworth and Hobden 2015). As Vint (2010:444) asserts, animal bodies, much like human bodies, are 'shaped and controlled by modes of biopower that designate ways of living and dying'. In this biopolitical, or 'zoopolitical' (Vaughan-Williams 2015:2) regime, animals are viewed as objects to be controlled rather than 'sentient beings' capable of interaction, emotion, and thought' (Sanders 2006:164). Cudworth and Hobden (2015) for example demonstrate the geopolitics of the 'zoopolitical' by engaging with war animals as transportation (such as

[11] A new journal began in 2015 entitled 'Politics and Animals', reflecting the growing interest in this area of study.

horses – see Raento 2016) pest control devices, sight aids (such as the use of glow worms to read maps in the dark), and sensory extensions of the human body (sniffer dogs being a prime example here - see Hediger 2013). Animals, like humans, have also proved experimental subjects in warfare. In 2010, for example, almost 10,000 experiments were conducted on animals including monkeys and pigs at Port Down military research facility (*The Telegraph* 2012). Turning back to the sea in Horowitz' (2014) 'War of the Whales' we also see animals subsumed under national security imperatives by US submarine surveillance systems during the Cold War. The system flooded entire ocean basins with high intensity sound leading to the mass stranding of whales.

In spite of these rich interventions there is more to be said about the intersection of animals, humans, and the military – particularly in relation to the sea. For example, how have militaries and navies learned from (rather than merely appropriated) marine animals? Who are the human actors involved in the process? Whilst Cudworth and Hobden (2015) hint at these complexities by describing how bees have been studied in an attempt to understand insurgency, an understanding of the specificities of this relationship are lacking, evidencing the need to further release biopolitical investigations from their 'tethering to the figure of homer sacer' (Vaughan-Williams 2015:2). Indeed, Lambert et al. (2006:483) suggest that an overemphasis on human agency has made for a 'curiously static and empty conception of the sea'.

2.3 An elemental geopolitics of undersea space

The final section of this chapter seeks to provide a framework through which to bring together the seemingly disparate discourses on volume and depth, the human body, the non-human body, and their relation to the sea. Current ontological frameworks grappling with the fluid and perpetual motion of the sea fall short at this intersection. Steinberg and Peters' (2015) 'wet ontology' is a prime example. Steinberg and Peters seek to use the sea's dynamic materiality to 'bring depth to volume' and in doing so, re-materialise and give motion to flat, horizontal, and calculated territorial constructions that are rooted in a periodised sense of time 'that minimised the chaotic underpinnings and experiences of place' (247). As Peters (2010:1263) highlights, however, conceptualising the sea can 'prove troublesome…because while it presents numerous empirical opportunities, ontologically it can be quite problematic'. The sea is difficult to grasp and pin down both materially and discursively and attempts to do so often fail to capture its complexities. Whilst a 'wet ontology' has been successful in bringing together a range of watery spaces or 'waterworlds' and in demonstrating the ontological applications of water to land, it is distinctly disembodied. From an embodied perspective, the sea is utterly immersive; it is surrounding, working intricately on, in, and with the body; it is not experienced as wet because it is the element in which the body is temporarily immersed and suspended by. 'Wet' is perhaps more of an experiential human condition that requires a relation with air in order to be felt and experienced – thus drawing imaginaries once again back to the surface. In the air, for example, we are acutely aware of water running down our face from our hair, of the chill that follows, of the need to remove water from our skin. Once fully immersed in water, these are not considerations because the water is all there is. A 'wet ontology', whilst aiming to bring 'depth to volume' exists in tension with deep immersive spaces- rather than capturing the fullness and richness in 'depth', it instead draws attention back to surface engagements with the sea where the body is primarily in the surround of air. 'Wet' also implies something that is inherently surficial – it clings to surfaces, bodies and objects rather than being a three dimensional, deep, inhabitable state.

This is not to say that the materiality of the sea should discounted, but perhaps a different approach to that proffered by Steinberg and Peters is necessary if the project of critical geopolitics is to bear 'witness to the irredeemable plurality' of undersea space and its 'multiplicity of possible political constructions' (Toal and Dalby 1998:3). I therefore suggest a framework that is better able to incorporate the sea and its myriad specificities, alongside and in conjunction with the human and non-human. I do so by drawing on the work of Derek McCormack, Peter Adey, John Protevi, Isla Forsyth, and others to foreground the elemental and to think through an elemental ontology that is attuned to the molecular. As McCormack (2015) highlights both elemental surrounds and the bodies they immerse have particular molecular properties that facilitate certain engagements. They push against one another, and are intricately connected providing a rich foundation from which introduce bodies to the elementality of the sea and vice versa.

To place this within its academic context, geographers are increasingly refuting the idea that the 'earth' is a passive and stable foundation on which geography takes place. The lively and unpredictable nature of natural environments should as Barry (2013) asserts, be understood as a vital mechanism in the conduct of (geo)politics. Indeed, Barry demonstrates that by taking materials, or elements, as a starting point, power dynamics and relationships can be deconstructed, raising 'fundamental questions about the very forces that generate, subtend, and sometimes destabilise territorialised political formations' (Clark 2013a:2829). Classical geopolitics has traditionally understood the geographical features of the earth's surfaces as relatively stable, 'the stage as it were, for geopolitical dramas to unfold' (Dalby 2007:105). As Lehman (2013b:485) asserts, 'while natural elements have long been considered factors in social and political realities, they remain inert, as backdrops, constraints, or resources'. Peters (2012:1243) demonstrates that this is beginning to change with 'work taking seriously more-than-human geographies of soils, earth and air', but there remains much to be done in this field of inquiry. As Clark (2013b:48) writes, 'Simon Dalby's call for a geopolitics that takes earth systems and their dynamics seriously as 'a practice properly deserving the term geopolitics', still comes across as a provocation, a challenge, an urgent summons' (Clark 2013b:48). If it is only when the accepted pre-existence or 'givenness' of something becomes unsettling that it is opened to political questioning – it is hardly surprising then that 'phenomena on the scale of geologic have proved recalcitrant' (Clark 2013:2828). The challenge therefore lies in exploring and bridging the 'juncture between that which is potentially political and that which exceeds the grasp of politics, between the narrow province of the polity and the vast dominions of the inhuman' (Clark 2013a:2831). Meeting this challenge involves critically reflecting on geography's (and particular political geography's) visceral reaction against the discipline's 19th and early 20th century partiality for environmental determinisms—an investment that has come to be seen as deeply implicated in Western imperialist projects' (Clark 2013a:2828). 'Mindful of regressing into counterproductive environmental determinism, scholars including Dalby (2007), Elden (2014), Barry (2013), Clark and Jones (2016) and Squire (2016a) have taken the 'geo' in geopolitics seriously as a means of engaging with a wide range of geopolitical questions (see also Whatmore 2006, 2013). Peter Adey (2015a) has demonstrated the intellectual purchase in engaging with the elemental without regressive determinisms. Rather than merely engage with airspace as a volume in which political activity and territorial practices occur and are constructed, Adey engages with the element of air itself. In addition to challenging a traditional geographical 'metaphysics which enframes the geo as a crust from which we raise our constructions' (Irigaray, 1999 in Jackson and Fannin 2011:436), Adey also seeks to offer an interpretation of volume that is 'qualitatively different' to the recent legal, techno-strategic, volumetric accounts of territory and verticality (Elden 2013, Adey 2015a:57), engaging instead with air cultures and 'volumes as they are immersive and inhabited'. It hints at a 'thicker materiality' that is released from measurement and calculation (Adey 2015:71), and which draws attention to the 'seemingly unspaced, to the negative spaces of air…that coalesce into certain conditions or possibilities'. We can see the significance of this thicker materiality in Adey's (2006) earlier work in which the air acts on airport infrastructure, causing gradual decay. Whilst Adey's key point here is that nothing is ever completely static, we can see that the elemental surround matters, it facilitates, and it acts.

As McCormack highlights however, the elements still remain somewhat backgrounded in Adey's argument. The sense of the elemental 'that treats elements in the way that a chemist or physicist might: as classes of matter, which, by virtue of their atomic character, have particular capacities and properties' is not granted the attention it is perhaps deserving of (2015:86). Furthermore, McCormack suggests that the force of the elemental need 'not be to remind us of the monstrous, exorbitant qualities…of elementailty… but of its fragile, minute, world-specific localisation', challenging the scale of enquiry outlined by Adey but also by Clark (2013) and other political geographers engaging with earth systems and climate change discourse. McCormack's critique of Adey offers an opportunity to attune the elemental to the molecular whilst simultaneously acknowledging the enormous scale at which the elements function. With regards to the sea, this enables an analysis of the ways in which the body (both human and non-human) and the sea relate. The element of water does not just exist in the sea but forms approximately 75% of the human body and a significant proportion of non-human bodies. Nothing can function without it and it is instrumental in constructing and maintaining the body's own three dimensional, mobile, fluid rhythm. The two 'bodies' of water can interact in interesting ways, as Straughan and Merchant demonstrate (see above), and these interactions must be understood in relation to the water in which the body is immersed and vice versa. Maintaining neutral buoyancy whilst diving where the body neither floats nor sinks would be one example of this intersecting relationship. Similarly, the lively and highly mobile molecules of the sea that change with pressure, temperature, and tides[12] are pivotal in shaping 'man's' behaviour in the water with the cells, water, and elements in the body responding to the external elemental environment. The elemental emerges through this framework as 'more than an imaginative resource' (McCormack 2016:4). On the contrary, it functions as a 'kind of generative chaos from which things and perception take shape and a condition and horizon of sensible involvement in the world' (McCormack 2016:4). We might, as McCormack highlights, also think of the elemental as an 'environmental milieu within which different forms of life are immersed, enveloped and take shape'. Within this framework the liveliness of materiality is emphasised whilst also accounting for the fact that 'this liveliness comes with a waywardness irreducible to the agency of human life' (McCormack 2016:4).

The elements here work at multiple scales from the enormity of the sea (which is turn shaped by the air and moon), to the minute, chemical and molecular inner workings of the body. McCormack's intervention opens a door to address these scales as all are constituted by molecules. Simultaneously it also enables Simonsen's (2009:9) concern that literature referring to the body often fails to 'deal with the body in any substantial way' to be addressed. Bodies, writes Simonsen, are not simply maps of meaning and power. Furthering understandings of the body

> 'requires us to tackle explicitly the relationship between the symbolic and the material, between representations of the body and embodiment as experience and social practice in concrete social, cultural and spatio-temporal contexts…I would plead for a continuous debate in which the involved notion of the body is much less taken-for-granted and becomes a focus of investigation, a debate in which different notions of the body are explored, compared and contrasted' (2009:9).

[12] Clearly these changes do not take place in isolation from other elements – air, wind, seafloor formations, the pull of the moon (see Jones 2011) are all implicated in what Tim Ingold (2008) would describe as a weather world. An elemental ontology, rather than a 'wet ontology' enables the 'weather world' to be interrogated without privileging the 'wet' or watery spaces of the earth.

In addition to social and cultural contexts, I would add that the geopolitical context (although intersecting with cultural and social phenomenon) is worthy of attention here too. The body (both human and non-human) in its molecular form and the ways in which this relates to external stimuli is perhaps an example of taking the body seriously, of decentring 'the human subject as a stable ontological given' (Vaughan-Williams 2015:7), and making it a focus point for investigation. John Protevi's (2009) work on Political Physiology is extremely useful here in understanding the relationship between external and internal elements both in the human and non-human. Indeed, for Sheryl Vint (2010), it is because humans and other animals share embodiment that they can be incorporated under biopolitical regimes – in breeding, training, in adopting ways of living and dying that are constituted across species.

Through the concept of 'political affect' Protevi (2009) investigates the 'imbrication of the social and the somatic: how our bodies, minds, and social settings are intricately and intimately linked'. In order to explore these complexities, Protevi (4) goes 'above, below, and alongside' the human subject. 'Above' refers to the social context in which the subject is immersed, 'below' to the somatic, pre-cognitive bodily reactions, and finally, alongside to the cognitive, felt, response. Whilst the cognitive, conscious, and psychological are given due attention within this framework, this holistic approach acknowledges that there are instances where the subjective level is bypassed in a complex 'interplay of brain, body and environment' (Protevi 2009:29). To illustrate this, tissue damage in the body will not be consciously felt until an intricate molecular reaction has taken place to alert the brain and trigger a pain response that in turn might trigger an emotional response. For Protevi (and others engaging with affect - see Anderson 2012) this interplay can be highly political, with government institutions 'employed to control non-subjective physiological processes' – fear being a prime example. This 'Political Physiology' as Protevi terms it may translate into cognitive 'Political Feeling' as it unrolls from incredibly complex and impersonal individuations to felt experience.

This has significant resonances for studies of the body (primarily the human body) in undersea space. We might, for example refer to an elemental political physiology that sees the body pitted against an external elemental stimuli. In Farish's (2006, 2013) work the body is not only subsumed under military objectives in the geopolitical context of the Cold War, but also by the natural, elemental conditions of the extreme cold spaces in which these objectives play out. Rather than engaging with the social context, the geopolitical and elemental context become extremely important in prompting pre-cognitive and cognitive responses. For those involved in Farish's Arctic case study, fending off the cold was a primary concern whilst beneath the sea, phenomenon such as the heart rate becoming paramount. Abrahamson and Schagatay (2014:174) illustrate the intricate interactions between environment and body in their work studying the Moken community in Thailand. Moken divers spend around 50% of their working time under the surface of the water with their bodies adapting to enable this to take place. Their study also illustrated how Moken children have superior underwater vision compared to a control group, with flexible lenses and pupil constriction allowing for better focus. Clearly, it is not merely the social, political, and somatic that intersect but natural elements and the ecological too (Protevi 2009:163). Protevi, for example cites Hurricane Katrina as an case study par excellence in exploring how the 'eco' and 'social' are inextricably linked in what was both 'an elemental and a social event' involving plate tectonics, weather, meteorology, wind, and fire. 'To tell the story of Katrina', writes Protevi (164) 'would be to tell the story of all the cosmos'.

Following Protevi's lead and going above to the geopolitical context and elemental conditions, below to the somatic reactions taking place beneath the border of the skin, and alongside the subject to their subsequent feelings, provides a productive framework through which to explore these intricate and extremely significant interactions that powerfully shape man's relationship with undersea space. Moreover, in affording the elemental and molecular the attention warranted by their significance in geopolitical life we can begin to hone in on the geopolitical and geographical complexities of operating in certain extreme spaces and environments (Squire 2016b). To reiterate, I am not disregarding the phenomenological (indeed the phenomenological has proved extremely important, see chapter 3). Rather I seek to, as McCormack (2015:88) suggests, additionally attend to the 'non-humans of which the' body 'is composed' in ways that make 'the human more, not less, interesting; more, not less, wondrous; more, not less, alluring' (McCormack 2015:88).

Concomitantly, this thesis also seeks to attend to the non-human body. Protevi's framework still has purchase here – non-humans, like humans, are adapted to exist and live in the environments and elements in which they are immersed and these adaptations are premised on the animals cellular and molecular underpinnings. There are, however limits to its application. It would be impossible, for example, to go 'above' the animal subject to interrogate the complexities of its cognitive, felt responses – it is what Clarke (2013b:49) might refer to as an 'interface between what is and what is not negotiable' in studying the natural world. My focus therefore would need to shift to better understanding the ways that marine life has been co-opted in the mission to master depth - how militaries have studied them, engaged with them, and worked with them to further 'man's abilities in the water column and on the sea floor.

Rather than turn to the 'cameliers' in the deserts of WWI to do this as Cudworth and Hobden (2015) have, the camofleurs of the WWII might provide some much needed insight. In Isla Forsyth's (2014a) work on mimetics and camouflage she traces the work of camoufleurs throughout the Second World War and in doing so highlights the intricate relationship between the military and natural environment. Environments, such as the desert 'and its specific ecological traits' altered the nature of battle and as a result, camouflage became subsumed into 'battle plans as part of aggressive strategy' (248). Concealing personnel and equipment from enemy sight, distracting, and deceiving the enemy were skills developed through an intimate connection with, and knowledge of, the natural world whether that be desert, tropical environments, or the cold of the Arctic to provide tactical and strategic advantage. Forsyth (2014b) also demonstrates how central the animal was in this process. One of the pioneers of camouflage during the Second World War was Hugh Cott. A zoologist by training, he was dedicated to the scientific studying and understanding 'adaptive colouration in nature', in other words, 'the means by which animals render themselves inconspicuous' (2014b:128-129). Scientific spaces and the intersections between science and the military once again prove pivotal and through this prism. Through Forsyth's work we see that space is hybrid and composite, filled with 'human and nonhuman relations' (137). Battlespace emerges with more than human geographies, with humans learning from the molecular physiology of nonhumans in order to gain strategic advantage. How then, might these geographies play out in undersea (battle)spaces or seascapes? It is already well acknowledged that the design of the submarine was based initially on the shape of the whale, and that the study of dolphins has been pivotal in furthering the understanding of the body under the sea (Ridgway 1988). 'Man' has long engaged with undersea life, attempting to mimic and manipulate it for strategic advantage to facilitate deeper exploration and undersea exploits. Sitting at the established intersection between science, the military, and the nonhuman, this is an area ripe for deconstruction in political geography.

To summarise, in order to engage with questions about how depth has been mastered and appropriated, this thesis argues that elements (both human and non-human) must play a central role. Engaging with the molecular workings of the body in conjunction with that of the element in which it is immersed provides a foundation from which to do this. This being said, as Protevi, Farish, and others have demonstrated, a molecular or elemental ontology alone would not be sufficient (wider cognitive experiences must also be understood), but it does provide a framework and common thread through which to draw the ideas described above together before being able to engage with wider questions pertaining to 'man in the sea'. It also enables a number of actors often neglected within geopolitical discourse to be accounted for. My engagement with these literatures, for example, insists on bringing scientists, physicians, engineers, and medical professionals to the fore (see Farish 2006, 2013, Doel 2003, Turchetti and Roberts 2014), along with the diver, marine animals, and other understudied bodies that allow for alternative and novel accounts of the geopolitics of sub-marine environments.

Chapter 3

‘Do you dive?’: Immersive and embodied research in political geography

> ‘This has got to be learning undersea geography the hard way.’
>
> (Bond 1965, entry 25th September 1965)

3.0 Introduction

This thesis interrogates the geopolitical volume of the sea as it is inhabited and as bodies, both human and non-human, are immersed within it. Yet, methodologically speaking, this is not necessarily a straightforward process. Whilst the explicit articulation of 'volume' in recent literature has proved to be an extremely useful means through which to produce novel insights into the construction of space and territory, the practicalities of doing this research are yet to be considered in great detail. How methodologically do we approach bodies as they are co-constituted with and by external immersive environments? How can political geographers combine existing and established methods like interviews and archival work with more innovative and experimental ways of knowing the world to better grasp the complexities of immersive volumes? How can we move from philosophising and theorising to exploring the empirical manifestations of the 'volume' to generate further insight?

Elsewhere in geography and the social sciences, methodological innovation and experimentation is more common place than in political geography. Cultural and social geographers, along with anthropologists and sociologists, for example seem much more at ease with an experimental, and even playful, research process (see Hawkins 2015). A more open and fluid dialogue and stronger interface between geography's sub-disciplines and social science partners might provide a means to address this. Conversing with physical geographers who study volumes, inhabit them, sample them, core them, and handle the earth's three dimensional materialities would also enrich the conversation (see Dalby 2013). As will be elucidated, engaging in the experimental and immersive is not necessarily straightforward and it involves being open to new experiences, vulnerabilities and sensibly accounting for risks. Whilst this process may not always be deemed fundable, the world can 'reveal itself during the performative research process' (Timm Knudsen and Sage 2015:6) and having permission institutionally and within the discipline to participate in this form of research forms part of the challenge of understanding the earth's immersive and inhabited volumes.

In the following sections of the chapter, I explore and analyse the use of three key methodologies that were deployed in this project as I sought to meet the challenge of researching the immersive Sealab project and to challenge the methodological norms governing political geography. Throughout the process, I attempted to go above, below, and alongside the subject matter (Protevi 2007) and to pick up on the ephemeral, the embodied, and the elusive to produce novel ways of knowing and understanding the Sealab projects. This process involved moving in, through, and engaging with a number of key sites. In the UK this included a local dive centre and hyperbaric chamber facility, and use of online archival sources. In the US, I spent time in Panama City Beach, home to the US Navy Experimental Diving Unit, Sealab I habitat, the 'Man in the Sea Museum' and a large Navy diving community including Sealab veterans. The mural pictured below (Figure 10) from the wall of Northwest Florida Beaches International Airport illustrates the importance of diving and Sealab to the area. Whilst 'Sealab' is not part of everyday lexicon and many people are unfamiliar with the projects, the Sealab I habitat features prominently above the door surrounded by the red and white stripes of the American flag. Elsewhere on the mural we see military divers, ships, and hovercraft coming together to brand Panama City Beach as centre of naval activity and sea-based prowess. Peter Adey has reflected upon the role of 'themed airports' as a means of 'celebrating local connections' (2007:163). Whilst the airport itself was not themed around the Navy and diving, the mural certainly functions as a way to connect those passing to local interests, to a sense of civic pride, and a localised identity that centres on naval expertise above and beneath the sea.

Figure 10: A mural painted onto the wall of Panama City Beach airport. The Sealab I habitat is pictured above the helicopter by the door (photo by author).

The second site in the US involved a short flight to the Florida Keys, home to all three of the world's undersea habitats and associated personnel. Some of those working on the habitats were also former Navy divers and aquanauts. Finally, my research took me to San Diego, the base of the National Marine Mammal Foundation and home to civilians involved in the running and founding of the Navy's Marine Mammal Program. The University of California, San Diego, is also home to extensive archive material from the Scripps Institute of Oceanography on the Sealab projects and documents about the relationship between the US Navy and the Institute.

Premised initially on the need to 'attend to the audience' that I was 'attempting to communicate with' (Finlay 2009:14), the first section of this chapter deals with my experiences of learning to scuba dive. In inhabiting the spaces and elemental atmospheres experienced by my participants (water, a hyperbaric chamber, and an undersea habitat) I utilised affective and immersive methodologies to gain an embodied understanding into my research subject(s) (see Lorimer 2006). On occasion, this entailed making my own body a testing site to (occasionally inadvertently) reconstruct the embodied phenomenon found in the archive. There were practical benefits to this process including building rapport with my research community, understanding the role of shared phenomenological experiences in shaping the interview process, and becoming more familiar with the technical language of diving. The process of learning to dive also pointed me to wider themes, such as gender, to explore further but theoretically it also functioned to corporeally disrupt the notion of the 'axis' and the linear, straight horizontal and vertaical lines and geometries that permeate volume discourse. As will be made clear in the coming chapters, immersive practices may also enable new ways of writing in political geography that are more at ease with the personal and positioned context of the researcher.

The second section in this chapter deals with my use of interviews. Through this method, interesting dynamics emerged regarding the role of the body. This section further explores these dynamics, exploring how the body becomes targeted (dis)empowered, and affectively modulated in the process (see Scott 1984 and Winchester 1996). Before reflecting on the need for experimental, creative, and immersive approaches within critical geopolitics, the chapter finally examines the use of archival research both online and in archives in Florida and California. Sources were both written and visual and included formal Naval and scientific reports in addition to personal diaries and documents. In terms of accessing and capturing the social, the somatic, and the elemental context, the archives proved pivotal. Reports from the Navy Experimental Diving Unit (NEDU), for example, provided detailed accounts about how the human body was tested and experimented on, and how vast quantities of data were gathered on how the human responds pre-cognitively to the 'hostile' environment of the sea; diaries, daily logs, and quotations from the aquanauts incorporated into the psychological reports produced after Sealab provide valuable insights into how they felt and behaved in the stressing environment; short films produced by the Navy on Sealab I, II, III, and 'the Aquanauts' provided insight into visual cultures of sub-marine life and importantly, certain messages that the Navy were trying to communicate to a mass audience about the need for sub-marine inhabitation.

3.1 'Do you dive?'

> 'What is still largely unspoken and unwritten is *how* we might grant the body its (well-theorised) status in the practice and representation of research? How can we make the body substantive in our research? How do we talk or write about the body?'
>
> (Perry and Medina 2015:5, emphasis in original)

> 'Having recently met former Navy Divers at the diving Museum I was struck by the sense of community that the divers shared. I was asked by a number of people, 'do you dive?' and my response, at the time, was something like 'no but I would love to learn'. After a flicker of disappointment had crossed their face I was often enthusiastically regaled with descriptions of what it felt like to dive. One former Navy diver for example stated that 'you feel like superman, like you are flying'. The shared experience of intimately knowing what it was to dive was a crucial element of this sense of community and it was one, as a 'non-diver' that I could not share in' (notes from my field diary, 21 October 2014).

The above is a short extract from my field notes on a visit to the diving museum in Gosport, Portsmouth in 2014. I had visited at the very beginning of my PhD in order to explore the direction I might want to take my research (see the preface for more context here). One of the questions I was asked by at least two of the volunteers at the museum was whether I had, for myself, experienced the underwater world. Just as Adrian Howkins (2010) experienced when writing about the history of Antarctica, the question of 'Have you been there?' or in my case, 'do you dive?' loomed large. As Howkins (2010:514-515) illustrates these questions are not insignificant, on the contrary they reveal the importance of the researcher 'visiting the places they write about' and, rightly or wrongly, confers a 'sense of legitimacy' and authority over the research process. 'Extreme environments', writes Howkins (2010:515), only 'heighten this sense of legitimacy' because they are difficult to access and to inhabit them requires significant effort and investment of both time and money.

For the former divers at Gosport, the experience of being underwater is obviously extremely important and this was articulated in their questioning of my diving experience. As Shreeves (2005:31) asserts 'diving isn't what you do. It's who are'. For divers, the activity and sense of community associated with the practice is more than simply a hobby or pastime. According to Shreeves, it is an identity marker. Within the research context this is important, as Dunn (2010:112) elucidates, building rapport with a research community 'is basically a matter of understanding their model of the world and communicating your understanding symmetrically.' There is also a precedent for this 'matching' of experience in archival records of researchers working on diving related matters. O'Neal et al (1965:38), for example, state that the emotional and motivational drive that compels aquanauts to live in precarious habitats beneath the sea can only be 'poorly understood by investigators who have never been exposed to an undersea situation'. There was something significant – both situationally and corporeally about having been under the sea, about being part of a diving community, and in sharing a love and interest in inhabiting and moving through the water column.

As Lorimer (2010:239) highlights, however, these 'more-than-human inclinations do not sit easily with the orthodox methodologies of the interpretative social science' many of which are 'geared towards the collection, interpretation and critique of texts and other disembodied representations'. In critical geopolitics in particular, it might be argued that 'human experience' has 'been flattened by a paradoxical reliance' on maps, satellite imagery, and the associated 'God's eye' perspectives (Graham 2016:1). This can certainly be argued of engagements with the sea that are mediated by the surface, typically because it poses many challenges to the social scientist (Steinberg 1999). Whilst physical geographers, oceanographers, and marine scientists may be familiar with technologies that enable an interrogation of undersea space such as GIS, acoustic and visual remote sensing and submersibles (see Wright 1999), the social scientist and political geographer seems comparatively ill-equipped. In political geography, at least, there is also a lack of literature in this area.

Of course, the geographies of Sealab, much like Howkins' (2010) histories of Antarctica, *can* be written without learning to dive as so much information resides on the surface and, needless to say, going underwater does not take you back in time to the projects themselves. But, as Stephanie Merchant (2014) highlights, if we to understand the sea as something be in and under, rather than simply 'on', then 'going there' offers some interesting opportunities. Exploring the 'three-dimensionality of ocean space' might require physically 'delving beneath the water's surface' in order to highlight the ways in which ocean space is moved through and inhabited (Merchant 2014:119. This is particularly significant given some of the critiques of current sea literature in geography outlined in chapter 2. Rather than analyse the sea as something to write over and striate, other more immersive approaches such as autoethnography/phenomenology that undermine the God's eye view would provide different understandings of undersea spaces whilst simultaneously working to unsettle claims of objectivity, and analytical coherence that may be implicit in the totalising, 'context-free' view from above (Anderson 2006b:460, see Butz and Besio 2009). This argument is neatly summarised in a quotation on display at the History of Diving Museum in Islamorada, Florida under the heading 'Writer Immersion'. With reference to the author Rachel Carson, best known for her book *Silent Spring*, the plaque described a conversation she had with American naturalist and explorer, William Beebe:

> 'Beebe arranged for her to be underwater for the first time. Beebe told her in no uncertain terms that she could not write about the world beneath the sea without

> having been there herself…Carson later wrote to Beebe: The difference between having dived…and never having dived is so tremendous that it formed one of those milestones of life, after which everything seems a little different.'

In an effort to avoid perpetuating the two dimensional, top down view of the sea, learning to scuba dive through the PADI[13] Open Water and Advanced Open Water qualifications became part of an immersive methodology. The physical act of inhabiting a body of water with my own body proved significant not only in terms of bringing volume and depth to my writing, but also in gaining a better informed and nuanced appreciation of both the substance that divers move through, and to gain an insight into the effects and affects this has on the body.

To be clear, I realise that the insights garnered through this process can only ever be fleeting and partial – especially when compared to the experiences of the seasoned military divers who informed the majority of my overseas fieldwork. Yet, as will become clear in the following pages, striving to 'achieve experiential access to life as an insider' (or at least partial insider) of my research community had many benefits (Butz and Besio 2009:1670). These included the practical advantages of gaining credibility among my informants and learning the 'language' and haptic feel of diving, in addition to the affective advantages of understanding how the body must constantly negotiate various aspects of the water, sub-marine gender politics, the idea and feeling that the sub-marine world is somehow 'other' to human experience, and a means through which to partially reconstruct aspects of my research. Much like the research on feminist and everyday geopolitics where the geopolitical is constituted by the small, often banal experiences (Christian et al. 2016, Militz 2016, Sharp 2007), autophenomenological research can add a building block to the formulation of geopolitical, and more broadly geographical knowledge if it becomes attuned to the anthropological. Before reflecting upon these further and exploring the impact of diving on the research process, these ideas are first situated within wider literature on methods and autoethnography/ phenomenology in geography, sociology, and anthropology.

[13] PADI Professional Association of Diving Instructors – PADI is the world's largest Scuba Diving Training organisation.

3.1.1 Autophenomenology

In response to the 'so-called crisis of representation' within the social sciences and humanities (Butz and Besio 2009:1664), new methodologies have emerged that seek to deal with the complexities of the social and geopolitical via the study of phenomenon that exceed the representational. The potential 'epistemological and ontological yields' generated by thinking beyond the representation are, as Butz and Besio (2009:1671) highlight, especially pertinent for contemporary geography given its growing 'preoccupation with affect, emotion and embodiment' and its 'enduring interest in the constitution of social life through interactions across space and the constitution of space through social interactions'. James Ash's (2010, 2013) work on video games would be a prime example. In addition to engaging with the representation of the video game, Ash explores how the process of playing affects the body, and how the body has been attuned to respond in certain ways to the action on screen, in order to explicate some of the complexities of the more-than representational experience of gaming. Similarly, as will be explored further in the following pages Stephanie Merchant (2014) explores the 'more than human' via an autoethnography of the sunken ship *SS Thistlegorm* in order to think through notions of haunting and materiality in the sub-marine. Through scuba diving to the wreck, Merchant (2014:120) also sought to take 'contemporary land based geographical debates of materiality, haunting, memory, and place meaning to ocean depths'.

Within this more–than-representational framework, the body, as demonstrated by Ash and Merchant, is placed at the centre of geographical enquiry. As Adams St Pierre highlights somewhat exasperatedly, *'we are bodies* and are completely entangled in the world' (2015:138, emphasis in original). Similarly, Brigg and Bleiker (2010:780) assert, researchers 'share one commonality: we serve as a type of 'hub' through which the world becomes known' and perhaps there is a need to more directly engage with the body, or the 'self as a methodological resource'. Autophenomenology and autoethnography are two methods that seek to incorporate lived, embodied experience into the research process. The two terms have been used interchangeably (see Anderson 2006a, Merchant 2014) and share many characteristics. On the one hand, autoethnography is an extension of ethnography. Whilst ethnography seeks to engage directly with 'one's own group' and the 'natural environment of the social world' intensely for long periods of time through prolonged observation and participation (Edles 2002:141), autoethnography is about observing the self within the context of the social group under study (Anderson 2006a, Ellis et al 2011). Anderson (2006a) for example, uses his membership in a community of skydivers to analyse his own embodied experience of jumping from a plane. Whilst Anderson has previously conducted ethnographic research among homeless people on streets and in shelters, even spending 'time in jail with some of them', he writes that he 'never completely inhabited their world – physically, psychologically, or socially' (Anderson 2006b:354-355). This is 'dramatically different' from his experiences conducting a skydiving autoethnography where he is completely immersed physically, psychologically, and socially in the world of the sky diving community. There is an 'autoethnographic sensibility' at play here that sees the ontological separation of academic researchers from their research subjects (the signification from the objects of signification) diminished (Butz and Besio 2009:1669). Similarly Merchant (2014) reduces the distance between herself and her subject matter by being immersed completely in the dive of the wreck thus enabling her to examine her own embodied encounter with a historical artefact and its associated affects. In doing so, both studies demonstrate the value in adopting an 'openness and even vulnerability to the world as a way of identifying and engaging the relational dimensions of knowledge' and a 'willingness to draw upon a range of different faculties such as sensation and intuition' (Brigg and Bleiker 2010:797) to learn and gain insight into the broader 'set of social phenomena that those provided by the data themselves' (Anderson 2006a:387).

In conjunction with the autoethnographic, phenomenological researchers too seek to gain 'fresh, complex, rich descriptions of a phenomenon as it is concretely lived' by taking seriously 'embodied experiential meanings' (Finlay 2009:6). As Ash and Simpson (2014) highlight, the history, practice, and conceptual underpinnings of the 'phenomenological' are incredibly complex. It is not my intention to explore these complexities here but the idea that research methods should be responsive to 'both the phenomenon and the subjective interconnection between researcher and researched' is compelling (Finlay 2009:7). As described by Allen-Collinson and Hockey (2010:2) autoethnography can be defined as the 'study of phenomena, things as they present themselves to, and are perceived in our consciousness'. It is about elucidating the world around us as it appears through a person's perspective and as it is felt and experienced on the body. The researcher's body and experiences become central in this approach to understanding specific aspects of the world and in doing so, they can also work to bridge the divide between the 'researcher' and the 'researched'. In the words of Finlay (2009:14) a phenomenological method and mind-set enables the researcher to 'attend to the audience they are attempting to communicate with'. As Garfinkel (2002 in Hockey and Allen-Collinson 2009:11) warns, researchers have a responsibility to fulfil the 'unique adequacy requirement'. In application to my own research, this approach would suggest that I 'must have some degree of familiarity with the phenomenon' that I am studying and that I need be 'competent in its production in specific contexts' (Hockey and Allen-Collinson 2009:11). Allen-Collinson (2009) argues that the methodology best suited to this way of *thinking*, and crucially, *doing* is 'autophenomenography'. Rather than engage with the process of ethnography wherein the researcher analyses, a 'cultural/subcultural social 'place', autophenomenography aims to analyse the researcher's 'own experiences of a phenomenon'. In other words, the researcher seeks to position themselves as the vehicle through which to explore phenomenon as they are experienced, rather than by engaging with others doing the 'experiencing'. Whilst the distinction between the autoethnography and autophenomenology is not clear cut, the emphasis on the lived, embodied experience is a useful one when seeking to better understand the interactions between the body and the depths of the sea and vice versa.

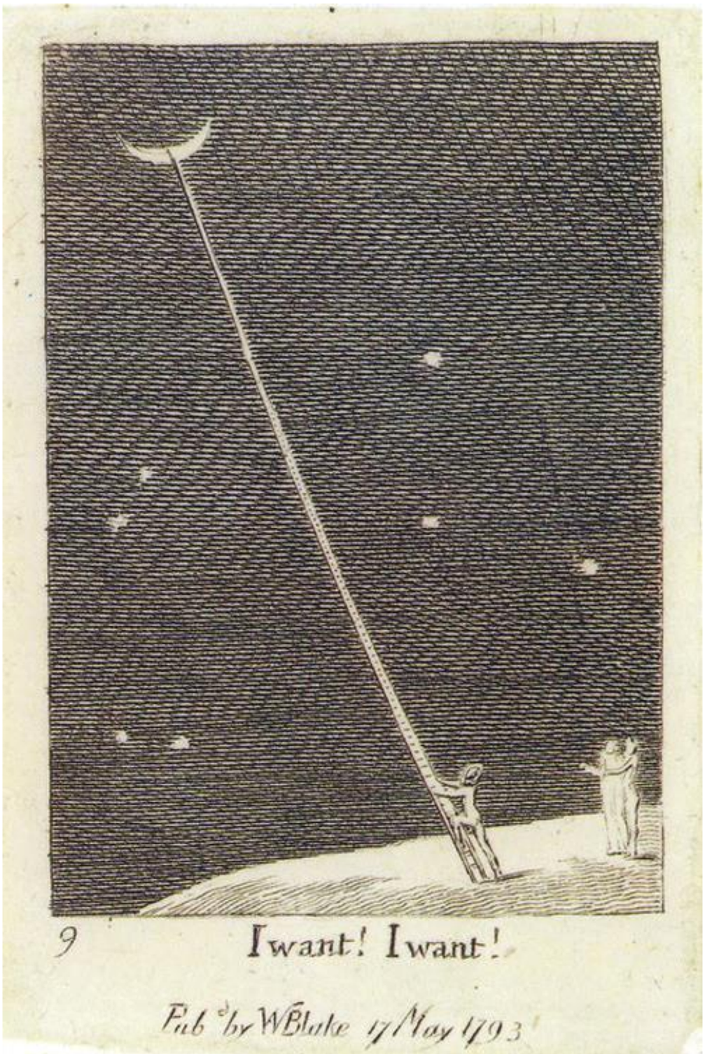
In their paper *Feeling the Way*, Allen-Collinson and Hockey (2010) seek to operationalise this approach and move towards a haptic phenomenology of both running and Scuba Diving. Drawing on their experiences as seasoned runners they sought to use their own bodies as a means of exploring some of the complexities and haptic sensualities of sport. Working from the school of sociology, they argue that this method provides a means of 'undertaking detailed, qualitative investigation into the sensory dimensions of sporting embodiment' (13). They advocate a form of 'phenomenological sociology' that can 'generate fresh insights, grounded in the carnal, 'fleshy', lived, richly textured experiences of the moving, sweating, touching, seeing, hearing smelling and tasting' body (Allen-Collinson and Hockey 2010). Whilst they are relatively successful in gaining these insights through the practice of running, the same cannot be said of Scuba diving. Despite emphasising the significance of *doing* rather than observing or discussing, the data used to explore the experience of scuba diving was generated from interviews with an experienced diver and follow up emails to 'grasp the embodied complexities of scuba diving in terms of how the body responds to such factors as depth, pressure, light, refraction, and so on' (6). As Gruppetta (2004 in Allen-Collinson and Hockey 2009:79) highlights, the phenomenological approach has at times been heavily criticised because most phenomenological researchers 'do not themselves participate in the processes under study, relying instead on second-hand accounts.' Allen-Collinson and Hockey surely fall under this critique in their analysis of the scuba diver. Not only can an interviewer only ever have a very partial insight into the phenomenon described by their interviewee if they too have not experienced it, but gaining information by email means that they would have failed to capture significant embodied acts such as gestures, body language, and tone of voice which can in themselves be incredibly revealing of emotion and pre-cognitive responses. It is worth returning to the quote at the beginning of this chapter here form Perry and Medina (2015:5) who ask *how* we might go about granting the body 'its (well theorised) status in the practice and representation of research? How can we make the body substantive in our research?' What advantages might follow from doing so?

3.1.2 Immersive research

Geography, with its 'long concern for issues of reflexivity, and its attention to how local, grounded, personal experience of place relate to larger processes' (Butz and Besio 2009:1671) is well placed to re-centre phenomenological research on the body. Critical geopolitics as a sub-discipline of geography is also well placed to explore the role bodies can play in the construction of geopolitical knowledge. Scholars of geopolitics are increasingly engaging with the everyday 'small stories' (2003a) that *make* geopolitics with the body as a pivotal site of geopolitical investigation (Dowler and Sharp 2002) and with emotions such as fear in shaping geopolitical imaginaries (Pain and Smith 2008, Pain 2010). Yet, in spite of these valuable interventions, the researcher's body perhaps remains underused in geopolitical research and the 'complex interplay between embodied experiences and the formation of geographical knowledge' under-explored (Lorimer 2003a:302). I am particularly interested in what autoethnography/autophenomenology might offer geopolitics when the emphasis on the social is temporarily suspended. As demonstrated above, much work on phenomenology and ethnography emphasises the 'social world' the 'social environment', inhabiting the 'world' of others. What happens when the social is removed and the focus falls on the 'world' and the 'environment'? In other words, how can this method be deployed in geopolitics to take seriously the 'geo' in relation to the body and the tensions that emerge as a result?

Straughan (2012) and Merchant (2011a, 2011b, 2014) demonstrate the potential of doing this to better understand the space of the sea as a therapeutic landscape and a tourist location. In both of their work, the body takes a central position as it enters into a different relationship with gravity, as the water works to change sight, sound (see also Helmreich 2007), and touch, and as the diver experiences a space that is somehow 'other' to land- a space in which encounters with objects such as ships are mediated by the water and life within it. For Straughan (2012) and Merchant (2014:119) diving offers a unique opportunity to look 'beyond the boundaries of the ocean surface to ocean depths'. It follows that if we are to understand a lively underwater geopolitical seascape that, like landscape, is about practice and 'come into being by drawing variably on embodied, material, and discursive domains' (Macpherson 2010: 6 in Merchant 2011a:216), then embodied methodologies are productive. Moreover, if we are, in contemporary geographical scholarship to avoid treating the sea as a theory machine then, in the words of Vannini and Taggart (2014:49) we need to more than 'just philosophise about it' (see also Spence 2014). Relocating ourselves (and not just metaphorically) (see Dowler and Sharp 2001:172) to corporeally experience the sea and get to grips with the scientific and physiological specificities of inhabiting it is perhaps one means of doing this. As will be detailed in the following sections, in my own research autophenomenology in conjunction with interviews and archival work, provided me with an opportunity to study the affects of the water itself and not exclusively the social context in which it exists.

Of course, there are limitations to the autophenomenological approach in geopolitics. For example, I can learn to dive to better engage with participants and to understand what it is to 'dive', but I will never be a military diver or a saturation diver[14] – as Haraway (1997:287) asserts, you cannot 'relocate into any possible vantage point'. Similarly, I will never have my body experimented on under extreme pressures like the volunteers at the Navy's Experimental Diving Unit. My insight into their experience can only ever be partial. At the same time, this partiality generates other potential issues. Knowing that my knowledge and experience of diving would only ever generate small and incomplete insights, I was often frustrated at my inability to learn and experience more. When discussing this with artist and author of 'That Oceanic Feeling', Rona Lee, at the 2015 RGS conference, she turned to a page of her book that featured an image by William Blake.



[14] It is here where I differentiate this methodology from the 'full-immersion' method described by Desmond (2011:61, see also Adams 2016) – 'the method that requires investigators to become, as completely as possible that which they wish to understand'. This was something I could not practically achieve and do not claim to have practiced.

Figure 11: I want! I want! – the figure aiming for the sky rather than the depths. By William Blake, 1793.

Lee used the image, entitled ‘I want! I want!’ to highlight the impulse to experience something that is unattainable. For Lee, ‘That Oceanic Feeling’ expresses a tension between making visible/feelable and known that which is unseen/unfelt in the sea and accepting that to an extent, a lot of it is beyond the human grasp and gaze. Indeed, the book starts with a verse from Ecclesiastes (7:24) from the Bible which simply reads: ‘That which is far off, and exceedingly deep, who can find it out?’ Yet this impulse to know, see, and learn more as represented in the image by the figure climbing a ladder to the moon has practical implications. Learning to dive, for example, is expensive, requires time, and a body that is able and willing to carry relatively heavy equipment and tolerate the pressures of water (as will be explored in chapter 5, this was not always straightforward). Undertaking the advanced course again requires more time and money, and a body can tolerate deeper depths[15] and the psychology of being immersed in water with no immediate exit if something goes wrong. Spending a short time in an undersea habitat was also a fortuitous experience, resulting from an interview with Iain Koblick who owns two habitats in Florida, and is not freely available. No doubt the same challenges ring true for immersive research in other extreme or ‘hostile’ environments such as the Polar Regions (see Howkins 2010). The key, as Brigg and Bleiker (2010:796), highlight, to ‘pursuing and evaluating the self as a legitimate source of knowledge is to recognise that autoethnographic claims are necessarily part of a larger struggle’ in the production of knowledge – it is not a full, transcendent account and can only ever offer insight (see Haraway 1997). I also sought to circumvent the inevitable limitations of my research by ensuring that the experience of diving formed only a part of my wider methodology. There is a risk, warns Atkinson (2006:402) that the researcher can become so absorbed in their own experiences that they become ‘more memorable’ in the research output than the data itself. The task lay in always looking outward to the wider phenomenon (social, political, and natural) via the interview and archive.

[15] As will be explored in chapter 5, this was something I ended up not completing precisely because of the effects of pressure on my own body.

In addition to the access constraints of finance, time, and differently able bodies, accessing experiences that are naturally of interest to scholars of critical geopolitics (such as those found in the military, in diplomatic circles, and in state institutions) can inevitably prove difficult. There are also obviously numerous safety considerations to be accounted for when engaging with embodied and experiential research in certain contexts and it may simply be too dangerous to attempt to experience certain phenomenon first hand. This being said, if these barriers can be overcome in other appropriate contexts, then an autophenomenonlogical approach may offer insights that open up 'perspectives on political issues or phenomena that would otherwise remain foreclosed' (Brigg and Bleiker 2010:796). There is certainly, therefore, something to be said here about developing (within safe, practical, and ethical boundaries) 'more refined ways of using the self as a source of knowledge' in critical geopolitics (Brigg and Bleiker 2010:782) wherein the researcher is brought out of their comfort zone. As Brigg and Bleiker (2010:795-798) highlight, in being open to vulnerability and susceptible to new experiences, the researcher can better mobilise faculties such as intuition, haptics and emotion and thus bring new insight into the 'envelopment of humans with their world and perhaps even engender new ways of understanding and solving' research problems.

As part of this process, I signed up to complete the PADI Open Water Diving qualification and the PADI Advanced Open Water Diving qualification. The former is the first of PADI's courses which enables you to dive to a depth of 18m with a diving 'buddy', teaches you basic safety principles, and practical skills such as clearing a flooded mask, finding neutral buoyancy, and learning what it feels like to run out of air by having your air supply momentarily turned off (see Shreeves 2005). The latter is the second of PADI's diving qualifications. It builds on the Open Water course and provided me with an opportunity to hone my skills with a wreck dive and to learn more about buoyancy control and underwater navigation. Additionally, I completed the PADI recompression chamber course which involved participating in a 'dive' to 40m in a hyperbaric chamber (see Figure 12 below) . As a result of the chamber dive I was unable to complete the Advanced Open Water, as I unfortunately got decompression sickness or 'the bends' as it's more commonly known. This will be explored in greater detail in chapter 5.

Aside from getting the bends, this was a process that I not only learned a lot from but which I thoroughly enjoyed. 'Enjoying' the research process is not something that we read much about in political geography and I thought carefully before writing it as it does not seem to sit easily or smoothly with the tone of the sub-discipline. Yet as Howkins (2010) highlights, 'going there' and 'doing' can be extremely fun, enjoyable, *and* productive. 'The emotional attractiveness of 'going there' should not be quickly dismissed' (2010:515). History, he writes is

> 'an emotive discipline and most historians are able to capture something of the zeitgeist of the period they study. Even a passing acquaintance with the literature of Antarctic exploration reveals the sense of excitement that has fuelled the history of human interaction with the southern continent. Visiting Antarctica can inspire similar feelings of romance, danger, bravery, and adventure that reflect the feelings of the subjects of historical study. Even disappointments can be informative (Howkins 2010:515).

Similarly, historian Helen Rozwadowski describes the importance of the act of 'playing' in knowledge production of the sea. People, she writes, come to 'know' the ocean through time spent in it. Writing within the context of 18th century knowledge production, Rozwadowski argues that it 'would be difficult, and probably pointless, to disentangle work from play' (2011:169). I would argue that Geography also thrives off the 'emotive' yet this sense of enjoyment and immersion in certain contexts and zeitgeist's is often neglected.

Figure 12: The hyperbaric chamber, situated within a hospital in East London in which I completed the course (and as will be explored in chapter 5, contracted the 'bends').

In chapters 4 and 5, my own experiences of learning by 'going there' are interwoven into the narrative to demonstrate how they brought clarity and new insight to my interviews and archival work and also raised questions pertaining to gender, the practice of engaging with archives, the constructs of territory and terrain, and the effects of water and pressure on the/my body. This has been done with an awareness that in drawing on my research diary, I am simultaneously re-writing and imposing meaning and narrative onto my experiences (Taber 2010, Edles 2002) and imposing a narrative on the phenomenon I experienced. As Anderson (2006a:380) highlights, circumventing this problem presents certain challenges. Unlike other research settings, the researcher must document and analyse action as well as purposively engage in it. Whilst it is important to avoid self-absorption during this process, it was also difficult in the context of my research to do anything other than analyse my experiences after they had happened. Clearly, writing during the dive would have presented practical challenges and the 'necessity of mentally and physically documenting one's activities creates additional tasks' and can at times inadvertently 'divert the researcher's attention from the embodied phenomenological experience' (Anderson 2006a:380). We are, as Hunter and Emerald (2016:29) lament, often forced to reduce 'embodied, emplaced, and multisensorial' experiences into words on paper, 'coded and remodelled summaries, or fragments of narrative'. In this project, the challenge therefore lay in capturing the embodied experience and subsequently analysing and narrating it in a way that furthers both my argument and, more broadly, the practice of geopolitical research. I aimed to do this throughout this thesis through a process of triangulation, drawing on my own experiences and setting them into play with my archival research and interviews in the field.

3.2 'Never trust a diver'? The body, intersectionality, and the interview

Before I embarked on my overseas fieldwork, I received two warnings from two individuals about working with divers. One, from my diving instructor, was simply 'never trust a diver', the other was a participant who suggested Navy divers enjoyed 'speaking about their adventures, of course as time passes some of the stories expand to unfathomable depths'. As a result, I anticipated that one of my main challenges in the interview process and subsequent analyses would be navigating my way through the fluid boundaries of fact of fiction. Whilst this was necessary given the blurring of the two in both interviews and archives, there were other components of the interview that proved more difficult to traverse. In the following paragraphs I will detail some of the challenges that arose, critically reflecting upon and 'allowing a conscious deliberation' of what I did, how I have interpreted the data, and how I related to my informants (Baxter and Eyles 1997:505). I will begin by exploring how gender was negotiated in the field before engaging with some of the complexities associated with interviewing elderly informants. Within each of these sub-themes is a cross cutting awareness of the importance of the physical presence of both interviewer and interviewee – a feature of the interview process that perhaps warrants greater attention. Before exploring these ideas further, I will briefly explain how and why I used semi-structured interviews in the field despite my interest in things that were often beyond the scope of the interview as research methodology.

As Winchester (1996) highlights, interviews have long been a popular method within human geography. The semi-structured interview, whereby the interviewer prepares with a few questions or themes that they want to explore, is particularly well utilised (Valentine 2005).

As Valentine highlights, the conversational and fluid form produced by this form of interview enables interviewees to construct their own accounts and experiences of their lives in their own words. In doing so, the interviewer leaves room for a wide ranging discussion allowing for the production of rich, detailed, multi-layered information containing 'the meanings people attribute to their lives and the processes which operate in particular social contexts' (2005:111). In preserving these accounts through quotations in written text the researcher is able to delve into how meanings and constructions of space are expressed whilst also preserving the voice and language of the informant (Winchester 1996). In my own research, these lived accounts based upon embodied experience were also extremely useful in gaining insights into my participant's understandings and perceptions of certain phenomenon, whether that be living underwater, being an experimental subject in the NEDU, or the ways in which different gas mixtures and water conditions affect the mind and body (see Hockey and Allen-Collinson 2009). Given that one of my aims was to go 'above, below, and alongside' my participants (see Protevi 2007), these accounts proved pivotal in constructing an idea of what it was like for a person to be engaged in underwater living and working in specific contexts.

During my two visits to the United States[16], I conducted interviews with a range of actors and agents involved in Navy diving during the Cold War to the present day. I also interviewed experts in undersea habitats and habitation and civilian personnel operating the Aquarius Reef Base. Throughout this process I kept a field diary and, where possible, took photographs to help me 'identify preoccupations' and recognise key themes or patterns that might be emerging around particular spaces or situations (Phillips and Johns 2012:116). Gatekeepers proved instrumental in securing a number of these interviews – one for example went through his phone, passing on the details of anyone he thought might prove helpful in addition to making phone calls on my behalf. He also joined me for the first hour of one interview as he wanted to catch up with the interviewee. His presence there was extremely helpful in breaking the ice and in drawing out details that only an 'insider' would know. Another gatekeeper made several introductions for me via email. In utilising the knowledge of gatekeepers, my interviews snowballed as one contact introduced me to

[16] Florida (Panama City Beach and Florida Keys) in February 2016 and San Diego in April 2016

another and so on (Valentine 2005). As this process unfolded, I was able to find specific actors such as a Navy diving doctor who, as one of my archival sources highlight, is the 'logical agent' for the endeavour of accumulating 'useful, authoritative information in the diving field' (Lanphier and Dwyer 1954:42). Situated at what Driver (2001:2) would describe as the 'unsettled frontier' between adventurous explorers and scientific travellers, other actors including aquanauts and habitat engineers proved equally as insightful. Hearing the experiences of these 'geo-graphers[17]' was crucial in revealing 'important dimensions of the shape and meaning of' sub-marine geographical practices' (Powell 2008b:58).

As Dunn (2010) and Valentine (2005) have highlighted, building and maintaining rapport is a crucial component of a successful interview. As demonstrated in previous sections of this chapter, one way I sought to do this was by learning to dive. Sharing backgrounds and identities with your informant can, according to Valentine (2005:113) facilitate the flow of information and produce 'a rich, detailed conversation based on empathy and mutual understanding. As Dunn (2010:115-116) suggests maintaining this rapport also involves being able to speak the language of the research community in question and to be able to recognise jargon, slang, and acronyms (see also Cohn 1987). Matching your informant's perceptual language and images of the world is a process that must begin prior to the meeting and if successful, can be a useful means of conducting a fruitful and constructive conversation. In one interview, for example, aquanaut Bob Barth asked me if I was a diver. I replied that I was 'a very new one' conscious of my lack of knowledge. He responded by saying 'well, still, you've been trained, you've been underwater. When people talk to you about this, that, or so forth, there won't be a word that you don't understand', he later added, 'you're a diver, you're trained, so you know what happens'. As a 'diver' it felt like I had been accepted and my presence there, as Howkins (2010:218) experienced with the Antarctic, gained a legitimacy that it did 'not necessarily deserve' given my comparative lack of training, experience, and knowledge (see also Squire 2017).

This being said, this occasionally backfired. One question, for example, was met with the response 'you're a diver, what do you think it would have been like?' which made it more

[17] They may not be geographers in the traditional sense but they had certainly fulfilled a geographic function in the sense of producing knowledge about the environment and earth.

difficult to access certain bits of information, particularly surrounding feelings. Generally speaking, however, being able to share even the very limited insights I had with informants (whether that be sharing stories of disorientation, the feeling of having a flooded mask etc) was extremely helpful in bridging pre-existing asymmetrical power relationships (see Dowling 2010:32). Similarly, embodied knowledge I had gained through learning to dive enabled me to ask informed questions that challenged assumptions of naivety or ignorance that may have been made of me based on my gender and appearance – two themes that I will now reflect on.

3.2.1 'That's diver's for you': Sensing and negotiating gender politics in the field

Generally speaking, I have always been keen not to over-emphasise my gender in relation to my research as in my own mind, my identity as a researcher supersedes any issue germane to gender – a frame of mind that Cynthia Enloe might describe as 'gender blindness' (1993:231). I (perhaps naively) did not consider myself a 'female researcher'. As Cloke (2005), Horn (1997) and Pini (2004) highlight, however, reflecting on gender power geometries should form a necessary component of a reflexive analytical process when using interviews (see Valentine 2005). This is particularly true, writes Horn (1997:302) when the research community is predominantly male, as is the case in the diving community.

A newsletter from the historical diving society illustrates this perfectly (see The Historical Diving Society 2016). Ironically, the email was well intentioned and sought to advertise an event that would draw attention to the role of female divers throughout history. Unfortunately, in its execution, it served only to enforce the idea that the sea is the domain of man. For example, rather than simply refer to the women as divers, they are referred to as 'diving belles' who have 'been discriminated against when trying to enter a man's world'. The email ends by acknowledging that:

> 'nearly half of the visitors to the diving museum are women. Some are divers, but most come with their families and children…we do realise that women tend to be more interested in people rather than things, so with this in mind we plan to increase our 'people' displays'.

In highly gendered environments such as this, the gender of the researcher ‘assumes greater importance and significance than it would’ elsewhere. Moreover, as Chiswell and Wheeler (2016) highlight, being a young, female researcher conducting interviews in the field raises its own specific risks and ethical issues. For example, how can/should women ethically utilise a non-threatening, naïve persona to their advantage to gain access information (Horn 1997, Gurney 1985)? How should a woman with strongly held beliefs about equality negotiate overtly sexist remarks (Gurney 1985, Chiswell and Wheeler 2016, Cohn 1987)?

The difficulties posed by the latter were drawn to my attention very early on during the taxi ride (with a registered company) from Panama City Beach Airport to my apartment. After asking my age and if I was travelling alone, the former submariner turned taxi driver was intent on discussing a number of his past exploits that made for an uncomfortable and disconcerting journey. Having told me he had lived in London for two years, he confessed with a smile and a false apology that he had been living at a Play Boy mansion. He continued to tell me in great detail about his young blonde girlfriend from Lithuania (some 20 years his junior) whom he’d met buying his house – ‘she came with the house’ he remarked laughing. Whilst driving he flicked through images on his phone to find a picture of her, asking me to comment on how attractive I thought she was and seemingly extremely pleased with himself that (to my great confusion) she was in a relationship with him. Among other sexist and gendered remarks, this was followed by an unprompted confession that he had recently been driving porn stars to a porn convention and had to explain to his girlfriend why he had pictures with the women on his phone. Feeling uncomfortable, slightly sickened, and somewhat vulnerable in the back of his taxi my responses were muted. As I tried to turn the conversation to mundane matters like traffic, I was eager for the journey to end. Whilst he was not an interviewee, and technically the data gathering process of my feieldwork had not started, this experience was formative in prompting me to think seriously about how gender matters in the field and the difficulties associated with negotiating gender politics in an overtly masculine sphere - of course, this is a challenge both men and women experience.

Fortunately, throughout my fieldwork, I was never the subject of overt sexism, I never experienced sexual harassment or ‘hustling’ (Gurney 1985) and aside from the taxi ride, I generally felt safe. My interviewees were courteous and informative, some were extremely helpful and went out of their way to assist me, and there were interviews that I really enjoyed conducting with people who had fantastic stories to tell, often accompanied by a great sense of humour. Yet, precisely for these reasons, there were some occasions[18] where I again felt that I could not 'openly object to sexist remarks', not because I felt vulnerable in the back of a taxi, but because I wanted to maintain rapport (Gurney 1985:44, see also Horn 1997). As Horn (1997:303) highlights, 'research participants frequently do more than is necessary to ease the way for researchers, receiving little benefit from the research', the 'risk to the research of confronting them over their behaviour seems too great'. There were times where sexist attitudes and comments expressed in various forms by Sealab divers in the 1960s were explained away with remarks like 'that's divers for you'. In another example, the achievements of one woman, were diminished by a man who suggested that she, as a medical professional, 'got off easy'. Having interviewed the woman in question, there was nothing easy about what she achieved, and if anything, her achievements were all the more remarkable given the barriers that were continually placed in her way for being a woman. I was continually given the impression that military diving was incredibly gendered and overtly sexualised – in one setting, for example, the light switch was strategically placed to look like penis with a male body drawn around it.

In failing to challenge prevalent gendered attitudes, I felt tacitly complicit in their reproduction and part of an awkward politics of conviviality as I sought to maintain a good relationship with the people I was working with (Winchester 1996)[19]. At the same time as revealing my own gender politics, however, these moments were also incredibly revealing about the gender identities of some of my participants. As Pini (2004:176) highlights, sexual comments and innuendos confer identity onto the speaker – in making these remarks, 'these men positioned themselves firmly within discourses of hegemonic masculinity and heterosexuality'. The researcher, can in this sense become a 'prop' in the gendered performances that reinforce a certain masculinised persona. These hegemonic masculinities were also evident in other ways during the interview process. As will be explored further in chapter 4, diving, particularly at the technical level, is highly gendered.

[18] It is worth noting here that these attitudes were not reproduced in every research context and interview.
[19] Needless to say, this would also raise similar questions for male researchers

The confluence, of technology, high risk, and the physical demands it imposes have created a highly masculine culture and this posed certain challenges in a couple of my interviews and interactions with participants. It was sometimes difficult, for example, to move beyond factual accounts to gain a better understanding of what it was like to feel and experience underwater life for a prolonged period of time or to have been experimented on in the NEDU. Whilst this was not always the case, in one particular interview, any attempt I made to ask about what these things felt like was met with responses such as 'you're a diver you should know', or 'it was fun'. In other instances, it was difficult to ascertain the difficulties that a diver may experience physically and mentally in undersea habitats, the NEDU or training. Overcoming physiological or psychological challenges seemed to be a means of reinforcing a masculine identity and 'man's' ability to overcome and master difficult environments.

Additionally, I found that the researcher's body is also important. As Chiswell and Wheeler (2016:2) and Gurney (1985:47) highlight, being female and appearing 'youthful' can have its advantages in the research process in both securing and conducting interviews. Whilst establishing cause and effect is impossible, Horn (1997) also argues that these characteristics are useful in the active construction of a harmless and unthreatening persona that puts informants at ease, thus granting access to information that may otherwise remain unsaid. I was asked my age on numerous occasions and told I did not look 25 – comments I brushed off by suggesting that 'it would pay off when I'm 50' (I was even asked at the airport if I was on a school trip). Whilst this may have had advantages in terms of appearing non-threatening, it also had disadvantages in terms of assumptions about my prior knowledge, the field emerging here through the affective interactions prompted by my appearance as something unstable and unpredictable. On a number of occasions participants seemed surprised when I knew basic information, such as being able to recognise an image of George Bond. Perceptions of a researcher's ignorance can, as Chiswell and Wheeler (2016:5) and Horn (1997) highlight prove useful in hyper-masculine environments as it can elicit responses intended to 'impress' or 'shock' yet it can also prove somewhat frustrating as the same information is provided multiple times. There is also a certain physicality to this, as will be explored in chapter 4, my own body frustratingly became a prop in justifying the lack of women in diving. As Enloe (1993:20) highlights, men often work to separate themselves from women to both accept and resist cultural ideas and ideals about what it is to masculine and I was perhaps being invoked as a tool of separation to achieve this. I often wondered during the research process how their perceptions of my level of knowledge and ability would have changed had I been a physically imposing man. Interestingly, I did not encounter any of these difficulties when interviewing a woman. She happened to be of a similar size to me, and when the size of my physical frame was drawn into the conversation, it was to highlight the capabilities of women, and to emphasise the unfounded judgements that were made about her abilities during her work and training.

3.2.2 Memory, vulnerability and shifting positionalities

Physicality and embodied positionalities were also significant in other ways. A key challenge in a number of interviews, for example, occurred because of the age of my participants. In addition to having limited mobility, both suffered with significant hearing loss[20]. I had to re-word my questions and re-think how I communicated. Had I realised the implications beforehand (or known their ages), I would have perhaps engaged in the interview process slightly differently, making greater use of images to prompt both discussion and memory. As Andrews et al (2006:158) highlight, 'narrative memories of places are often constructed through a focus on material objects that possess personal historical significance' and the use of objects and images would have been extremely useful. The value of this was realised in one of the interviews when the conversation became much more fluid, rich, and fruitful when we began discussing relevant photographs on his wall and various objects around the house. This would have also been useful in the second interview as it became difficult at times to keep the conversation on track.

Researching geopolitical events of the past will mean at times that the participants are elderly yet, with a burgeoning literature on young people in geopolitics (see Benwell 2016,

[20] This was partly as a result of the ageing process but also, as I was told, a result of years of diving and the associated pressures and strains that are placed on the ears. An archive of the body emerges here wherein the physical environment of the sea leaves traces and scarring.

Benwell and Hopkins 2016), there is little in critical geopolitical scholarship on researching with the elderly and the specific challenges and riches that are associated with the sense of place and space constructed when time and distance is put between the event and the interview. Allison (2004:75) for example, demonstrates that with time from an event or series of events, comes opportunities to impose order on memory – particularly after traumatic or stressful events. Memory, writes Allison, works to make sense of the past which involves 'providing explanations, context, drama, value, significance, and justification' (2004:82). Whilst this process is true of all participants, it is perhaps exacerbated and exaggerated with elderly interviewees as the passage of time is greater. Certainly, I found that my participants (understandably) could not remember details like depths, dates, and sometimes names were elusive. With one participant, the information provided largely consisted of a broad overview of events (this changed when we began discussing the photographs on his wall and in his book). As Lorimer (2003a:202) highlights, 'the passage of time quickly erodes ephemeral multi-sensual realms, rendering them all the more elusive'. As a result, the task of capturing 'haptic…and kinaesthetic forms of experience' and exploring the complex interplay between 'these embodied experiences and the formation of geographical knowledge' (Lawrence and Schaeffer 1998 in Lorimer 2003a:202) becomes all the more challenging. Of course, this does not mean that the interview loses its value – as Cook and Schwartz (2002:172) highlight, memory is not something that be found and collected by solely engaging with archival sources, it is continually made and re-made and engaging with this process is in itself a valuable endeavour. It does suggest though, that the interview cannot function alone as a primary source and other methods are necessary to contextualise the data including using tactile objects and walking tours of past immersive spaces such as diving chambers (Allison 2004).

There are also different social power geometries at play. Due to my informants' age and limited mobility I went to their homes to conduct the interviews. The home, as Andrews et al. (2006:154) suggest, is a place where control over one's life can be freely exercised'. In hindsight, this may have had significant implications on the structure of the conversation. At times I felt I had little control over the interview – one participant, for example, would finish his sentence and then prompt me for the next question, in the other, I struggled to prevent significant deviations from occurring. Where my other interviews had taken place in coffee shops or the lunchrooms of offices, this was not a problem and the interviews generally evolved into flowing and less contrived conversations.

Additional subjective power geometries existed beyond the conversation itself and again highlight the importance of the physical embodiment of both the researcher and the participant. Having been aware of literature that warns of the potential vulnerabilities associated with a young, female, researcher conducting interviews in the homes of men (see Tarran 2015 for example), I was conscious that for one of my interviews I was driving to a very remote location. As I went along the long, and seemingly endless, dirt road to get there (see Figure 14) I was aware that it was a very isolated area, yet when I arrived at the informants home, my perceptions of my vulnerabilities as a researcher and their comparative power as a participant shifted. As I arrived I was asked by a neighbour if I was a nurse (presumably given I was young and female), not long afterwards a carer arrived. Again, physicality/corporeality became important here. My participant and his wife were elderly, he had forgotten I was coming but graciously invited me into his home. Far from feeling vulnerable, my presence there felt somewhat intrusive. The participant commented that he might not have much time left and I was acutely aware of imposing myself and my questions, which came to seem insignificant, on them. My perceptions of my own physical vulnerabilities shifted. The body here becomes a source of shifting power geometries capable of creating and removing feelings of physical insecurity whilst prompting feelings of intrusion. Perhaps my own body was at work here too – my relatively youthful appearance, gender, and size, all working to ensure that they did not feel threatened by my presence in their home.

Figure 13: The long and remote dirt road to the house of an interviewee (photo by author).

3.3 Locating the body in the archives

'Archives are contradictory, incomplete sites where interpretations are forged and not provided'

(Farish 2010:xxiv)

Whilst both learning to dive and interviews were important tools in the data collection process, archives proved pivotal. I had initially expected the material, such as that from the NEDU, to produce information pertaining to the somatic - to the pre-cognitive, minute, molecular bodily interactions that take place when men were immersed in either the depths of the sea, or simulated depths in a dry hyperbaric chamber. As will be explained, whilst this proved to be the case, archived diaries, chronicles, psychological reports and photographs offered glimpses into what Dwyer and Davies (2010:91) refer to as 'archives of the feeling body'. As they highlight, by drawing the 'body into the landscape' or in this case, the seascape, different sensibilities are brought to bear on the 'narratives, materialities, and images of these extreme environments'. Similarly, Lawrence and Schaeffer (1998 in Lorimer 2003a:202) suggest that whilst there are inherent difficulties in tracing ways of moving, feeling, performing, and being in the past, archives can function to 'construct a body that no longer exists' enabling the researcher to present a 'substantiated and convincing account' of past embodied experience (Baker 1997:232). The everyday routines, fleeting encounters, 'embodied movements, precognitive triggers…affective intensities and sensuous dispositions' (Lorimer 2005:84) revealed through these documents proved instrumental in understanding how undersea space is both constructed in the minds of the aquanauts and divers and how it was corporeally experienced. The archives thus served the dual function of filling in blanks on technical and physiological information whilst also providing some of the sensual, cognitive, and felt experiences of those who are not around to remember in the present.

In the following sections I reflect on my experiences of working with archives of various forms and guises. These included the Man in the Sea Museum in Florida, the University of California, San Diego (UCSD), which houses the archives from the Scripps Institute of Oceanography, and online sources from the Navy and NEDU. Far from being a homogenous experience, the archival work proved lively and at times political, revealing the centrality of certain people, bodies of knowledge, and haptic processes in the production of knowledge. Throughout this process, nuanced insight into the functioning of body and mind beneath the sea, gender, the Cold War mind-set, the role of non-human life, and the geophysical specificities of the sea itself were revealed.

3.3.1 Negotiating the formal and informal archive

Much of my time in San Diego was spent at the special collections and archives reading room at UCSD (see Figure 14). As highlighted, this is the access point for material from Scripps Institute of Oceanography who were a key partner in Sealab II. The institute provided information on locating the habitat on the seafloor, details and maps of the surrounding area of La Jolla Submarine Canyon, and personal letters, logs and diaries from Scripps oceanographer/Sealab II aquanaut Earl Murray who was responsible for the installation of the undersea weather station in addition to other biological and ecological experiments and projects. The material, then, had the potential to offer a different perspective from the Navy and open up interesting insights into the underwater environment, how it was made known to scientists, and the struggles against non-human sea life that ensued in the process. The sources were invaluable and included personal diaries, daily logs of activities, press kits, images, newsletters written by George Bond and a large collection of newspaper clippings.

It also offered an opportunity to reflect on some of the politics and procedures of this kind of archive work, which involved sending for boxes containing numerous folders and then sitting with one box at a time in an isolated reading room. The boxes were requested based on crude search criteria such as 'Sealab' and then ordered based on my interpretation of their relevance. Inevitably, this meant that my own value judgements and research questions shaped the results I received and meant that some things were inevitably lost or never came to my attention in the vast library of documents (Guest 2010). Archival work emerges here as a somewhat 'contradictory process' wherein efforts to capture and give form to the 'identities and capacities of past communities, spaces, and landscapes' simultaneously erases that which cannot be so easily captured' (Dwyer and Davies 2010:89). Historical research, can as Black (2010:467) asserts only ever 'deal with residues, or to use a geological metaphor sediments'. Whilst this is certainly true, there are a number of factors that can influence which 'sediments' come to light. The folders I requested, for example, arrived with the whole box enabling me to look around, behind and in front of it to unearth information that I otherwise would not have found. Of greater significance here is the role of the archivist. Whilst the staff at the library were extremely helpful and pointed to a number of useful sources[21], the archivist with specific knowledge of the Scripps material had retired and not been replaced. Whilst I was able to seek his advice informally having been given his email address after contacting the generic enquires address at Scripps, the body of knowledge that they had accumulated on Scripps material had been transported with them in their retirement and as such, was no longer readily accessible through formal channels. The specialist insights of the archivist are distinctly embodied. Decades of pouring over material and getting to grips with a vast collection is a haptic, time consuming process and the wealth of knowledge wrought as a result is an indispensable resource to any researcher seeking to transverse and get behind the lines of search algorithms and search criteria. The fact that the archivist had not been replaced and the

[21] One occasion this was serendipitous. I overheard the words 'militarised dolphins' and was shown some papers on Operation Headgear – an attempt to control the movement of sharks. Categorised under the title 'James Snodgrass papers' this was not material I would have otherwise found.

‘specialist’ not deemed a priority meant that the formal archive had lost these insights. As was explained to me, resources are being ploughed into digitising material and as they are diverted into this process, much is lost as specialist knowledge falls by the wayside. They also explained that there is a wealth of resources yet to make into the online search database making it impossible to know what the collection holds and how it might be used.

An additional challenge of the UCSD archive was the restrictive measures in place on duplicating material. No photographs could be taken and a researcher who is not attached to the University can scan copy only 250 pages per year. Documents that you wish to copy have to be marked and approved and the total includes images which cannot be captured in any other way. My time was spent copying out articles or sections of reports which, whilst helping me process and familiarise myself with the material, it meant that I was unable to capture some contextual information. In order to circumvent these difficulties, I was extremely fortunate to be in contact with two individuals with an interest in Sealab who had digitised a large collection of original material, including Berry Cannon’s personal journal of his Sealab experiences. Through the use of Dropbox and a USB drive, my contacts kindly provided me with vast amounts of visual and textual data that drastically enriched the project and provided nuanced information on the effects of undersea living on the body and mind. A personal archive of scanned material proved just as valuable as the official UCSD collection, highlighting the centrality of informal archival channels in accumulating data.

My experience of the UCSD archive (see Figure 14) was markedly different from that of the Man in the Sea Museum (see Figure 15). The differences are depicted in the images below and the restrictions placed on my interactions with documents in the more sterile environment of the UCSD archives made for a very different experience that in the less regimental archive of the Man in the Sea Museum. Rather than being a formal institutional archive, the museum’s collection is labour of love - it is the proud home to the Sealab I habitat that was reclaimed from the sea by volunteers keen to see it established to its former glory and surviving aquanauts, Sealab engineers, and Navy saturation divers have all donated documents, images, and objects relating to their experiences. Located in a room just off the museum, the library contained an uncatalogued collection of original documents from the Sealab experiments, diving manuals, and books and objects. I was also able to sort through boxes containing donations from the late Aquanaut Berry Cannon's family along with collections from a Sealab engineer and aquanaut that had yet to be processed[22]. These included newsletters penned from 'Papa Topside' to the Sealab aquanauts and their 'aquaspouses', scrapbooks containing newspaper clippings, and personal collections of photographs[23]. The wider collection contained documents such as George Bond's diaries/chronicles from each of the three Sealab experiments, press handbooks, press releases, and reports on various aspects of the Sealab program. I was kindly granted permission to look through the documents, photograph the material, and search through the boxes around the room. As Ashmore et al. (2012:86) highlight, 'location plays a role in the encounter with archival materials' as objects, documents, and photographs are enlivened by the context they are experienced in. Rather than processing isolated materials delivered to a reading room to be worked through alone, the context of the Man in the Sea Museum was motivating. Whilst Ashmore et al. refer to archives in the domestic setting, this local collection possessed many of the same qualities. For example, the emphasis shifted to 'emergence' rather than 'targeted burrowing' and information arose in a 'more haphazard way' (2012:87). Rather than being funnelled through incomplete online databases, I was able to search the shelves and document what I saw whilst avoiding the 'dangers of searching intently and thus dismissing superficially tangential but perhaps more rewarding connections in the long term'. The nature of the Man in the Sea Museum collection allowed me to transgress the norms, rules and set practice and behaviour of the formal archive (2012:89) (see Figure 14). It was a motivating experience that was only enriched by the presence of large artefacts such as the Sealab I habitat just outside which I was able to explore (see Figures 16 and 17).

[22] Unfortunately three boxes of personal documents from family members of the aquanauts were shipped to Florida to the Man in the Sea Museum from San Diego just days before I arrived in California. The movement of Sealab material from person to person and to different locations was somewhat confusing and haphazard but in the future it seems they will converge on the Man in the Sea Museum.

[23] 'Although this 'archival turn' has often focused on official collections, more recently there has been a broadening out of what is considered worth saving and what we can consider as an archive. A plethora of work has begun to consider less formal collections, considering everything from family photograph albums, to postcards and recorded birdsong (Ashmore et al 2012:82)'

Figure 14: The formal archive at UCSD (photo by author)

Figure 15: An example of sources in the less formal archive of the Man in the Sea Museum (Photo by author).

Inevitably, in both the UCSD archives and the Museums' there were also stories missing. On the one hand these missing stories refer to the documents from aquanauts and associated personnel that have yet to make it to an official collection – as Hellwarth (2012:268) highlights, official records on Sealab are 'spotty at best'. On the other hand, absences were also socially produced. Narratives of men dominate with women only surfacing in the gendered musings of the personnel involved or the journalists reporting on the experiments. For example, the experiences of two male Scripps employees who were involved in Sealab, were well documented whilst the female scientists from Scripps who took part in the later Tektite II habitat project have no such folders. Press clippings of their experiences were all that was held. The archive, as Cook and Schwartz (2002:172) assert, is not a 'passive storehouse of old stuff' but an active site 'where social power is negotiated, contested, confirmed'. What is preserved and survives intact is an inherently 'social and political process' that can reveal much about the conditions under which information is produced (Ogborn 2010:92).

Figure 16: The Sealab I habitat at the Man in the Sea Museum (photo by author)

Figure 17: Looking out of the Sealab I habitat through the porthole (photo by author)

In addition to physically inhabiting archives, I also spent a significant amount of time working my way through the historical records of the NEDU from the 1950s -1980s that are available through the Rubicon Foundation online. The records generally consist of detailed scientific accounts of experiments conducted by the NEDU, offering an incredibly rich insight into the bodily, somatic, and pre-cognitive life of the aquanauts and experimental subjects. Experiments range from memory impairment during deep helium dives (see Biersner and Cameron 1970) to aptitude selection tests for the Navy's dive school (see Wise 1963). Other documents included annual accident reports detailing occurrences of decompression illness, oxygen toxicity, other diving related problems, and psychological considerations in Navy diving. There were also other unexpected insights that were garnered from the documents. The acknowledgement sections, for example, on some of the papers provided some interesting examples of the gender dynamics at play in the production of Navy diving knowledge. As a case in point, Berghagn (1966) thanks numerous men before finally wishing thanks to 'his wife who spent many of her evenings working with diving accident reports'. As gratitude is expressed, this (presumably) unpaid labour in the domestic sphere comes to light, highlighting certain power relations, positionalities and regimes of inclusion and exclusion that are tacitly created or implicitly implied in the writing of acknowledgements.

Whilst the NEDU archives proved to be an incredibly rich source of information, there were a number of practical challenges in engaging with the online source material. The lack of tangible paper and the associated haptic experience of handling documents, searching through shelves and boxes and conducting the research in-situ makes for a markedly different research experience whereby you feel more disconnected from the research material. Moreover, whereas my time in the Man in the Sea Museum enabled me to gain an overview of the documents available and to come across tangential, but very relevant, documents, this was more difficult to achieve online where your results are pre-filtered through search criteria (Ashmore et al 2012:82, Ogborn 2010:98). This, coupled with the sheer volume of data available (see Hodder 2017 for some excellent insights into the difficulties of 'handling' archive material in the digital age), meant that I inevitably channelled my search criteria using limited phrases and words to try and grasp the relevant data. As highlighted above in relation to search criteria on archive databases, this creates a certain short sightedness that reminds me somewhat of the changes to your field of vision when diving. With a mask on and a three dimensional volume to look through, your field of vision is dramatically narrowed and things that may be happening around, above, or beneath you may not be immediately apparent unless you know where you need to look. Without a concerted effort, your visions is tunnelled and channelled into a particular area rendering everything else absent from your experience. The challenges therein lies in retaining the 'dialogues between that which can be made a lively presence and what remains a telling absence' (Dwyer and Davies 2010:89). Trying to contextualise the data was key here. I actively sought to connect the stories contained within individual documents to wider phenomenon (see Lorimer 2003a), always triangulating what I was reading with other archival material and information from interviews. As Baker (1997:235) suggests, no sources can be taken as face value. On the contrary they need to be critically evaluated within the context of other relevant information such as the documents own geographies and its political, temporal, social, and cultural context.

This sounds a relatively straightforward task but it proved difficult given the volume of documents and the nature of their contents. I used specific search terms with the NEDU documents such as 'diver selection' or 'psychological considerations'. Whilst this proved extremely fruitful some of the documents contained information that was beyond my ability to understand. For example, whilst Kuehn and Zumrick's (1978:216) paper on thermal regulation was mostly understandable, it often became very mathematical pointing to a wider problem within this particular set of documents. Whilst they were full of scientific detail and information on particular bodies and their somatic reactions, they often lacked detail beyond this. Context, operational applications[24], and accounts of lived experience were lacking, making my other sources and methods all the more valuable. For example, Berghage (1966:1) describes how he sorted records of diving accidents using mathematical formulas and 'machine data processing cards'. Whilst the numbers produced through this method were extremely useful in gauging the scale and types of incidents that

[24] To illustrate this, it is documented that the Navy were increasingly looking to improve their diving operations in cold water but the documents do not elaborate on why or where precisely the military were working. Other archival sources and interviews proved useful in fleshing in the gaps.

were occurring during the experimental operations, the accounts needed fleshing out. Some of this was achieved in other archival sources where the documents were significantly more personal and descriptive, whilst a number of interviews proved to be extremely insightful. One interviewee, for example, described what it was like to suffer from Oxygen toxicity, putting thoughts, feeling and memory behind the figures produced by the NEDU. The challenge lay in balancing the seemingly objective (the pre-cognitive) with the subjective (the cognitive) and vice versa.

In addition to written documents, visual and film archives proved invaluable. These came in a number of forms, from a wide range of photographs taken at the time of Sealab, films produced by the Navy for the public on Sealab I, II, III, and a final film on 'The Aquanauts'. As Dodds (1996:575) highlights, visual culture is extremely important in understanding how space is produced and experienced. The Public information videos produced by the Navy were particularly useful here, playing on the tropes of science fictions via music, sound, and voiceovers, they package the experiments for a public audience. In doing so they centralise certain applications (such as access to resources, improved security, and the potential for undersea farming) whilst bypassing the more covert applications of saturation diving. Kinney's (2013) analysis of *The Big Picture* television series (produced by the US Army during the Cold War) is helpful here in establishing the merits of engaging with this form of archive material in political geography research. Kinney (2013:346) highlights how military-produced films act as a contact point between the military and public, mediating the intentions of 'internal image makers' and 'the wider world of public opinion. Existing as 'set of historical…records turned 'inside out'', military-produced videos are worthy of investigation and analysis (*ibid*). In the case of *The Big Picture*, and likely also the Sealab videos, the films make a case for relevance, justifying funding and enrolling the public's imaginations into military efforts (Kinney 2013:249). They perhaps also form part of a 'haptic visuality (Marks 2000) that create a sense of immersion as audience is transported with the camera and the bodies depicted beneath the waves or onto the ice as the case may be. Whilst the viewer does not literally touch the screen, feelings of awe and wonder are prompted as the public is guided to imagine the future of mankind beneath the waves.

Other visual sources such as photographs were extremely useful as a means of examining embodied practice whilst also prompting the haptic affects described above as the viewer imagines being in the context of the photographed subject. As Yusoff (2007) highlights through her exploration of how the Antarctic landscape is rendered through expeditionary photography and embodied practice, historical visual records can offer unique insights into embodied endeavours. Feelings of pain, exhaustion, and in the case of the Antarctic, snow-blindness and exposure interrupt and 'puncture' narratives of heroic exploration in extreme spaces. Whilst this highlights how embodied gestures can be captured in a photograph, the relationship between the hero explorer and expressions of discomfort that may be expressed in photographs is a complex one with both photographic and bodily exposures colliding with interesting effects and affects (Dwyer and Davis 2010:91). On the one hand, as chapter 5, explores, we might think about how such images challenge ideas of a sanitised Cold War hero, whilst on the other, the physical discomforts experienced by those in Sealab and portrayed in photographs, also served to emphasise their exceptionality and their ability to overcome the trials implicit in the mastery of extreme spaces.

3.4 Conclusions

In moving out of my comfort zone and making myself a test site of sorts, vulnerable to a new elemental surround when diving (in water and in a hyperbaric chamber), I was able to corporeally experience a snapshot of the 'world' of my participants. On numerous occasions they described being underwater as being like another world, or another earth, and only when submerging myself and immersing myself in this environment could I gain any sort of appreciation of what this meant or entailed. Inadvertently getting decompression sickness (or the bends as it is more commonly known) only served to highlight the possible complications and affects/effects on the body from pressure and the role of the body as an archive for certain artificially created atmospheres (see chapter 5). As highlighted, these experiences also had practical implications in terms of framing questions, imagining/embodying the experiences of my participants, and familiarising myself with jargon and knowledge necessary to access the embodied sub-marine world. In interviews, my own body was brought into conversations, highlighting certain gender norms and expectations in the process whilst the age of a number of my participants affected the information I collected. Simultaneously my own feelings of vulnerability were challenged as I visited their homes. Finally, in the archives, the body of knowledge held in the mind/body of the archivist is crucial, a corpus of information accrued through years of physical interaction with documents and people – at his/her fingertips one might note. The archives also proved an incredibly rich source of both somatic and cognitive bodily responses in humans, and the ways in which non-human life came to be significant (see chapter 6). The body in various forms and guises was ever present. In engaging with the complexities associated with this presence (and associated absences – as will be illustrated in the coming chapters), certain feelings and accounts surfaced whilst others remain submerged and unaccounted for, I was able to better understand and grasp the ways that the sea acts on the body, and to learn more about the nature and composition of the sea and the life contained within it in the process. Attuning to the embodied affective and performative modalities at play (whether operationalised through autophenomenology, the archive, or the interview) brings additional complexity and nuance to this project.

Whether I was immersed in water, conducting interviews, or working through archives, the intersections between my own body, and the bodies (and bodies of knowledge) of the experimental subjects of Sealab proved to be a significant part of the research process. It was a process laced and entangled with a range of affective and performative modalities that emanated from my own body and those of others. Negotiating various affective terrains and contours was an important component in this whether it involved feeling apprehensive in the taxi ride, being mistaken for someone at school and a nurse, the frustration of becoming enrolled as prop to reinforce gender norms, and feeling that as a researcher, my presence was, in some contexts, intrusive. This affective landscape characterised the research process and my subsequent engagements with the material I collected. In recovering and reflecting on these affective experiences, 'the body' emerges as an important construct. Clearly, the primary aim of this was to enable the recovery of the materialities, experiences, histories, and feelings of those who had been involved with Sealab. It is in the collisions between these practices that the insights and reflections in the following chapters have been generated as I sought to animate the archive, the interview, and autophenomenological practices by bringing them into contact with one another. There is certainly need in the conduct and practice of critical geopolitics for experimental practices such as this to unfold, to be oxygenated and granted permission to breathe. Notwithstanding the above, Merriman (2014:177) highlights the inherent importance and value of experimentation (see also Wylie 2005). According to Merriman, it aids self-discovery facilitates discussion, and the process can become equally, if not more, significant than the outcome. Whilst there may be aspects of volumes and the elemental that remain 'in excess of the apparatuses of their capture' (Lehman 2013:52, see also Philippopoulos-Mihalopoulos 2016), consciously inhabiting the earth's volumes and pro-actively engaging with those that not only inhabit, but engineer, work, craft, and create volumes can potentially enrich our understandings of these complex spaces and their affects/effects on the body. As Timm Knudsen and Sage (2015:6) highlight, this approach might entail complicating 'the dichotomy between doing something to the world and investigating it' (Timm Knudsen and Sage 2015:6).

Chapter 4

Homesteading the underwater frontier

> ‘The Navy aquanaut -deep sea diver and explorer, technician and researcher, pioneer and builder. The Aquanaut - a man in peak physical and mental condition, ready for any underwater emergency. Product of a training program to prepare him, not only for the man in the sea project but to accept the challenges to come, spearheading a new era of exploration and discovery in an ever expanding conquest of the ocean world for the benefit of all men, everywhere’
>
> (US Navy, The Aquanauts, no date)

4.0 Introduction

'Little by little he transforms the wilderness'

(Jackson Turner 1893:200)

Making the US Navy's undersea living experiments a reality was no simple task. On the contrary, inhabiting the sea floor and the surrounding water column both in the Atlantic and Pacific Oceans, involved a great deal of strategic, imaginative, material, and bodily labour. Moreover, the projects did not take place within a political, cultural, or social vacuum. The significance of the US as a frontiering[25] nation and the white Christian man as a pioneer, the desire for territorial expansion during the Cold War, and the gender norms that governed American society during the 1950s and 60s all loom large over, and are wholly imbricated in, the Sealab experiments. This chapter seeks to explore the underlying imperatives, imaginaries, strategies and practices that drove and facilitated the Navy's 'Man in the Sea' agenda to better understand and raise novel questions about established geographic concepts such as *territory*, *terrain, gender*, and *home*.

Before engaging directly with Sealab, the first section of the Chapter provides some context to the significance of the 'frontier' in the American Imagination from the late 1890s and early 1900s with Jackson Turner's *Frontier Thesis* to the Cold War. Whilst this ground has been well covered elsewhere, the notion of frontiering is a common thread running throughout this thesis and the context is extremely significant in understanding the Sealab experiments. After briefly exploring the frontier in the American imagination, I then move on to consider how this geographical projection and construct was understood and operationalised by Sealab protagonist, Capt. George Bond. As one of the key drivers behind the projects, Bond's perspective on how and why 'man' should venture beneath the sea provides insight into a range of phenomenon - from the belief that Sealab was a divinely ordained and an inherently spiritual endeavour, to understanding the construction of the undersea environment as a naturally masculine space where the elemental power of the sea can only be withstood by male bodies.

[25] 'Frontiering' used deliberately here to describe an ongoing process

Having explored the underlying motivations and driving factors both historically, politically, and in the imagination of George Bond, the following three sections deal with some of the practicalities and challenges involved in homesteading the immersive, pressurising undersea environment. These include the difficulties associated with mastering the elemental properties of the sea floor and water column in order for an appropriate site to be located and for the operations to run smoothly. This raises interesting questions about how we conceptualise naturalised constructs such as *territory* and *terrain,* as well as understandings of the 'frontier' in a three dimensional, constantly shifting space. Moving on from site location, the chapter turns to the practices of domesticity, home, and routine that came to define the project as a homesteading, pioneering initiative. In doing so, light is shed on the gender norms governing undersea living and how the wives of the aquanaut's came to be disempowered as their husbands were empowered by their new domestic responsibilities under the sea. Finally, the chapter explores some of the dangers of feeling *too* at home on the sea floor, drawing on the so called 'breakaway phenomenon' to raise questions about how we understand and conceptualise the construct of *home* in extreme spaces where the immersive environmental and elemental surround is of significant importance. By way of conclusion, I draw on the concept of 'dwelling' (see Wylie 2012 and Cloke and Jones 2001) to tie some of these themes together to better understand the role of elemental in characterising the aquanauts' relationship with sea and in inhabiting the world more generally, and a means to explore the conditions that make the practice of dwelling possible for some and not for others.

4.1 Frontiering

The significance of the 'frontier' in the evolution of the American geographical imaginary is well documented (see for example Grossman et al. 1994, Slotkin 1998, Billington and Ridge 2001, Kahn 2005). The purpose of this section is not therefore to repeat this well covered ground, but to provide some context to the forthcoming empirical material on the US Navy's undersea living experiments. The frontier imaginary, is after all, paramount in understanding the motivations and underlying psyche of key actors such as George Bond (as expressed in his diaries) and in better understanding the language and framing of the projects.

The explicit articulation of the significance of the 'frontier' can be traced back to Frederick Jackson Turner's 'Frontier Thesis' (1893). In this Thesis, Turner posited that the unique character of American civilisation could be ascribed to the continuous 'evolution and adaptation of organs[26] in response to a changed environment' (Billington and Ridge 2001:3). American development, he argued, has not merely advanced along a single line, but has seen a return to primitive conditions on a 'continually advancing frontier line':

> 'American social development has been continually beginning over again on the frontier. This perennial rebirth, this fluidity of American life, this expansion westward with its new opportunities, its continuous touch with the simplicity of primitive society, furnish the forces dominating American character' (Jackson Turner 1893:199).

Turner argued that the movement of people from all over the world into the vast unoccupied Western regions of America, necessitated alterations in established ways of living. The primal tasks of collecting food, utilising natural resources, and ensuring survival became paramount as older practices were adapted to meet the demands of a new environment (Billington and Ridge 2001:2). Led by fur traders, hunters, miners, and farmers, 'innovation, adaptation, and invention' became defining characteristics of frontier life as societies were continuously reorganised and 'beginning over again' in the West (Billington and Ridge 2001:2). The main attention was directed toward the outlying areas – places 'of experimentation (and even lawlessness) where settled patterns of the centre are challenged and manipulated' (Dixon and Monk 2014:858 in Hannigan 2016:21). Throughout this process, the specialised knowledge of white, male pioneers was paramount with the practice and performance of frontiering requiring techniques of land clearing, home building, fencing, and 'solving the problem of defence' (Billington and Ridge 2001:10). Lying at the 'hither edge of free land' (Turner 1893:199), the process of mastering

[26] The following Chapter will reflect on the role bodily organs and human physiology in this process.

the American frontier was a meaningful one with individuals 'bent on applying their skills to the exploitation of unusually abundant natural resources' (Billington and Ridge 2001:3). This American struggle to master and dominate the untamed wilderness in successive spaces and sites is, according to Hannigan (2016:22) the 'single most important causal explanation for the development of American culture', working to 'evolve the citizenry…and the very democracy of the country' (Kahn 2005:2).

Clearly, frontiering is an inherently spatial and practical process involving manual labour and boundary marking performances. As Billings (1997:187) highlights, the frontier can be defined as an advancing or shifting 'zone that marks the limits of settlement and civilisation'. Yet, as Turner (1893) himself highlights, the 'frontier' is as much a 'psychological place, a sort of organising principle' as it is a (geo)physical entity or 'objective condition' (see Hannigan 2016:21). It is an extremely powerful ideological construct, which in the words of Kahn (2005:3), reformulates the master/slave dialectic in geographical terms: 'the wilderness masters the colonist, the colonist masters the wilderness'. In this imaginary nature is to be assaulted and attacked (see Farish 2006) in a push toward self-determination. Although the American frontier in its physical sense, 'was declared 'closed' by the US Census over a century ago in 1890', imaginatively, geopolitically, and discursively it has remained 'startlingly 'open'' (Khan 2005:1). Ever since Turner's articulation of the significance of the frontier, there has been a continuing reliance upon the 'discursive metaphor of progress, particularly American progress, which refers directly to projects of territorial expansion and control' (Kahn 2005:1) into imagined wildernesses 'of stark extremes, of broad horizons empty of humans' (Oslund 2002:313).

The 'frontier' with its associated images of 'pioneering, homesteading, claim-staking and taming' (Billings 2006:252, see also Billings 1997) is embedded deep within the American psyche. America, has been imagined as having a limitless future, assuming a transcendental identity where terrestrial limits are mere stumbling blocks to overcome. This identity was (and is) constituted by a white, male, puritan belief that the America had a 'manifest destiny' expressed through a spirit of confidence, sense of power, and pre-destined political and territorial eminence (Billings 1997:188, Sage 2014, Spiller 2015).

4.1.1 Cold War frontiers

'We have tried to find the entrance to the great hydrosphere because we feel that the sea age is soon to come'

(Cousteau 1954:222)

With a Western border manifestly ended at the Pacific Ocean, 'what was to be America's destiny? Could a case be made that the process of the American frontier could sublate its own history of material expansion and move in a new direction or another dimension?' (Kahn 2005:7). Buttressed by a literary and popular tradition that romanticised and promoted the frontiering, homesteading, transcendental imaginary (Sage 2014), the idea that America could be a 'mighty and noble race free from physical instrumentality' (Farish 2010:64) did not end on the Western frontier. On the contrary, the 'quest for new geographical knowledge' meant that 'every place, every type of place, possessed a potential Cold War purpose' (Farish 2010:55) in a geography that was profoundly 'imaginative and dependent on *perception'* of spaces that could be mastered and conquered (Farish 2010:2, emphasis in original). As such, the frontiering imaginary enveloped a wide range of spaces during the Cold War including the Arctic (see Farish 2006, 2010, 2013), Outer Space (see Sage 2014, Billings 1997, 2006, Hitt et al. 2008, Rowland 2009) and the Antarctic (Spiller 2015). Whilst the vast oceans surrounding America served as a 'frontier line behind which empty land beckoned settlers' (Rozwadowski 2012:17), it also became a frontier space ripe for exploitation and cultural development in its own right. Innovators like Frenchman Jacques Cousteau were crucial in cultivating a frontiering imaginary at sea. His work not only enabled humans to venture beneath the waves for the first time via the invention of the aqualung, but he sold an oceanic frontiering vision to a mass Western audience via spectacular broadcasts and richly illustrated books. 'Obviously' wrote Cousteau:

> 'Man has to enter the sea. There is no choice in the matter. The human population is increasing so rapidly and land resources being depleted at such a rate that we must take sustenance from the great cornucopia' (1954:223).

Writing about the 'incredible realm of oceanic life which is still waiting to be known', Cousteau encouraged his audience to look beyond the 'thin tissue' or habitable land to the ‘living space of the oceans’ averaging some ‘twelve thousand feet in depth’ with a ‘volume more than a thousand times as great’ (Cousteau 1954:222). This vision was shared by the US Navy and Cousteau was in regular contact with the Sealab team. Not only were Cousteau and Sealab protagonist George Bond good friends and friendly rivals but Cousteau suggested designs for the undersea habitat in a letter to engineer, Bill Culpepper (Cousteau 28 May 1965). This relationship and shared imaginary was cemented in Sealab II with the world’s first undersea phone call made from the Sealab II habitat to Cousteau’s undersea habitat ‘Conshelf III’ off the coast of France (see Bond 1965, entry 1 October 1965, Helmreich 1968). For both the Navy and Cousteau, the surface of the sea was the frontier to be broken through and the ocean came to assume many of the ‘very same characteristics’ that had been typically associated with the land based frontier territories in the 19th century’ (Hannigan 2016:23).

Indicative of a public fascination with the sub-marine cultivated by the likes of Cousteau, a visual example of these collaborations and imaginaries can be found in the newspaper advert for a 1965 television program, ‘Man invades the Sea’. Under the heading ‘…and the sea shall give up its secrets’, we see an image of a diver, suspended in an invisible element, the bubbles rising from the regulator the signifier that the body is not in air. Narrated by actor Robert Montgomery, the programme detailed ‘man’s assault on the last of the earth’s frontiers’. Featuring ‘famed underwater explorer Jacques-Yves Cousteau’, ‘Capt. George Bond and the US Navy Aquanauts of project Sealab’ and ‘leading oceanographic scientists’, the program sought to ‘show man’s progress in the conquest of ‘inner space’. The actor, the popular underwater explorer, the Navy, and the scientist work to collapse the realms of fact and fiction, blurring the distinction between what is imagined and what is scientifically possible through military might. Just as America’s Westerly expansion was folded into an expansionary destiny, so too was an emerging relationship with the ocean taken to be part of an evolutionary trajectory that would see humans return to the sea, freeing homo sapiens from the territorial constraints of terra firma (Rozwadowski 2012) through an invasion of the element of water itself.

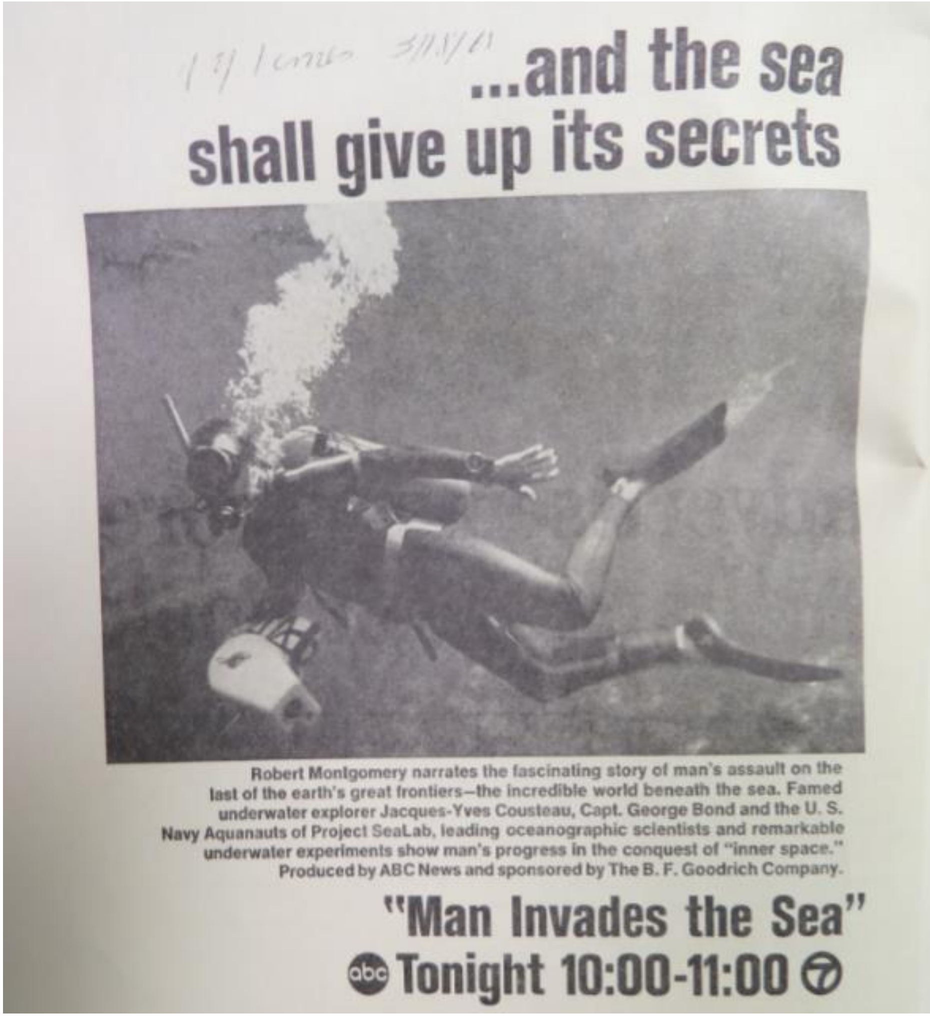


Figure 18: ABC advert, 15 March 1965, US Navy Album (Kirby Morgan Dive workshop Panama City Beach, Florida)

As with the Western frontier, the sea was imagined as a space of infinite natural riches ripe for harvesting and farming, a place of potential peril whilst simultaneously a space with the potential to save mankind from problems caused by rising population levels[27]. 'Ocean boosters' consisting of scientists, explorers, writers and film makers dreamed of a new era of development beneath the seas (Hannigan 2016:12). In the 1950s and 60s authors like Arthur C Clarke (who was a keen diver, spear fisherman, underwater photographer, and treasure hunter) envisioned a seascape that was farmed by humans, where man had

[27] Whilst it is beyond the scope of this thesis, there are many comparisons that can be made to outer space here (see Sage 2008).

subdued the environment to allow futuristic ocean industries and technologies to flourish (Rozwadowski 2012:4-5) – it was an underwater world where the primitive hunting of wild fish would give way to the farming and cultivation of fish, plankton, and seaweed, just as farming had replaced hunting and gathering on land.

Clarke's diving informed his writing and in his 'words and deeds, and also in the minds of a generation of scientists, divers/explorers, engineers, and entrepreneurs, the ocean promised to become the premier outlet for their economic, intellectual, cultural, and social ambitions' (Rozwadowski 2012:2). Embedded in this assumption was a view that the ocean frontier should be systematically and maximally exploited, just as the resources of the American West had been (Rozwadowski 2012:18). We see these ideals expressed clearly in a speech made by Charles Melson (Vice Admiral of the US Navy) during the Sealab experiments in which he describes the 'vast implications' of 'opening the oceanic world to mankind' (Melson 23 March 1965:5-6):

> 'With the increases in population that we will see over the next few decades and the demands for additional resources to support the unborn billions of earth inhabitants of the future, we must learn to look at the world as an entirety, not as small, semi-isolated land masses. Yesterday, the world beneath the sea surface was a frightening one to mankind. Today its hostility remains, but by better understanding the demands of this environment, we will be able to leave to the world of tomorrow a priceless asset whose perils are understood.'

Imagination played a key role here in shaping the Navy's and wider public's perceptions of what would be possible in the sea's third dimension. The documentary films and television programmes of Jacques Cousteau for example, captured the public imagination as man was seen moving and breathing beneath the surface of the water in colour for the first time. Away from the screen and much like imagery of outer space colonies, artistic impressions of inhabiting the undersea environment played on an oceanic optimism that associated the sea with spatial transcendence and escape. One such example is pictured below in Figure 19 from a book by Donald Cox entitled 'Explorer's of the Deep: man's future beneath the sea' (1968) in which Cox declares with certainty that the day will come 'when man will be able to live and work on the ocean floor with air of artificial gills' (90). In what looks like a military base, we see divers, submersible vehicles, and transport systems supporting a set of dome shaped habitats.

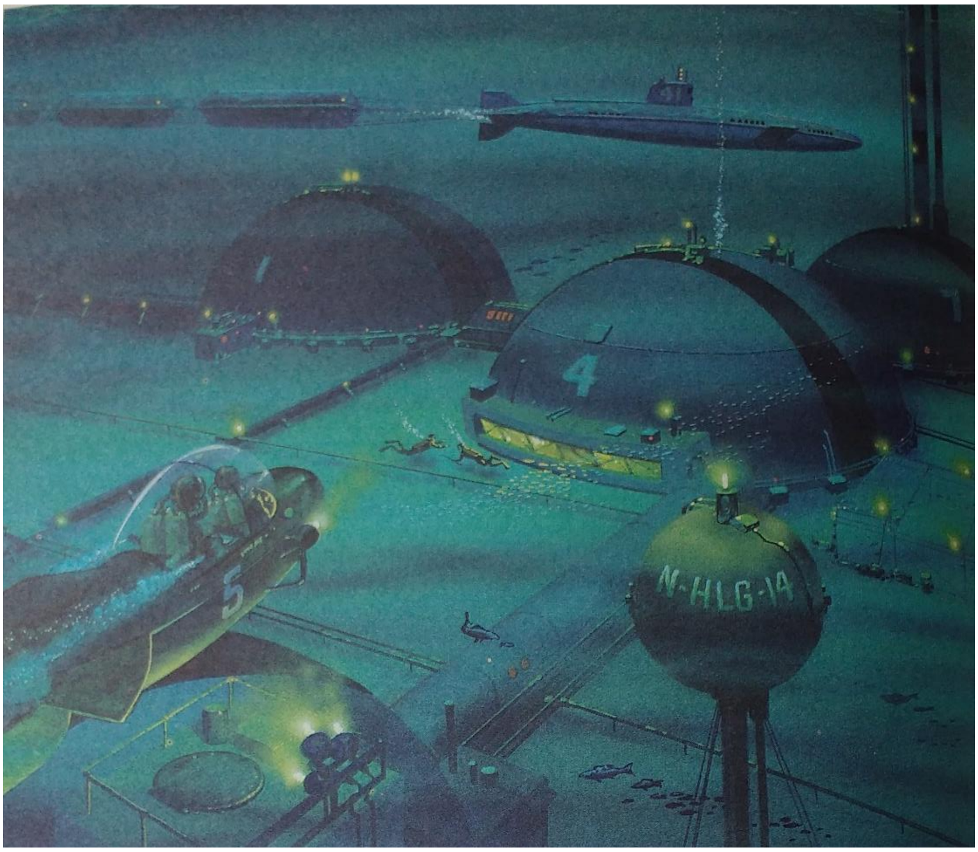


Figure 19: 'Man's future beneath the sea' (in Cox 1968:86).

These and other popular outputs (such as the magazine *Popular Mechanics* or the Aquatic James Bond films) all point to a space in which geopolitical concerns unfold via human technologies and bodies beneath the waves, where the ocean frontier had been subdued and irreconcilably mastered by man. As Hannigan (2016:78) highlights, 'fictional dramas often swim in the currents of geopolitics' (see also Dodds 2005, 2008, Dodds and Dittmer 2008) and the frontier featured prominently in the minds of scientists and military personnel. Indeed, science described by Bush (1945) as the 'endless frontier', became synonymous with the 'conquering' of inner space. As Bush (1945, see Kahn 2005:8) asserted:

> 'the pioneer spirit is still vigorous within this nation. Science offers a largely unexplored hinterland for the pioneer who has the tools for his task. The rewards

> of such exploration both for the Nation and the individual are great. Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress.'

Science became essential to the post-war American project with Turner's frontier transformed into an imaginary site through which America could assert its own imperial claims, continue its development, and ensure its future security at the onset of the Cold War (Kahn 2005:8). As Kahn highlights, a parlance was constructed that brought together science, technology, and the frontier for the betterment of American geopolitical ambition. The sea became enrolled in these entanglements, the American Association for the Advancement of Science dedicating a session of their annual meeting to 'The Sea Frontier' in 1953 (Rozwadowski 2012:12). In the intersecting of these two narratives, geopolitical and scientific frontiers became synonymous (Farish 2006:169) as 'new intellectual territory' was forged (Kasier and McCray 2016:4).

The melting pot of popular frontier imaginaries, scientific advancement and strategic military imperatives coalesced to create 'seductive geopolitical scripts' that served to 'explain, naturalise and reinforce America's exceptional destiny' (Sage 2008:29). Inspired by the likes of Jacques Cousteau, the Sealab experiments were highly complicit in this. The propagandistic language of the frontier that so pervaded early American history permeates throughout the US Navy's quest to inhabit the sea floor. We hear, for example, in the US Navy's public video on Sealab I (1964), the narrator (again an actor) state:

> 'And perhaps there are those who pause at the miracle of travel into space and beneath the sea… For this is an age of wonder. It will produce in the bigger perspective of time, new Columbus' and Magellans' that men will remember when our own age of exploration is history. Sealab I is part of that adventure. A beginning part in our own times'.

Meanwhile, in the *San Diego Tribune*, the aquanauts were described as being:

> 'truly 20th Century pioneers, as much as the men conquering space or the 19th century American pioneers who opened a new nation. The dangers they face are no smaller than the dangers faced by other pioneers, only different…the aquanauts are advancing the frontiers of knowledge and the nation will benefit' (*The San Diego Union*, 29 September, 1965).

Other articles reported on the 'Jules Verne quality of the undersea frontier' (*San Diego Evening Tribune*, 27 August 1965), commented on the 'Sealabbers' exploring the 'dark world' (*San Francisco Examiner*, 31 August 1965), and asserted that Sealab had opened the 'door to a new frontier' (Sitomer 17 September 1965). Spatial and temporal frames collapse here as Sealab I is drawn into the same narrative as Columbus and Magellan (see also Sage 2014:34 for similar comparisons in outer space). Presented as part of an ongoing exploratory and homesteading trajectory, the Navy continue a territorial myth that reifies America as a state that has a future without limits both figuratively and geographically. In his speech during Sealab II, Melson (23 March 1965:5) enforces this narrative, asserting that:

> 'We will give him the abilities to develop new concepts that have not been and cannot be developed above the surfaces of the watery realm. Our fathers were surface-bound and gazed in wonderment at the first attempts of the aviator to free himself from the limitations of the surface. Our children accept aviation as an accomplishment that is no more remarkable than next year's spring clothing styles. Who is to say that our grandchildren should be brought up to look toward oceanic technology in the same manner?'

The Sealab experiment is framed as a necessary step in humanity's progression (Sage 2014:15) involving the freeing of 'man' from the limits of the two dimensional surface and the earth's crust. Of course, this 'freeing' also involved access to resources. As Bowler (reporting for the *San Diego Tribune*) reported:

> 'The US acquired sovereign rights to more than a million miles of submerged lands off its coasts. The acquisition came with the signing of the International Treaty on

the continental shelf. He compared the magnitude of the acquisition with the Louisiana Purchase, and said this country is no better prepared today to explore and exploit these lands than it was to explore the Louisiana Purchase[28] when it was made… 'it will point the way toward an exploitation of the mineral, geological, geophysical, piscatorial and agricultural potential of the sea…an excursion to an advanced sea habitation 600-1000 feet below the sea will be an experience as commonplace as jet air travel is today'.

Far from being closed or limited to outplaying in Antarctica and Outer Space (Spiller 2015), the sea emerges here as an extension of the American frontier. As has been illustrated however, this was not just a horizontal extension but a literal and imaginative deepening of the imaginary into a third dimension extending 1000 feet below the surface of the sea. The frontier is moved offshore, transporting the flat frontiering imaginary into an immersive three dimensional state. In doing so, the sea is imagined, constructed, and occupied via certain visual and discursive interventions as space of opportunity, inspiring action to be taken in the present to plan for the future needs of mankind and the military.

4.2 A transcendental seafloor destiny: The geographical imagination of George Bond

As demonstrated above, the Sealab projects functioned as an extension of the American frontier imaginary and the following pages will explore how this narrative inspired and drove Sealab protagonist Capt. George Bond in imagining and implementing the undersea living experiments. Not only is this important in gaining insight into the driving factors behind the Navy's experiments but it also illuminates some of the social and cultural issues that surface in what unfolds to be a white, puritan, march to the sea. As highlighted in the 'People and Projects' glossary of this thesis, George Bond (originally a General Practioner from Bat Cave, North Carolina) acted as senior medical officer and principal investigator of

[28] The Louisiana Purchase (1803) to which the article refers was an extremely significant land deal between the US and France in which the US paid $15 million for approximately 827,000 square miles of land West of the Mississippi River.

the US Sealab program. Known now as the ‘father of saturation diving’[29], Bond was a key driver behind the programmes from Project Genesis through to Sealab III. As a pioneer of undersea living and diving techniques, Bond’s frontiering imaginary is an important starting point in understanding this homesteading endeavour. Affectionately known by ‘his’[30] aquanauts as ‘Papa Topside’, the main question for Bond was never ‘can you do it, but rather, how could it be done?’ (Bond 1964, entry 14 July). Like his friend Jacques Cousteau, Bond believed that ‘the conquerors of the shelf will have to get wet’ (Cousteau 1954:223).

A white man rooted in his Christian faith, the traditional frontiering archetype is evident throughout Bond’s writing on the Navy’s undersea living experiments. After the completion of Sealab I, Bond declared that ‘we have only turned the first page of a potentially great chapter in human achievement’ (Bond 1964, entry 21 July), setting the scene for his ‘handful of determined pioneers’ to continue their assault on the sea in Sealab II (Bond 1965, entry 9th July). Harking back to the Age of Exploration, Bond invokes the names of Buffalo Bill, Magellan, and Christopher Columbus to contextualise his work (1965, entry 1 August) but there are other significant elements to his imaginary too – namely invocation of the divine and spiritual to frame the projects. We see this most obviously in the naming of Project Genesis[31] after the first book of the Bible. Marking an ordained beginning, Bond was quick to shift the original Biblical language to suggest that man should ‘acquire dominion over the seas and the creatures therein’ – changing the emphasis from the ‘fish of the sea’ to the matter of the sea itself (Hellwarth 2012:17). Post Project Genesis, the spiritual looms large in Bond’s chronicles of both Sealab I and II. He describes his undersea proposals as a ‘true and proper Gospel’ to which the ‘second guessers…heard and became believers ‘(Bond 1964, entry armed forces day). Indeed, Bond’s private chronicles are littered with Biblical references, whether that be describing himself as an ‘obedient servant’ (Bond 1965, entry 19 September) or his personal, and his men’s ‘own solitary and necessary road to Damascus’ (Bond 1965, entry 19 August). Similarly, whilst on the sea floor, the importance of Sunday as a day of rest for the Aquanauts was stressed:

[29] His picture adorns the walls of the US Navy Experimental Diving Unit and at the Aquarius Reef Base. He also has a boat named after him at the base.
[30] Bond refers to ‘my’ aquanauts throughout his diaries.
[31] More will be said on this in the following chapter but see also ‘People and Projects’.

‘A second Sunday for our Aquanauts on the bottom, but somewhat different from one week ago. To me this seems to recall the opening chapters of Jules Verne's Mysterious Island, in which the castaways were so desperately concerned with bare survival that Sunday worship was confined to a hastily muttered prayer, as no day of rest was allowable. As they improved their situation, however, the in habitants of the island gradually were able to set aside a day of rest and worship, to be maintained throughout their stay on the island. And so it is with our first team of Aquanauts. Last Sunday, the urgency of critical house preparation items did not permit the luxury of a Sunday holiday routine. Today, however, although the job is far from done, they all recognize the necessity of physical and mental rest. And so it is that strict communication silence will be maintained through most of the day, save for about a half hour, reserved for church services’ (Bond 1965, entry 5th September).

Figure 20: 'Captain Bond, principal investigator, conducts church services for the aquanauts in the first team aboard Sealab II. A few hours later they began their ascent to the surface.' Photo by Gerald R Boiling, Official US Navy photograph, reproduced with permission from Scripps Institute of Oceanography archives, UCSD.

As Figure 20 depicts, Bond's 'weekly Church of the Sea services' (Bond 1965, entry 3 October) were delivered to the Aquanauts below on subjects ranging from faith to the long suffering Biblical character Job (Bond 1965). The 'Sealab Prayer' was also a mainstay of the experiments. The prayer, written and delivered by Bond, read:

> 'Almighty God, who declared through Holy scripture that man would one day acquire dominion over the seas, and the creatures therein, grant that this day fulfilment of thy work is at hand. To the brave and dedicated men who have committed themselves to this project, grant Thine unending watch and safeguarding care in all the many hours of their life under the sea. Give unusual wisdom to those of us topside who might somehow control their work and safety as they perform their duties below. And when their work and Thy will together be done, grant us all a safe and worthy respite from our labours for a time to come. We ask all this in the name of Jesus Christ our Lord. Amen.'

The Sealab endeavours, under Bond's leadership, became enrolled in a scientific-religious-military complex of sorts and came to confirm (much like America's march into space), a 'unique messianic destiny' (Sage 2014:13) that would encompass not only spiritual salvation, but a material and elemental freedom from an earth in the grips of the Cold War. The idea of a 'manifest destiny', the seeds of which were sown in Genesis in the mind of Bond, became appropriated to achieve 'spatial transcendence' with Bond believing that the endeavour was not just the work of the Navy, but an act in accordance with God's will. As highlighted in the introductory chapter to this thesis, this manifest destiny to obtain dominion over the sea was not geopolitically innocent. The manifest destiny served to justify and facilitate a range of political and military strategies whether that be the publicly expressed ambitions of sea floor living, undersea farming, resource exploitation and exploration or the military imperatives of submarine rescue, diver lock out, and amphibious warfare.

4.3 Masculinities and gender

Like the early American frontiering projects, Bond's quest for spatial transcendence and fight against nature did not take place in a social and cultural vacuum. On the contrary, it was synonymous with 'masculinity and whiteness' (Sage 2014:86) and took place within a Cold War context that posited that men 'were weakened by peace' (Gagen 2000:24). Just as the American West acted a stage 'upon which an exceptional, and exclusive (white, Christian), version of American identity could be performed' (Sage 2014:25), the sea provide an immersive space in which these performances could take place. As is evident in Bond's diaries, his geographical imagination was one that framed undersea inhabitation in highly gendered terms. The Aquanaut's masculinities are valorised in his writing, each commencing 'their own uphill fight against the hostile environment' (1964, entry 8 September). They were described as pioneers, and for Bond:

> 'men like my SEALAB personnel and Scott Carpenter are truly a breed apart. They are immensely resourceful, incessantly curious, impervious to hazard, and impatient with the progress of the world. They are the men who take the chances for all of mankind, who care nothing for fame, but seek only the satisfaction of battling odds and attacking new frontiers. Scott had long been in this fraternity' (Bond 1964, entry 18 July 1964).

This was sentiment echoed in the popular media, the long suffering, hardy attributes of these 'pioneers' emphasised:

> 'The aquanauts have suffered considerable hardships in this unique search for scientific knowledge. Nine are plagued with painful ear infections. They have had to endure 'paralysing cold' due to inadequate protective suits. There is the ever-present danger the capsule might slip off the ocean shelf and break the cord attached to the mother ship above. As they brave the perils of sharks and scorpion fish, with the usual good humour of the intrepid, some of the depth pioneers are calling themselves 'aquanauts'. The hardships will not be in vain' (*News Detroit*, 10 September 1965).

Aquanaut, Dr Sonnenburg, who was described by Bond as being 'fearsomely large and strong' (Bond 1965, entry 31 August) reported in *the Atlanta Journal* (9th September 1965) that there was 'no feeling of insecurity here, we never think about that'. Finding men who conformed to this masculine ideal featured strongly in Bond's diver selection process. He describes one such instance in his diary in the lead up to Sealab I (entry 5 July 1964):

> 'Next, we were presented with an effeminate character, who said, "Oh my God - I've never been below 60 feet". Obviously, he was in the right tent, but the wrong desert. He disqualified himself immediately…Now came a female, complete with a single bottle of compressed air and an Aqualung, demanding a five-day stay in Sealab. Her measurements were below par… My aquanauts said they'd rather study their magnificent pinups - scratch that female…Finally, a host of characters like the Thresher woman[32] and the man with the loose bowels, of which the world seemingly has no end. All such people demand entrance to Sealab habitation, and threaten legislative reprisals or the fix of an actual malignant curse on the whole enterprise. Somehow, we survived all these malcontents, and prepared for the final phases or our mission.'

At a time of great anxiety about forging a masculine identity (Dean 2001), we see the valorisation of muscular strength. In the context of the Cold War, muscularity was not without cultural meaning. As Dean (2001:29) describes, 'the muscular male body symbolised the aggressive defence of boundaries…it stood for a resurgent defence of class, race, empire, and Christianity'. The muscular contours of a male body revealed the social and political contouring of Cold War America with peaks and troughs of masculinity and social pressures. In the process, we also see above what Cuorileone (2000:522) would describe as 'excessive scorn for the feminine' or 'effeminate', with a premium instead placed on courage, hardiness and other qualities associated with the masculine and disdain

[32] The 'Thresher woman' refers to 'a fat, pleasant-looking lady, in her fifth decade' who, after the tragic loss of the Thresher submarine, asked Bond during a public event about the escape and rescue capabilities 'of the Submarine Force'. Bond described her as a 'prosecuting attorney' in her approach (Bond 1964, entry Armed Forces day).

for ‘loose bowels’. The female becomes reduced to an objectified body who can’t match the ‘magnificent pinups’ adorning the interior of the habitat. Females visiting the support vessel during were subject to the same objectification. When a ‘boatload of visitors’ arrived the ‘sprinkling of females’ were deemed ‘not the pick of the litter’ in Bond’s judgement (1965, entry 19 September). In one more disturbing entry, Bond wrote of his disgust at reading the report of a female journalist who had claimed he had acted inappropriately towards her whilst also expressing his disdain at her complaints over a lack of female bathroom aboard the Berkone support vessel:

> ‘Topside, I shed my cares long enough to read the column of one of my favourite journalists, Judith Morgan, who invariably gave the project good press. Today's column started innocently enough, purporting to describe the trials of an attractive female reporter on board the Berkone. At about the second paragraph, Papa Topside appeared on the scene as the official escort of Judy's day at sea. Assisting her up ladders and over scuppers (it read) I managed to pop buttons on her garments, lead her beside fresh paint, and to anoint her countenance with grease in the presence of her rival journalists. Somewhat later, it was alleged, I led her over turbid waters to the pen where Tuffy played, there getting her splashed by my pet porpoise. In final tribute to her stamina, it was alleged that I attempted to boost her from a bobbing skiff to the Berkone deck some ten feet above, clutching only those portions of her anatomy which on that day were not protected by a girdle. The resultant black and blue handprint, she vowed, would meet the requirement of the most Bertillon expert; and her sole satisfaction lay in the fact that an over stressed panty garter popped me square in the face. A closing paragraph dealt with her retentive experiences all day long on a ship without a ladies rest room; but I was too stunned to read it. Considering that this winsome girl's husband is some manner of an all-around athlete, I can only hope he never reads the rash hyperboles of his attractive wife. In any event, I have ascertained that deep-sea diving is not one of his accomplishments’ (Bond 1965, entry 23rd September 1965).

Misogyny manifested itself in other ways too as women came to be framed as frightened bystanders incapable of understanding the homosocial world of Bond and his men:

> ‘Among the many visitors from the fourth estate today was a female type, early fortyish, and wearing a head dress that would make Hedda Hopper's look like a skullcap. Her invariable response to all situations and statements of fact was "Oh, dear!". Try as I might, I could elicit no more lucid response. She ‘o-deared’ my announcement that Scott Carpenter was about to wash the luncheon dishes; that Tuckfield had suffered a Hookah[33] casualty, and had to retreat to the habitat; to the announcement that chow was being served; and finally to the P.A. announcement that ladies could use the officer's head, under suitable escort. I never read a word of her copy in the days to come, and suspect strongly that she got side-tracked on her way to a wedding or fashion show. In any event, here is no spot for a frightened reporter on the distaff side on board the twin barge, Berkone’ (Bond 1965, entry 29th August).

These attitudes are indicative of a Cold War masculinist culture that placed a premium on ‘hard ‘masculine toughness and rendered anything less than that soft and feminine, and as such, as real or potential threat to the security of the nation’ (Cuordileione 2000:516). Within this context, femininity became associated with the liberal left, a standpoint that acted as an object of criticism for the right who stressed their psychological and intellectual timidity and failure of moral nerve (Cuordileone 2000:521). As such, the ‘feminine’ became, within the context of Sealab and elsewhere, a barometer against which to measure manliness and masculinity – a state of being seen to be ‘naturally braver, more inventive, more professional, more disciplined’ than their female counterparts (Enloe 1993:83 and Enloe 1989) deemed ‘irrational, emotional, unstable’ (Tickner 1992:9).

We see these feminine and negative qualities associated with the Earth too. Melson (23 March 1965:6) for example, describes how in ‘playing the game according to’ the seas ‘rules, man will become truly ubiquitous and a full partner of nature in all her moods’. Presented here as volatile, moody, and predisposed to mood changes or swings. The hostile sea, part of ‘mother earth’, was to be attacked and mastered much like the battle to maintain masculine ‘norms’. Similarly, the Sealab I habitat was a described as riding the water ‘like a queen’ as it was being towed (Bond 1964, entry Armed Forces Day). Female

[33] Hookah refers to a piece of breathing equipment

adjectives are deployed to denote passivity and volatility, representing a violent exclusion of the female in the work of the Navy, and particularly Navy divers were valorised for strength and a calm head under pressure. This also stands in stark contrast to Bond's identity as 'Papa Topisde'. As Cohn (1987:607) highlights within the broader context of Cold War geopolitics, 'the United States frequently appeared in discussions about international politics as "father," sometimes coercive, sometimes benevolent, but always knowing best'. As the Western frontier was closed, so too was a medium through which a 'peculiarly American primitive masculinity was shaped' and as such, outlets through which this could be reasserted became important Cold War spaces (see Gagen 2009:32).

The projects were a microcosm of sorts, a social biome in which the strong, brave, white Christian man survives whilst the feminine other is consciously excluded. Secondly, the Sealab projects highlight how activities at sea, like land, are shaped by cultural and social processes. Far from existing as a realm that is 'wholly other' as in Deluzian thought, or as a space of 'negation, radical otherness, or utopian or dystopian release' (Connery 2006:497) it served as a space – and place – that reinforced and reproduced heteronormative social norms. The social aspects of the project were far from disordered and chaotic as the sea is imagined to be, an environment in which only the strong male body can survive. As will be explored in more detail, the Sealab homesteading initiatives functioned as a testing ground and stage of white masculinity (see Waitt 2008 for an analyses of gender in surfing on the surface). Moreover, this continues to unfold in the forthcoming sections as the chapter moves to explore some of the practical and elemental considerations of homesteading and domesticating the sea floor, demonstrating as it does so the significance of the depths as a *place* that was wholly imbricated in prevailing social and cultural norms.

4.4 'A curtain of silt' and a plastic rug: Managing the elemental

For George Bond, the sea was imagined as a space that could be colonized and inhabited. The seafloor conceived of as something that could be lived on, and the water column something that could be mastered, attacked and negotiated by the pioneering white American man. Yet, transcendental agendas aside, Bond and the divers/aquanauts, oceanographers, scientists, and engineers, first had to reconcile the practicalities of underwater living if the march to the bottom of the sea were to be successful. The ‘full-scale invasion of inner space’, wrote one journalist, was predicated on ‘painstakingly precise steps’ (Costello 26 May 1965) which began in both Sealab I and II with the identification of appropriate sites on which the habitat could be situated.

In the relatively clear and predictable conditions on the seafloor off Bermuda this was somewhat more straightforward in Sealab I. The site, wrote Bond, ‘had been studied from the point of view of five-year bottom current reports; daily sea-states for an equivalent period; uniform ocean-bottom depth; and minimal obstruction hazards to the aquanaut on a sortie’ (Bond 1964, entry 6 July). The space had been studied, charted, and made distinctly knowable and predictable. In understanding the rhythms, mobilities, and materialities of the environment, it became a place that could be colonised and lived in by the Sealab aquanauts. At the same time, this knowledge was coupled with alluring unknowns, the selected site being ‘atop an Atlantic seamount which had never been the subject of intensive study’ (1964, entry 6th July) therefore providing an opportunity to extend ‘man’s’ knowledge, understanding, and thus power over the undersea volume and sub-terrain.

In Sealab II, a similar process was undertaken to establish the most appropriate site on which the second experiment would take place. This involved extensive mapping and modelling of the sea floor before eventually settling on a location on the continental shelf just north of La Jolla off the Californian coastline (ONR 1967). The proximity to Scripps Institute of Oceanography meant that the seafloor was as well charted as any comparable site and after making detailed soundings and models (see Figure 21 below for three dimensional example of this), it was decided to place the habitat between two branches of La Jolla Submarine Canyon where the shelf was covered with ‘fine sand and coarse silt’ (Murray et al 1967:370).

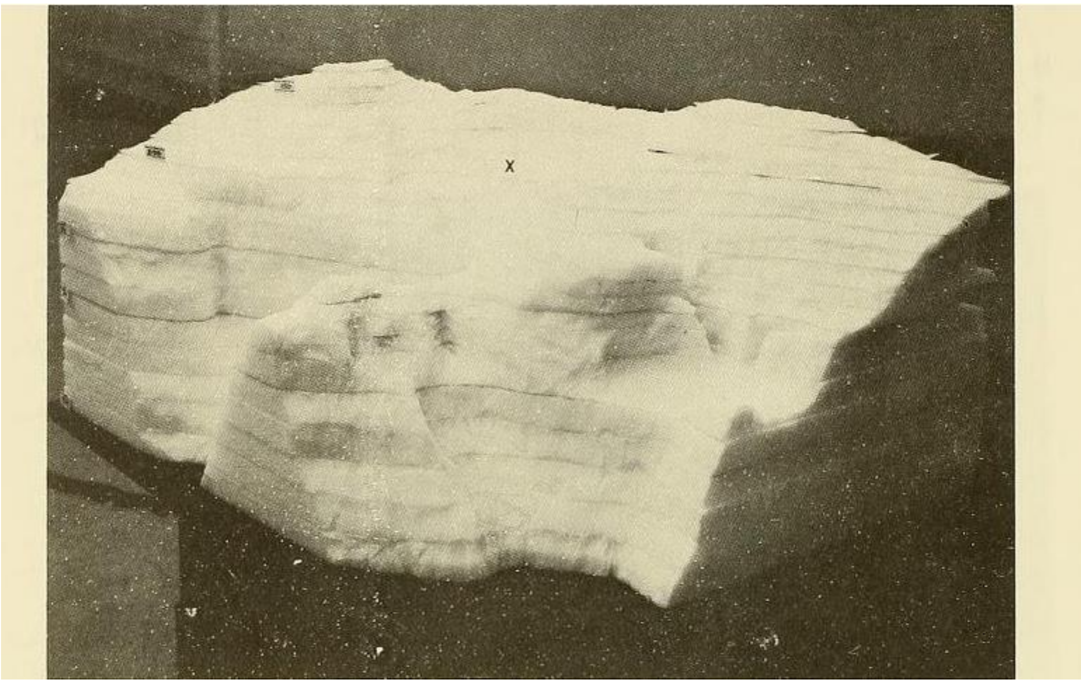


Figure 21: The final site as shown on a three-dimensional representation of the Sealab II area (ONR 1965) - it helped to make visible something that was invisible from the surface, and allowed an engagement with the space that could not easily be achieved via a two dimensional contour map

Not only would this avoid the steep inclinations and great silt deposits identified in preliminary dives to other possible sites, but the canyon provided an ideal area for excursion diving to even deeper depths without the aquanauts having to swim long, exhausting, and air demanding distances to get there (ONR 1967: 13). As Figure 22 details, contour bathymetry maps were crucial in this process, detailing various heights, and depths, peaks and troughs (ONR 1967) as they wound their around various subsea formations (see Squire 2016). In doing so, they sought to make visible and known a space that was invisible and unknown to the eye on the surface, thus allowing the frontiering imaginary to be projected beneath the waves.

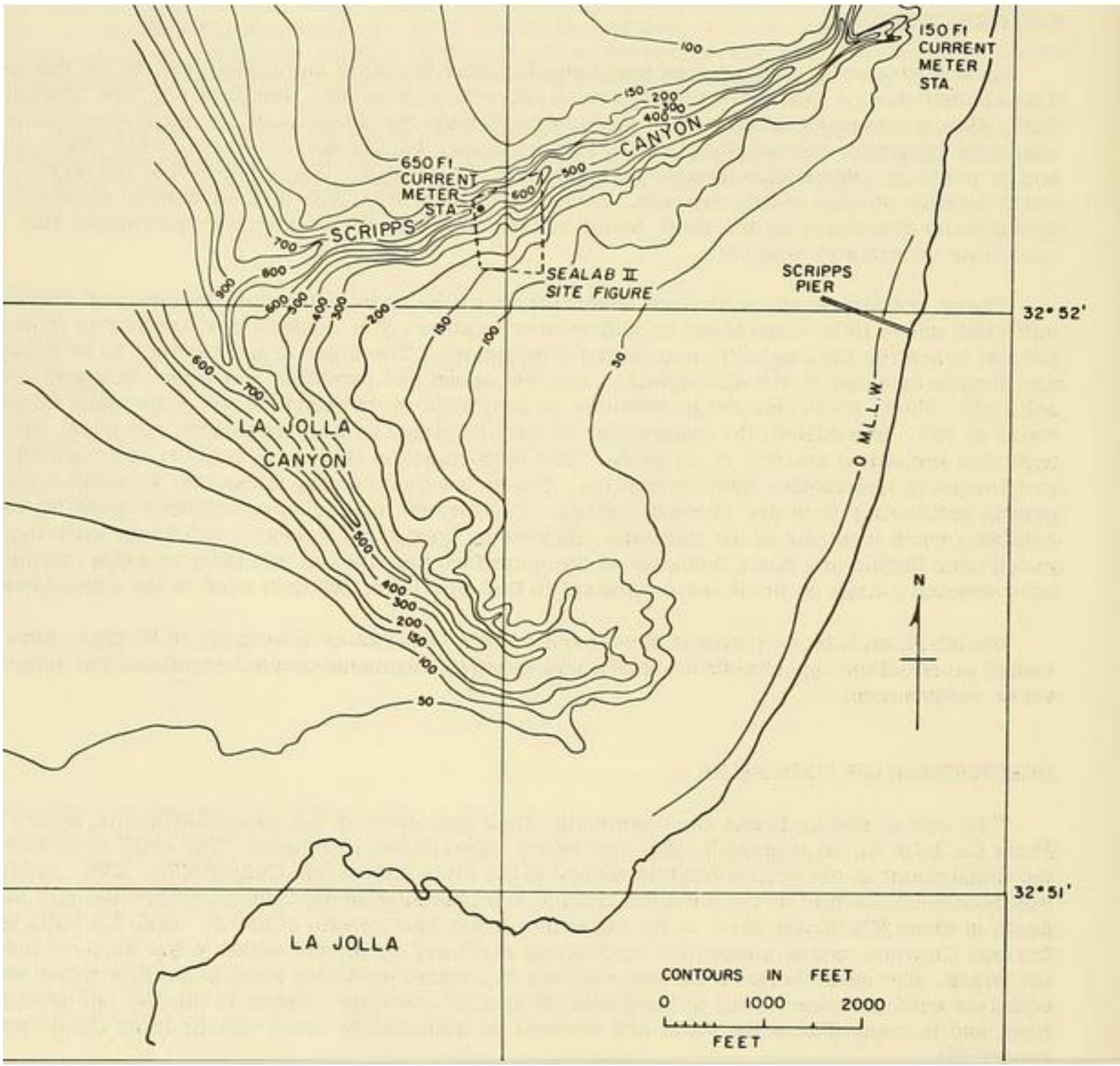


Figure 22: 'Index chart showing bathymetry of the continental shelf off La Jolla, California. The Sealab II site is indicated in the dashed area' (Murray et al 1967:370).

Yet, the static model and the contour lines depicted in Figure 22 have the capacity to conceal as well as illustrate. As Farish (2010:xiii) highlights in *The Contours of the Cold War*, 'in the abstraction of a contour map, the space between two lines is homogenous but this is of course a severe simplification.' In the case study of Sealab, the lines, whilst highlighting areas of elevation and depth did very little to account for the 'extremely uneven and fast changing ocean bottom' (Culpepper et al 1967:335). Far from being a static terrain, surveys prior to Sealab revealed that approximately '200,000 cubic yards of sand' was being lost each year into Scripps canyon as the ocean currents moved and changed above and around the floor (Murray et al 1967:371). Whilst they depict certainty and structure, the contour lines around Scripps Canyon came to 'hum with both authority and contingency' materially and elemetally (Farish 2010:xiv) as the highly mobile three dimensional entity of the sea added pracarity to the certainty implicit in the lines curving and winding around the sea floor.

Whilst only four metres deeper than Sealab I (62m as opposed to 58m), the different operating environment proved incredibly challenging as a frontier to be mastered. 'Despite months of photo surveys, core sampling, personal dives near the site, and long interrogation of Scripps divers', Bond and his team were, at times, confounded by changing seafloor - 'I can protest an act of God' wrote Bond (1965, entry 6 August), 'a mysterious sediment shift, or the Red Tide factor[34] – but to no real avail.' This caused a number of problems for the team. Firstly, there were significant concerns about the levels of visibility that the aquanauts would have to tolerate:

> 'A fairly serious problem in connection with our operation grows more ominous by the day. This relates to the environmental conditions prevalent at the selected site for Sealab II. Because of the season, unusual sediment transport, or the prolonged siege of Red Tide-or for other reasons, unknown-the visibility at the site has remained near zero. Worse yet, the silt accumulation, all black, threatens to further obscure what little visibility may be had. It seems entirely possible that visibility may range from six inches to one foot through the operation. This possibility raises very grave problems to the fore. If these conditions continue, as they have for at least two months, we will be deprived of nearly 70% of our human performance data, for lack of visual records. Additionally, motivation for prolonged undersea work will undoubtedly plummet if my people are required to exit into a black curtain of silt, consistently failing to do their appointed jobs, and leaving no record save that of failure. I had selected this site because, among other more important reasons, I wanted to present our aquanauts with varying degrees of water clarity. I did not, however wish to offer; them a set of hopeless conditions around the clock' (Bond 1965, entry 1 August).

[34] This describes a form of Algal Bloom

Similarly, in a letter to a colleague, Earl Murray (2 September 1965) describes the thick clouds of black silt that became suspended in the water as a result of a diver's fin kicks.

One of the strategies employed during the preparations for Sealab III to prevent rising sediment from causing this troublesome problem took on a distinctly elemental and material tone as the following technical reported noted:

> 'One of the more perplexing problems confronting divers at work in the ocean depths is the nature of the sea floor itself. More often than not, the bottom and the object of the work are covered by a fine sediment easily disturbed and sent into suspension by diver movement. The suspended sediment obscures diver vision to varying degrees…Various methods have been proposed to alleviate this problem. One such proposal has been the subject of a development program; the procedure is being tested and demonstrated in shallow-water exercises and will be applied at the deeper depth. The principle of the procedure is to utilize a dissolved plastic with a specific gravity greater than that of seawater. The material is spread upon the bottom in a thin sheet where the water soluble solvent is leached out, leaving a tough film covering the sediments' (Bayles 1970:3).

Life Magazine (4 October 1968) captured this process in the image below (Figure 23), describing the use of a plastic spray that hardens the moment it touches water and settles on the bottom, thus forming 'a rug that prevents the diver from kicking up sediment'. This was a literal mastery of the elemental as the silt was pinned down, fixed, and adapted for human use.

Figure 23: Spraying the sea floor (*Life Magazine* 4 October 1968)

In this example, the elements were unruly, the interactions of water of silt demanding a 'solution', and a technological intervention. It was a terrain that needed to be flattened, tamed and brought under control to restore the sight and vision of the coloniser and prevent it from literally engulfing the body.

As a result of these temporal and spatial ruptures learning about the surrounding area took time and required an understanding of depth and direction. According to one newspaper reporter, the men in Sealab II were asked were asked to:

> 'orient themselves to such an extent that they can chart the bottom with accuracy. This will include establishing 'landmarks' so that from these familiar spots they will know instantly their exact locations They will be confined to two vertical zones of 33 feet each above the sea lab and a horizontal distance of about 500 feet…geologists also will be asked to determine how rapidly the bottom shifts and why' (Costello 26 May 1965).

This sense of orientation and place was not just a matter of convenience for the aquanauts but one of life and death too. As Costello highlights, the men were confined to 'vertical zones' above the habitat and the surrounding area. If this zone were to be crossed and the diver to ascend too far, his body would explosively decompress causing certain death. Imagine rigorously shaking a bottle full of Coca-Cola and then opening it – the bubbles explode out as the pressure is released and this is not dissimilar to what would happen were the aquanauts to take the lid off, so to speak, by surfacing. In addition to the contour lines of depth encircling the sea floor, there are also lines of atmosphere and pressure that extend into the surface. With every 10m line from the surface, the pressure exerted on the body by the surrounding water increases which in turn compresses the air, thus increasing the uptake of air molecules in the body. Inhabiting the water column at 62m for a prolonged period of time meant that the aquanaut's bodies became fully saturated with air, meaning that no more could absorbed. If they were to return to the surface, or even deviate upwards too far from the sea floor, the air molecules would decompress, increasing in size and escaping into the bloodstream. Orientation, then, was key and plans were drawn up prior to Sealab II to illustrate the 'lay of the land' (Figure 24). Yet, as the mental maps created by aquanauts Berry Cannon (1965) and Earl Murray (1965) demonstrate (see Figures 25-27), the process of orientation required embodied process of knowing, of diving in the area and drawing what they remembered on their return.

In addition to posing challenges to in-water visibility, the shifting environment also posed challenges for top-down visibility. Throughout Sealab II, Bond (1965, entry 19 September) expressed concerns about knowing exactly where the habitat was situated. 'Over many long years', he wrote, 'I have the learned the hard way that the location of objects or specific spots on the ocean floor is an exceedingly difficult task'. He goes on to explain that:

> 'objects of known location on the ocean bottom are not in fact there, but more often are eventually found at some considerable distance away, and on a new azimuth. This might be termed Bond's corollary to Murphy's Law[3], though I do not recommend such designation. Yet it is a solid fact that, though we have been moored over SEALAB II, an object nearly the size of a small submarine, for about a month, we still don't know where the habitat lies, nor on what heading. Surely we

must one day build locating devices oriented only to ocean floor topography, and bearing no relation to Polaris or even Betelgeuse[35]'.

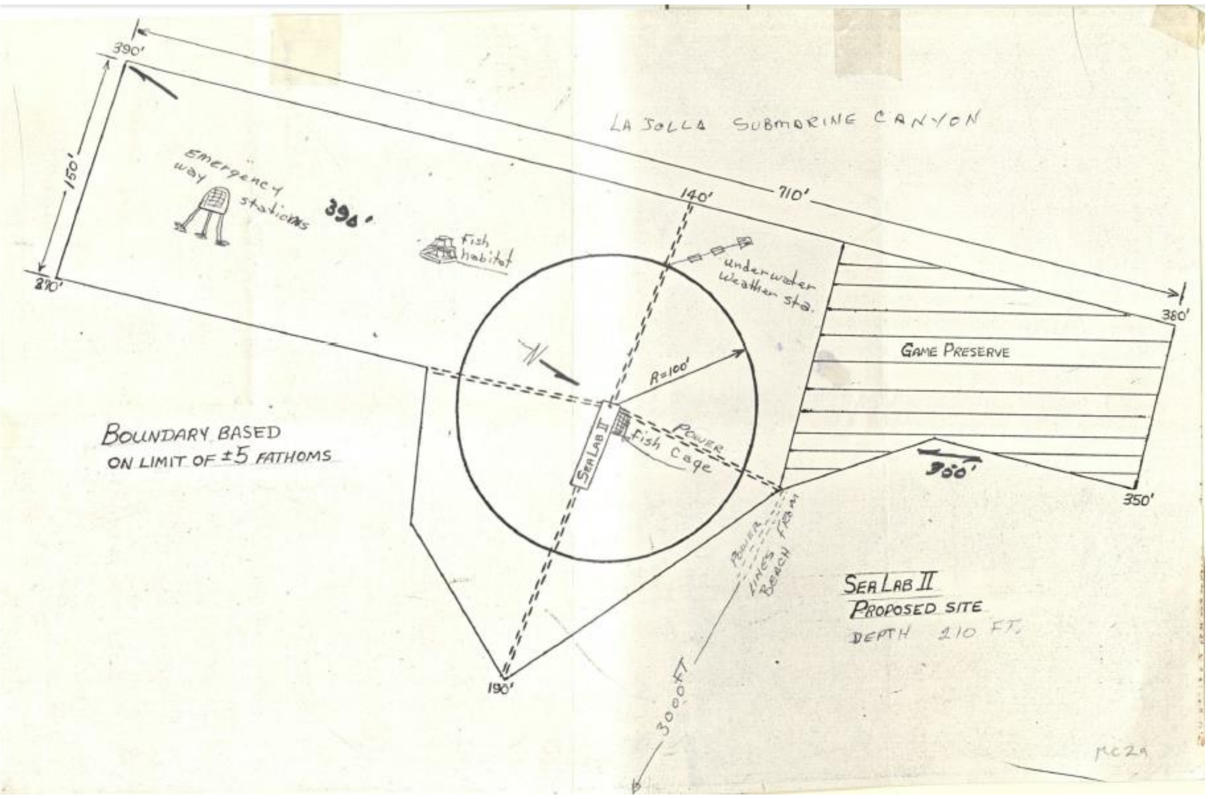
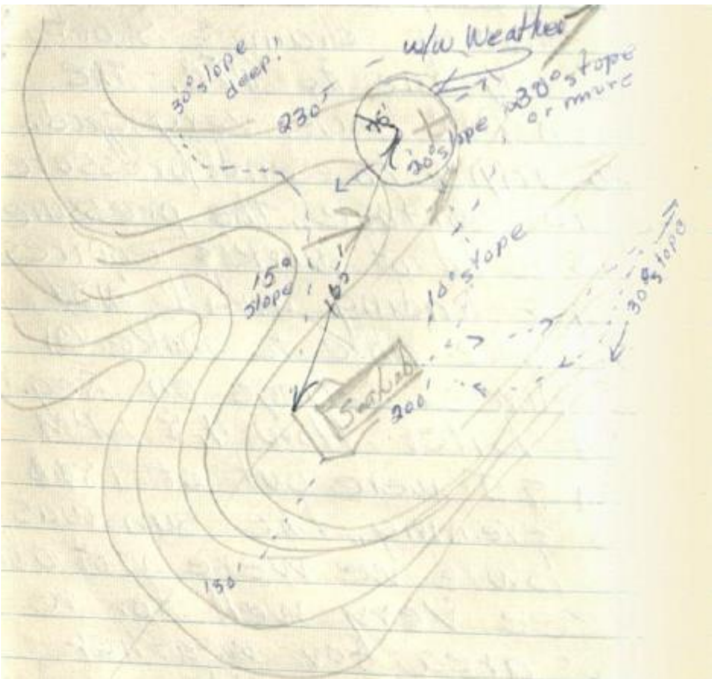
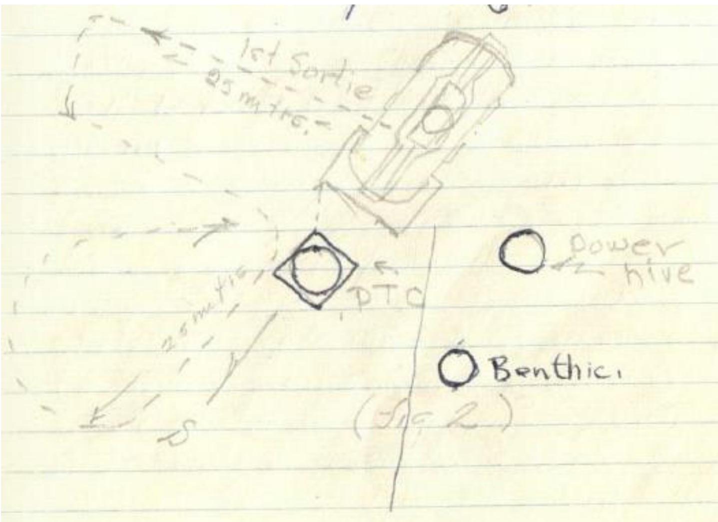
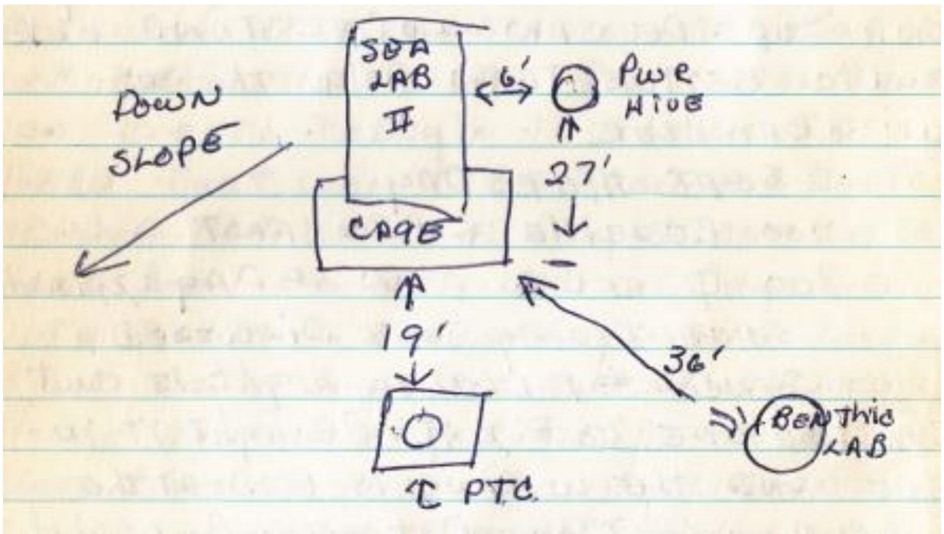


Figure 24: Sealab II proposed site diagram (1965) (Scripps Institute of Oceanography Archives, UCSD).

[35] Polaris and Betelgeuse refer to stars that would have been involved in the orientation process. As highlighted in chapter 2, this again hints at nuanced and distinct ocean knowledges that are not always captured in contemporary geography.







Figures 25-27: Mental maps of Sealab and the surrounding area. (Top and middle: Earl Murray 1965, entry 30 August. Bottom: Berry Cannon 1965, 1 August)

These combined insights of a 'curtain of silt', the spraying of a 'rug', contours on the sea floor and suspended via pressure in the water column, of poor visibility in the water and from the topside perspective raise some interesting questions in relation to homesteading practices and, more broadly, the geographical constructs such as 'territory' and 'terrain'. To take territory first, it is now widely acknowledged that the practice (as it relates to land) is not a static construct. It is mobile, constantly being made and remade and resultant of a host of social, political, cultural, environmental, and economic processes (Elden 2010, 2013, 2013b). Yet this state of flux, is as Steinberg and Peters (2015) highlight, drastically intensified at sea. In acknowledging the sea as a volume 'within which territory is practiced' (261), the constant reformation of territory is laid bare as the seafloor shifts, moves, and is displaced by the volume of water immersing each particle. This was not a stable frontier to master. On the contrary it had a transience and intangibility about it. It could not easy be pinned down and fixed and came with distinct temporalities and mobilities than are encountered on terra firma. This raises interesting questions about the intersections of time and territory in environments beyond the surround of air. Not only does the water have the capacity to suspend the earth's materials in its volume (obscuring vision as it does so), but it also has the capacity to shift and disrupt spatial knowledges and understandings as they exist from surface-depth. It is perhaps the exemplar of a processual territorial construction. Whilst the process may be less noticeable on land, we live in a world that is constantly moving and changing. As Adey (2006) highlights in relation to airports on land, infrastructure decays and different elements interact with one another, constantly changing and morphing the infrastructure, objects, and the environment. This movement and flux was far more noticeable in Sealab as the elemental worked to disrupt the sea floor and to lift sediment into the water column. We might also consider more violent ruptures such as earthquakes, landslides, and avalanches where territory and place are remade by the forces of the earth. Yet, even large scale events such as these are premised on molecular, elemental interactions.

This also has implications for how we conceptualise the construct of *terrain.* As Elden (2010) has highlighted, this is a term, or concept, that is deployed with vagueness and little conceptual precision within geography. Like territory, it 'seems so obviously universal' and is used, often straightforwardly, to describe the lie, or formation of land and to assess its geophysical properties (Elden 2010). It is also heavily associated with military planning and strategy. As Doyle and Bennett (2002:xi) suggest, ‘terrain has a profound effect upon the strategy and tactics of any military’. The ‘landscapes of battle and the geology that underlies them’ strongly influence the outcomes of military events and engagements and Doyle and Bennett have demonstrated the value of deconstructing terrains (which may include geology, geomorphology, hydrology, meteorology, agriculture and civil engineering) in order to interrogate these effects further. Similarly, Rose and Clatworthy (2008) highlight of the role military geologists in the Second World War in identifying areas of key terrain for the war effort through practices including soil sampling, permeability testing, and rock type classifications.

In engaging with the earth in such a way, the physical terrain becomes something that can be exploited, its natural and man-made features, structures, and conditions analysed to achieve both offensive and defensive objectives and are often represented on maps with contour lines following the lay of the land (Rotc Cadet Command 2002, Richbourg and Olson 1996:207, Galgano and Palka 2011).Testing the soil to check its weight bearing capacities and analysing ‘vegetation features’ such as shrubs, grasslands, and woodlands for concealment, intelligence operations, and manoeuvrability are just two examples of how the military might engage with terrain in order to occupy an area or position that provides a marked advantage against an opponent (US Army 1990:4). Other ‘terrain factors that affect movement of troops, equipment, and material’ might be elevations, depressions, slopes, landform types (i.e. the physical expression of the land surface), water and surface roughness (US Army 1990:1).

Yet Sealab raises fundamental challenges to this understanding. We may conceptualise the seafloor with its peaks and troughs as an undersea terrain but how do we then account for phenomenon such as the ‘curtain of silt’ hanging in the water column? Far from being a surface to traverse and map, the silt existed in three dimensions hinting at a terrain that is distinctly ungrounded. It was something, much like the social pressures of the time, that engulfed the body and which could not be mapped with contour lines. Similarly, we might think of the pressures at play under the sea in the same terms. These invisible 10m striations that prevent the aquanaut surfacing are similarly vital lines in moving through and managing the space but again, a two dimensional understanding of terrain cannot encompass them.

Terrain, along with the frontier, emerges here as a construct that is inherently three dimensional. In understanding it in this way, a door may be opened to explore alternate terrains where the concept and practice is released from its grounded roots on 'terra', soil, and earth. In doing so, the 'metaphysics which enframes the geo as a crust from which we raise our constructions' (Irigaray, 1999 in Jackson and Fannin 2011:436) is uprooted and unearthed as a concept and practice that exists *in* the world, not just on it. This has interesting implications for thinking through the concept of terrain, and thus the practices of territory and frontiering, in unruly spaces (Squire 2016b).

4.5 Dressing gowns and dishwashing: Domesticating the extreme

'The ocean is still a hostile environment but we are taming some of it, bit by bit'

(Bond 1965, entry 30 August).

The process of frontiering and homesteading the sub-marine required more than just a taming of the elemental. Discursively, for example, the practice of mastering the 'hostile environment' (Bond 1965, entry 30 August) saw language relating to the domestic become common place. The cramped cylindrical habitats were continually referred to by Bond as the aquanauts' 'new home' (see Bond 1964, entry 19 July for an example of this). Whilst Berry Cannon (1965 Sealab II log, entry 28 August) reported that the Sealab II habitat was 'a little unpleasant' upon entering, newspaper reporters focused on the home comforts of the 'house', drawing attention to the fact that it was 'complete with hot showers, food, bunks, and electric light 215 feet beneath the sea' (Baldwin 24 July 1965). The Navy (US Navy 1964) also emphasised the home-like qualities of Sealab I:

> 'Day followed day, it was a tight life in the Sealab. After four days it became home sweet home, all forty by 9 feet of her, minus of course, space for three transformers and all of the other gear. Such as 6 berths, tables, storage lockers, a shower, 6 electric heaters, a chamber of commerce sign, a hot plate'.

The way station that would provide a source of air away from the habitat was too described as a ‘home away from home’ (i.e. a home away from the habitat) with an inscription penned by Captain Walt Mazzone (see Figure 28) that read: ‘Happy haven way station – Free Air – Home away from Home – our sole purpose is to serve’.

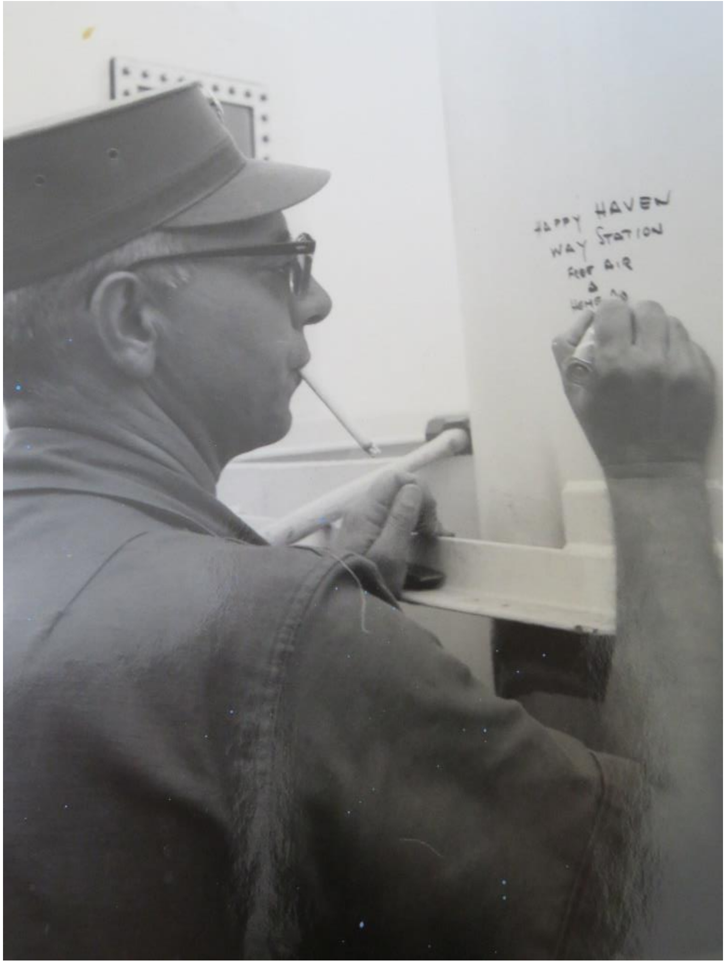


Figure 28: ‘Legend penned on Aquanaut’s way station by Captain Walter Mazzone MSC, USN, Physiological control officer (Official Navy photograph – private archive collection)

Banal, land-based services were made available to the aquanauts to cultivate this sense of home and belonging - mail delivery was ‘about as prompt as anywhere else under the American flag’ (US Navy 1964). A year later in Sealab II the aquanauts developed ‘a certain gladness to be home’ having been in the surrounding water, ‘sweet helium breathing, crowded, celibate, t-totalling home’ – ‘Already, if you take the fish eye view, the interlopers are making themselves at home’ (US Navy 1965). There were other more embodied signs of homesteading and domestication too. Scott Carpenter standing in his dressing gown (see

Figure 29) serving as one example. The dressing gown, an item of clothing associated with the home and private sphere disrupts expectations about living in the undersea environment, creating the impression of normalcy. The image stands in stark contrast to those of Carpenter as an astronaut, always adorned with the silver space suit synonymous with space travel and journeys beyond the earth. On the contrary the dressing gown is a signifier of domesticity, hinting that a home had and could be made beyond terra in the earth's inner atmospheres.

Figure 29: Scott Carpenter standing in his dressing gown in Sealab II (Official US Navy photo, reproduced with permission from the Man in the Sea museum)

The surrounding water and seafloor were not exempt from this domesticating narrative. Scott Carpenter and 'his boys worked like dogs' to complete the cleaning of their new 'front yard' (Bond, entry 30 August 1965) a swim in which was 'like a walk' in the garden (*The Atlanta Journal* 9 September 1965). Meanwhile the US Navy (1964) referred to the water outside Sealab I as the 'new countryside just beyond their back porch' and the Bermudan sea as a 'neighbourhood'. Part of constructing this mentality was the maintenance and practice of certain rhythms and routines, an example of which is detailed in Berry Cannon's journal (1965, entry 30 August):

0700 Reveille (wake up)

0730 Chow

0800 Quarters

0800-1130 Diving

1200 Chow

13-1400 Siesta

1400-1800 Diving

1830 Chow

2200 Taps

The day is methodically broken up into the seemingly banal activities of waking up, eating, tending to the quarters, sleeping, diving, and attending to the various taps in the habitat. Similarly, various news agencies reported on Sealab's routines which included 'undersea haircuts, regular meals, and sorties into the sea' (Bowler 1965b). In another example, the reporter describes how:

> 'Every morning, ten Navy divers crawl out of their bunks, brush their teeth, shave, then eat a hearty breakfast. Later, some of them put on wetsuits and breathing gear, climb down the ladder through the floor of their quarters and swim to work. Traveling 210 feet below the surface of the sea, two men, on a typical day, might swim off to repair a malfunctioning telemetering station not too far away, while another pair tests the range of underwater communications gear' (Mason, 23rd August 1965).

Routine chores could take up to an hour every morning and included washing the dishes (see Figure 30), vacuuming the habitat carpet, and, as Figure 31 demonstrates, watering their experimental crops.

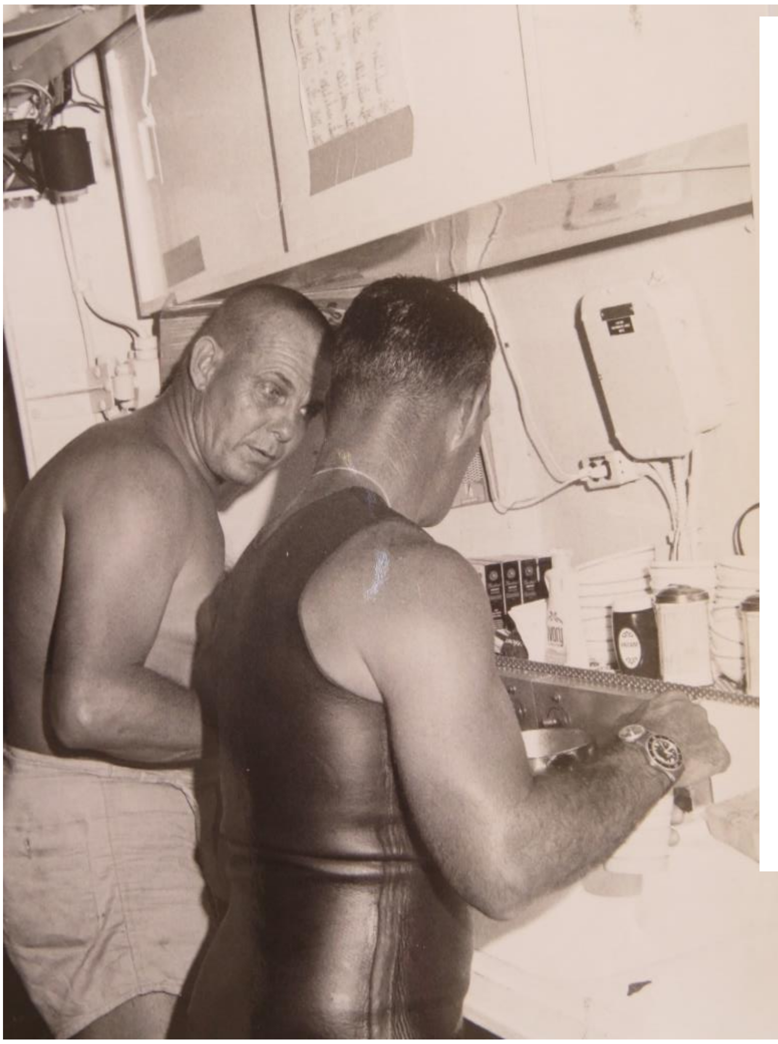


Figure 30: Caption from original photograph: Aquanauts Cyril Tuckfield manages the cooking and aquanaut Wilbur Eaton (in wet suit) washes dishes in the Sealab II galley. Household chores takes up a good hour every morning, noon and evening for the ten aquanauts. Chores even include vacuuming the special carpet in their undersea home (inside Sealab II photo by J.D Skidmore – reproduced with permission from the Man in the Sea museum, Florida (7 Sept 1965)

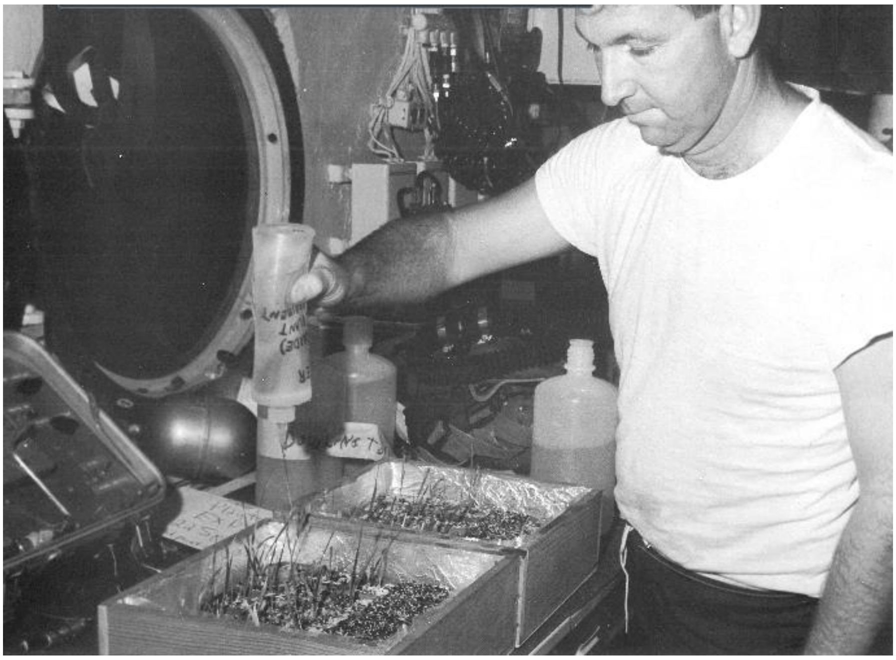


Figure 31: Aquanaut Tolbert uses a special plant nutrient for plants grown in Sealab II. If 'man' were to master this frontier, then farming would be extremely important in future exploits (see Cox 1968). Image reproduced with permission from the Man in the Sea Museum, Florida

The Denver Post (9 September 1965) asserted that 'Life in Sealab turns routine' whilst the US Navy (1964) posited that 'there came forth here beneath the sea, a dailyness and a routine that were in themselves a moot tribute to man's power of adaption'. In Sealab II this apparent banality and normalcy was established with 30 days passing in 'a methodical sequence of work inside and outside the habitat, of meals and housekeeping, of human measurement and evaluation under high pressure' (US Navy 1965). Exploration, and arguably the associated practices of environmental mastery, frontiering, and domestication, were according to the Navy (1965), premised on bringing 'the normal world into an abnormal place' and if this could be achieved in Sealab, 'why not the moon? Why not on mars?'

Through this narrative the ultimate mastery of the extreme is the establishment of 'normality'. Part of the 'assault on our friendly adversary, the sea' (Bond 1965, entry 4 October) centred upon the establishment of domesticity and in doing so, spatial imaginaries collapse, extending the geographical imagination to other hostile and extreme spaces awaiting the arrival of the American man. Simultaneously, we also see the significance of temporal imaginaries. As the men 'came dangerously close to the classification of routine, if such can ever be said of sea floor living' (Bond 1965, entry 4 October), the management and construction of their time proved pivotal. In breaking their days down into certain activities and routines, the hourly daily existence of the aquanauts became enrolled in a much wider pioneering narrative extending from Magellen and Columbus through to the astronauts and aquanauts of the future mastering other different frontier spaces.

We might also think of the gendering implicit in the domesticating agenda. In contrast with the hard masculine language associated with attacking the hostile frontier, establishing, or at least communicating the establishment of a temporary 'home' required the adoption and completion of tasks typically associated with women in domestic settings. Language of 'home', routines, the emphasis on vacuuming the habitat, cooking and creating 'rugs' on the sea floor (see section above) complicate the roles of male and female, the extreme environment rendering activities like vacuuming masculine in their practice. As Kaika (2004:265) highlights, the 'house' serves to traditionally to separate the 'inside from the outside, nature from human beings, the public from the private sphere' yet in this case study, the 'house' and its associated embodied performances serve to fully imbricate the men into the environment of the sea. Far from separating, it is a demonstration of dwelling within an extreme space as the habitat and men within are incorporated into the seascape, forging a sense of belonging in an 'increasingly alienating world' (Brickell 2012:226). In doing so, the ideal that frames the home as 'the epitome the spatial inscription of the idea of individual freedom, a place liberated from fear and anxiety…a place enjoying an autonomous and independent existence' is transferred onto the seafloor (Kaika 2004:266). This being said, the associations between domestic practices and masculinity were short lived. Bond was quick to realise that:

> 'In planning the program, an extremely important feature was disregarded or overlooked entirely: the matter of daily housekeeping. In retrospect, it is unreasonable and unwise to believe that experimental subjects in a new and difficult environment can be expected to tend to all of the menial chores of running an orderly household…future generations of Sealab must provide a small cadre of housekeepers who will constantly mind the store while the subjects are free to harvest data….we must have aquachefs, aquamaids, and aquaswampers[36]' (Bond 1964, entry 27 July).

Having broken the new ground via muscular interventions including domestic chores, the way was now paved for women or 'lesser men' to assume the role of maid and complete the 'menial household chores' associated with daily domestic life. In the meantime, the role of the woman in the habitats was to serve as an object of desire and homosocial bonding via the figure of the 'pin up' and vulgar language. 'Throughout the experiment…vulgarity was an effective device for the promotion of group activity' (O'Neal et al 1965:37). Within this context of 'vulgarity', women's bodies once again became a significant prop. In Sealab I, for example, Thompson (1996, entry 23 June 1964) described pin-ups as an item 'for comfortable living' that would provide 'future morale boosts' (Thompson 1966, entry 23 June 1964). In the maintenance of a masculine community, 'the female must by necessity be excluded' (Jeffords 1988:83) or in this case incorporated via objectification and subordination – processes marked in overtly sexual terms (Jeffords 1988:86). Whilst very different from the sexualisation occurring here, my own body was certainly drawn into the

[36] Another word for an assistant.

homosocial norms permeating this discourse and the diving culture. When I asked about the lack of female divers at the Navy Experimental Diving Unit, the response was to gesture to my body and apologetically imply that my physical frame was why there were so few women. During my visit, I saw one muscular female diver. The rest were men, one wearing a rash vest that made him look like Mr Incredible – a superhero from Disney's 'The Incredibles' known for his super human strength. Whilst I was visiting the EDU some 52 years after Sealab I, it was clear that these exclusive heteronormative norms were still pervasive, my own body serving as a prop through which this was practiced and reinforced. At a recreational level too, these insights became apparent as I immersed myself in the water and learned to dive. Our group was split into 'girls v boys', given that it was November, the women were given second wetsuits whilst the men were not offered extra insulation (we were told 'men don't say when they're cold'); a member of my group was told to put the weight belt around her 'child bearing hips'; and I was told 'look around…it is mostly men, diving is a macho sport'. Immersing myself within the diving community and the water itself produced novel and important insights into the gendering of the diving body – an entrenched social norm that remains pervasive.

Returning to Sealab, the so called 'aquaspouses' and 'aquawives' (see Bond's 1965 newsletters) – i.e. the wives of the aquanauts played a significant role on the surface in maintaining these social regimes of homosoicality. In contrast to the masculine divers who were capable of making home in the water, Scott Carpenter's wife told a newspaper that unlike her husband, 'I'm not at home in water…we live on a lake in Texas, though, so I'm learning to water ski. It's quite a challenge because I'm scared of water and don't like the speed' (in Morgan 1965). Furthermore, the absence of their husbands and their presence beneath the sea were reported to cause problems. Pat Sonnenburg, wife of aquanaut Dr Bob Sonnenburg for example, tried to make a cake that could be transported down to the habitat for her husband's birthday. She came aboard the Berkone support vessel bearing a 'large devil's food cake, complete with Sealab II decorations all nested in a gay hat box' (Bond 1965, entry 6 September). According to Bond,

> 'she was in near tears when the box was opened, revealing a shattered masterpiece…nevertheless she bravely packed the cake and cards in our pressure

> pot, posed for the TV and other cameras, and sent it on the long journey to Sealab II'.

The finished article can be seen pictured with Dr Sonnenburg in Sealab II (see Figure 32) and the media were keen to emphasise the apparent devastation the cake had caused his wife. Under a headline 'Cake falls- Aquanaut wife crumbles' the article begins by describing Pat's 'red and green maternity blouse' before describing her response to the damaged cake:

> 'I've never been so upset in my whole life', she said. 'It was so pretty. I'd rather go through having a baby than take what's left of the cake out to the ship. I'm so embarrassed. I feel like throwing it in the bay' (*San Diego Union* 7 September 1965).

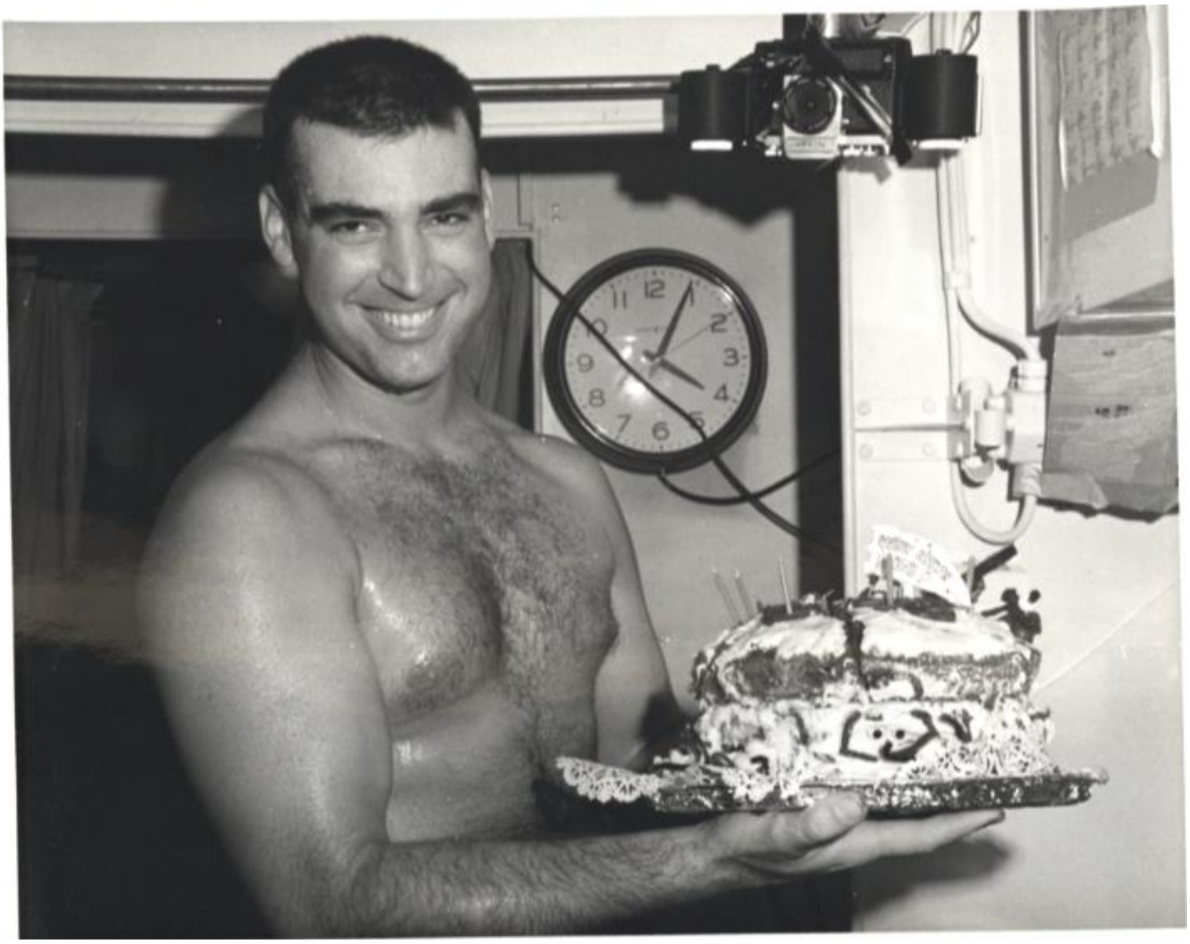


Figure 32: Aquanaut Dr Sonnenburg holding the cake from his wife in the Sealab II habitat (US Navy photo reproduced with permission from the Man in the Sea Museum).

Patricia Sonnenburg's dependency on her breadwinner husband was also emphasised in the media. In what was presumably a staged encounter, Mrs Sonnenburg arrived at the Sealab support vessel to send an envelope with cheques in need of co-signing by her husband so that she could 'keep family groceries' while he was in the Sealab habitat (*San Diego Evening Tribune* 31 August 1965). According to the Tribune, 'Mrs Patricia Sonnenburg was able to get a reassuring look at her husband' as he received the package of cheques (see Figure 33). 'Even if Lt. Robert Sonnenburg is at bottom of Pacific, bills must be paid' and he subsequently 'floated' them back to his wife who 'receives help opening the envelope from Eric, 2, Sandra, 4, and Suzanne, 8 months' (*San Diego Union* 1 September 1965, see Figure 34).

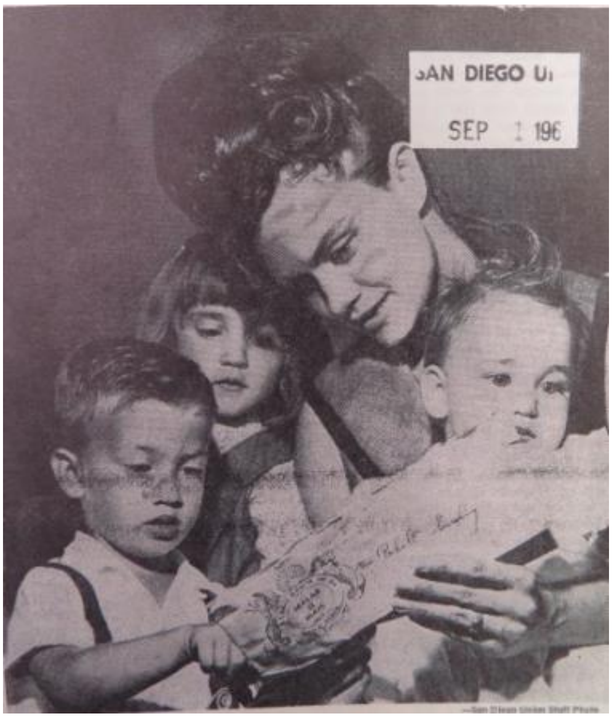


Figure 33 (left): Pat Sonnenburg gazes up at a CCTV screen to see her husband (*San Diego Union*, 1 September 1965)

Figure 34 (right): Pat Sonnenburg, looking down, opens the cheques from her husband with her children. In both images the role of the 'gaze' is important. She looks up to her husband, and down to her children, her relevance always in relation to someone else (*San Diego Evening Tribune*, 31 August 1965).

In need of reassurance, somewhat hysterical, and defined by dependency, motherhood, and their ability to alleviate boredom, the 'aquaspouses', via interventions from the media, came to reinforce their husbands masculinity and the exclusive practices at play. Within this, we see the gendering of valorised attributes such as courage. On the one hand, the courageous aquanauts put their bodies on the line to further the boundaries of America for all of 'mankind', on the other the newspaper reports Bond describing Pat Sonnenberg 'bravely' packing the damaged caked into the pressure pot whilst Mrs Carpenter is scared of the water. The sea, as a recalcitrant, dangerous, hostile substance serves an element that allows masculinity to prevail as the men vacuum in an extreme space whilst simultaneously supporting their wives on the surface who must show courage in their own ways in their husband's absence.

4.6 Going Native: Feeling *too* at home on the seafloor

'Thanks to the wisdom, skills, and energy of the men have pioneered in these efforts', wrote Vice Admiral of the US Navy, Charles Melson, 'the question of whether man can enter the hostile oceans and wrest from them their secrets has been answered in the affirmative':

> 'No longer must man venture hesitantly into the oceans like a toy encased in a protective coat dangling from the end of a string tethered precariously to a ship on the surface. His ability to live beneath the surface at depths greater than anyone envisioned a few short years ago has been proved. He now possesses the ability to live, work, eat, sleep, and participate within the oceanic environment – remaining not for minutes, but for days, weeks, or months if the need arises. With the facilities now available, man is no longer a spectator looking at the changing subterranean scenery through glass ports; he is a member of the aquatic fraternity' (Melson 23rd March 1965:4)

Writing in the aftermath of Sealab II, Melson highlights the pioneering efforts of the men involved in the program, emphasising again the seemingly mundane activities and routines of working, eating, and sleeping in the extreme environment of the sea. Yet in his speech, Melson perhaps takes the idea of mastering the sea one step further, describing how the men became part of an 'aquatic fraternity'. There is a sense of belonging implicit in the phrase and it is to this idea that the chapter will now turn, along with the implicit fears that the aquanaut's were, in a sense, 'going native' to the concern and exclusion of those topside.

Whilst the construct of 'home' and the feeling of being 'at home' was invoked throughout the Sealab projects, George Bond expressed concerns during both Sealab I and II that the men might start to feel *too* at home. In their public films about the project described how:

> 'The men living in the still alien realm of the waters lost all their fear, began to feel that they belonged where they were, that they could go for a swim without their air tanks. 'You even forgot you had to go back to Sealab for air', Dr Thompson recalls. One night I dreamed I was breathing oxygen from the sea' (US Navy 1964).

This sense of belonging raised concerns for Bond about the levels of independence that the aquanauts both sought and asserted. He first expressed these concerns during Sealab I after he had informed the aquanauts that the Navy would be acting on expert advice and terminating the project due to an impending hurricane on the surface:

> 'A spokesman for the aquanauts, who shall be forever nameless, spoke up loud and clear, "Papa Topside, for Christ's sake, give the S.O.B. a handful of tranquilizers, and send him below. Since this project started, we've heard nothing but 'can't do it', 'can't help it' and 'can't stand it'. Tell him to cut the God-dammed umbilical and run for shelter. We can f-----g take care of ourselves." I could only say, go to bed, sons, and sleep well; you are right -- the world does not come to an end every hour on the hour. And so that colossal bit of mass disrespect, if such it was, went unrecorded, save on these pages.' (Bond 1964, entry 26 July)

Two days later Bond reported that:

> 'our subjects had daily grown more independent with respect to many aspects of topside direction and control so necessary to purposeful action and survival. So much was this the case that important events in Sealab I were going unrecorded, and even changes in the atmosphere of the habitat were effected without notification or concurrence of Walt or myself topside. Finally, bit by bit, and despite our admonitions, the general rules of underwater safety were being violated all over the place. The buddy system fell apart; breath-holding skin dives, alone, and without

knife or weight belt were frequently viewed on our TV; and our expressions of dismay fell on deaf ears…Predictably, and in keeping with the independent spirit of the under-sea dwellers, they proceeded that morning to use up most of their helium air open circuit mixtures, and a good deal of their MX VI gas in accomplishing petty tasks around the habitat, and this without permission from Papa Topside' (Bond 1964, entry 28 July).

This was echoed in an official Sealab I report which described how the aquanauts 'sought, psychologically, to cut the umbilical cord to the surface-support vessel and to the Sealab control operators' (O'Neal et al 1965:38). In the log within the report, Bond descried the aquanauts' as being as 'independent as hogs on ice' and subsequently they were 'chewed out, and threatened with a break of communication with Argus Island unless they mend their ways' (Bond 27 July 1964 in O'Neal et al 1965:47). We can see an example of this independence and disregard for safety protocol in Figure 35 which depicts aquanaut Bob Barth outside of the Sealab I habitat without an air supply or weight belt.

Figure 35: Aquanaut Bob Barth outside of the Sealab I habitat (Image from Bob Barth's personal collection, reproduced with permission).

These concerns pervaded into Sealab II with Bond listing the 'aquanaut breakaway phenomenon' among his two major concerns (the other being the establishment of reliable communications) (Bond 1965, entry 27 July). With origins in flying and aerospace, the breakaway, or break-off phenomenon refers to a sense of estrangement, unreality or detachment from land (Benson 1973, Tormes and Guedry 1974). A pilot, for example, performing certain manoeuvres in the air might become disorientated, losing a sense of up/down, and land in relation to sky. George Bond describes the phenomenon as disorientation 'in space, time, and philosophy' where the human becomes lost *in* sea rather than *at* sea at the surface. It hints at a psychological process dependent on being immersed in an elemental surround where the human is no longer grounded and the body is suspended thus losing touch with the earth's surface. For Bond, it was a potentially dangerous phenomenon where aquanauts would 'breakaway from topside control', it could not be 'fully predicted' but perhaps 'circumvented by precept, prayer, and brainwashing' (Bond 1965, entry 28 July). Bond himself describes the experience of feeling separated from terra firma in the 'silent, black world' as he recounts an occasion where he and Walt Mazzone paid a brief visit to the Sealab II habitat:

> 'A long scan of the underwater scene reveals a dim light below and at an azimuth unknown to either of us. It must be Sealab II, or a portion thereof; but which end or which side we know not. Walt nods to me and I respond with a thumb down. We commence our free dive downward, despairing of the descending line, long since fouled on an object far above us. Down, straight down we swim, suddenly very aware of the syncopation of our fin beats and exhalation sounds, so loud in this silent, black world. And now, as we approach the bottom, a strange and beautiful phenomenon becomes apparent. Out two fathoms off the ocean floor, we suddenly break through the murky wall down which we have been sliding. Below us, the bottom looms clear, and free of all turbidity. Visibility jumps from inches to many feet, and Sealab stands clear in its entirety. Light seems to emanate from the ocean bottom, while above us all is black. On a mutual impulse Walt and I roll on our backs

> to stare up at the world from whence we have come. It is no more - only a forbidding black curtain lies above. Only here below is light and safety. Surely this is our refuge, and our home. We stare at one another, each reading the identical thoughts of the other, disoriented in space, time, and philosophy... I spin about to face one of my aquanauts, sent out to save us from wandering past the security of the Sealab vicinity, and the limited range of our compressed breathing mixture. We swim slowly to the shark cage, guided and protected by our aquanauts, to whom this part of the continental shelf is a familiar front yard. Graciously sweeping aside the poisonous scorpionfish from the steps to the entrance hatch, these undersea experts and friends bring us to the marvellous gas-water, dark-light interface which marks the only safe two foot square area for miles around-the entrance hatch to Sealab II' (Bond 1965, entry 7 October).

This almost spiritual experience for Bond beneath the surface with the 'undersea experts' proved to be more concerning when the dichotomy between surface and sea had been re-established upon returning to the surface. Like Sealab I, Bond describes how 'carelessness' became a significant issue within the habitat. Mistakes were made by the men in managing their life supporting equipment; the system of 'buddy checks'[37] was not strictly adhered to; dives were undertaken on half-filled air canisters and reports of entry and exit times from habitat to sea and vice versa were not made; situation reports were late; calls went unanswered and messages were ignored for as much as half an hour. There was, writes Bond (1965, entry 16 September) 'daily increasing evidence of the type of independence which strikes terror to the heart of the topside watch-stander.' The day 'has not yet arrived' when the 'judgement and planning of the topside control can be ignored or modified substantially by the subject in the habitat' (Bond 1965, entry 16 September). Team leader, astronaut and aquanaut, Scott Carpenter, proved to be particularly difficult. Carpenter was chosen, wrote Bond, because 'of his excellent powers of observation, traits of leadership, positive attitude and infinite curiosity'. On the sea floor however, 'where autonomy is stressed, and personal responsibility of the team leader is a heavy burden, some of these

[37] Checking one another's equipment before commencing a dive.

sterling qualities have become a source of irritation and occasional outright friction between topside control and the team leader':

> 'The problem becomes gradually magnified with the passage of time and the inevitable accumulation of frustrations and personal discomforts which attend such a long stay in a cold, dark and hostile environment. In any event, Scott's natural curiosity seems frequently to generate excess questions, with every decision handed down from topside challenged by demands for infinitely detailed explanation…I must each day go through an ordeal of rebuttals, defences, and renewed demands that the condemned equipment be used for highly experimental and dangerous excursion dives…Finally, some decisions which can only be made by topside control relative to atmospheric mixtures are challenged--and this is not permissible' (Bond 1965, entry 20 September).

The lead psychologist studying the behaviour of the men also reported on the phenomenon. In describing the effects of being 'separated from the world by 200 impenetrable feet of water', Helmreich (1967:37) described how several of the men observed feelings of isolation from the outside world; surface personnel were referred to as 'earth people' and occasionally held in mock contempt by the sea dwellers. 'On one occasion' writes Helmreich, 'a diver said 'I have a message for the earth people. Fuck you!' Similarly, Helmreich reports that the diver who communicated most with the 'outside world' was 'severely ridiculed by his team mates for his preoccupation with 'earth people' (1967:59). As Bond explained to a reporter, 'he felt that he was in some sense 'losing' them'…'they soon were acting in an independent manner that was both dangerous and puzzling. It was as though the men were mentally leaving the world above the water surface for a new world to which they now belonged' (Cowen, *Christian Science Monitor*). Whilst not expressed in such extreme terms, we can see in Berry Cannon's journal how the men got used to the extreme environment. As Cannon writes, it's 'amazing how time gets away from you…There is no sensation of pressure and the water doesn't seem to be as cold now as it first appeared' (Cannon 1965, Sealab II log, 30 August). We see these ideas expressed further in a report in the *Christian Science Monitor* (Cowen 1965):

> 'The men later explained some of their independence as a response to confusion and conflicting commands from above. Captain Bond acknowledges the confusion. But he thinks the problem goes beyond that. He recalled the nickname he, the commander, was given. 'Within an hour, he said, 'I was told I was no longer Captain but Papa Topside and so I remained for the experiment. It was partly good fun but I also felt it was part of the process of somehow losing them men. When a man is in an environment he really enjoys,' he explained, 'and when he feels he's really a first in the Navy, he feels independent. He beats himself on the chest. He feels he knows best what to do. This is dangerous for command and for him if he forgets that he is really in a very hostile environment'.

This sense of belonging is important. As Trudeau (2006:423) highlights, the feeling that you belong in an environment 'is central to understanding the social control of space…it necessarily entails bounded classifications of characteristics' associated with membership, distinct territory 'whether imagined, metaphorical, or material'. Belonging writes Trudeau (2006:243) is 'inherently spatial…to belong to a polity is to belong to its associated places'. Space, and place are clearly important in 'belonging' or feeling at home but so too is the elemental, material substance in which the aquanauts were immersed in. As Ten Bos (2009) asserts water is incredibly apt at surrounding and creating a sense of immersion. Even at a recreational level, I noted a comment made by a fellow student about how she had felt she 'was in a different world or territory'. Looking back on my diary I also noted that being 'removed from land is liberating, you feel detached'. To dive beneath the surface is to move from 'a confronting mode of being' wherein the human gaze stretches across the expanse of the sea, to a 'medial mode of being' (Ten Bos 2009:77). As Greek poet Symeon wrote (in Ten Bos 2009:77):

> 'If a human being walks up to his knees or hips into the sea he is able to see the water all around him. If, however, he dives into the water he will no longer know something outside him; all he knows is that his entire body has submerged in water.'

This implies, argues Ten Bos (2009:78) that surrounding medium of water loses its object status: 'you are in it rather than in front of it', conforming to a deeper desire within the human psyche that desires to 'be encircled and surrounded', wherein the human demands the ‘right of isolation’ (Ten Bos 2009:81). We see this sense of isolation and medial objectivity in Berry Cannon’s diary (1965, Sealab II log, 29 August). He describes, for example, how ‘no surface light was visible’ and how he couldn’t always see the sea floor from the portholes. There is a feeling of suspension with a porous barrier between the habitat and the sea. It was almost, stated the US Navy (1965) ‘as if you are on another planet although you are within the territorial waters of the Unites States’. Similarly, Figure 36 below speaks to these themes. We see the porous boundary between habitat and sea with one of the aquanauts standing in the entrance hatch, half in air, and half in water – one of the men (in Cox 1968:74) described leaving the habitat as being ‘as easy as falling off a log’.

Figure 36: One of the aquanauts stands in the entrance hatch of Sealab II. No doors separated them from the sea, the boundary between habitat and sea was porous and maintained by air pressure inside the habitat (Man in the Sea Museum).

If the 'diver' is a worthy focal point of Ten Bos' analysis, then the aquanauts in Sealab are surely the example par excellence. Spending a prolonged period of time in an environment so removed from life on land had implications for how the aquanauts viewed themselves in relation to terra firma. This is only exacerbated by the fact that, as previously highlighted, the aquanauts could not simply return to the surface as their bodies were saturated. 'You are', as the Navy (1966) highlighted, 'an inhabitant of the sea until you decompress for 30 hours'. By the same measure, any visit to the habitats by those topside could only be very brief or else they too risked their bodies becoming saturated and thus rendering them unable to return to the surface without the use of a diving bell and extensive decompression. The men, as highlighted by a reporter in the *Christian Science Monitor* in 1965 (Cowen 1965), 'lived in a world that, except for short dives, was barred to those on the surface'. The dichotomy described by Bond between those on the sea floor and the 'earth dwellers' was only reinforced in his diary where he describes how the men 'will file out of Sealab II one at a time, to greet and to be greeted by surface dwellers' (Bond 1965, entry 8 September). The sense of belonging fostered beneath was complex in its manifestations. The Sealab programs, in the words of Craven (2001:144) 'signalled the occupation of the sea by humans as marine mammals' and Bond framed himself in his diaries as a God like figure of sorts, seeing the aquanauts 'through the affectionate perspective of a father, or grandfather…I found myself counting them anxiously, and knew that, day and night, I would count these sheep for a long time to come' (Bond 1965, entry 29 August). A few days later he urges himself and the reader to 'remember that even Aquanauts are God's creatures also' (entry 3 September 1965).

Needless to say, there were significant moments of rupture that reminded the men of the dangerous environment in which they dwelt. Bond recalled one such occasion in his diary:

> 'On a swim yesterday afternoon, one aquanaut, wearing insufficient weights, became uncontrollably buoyant, and was saved from a hasty and fatal ascent only by quick action of his diving buddy, who hauled him down and back to Sealab II. I realize that our men do not wish to be so heavy that they must crawl among the thousands of scorpion fish on the bottom; but surely they know full well that a state

of positive buoyancy is likely to result in a fatal rise to the surface' (Bond 1965, entry 16 September).

In another incident, the air line linking one aquanaut to the habitat was fouled and he was found unconscious in the entrance hatch – an accident blamed on the 'dangerously carefree attitude on the part of the aquanauts' (O'Neal et al 1965:38). As illustrated in the 'People and Projects' section of chapter 1, Berry Cannon's death during the Sealab III operation was as stark a reminder as any that feeling 'at home' in the sea was a fallacy designed and delivered to a public keen to see America expanding its Cold War boundaries into the earth's extremes. Nevertheless, the experiment raises some interesting questions about the concept of 'home' within geography and its relation to the external environment. As Philo (2012:2) highlights, the construct of 'home' is inherently geopolitical. Sites, such as Sealab in this case study, are invoked in the name of a security agenda or for 'homeland security' and can be readily allied with protecting the intimate spaces of domesticity. They also point to a power to include and exclude unwanted people from the cosy, safe comfort of the home. Simultaneously, the significance of the 'elemental' is also laid bare. The experience of feeling homely (or not as the case may be) was mediated by the water in which they were immersed. It not only created physical, psychological, and social distance from the surface, but also a pressure ceiling that physically prevented the men from surfacing safely. Katherine Brickell (2012b:230) has called for further work on the 'extreme' dimensions of home (referring to homelessness and the practice of domicide) whilst Moore (2000) emphasises the need consider the context of practices related to home, yet neither articulate the significance of elemental contexts and extreme environments. Whilst Sealab is a context specific example, environmental factors that influence and the construct and practice of home are not.

4.7 Conclusions: Dwelling in and on the extreme

In exploring how the Sealab projects transformed the sea floor and surrounding water column into 'a relevant place' (Rozwadowski 2010:251), a number of key interrelated geographical themes have been examined and deepened. These include complicating the intersections of the Cold War, gender and the frontier; the elemental and its implications for territory and terrain; and the practice and construct of 'home' in the extreme environment of the sub-marine. To begin with the Cold War context, American expansionism into new 'hostile' spaces has been well studied yet the case study of Sealab adds further colour and texture to the Cold War frontiering landscape. Alongside the work of scholars including Farish (2006) on the Arctic, Spiller (2015) on the Antarctic, and Sage (2014, see also Spiller 2015) on Outer Space, this chapter has demonstrated that the US military frontiering imaginary and the desire to physically inhabit and dwell in extreme spaces extends to the seafloor as well on ice and outside the earth's atmosphere. Indeed, Scott Carpenter worked across these spaces having inhabited outer space and the depths of the sea, newspapers reported that he saw 'no difference in the length of time man can stay at great depths beneath the sea, or in isolated areas such as DEW line sites' (Hillinger, 1965, *Los Angeles Times*, see also *Houston Post* 29 Sepetmber 1965). The DEW line, which extended through Arctic regions, came to be imagined here as part of a series of extreme analogues, with highly differentiated spaces characterised by their overt hostility to human survival and environmental conditions in need of taming or mastering. As illustrated throughout the chapter, this process of frontiering was gendered, the sub-marine wholly imbricated in perpetuating, exacerbating, and emphasising prevailing white masculine norms. Extreme spaces seem to be a breeding ground for this, with exclusionary practices legitimised in the face of an 'enemy' environment. This imaginary worked temporally too and came to be reliant on the collapsing of temporal frames that saw Sealab incorporated into a historical narrative stretching back to Columbus and Magellan, and even the creation of the Earth itself via 'Genesis'. Simultaneously these narratives, via certain temporal routines, stretched into the future, providing a glimpse into a world of permanent sub-marine inhabitation. Time here was a frontier that collapsed, shifted, and ruptured.

Managing temporalities also proved significant in other ways. Those on the support vessel have to negotiate and adapt to an ever changing, shifting sea floor and water column that paid no respect to the traditional territorial practices of mapping and charting. In determining the location of the project, and in managing life on the sea, the elemental proved to be extremely problematic. Not only did the sea floor shift and change but it did not remain rooted to the earth's crust. It hung in the water, creating a curtain, a blackness, a suspended and engulfing terrain that had to be negotiated, managed and overcome with novel technologies if the experiments were to meet their objectives. Setting the Sealab endeavour into play with questions of territory and terrain results in an exemplary example of how these are anything but static constructs. On the contrary, they are shifting, three dimensional, and temporal – all processes that are laid bare in extreme environments whether that be the sea, the Polar Regions, or Outer Space.

We might think of the effects of this terrain in other ways two. The elemental properties of water meant that the aquanauts could not surface. As they descended and the pressure contours were crossed, their bodies became imbricated in the environment, cultivating and facilitating a sense of belonging – a sense that the 'earth dwellers' were interfering and unnecessary and providing unpassable physical distance from the 'surface dwellers' topside. This raises interesting questions about the nature of immersion in elemental surrounds, how they can engender a sense of belonging, separation, and distinction from those elsewhere in more 'natural' environments. Moreover, it prompts the question, what does it mean to be 'at home' in environments that are overtly 'hostile'? How does the sense of immersion engendered in these spaces affect perceptions of domesticity, homeliness, and feeling removed from the threat of the environment? Perhaps Sealab demonstrates a need to acknowledge the relevance of the extreme *geo*graphies of home beyond the frameworks of homelessness and forced eviction (Brickell 2014), whether that be under the sea, on mountains, the polar-regions, outer space, caves, and other geographical contexts that require the human to adapt to, and homestead, extreme external conditions. Needless to say, these practices, like Sealab, exist with heavy social, cultural, and political baggage.

Perhaps the concept of 'dwelling' is useful here. Described by Cloke and Jones (2001:651) as the 'rich intimate ongoing togetherness of beings and things which make up landscapes and places, and which bind together nature and culture over time', the concept of dwelling hints at an intricate and intimate relationship between the environment, temporalities and people. It can, argues Cloke and Jones (2001:652) help to account for the:

> 'rich, intense, making of the world, where networks fold and form and interact in particular formations which include what we know as `places'… In effect, dwelling is ``the manner by which we are on the earth'' (Vycinas, 1969, page 15), and incorporates both a spatial and a temporal dimension.'

Dwelling is thus bound up with ideas of home and the environment. To dwell, then, 'is to become rooted by the act of accommodation in place' (Cloke and Jones 2001:651). Wylie (2012:377-378) builds on this to explore the idea of dwelling in 'deep spaces'. Drawing on the work of writer Tim Robinson to explore questions of landscape, Wylie describes a 'deep landscape' as a 'precarious, processual fusion of land, atmosphere, history and identity'. Walking is one way in this feeling of dwelling in 'deep space' is achieved. For Wylie, walking 'prompts closer attunement between self and landscape, and thus the in situ elaboration of a wider ethos, one in which life is best lived through close synergy with local life forms and rhythms' (2012:371). Walking therefore comes to represent a privileged route to deeper knowledge of landscape, it marks a passageway through which the visitor or incomer can begin to sense the perspective of the longer-term inhabitant, and perhaps (given time – dwelling's other key cultivator), even become that inhabitant' (Wylie 2012:371). The idea of dwelling in 'deep space' is deployed by Wylie as a metaphorical, affective construct but if we take the 'deep' in Wylie's analysis literally (or even invert it to incorporate 'high' spaces) a productive prism emerges through which to unpack 'the precarious fusions of the environment and the human and the multiple concordances and correspondence between 'land' (or in this case the sea), and 'life' (Wylie 2012:371). 'The clear intention', writes 'Wylie (2012:373), is to suggest that land and life are not so much laminated or superimposed onto each other, but are rather interwoven as strands within a single yet infinitely complex fabric'. Similarly, in this case study, the process of homesteading, territorialising and domesticating the seafloor are intricately interwoven with the physical environment.

The idea that 'dwelling' might have applications beyond landscape studies is well established (Lorimer 2006, Johnston 2008:640) and clearly it has methodological resonances too. The dwellings, ponderings, and imaginings of certain actors, such as George Bond, have been pivotal in understanding the underlying transcendental agendas and divine driving forces behind the Sealab experiments and it is only through his diaries, by exploring his thoughts as he dwelt and experienced the projects, that these become apparent. The diary enables a remote sense of dwelling and of the experiential which are only enhanced if the researcher's body also dwells on certain documents and in certain environments beyond the landscape. Inhabiting the EDU, and learning to dive (which required dwelling in water) for example, produced novel gendered insights that would otherwise have remained elusive. If we move away from the two dimensional landscape, we can begin to explore what it means to 'dwell' in the three dimensional whether beneath the sea or elsewhere such as at altitude. As a result, we might be in a better position to unpack the associated implications this has for the geographical concepts and constructs analysed throughout this chapter, and for the practice and conduct of geographical research more broadly.

Chapter 5

Sub-marine pressures and elemental entanglements: Airs, volumes, and bodies

> 'In short it is believed possible that ocean air is not the best of all possible atmospheres for human existence'
>
> (Bond in Barth 2000:17)

5.0 Introduction

Whilst the Sealab endeavours were framed by the ONR as an attack on the hostile environment of the sea and a mastery of the sea floor, the experiments were predicated on mastering other elements and voluminous bodies. As this chapter will illustrate, prior to any descent to the sea floor, numerous experimental tests were undertaken within the space of the hyperbaric[38] chamber to ascertain the limits of the body's tolerance in an artificial air mixture. Air emerges here as a plural construct in its interaction with pressure. Capable of taking the human body along a vertical axis to altitudes and depths, the chamber served as a territorial analogue through which to explore the effects of multiple airy constructions. In doing so, the role of analogue spaces in the construction of territory in extreme environments is highlighted. Building on this, the second section of the chapter addresses the process of decompressing from Sealab and how the 'exotic' atmosphere breathed by the aquanauts on the sea floor was removed from their bodies. Whilst demonstrating how the body of aquanaut Scott Carpenter served as an archive in this process, I also seek to demonstrate the value of immersive and embodied research here, not only in aiding the communication of complex ideas but in the cultivation of an embodied empathy which brought novel insights to the archival material.

As will be explained further, the aquanauts were unable to breathe 'normal' air whilst on the sea floor. Instead, a different form of 'ocean air' was constructed composed primarily of helium. The chapter moves to reflect on the function of helium at depth demonstrating in the process that air can be a malleable and mixable substance with significant embodied consequences. Perhaps the most significant conclusion of this section, however, is the introduction of the concept of 'cyborgean territory' to explore how territory is constructed in extreme spaces via certain technological, elemental, and embodied entanglements. The final two sections of the chapter move away from the element of air to explore how the bodies of the aquanauts were brought under certain homosocial, physiological, and psychological regimes, reflecting first on the idea of the Cold War hero and intestinal fortitude, before exploring how the term 'red blooded masculinity' came to apply literally

[38] Hyperbaric: Pertaining to or utilising gaseous pressure greater than normal

as the aquanaut's bodies became a terrain to map, manage, and monitor. By way of conclusion, I reflect on three key themes. The first pushes work on the elemental, asking what a critical geopolitical intervention into individual elements on the periodic table might look like, the second offers further reflections on the role of cyborg imaginaries and practices, and the third addresses how we might think of *terrain* as an embodied concept in addition to one relating to a geographical environment.

5.1 The chamber: encapsulating sub-marine pressures

'Half the stuff they asked of us I never knew the human body was even capable of doing' (Barth 2000:10)

'In short it is believed possible that ocean air is not the best of all possible atmospheres for human existence' (Bond in Barth 2000:17)

Whilst the Sealab projects have been the protagonist of this thesis thus far, I was reminded in an interview with aquanaut Bob Barth (7 February 2016, Mr Barth's home) that a great deal of work was done beforehand to make undersea inhabitation possible. Beginning in 1957 at the Naval Medical Research Laboratory in New London, Project Genesis (1957-1963) began with experiments on animals (goats in particular) to 'demonstrate the feasibility of saturation diving' (Summitt and Kulig 1970:2). Defined by Larsen and Mazzone, a saturation diving operation was one in which divers undergo increased pressure in a chamber or in the sea, and remain there for a period of longer than 24 hours. The principle allows 'all the tissues of the body to become saturated with the inert gas or gases being breathed' (Summit and Kulig 1970:2). Imagine for a second that you have a sponge and a volume of water. If you immerse the sponge for a short time a proportion will become saturated with water. If you immerse it for 24 hours, it will become fully saturated. It cannot take on any more water but maintains its structure and identity as a sponge. A similar process occurs in saturation diving in the body's cells. In doing so, the decompression time (or the time it takes to remove excess air from the body) 'remains fixed, regardless of the length of time the individual stays down:

> ‘Thus, if divers can be maintained in undersea quarters in which the inside pressure is equivalent to the pressure of the surrounding water, they can have free access to the outside water. Only one decompression time is required and only on the return to the surface. This provision makes the ratio of working time on the bottom to decompression time far more favourable’ (Naval Research Review 1965:2).

Described by Barth (2000:7) as the ‘monkey on the back of divers’, prior to saturation techniques, a dive to 380 feet for 30 minutes required over three hours of decompression ‘hanging in the water’ at various depths to slowly eliminate the excess gas absorbed by the body at depth. Saturation diving then, if it could be realised, offered great promise for Navy diving operations because it would optimise ‘dive time’ and shorten ‘recovery time’.

Ascertaining a gas mixture through which this could be achieved was key. The air we breathe on land (21% oxygen, 78% nitrogen and approximately 1% other trace gases) can kill when breathed at the depth of Sealab. Due to a phenomenon known as Boyle’s Law (see Figure 37) which dictates that the volume of gas decreases as pressure increases (thus meaning that more molecules of gas are inhaled per square inch as pressure increases), oxygen becomes toxic at anywhere around 60m as the human body becomes unable to deal with excess oxygen molecules interfering with metabolic processes as they circulate around the body under pressure. It leads first to convulsions and if not addressed, can be fatal. One of my participants, a pioneering female saturation diver (anonymous) in the aftermath of Sealab described her experience of a convulsion during an experiment in an experimental testing facility to ascertain whether the human body could conduct multiple dives on pure oxygen. The subjects were riding submerged bicycles in a tank to simulate underwater exercise which was believed to increase the risk of an ‘oxygen hit’ or an ‘oxygen toxicity event’. My interviewee was one of the ‘data points’ in the experiment that demonstrated that the body could not tolerate multiple oxygen excursions:

> ‘I can tell you what it was like to have an oxygen convulsion… the mind is an incredible thing …we’re trained – if you start to experience signs of oxygen toxicity you reduce the amount of oxygen you are breathing, the best way to do that is to come to the surface, take the rig out of your mouth…you’re trained and this is what you do (in the experimental tank). So I was peddling the second time as we made another excursion down (via pressure). I started feeling, ‘something’s not right’, and

that's all I could say, something just wasn't feeling right. What I recall is that I start pushing myself off the bike, the bicycles were just below the waterline so all I had to do was stand up on the platform and my head would be out of the water, so I stand up, take my rig off, and breathe air to reduce my risk of an oxygen convulsion – that's what I thought I'd done. What had happened – I find out later – I did push myself off the bike and we had tenders on the surface breathing air, everyone had a tender watching them, and as soon as my tender saw me push myself off the bike, he grabbed me, and part of his job was to get the rig out of mouth and hook me up to the harness in case I had a convulsion so I don't fall back into the water because when you're having a seizure your airways cut off. As a result if you came up you'd blow out your lungs and an air embolism would occur, or a pneumothorax, or both. Anyway, I thought I was doing everything correctly - I thought I was removing my rig but I was in fact removing his snorkel. I was disassembling the tender who then hooked me up and I had my convulsion from the oxygen hit…I never knew the human body had so many muscles, I hurt, every muscle in your body twitches and I was definitely foggy for a few days (13 February 2016, local coffee shop).

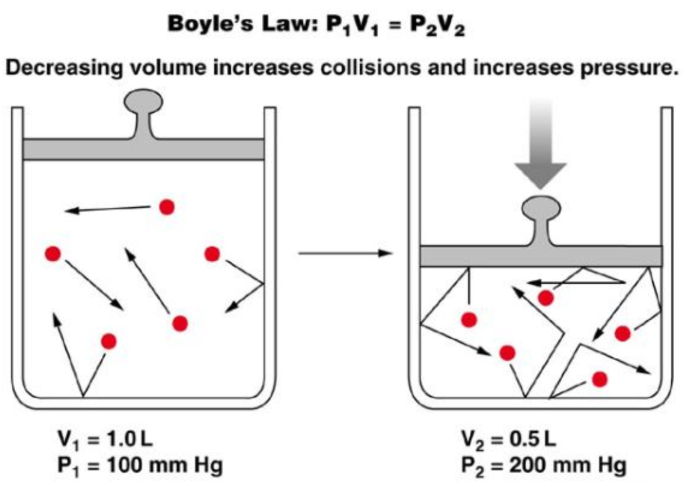
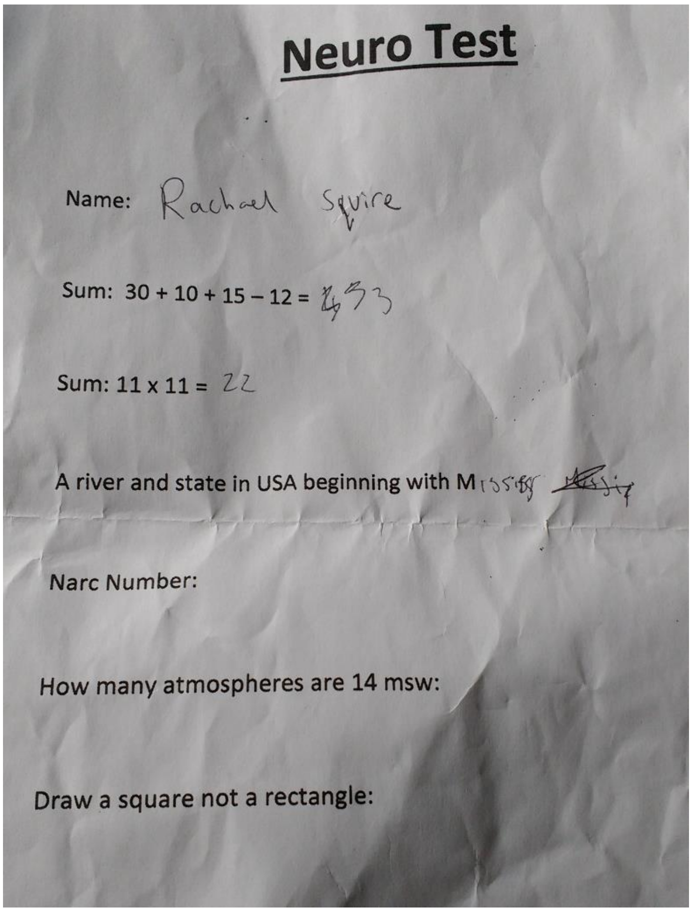


Figure 37: Illustrative examples of Boyles Law depicting how the volume of gas changes as pressure increases

Nitrogen too becomes problematic. Whilst it is not toxic, it becomes narcotic at anything from 24-30m depending on individual susceptibility. Known as 'the rapture of the deep'

(Naval Research Review 1965:4, Cousteau 1954), being ‘narked’ can be extremely dangerous. I experienced the consequences of this first hand as part of a recompression awareness course which involved completing a 40m ‘dive’ in a hyperbaric chamber . As I discovered, one of the key dangers of nitrogen narcosis is that it effects the body without you necessarily realising. We had been warned by the attendant we would be ‘shitfaced’ when we reached 40m. When we did get there he asked how we were feeling. Everyone responded that they were fine and, feeling somewhat smug about my ability to withstand the ‘rapture of the deep’, I was resolutely convinced that I had not been affected. This changed, however, when we were given a short neurological test to complete (see Figure 38) and I realised that I was very much in the rapture of nitrogen narcosis. When it came to answering simple questions my head felt thick and foggy and there was a disconnect between what I was thinking and what I could physically do – I struggled to write the ‘q’ in my surname, answered the maths questions wrong and failed to spell ‘Mississippi’ despite mentally reciting the rhyme. I ran out of time to complete the remaining questions because I had spent so long on the first three. In the relative safety of the chamber this was somewhat baffling but amusing, whilst also serving as a prime example of the ‘rapid education’ into the nature of human interaction with pressurised environments (see Howkins 2010:515). Needless to say, underwater it can be extremely dangerous, leading to poor decision making, a sense of euphoria and over confidence, and as my diving instructor reported, illogical and life threatening behaviour (he has once witnessed someone trying to give their air supply to a fish). The aquanauts’ lives depended on their ability to think clearly and act rationally and, this is not possible when ‘narked’.



Neuro Test

Name: Rachael Squire

Sum: 30 + 10 + 15 – 12 =

Sum: 11 x 11 = 22

A river and state in USA beginning with M

Narc Number:

How many atmospheres are 14 msw:

Draw a square not a rectangle:

Figure 38: Neurological test undertaken during a 40m chamber dive (photo by author)

Dr George Bond and Bob Workman had been working on a theory that would avoid using toxic levels of oxygen and narcotic levels of nitrogen. They believed that helium, as an inert gas that does not interfere with the body's metabolic processes or become narcotic could replace nitrogen as the primary elemental substance in air. They spent five years testing their theory on animals in hyperbaric chambers (the final subjects being goats that the men became 'damn fond of'[39]) before permission was granted in 1962 to begin tests on humans at the Navy Medical Research Institute[40]. The first test in a hyperbaric chamber was conducted at ambient pressure with a breathing mixture of 21% oxygen, 4% nitrogen, and 74% helium. To try and attain the right mixture and prevent gas leakages[41], the attendants

[39] Bob Barth responsible for their care and, dubbed the 'goat runner' exercised them around the Naval Yard (Barth 2000:11)

[40] Whilst in Sealab George Bond assumed the title 'Papa Topside' to his test subjects 'back in the days of Genesis', he was 'PapaGen' and his 'subjects genitalia' (Bond 1964, entry 21 July) , once again highlighting the overly sexualised environment of US Navy diving'

[41] Chambers seal under pressure

first ‘flew the chamber to around 40,000 feet’ whilst within the men breathed ‘oxygen like an aviator’ as they ascended’ (Barth 2000:14). Then as planned, they ‘brought the chamber back to the surface on the appropriate gas mixture’. Even with these measures Barth noted his surprise at ‘how easy it is for unwanted air to creep into a chamber’ (Barth 2000:14). The experiment was a success with no measurable physiological decrement although, it was noted that the men’s bodies had revealed a ‘clear-cut response and a potential bacteriological problem’ (Barth 2000:17). As will be reflected upon in greater detail in the third section of the chapter, this knowledge was wrought through extensive physiological testing. ‘Like all experimental dives’, wrote Barth (2000:14):

> ‘there was an overabundance of tests to perform…if you weren’t being asked to exhale everything you owned into a spirometer, you were reading ink blots or maybe giving a gallon or two of blood (a few CC’s at a time) to vampires lurking outside’.

The final phases (D and E) of Project Genesis involved adding pressure to the chamber to take the men first to 100ft, and then to 200ft. After a successful first experiment (minus helium leakages) that saw the men safely ‘arrive at the surface a day later’ (Barth 2000:27), Barth and two Navy doctors spent two weeks at 200 feet at the Navy Submarine Medical Centre. It was highly experimental and the situation was precarious at times. Barth recalled, for example, that the ‘chamber had one characteristic that we weren’t too crazy about. That was the ability for it to go from surface to depth instantaneously via a very large exhaust system which could activate if power was lost during a dive’ (Barth 2000:33). Whilst a solution was found to prevent the chamber from ‘surfacing us’, it highlighted the risks being taken by those inside. As with Phase D, Barth remembers that this dive:

> ‘was chock-a-block full of dastardly gut wrenching physiological tests. One particular day finds Manning[42] with a fairly large rectal probe inserted where rectal probes are inserted, a temperature probe in his ear (up against his eardrum), a rubber hose shoved down his nose into his stomach with a balloon on the end if it and a fourth wire going into his arm someplace. He was miserable and his disposition showed it’ (Barth 2000:38).

[42] Tiger Manning, also a Sealab (I) diver

After two weeks the men were surfaced at a rate of 12ft per hour based on Bond, Workman, and Mazzone's calculations that a 'human's slowest tissue would require 180 minutes to achieve 50 percent desaturation.' 'In retrospect' Bond (in Barth 2000:40), noted 'we now know that this was a dangerous schedule' and catastrophe only avoided by an additional two hours that were added as decompression was paused to check various valves and settings.

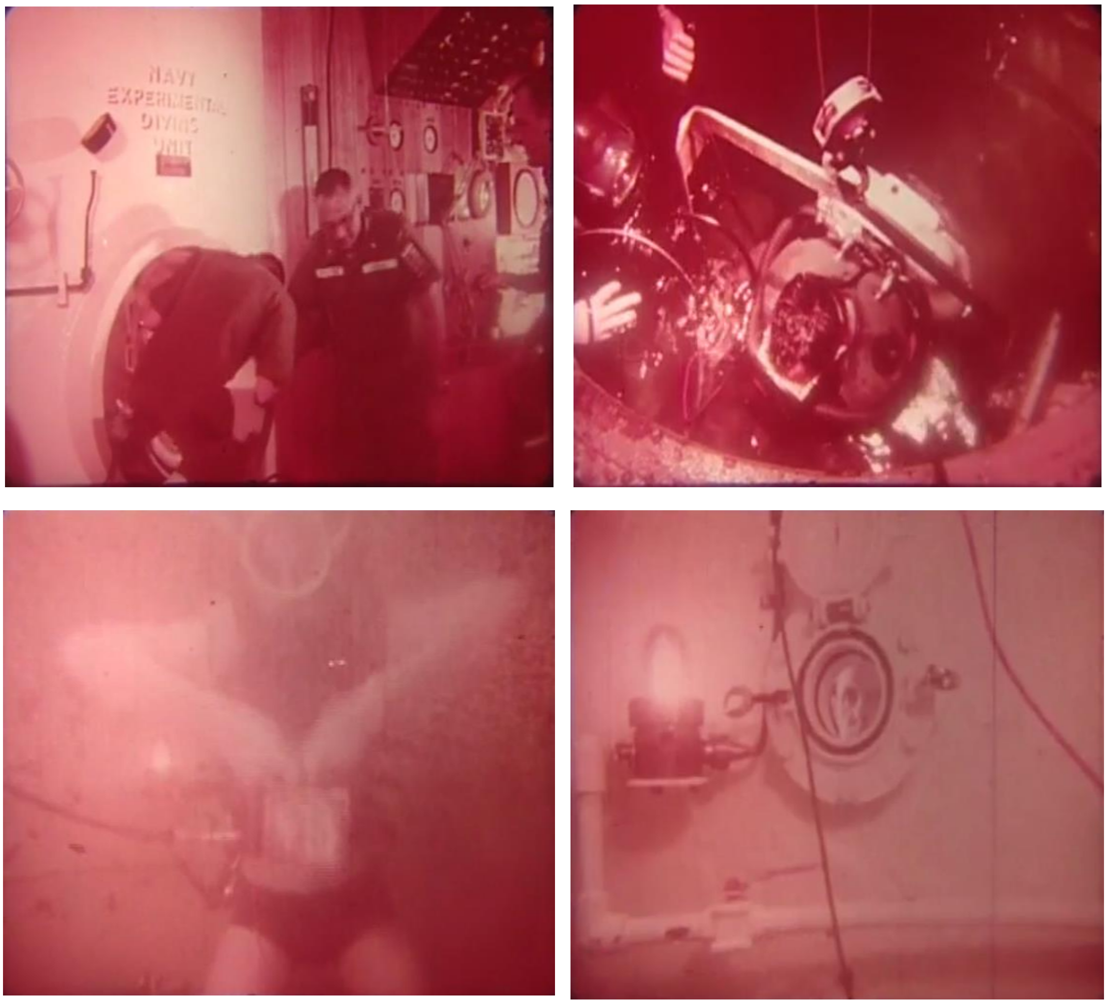


Figure 39: Stills from the public information film 'the Aquanauts' (date unknown). They show divers at the EDU shaking hands with Mazzone upon entering the chamber, conducting tests in the 'wet pot' and the view inside of an outside observer.

Figure 40: Walt Mazzone with aquanauts outside the chamber at the Navy Experimental Diving Unit (date unknown, image courtesy of Kevin Hardy).

After Phase E and the onset of Sealab I, 'the chamber' remained an important space for training, further experiments, and in ascertaining decompression schedules. For example, in preparation for the ill-fated Sealab III, scheduled to take place at 610ft (186m) on the sea floor, twenty three saturation dives to depths of 200 to 850ft were conducted at the US EDU to verify a decompression schedule (Summit and Kulig 1970:1). 71 divers completed 97 dives testing schedules based on two different rates of ascent. In addition to the chamber (see Figure 41) there was also a 'wet pot' – a body of water in which experiments and physiological tests could be conducted. Described as a series of 'sliding dives', the chamber also enabled the diver to make 'excursion dives' to greater depths than the base saturation depth (Summit and Kulig 1970:7). For example, in one instance they were taken from a base depth of 825ft to 1025ft (251m to 312m) for a time of twelve minutes and thirty seconds to simulate a deeper dive from the habitat (Summit and Kulig 1970:9).

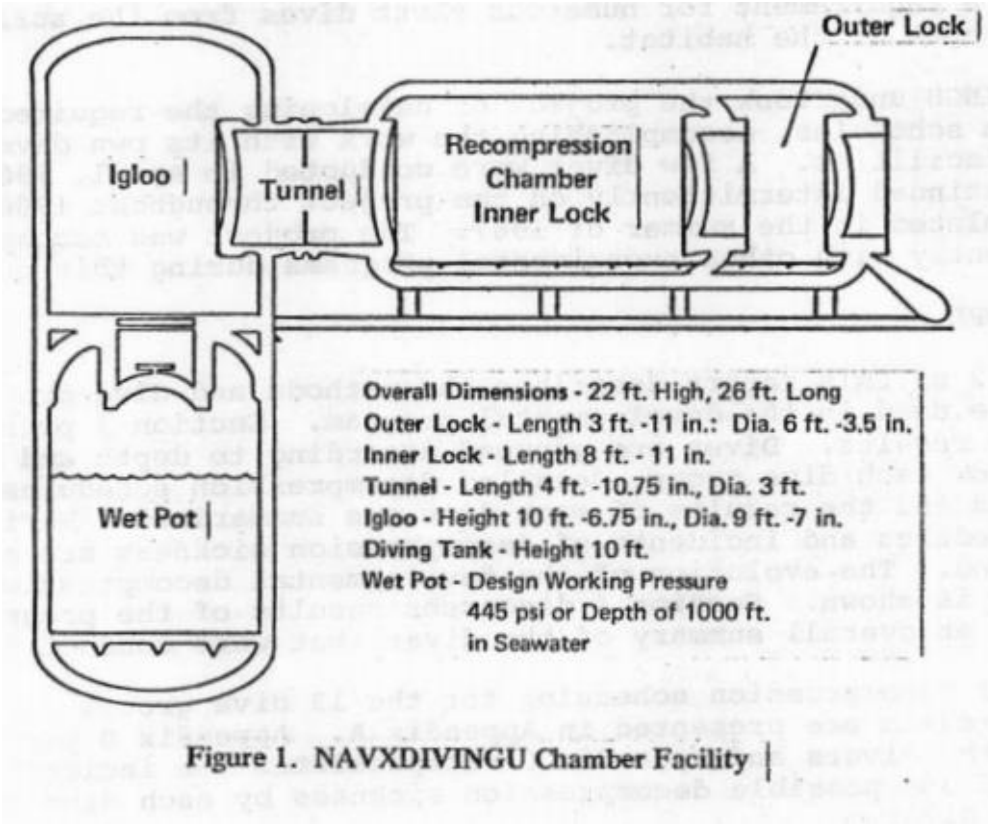


Figure 41: EDU facility for testing Sealab III deco schedules including decompression chamber and wet lock (Summit and Crowley 1970:2).

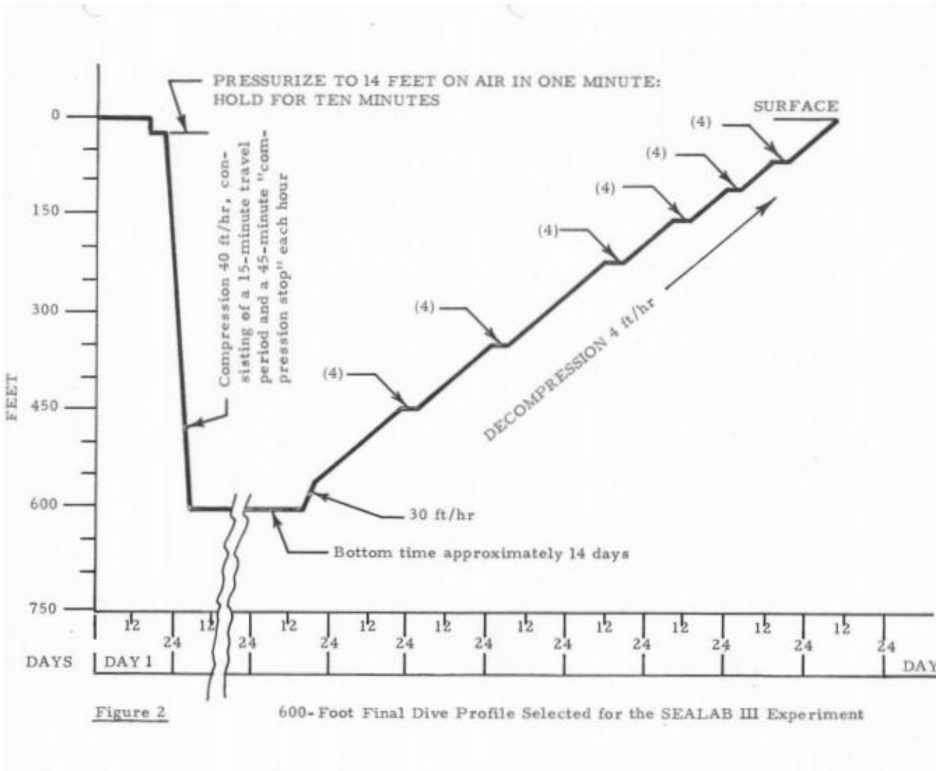


Figure 42: The final dive profile for Sealab III (Summit and Kulig 1970:14)

Whilst a decompression schedule for use from 600ft was developed with an ascent rate of four feet per hour (see Figure 42), 'eight cases of decompression illness occurred during the dive series' (Summit and Kulig 1970:1). Interviews with the participants conducted after the event revealed that they there were most likely more cases but that the divers had been reluctant to report them in fear that it would affect their likelihood of being selected for the program (Summit and Kulig 1970:13). This sat within a wider Navy imperative at the time that sought to 'distinguish the 'bend easy' from the rest of divers' (Kelley et al 1967:27). Whilst there was no evidence to support that 'bend easy' divers existed, there was a feeling from 'the most experienced diving personnel that individual physical differences play an important role in the occurrence of bends' and that some may take a 'hit' more often than others.

The chamber emerges through this case study as an interesting geographical site and one that is productive of a number of geopolitical questions. As the graph in Figure 41 demonstrates, whilst it is a stationary volumetric construct, the relationship between time and pressure takes the body on a pressurised journey through verticals and depths. Within the volume of the chamber, bodies 'fly' and 'dive' as the air is compressed and decompressed. Depth and height within the chamber become atmospheric conditions rather than geographical or geologic states and in doing so, the effects of verticality, depth, and the process of returning to the 'surface' are laid bare and tangibly felt on the body.

The chamber provokes questions pertaining to depth and pressure in a manner reminiscent of the balloon for 'uplift' in Derek McCormack's writing. For McCormack (2009:48), the balloon is a means of sensing the vertical and in rendering 'explicit the materiality of air and atmosphere'. In the chamber, the body takes the place of the balloon and is able to sense and corporeally experience the effects of pressure. In the 40m chamber dive undertaken as part of my methodology, for example, the temperature rose as the air compressed, our voices became comically high pitched and the thick air meant that when a parachute man was dropped, he fell very slowly to the floor. The effects of pressure are made known on the body and whilst visually nothing changed, everyone in the chamber became acutely aware of the different atmospheric conditions. Just as a balloon might be 'enveloped, inflated, and buoyant' (McCormack 2009:39) the body becomes enveloped, compressed, and situated at 'depth'. As it does so, we are reminded of the multiple ways in which 'air' can act forcefully on the body, pushing 'in all directions' (Philippopoulos-Mihalopoulos 2016:152) and accounting for the 'shape of forces as they make a felt difference across and within bodies' (McCormack 2014:3). Finally, we might also consider the role of artificial, engineered, elemental spaces and the role of 'analogue' spaces in learning about how to inhabit extreme conditions where the body is forced to adapt in one way or another to an external, potentially threatening environment. The chamber served here a biome of sorts, creating particular sets of conditions and microclimates that enable the study of certain elemental conditions. This raises the further question, what cannot be replicated? What is it about the elemental that cannot be contained? As was explained during my time spent at the Experimental Diving Unit, studies undertaken in a chamber often deviate from results found in the water confounding physiologists and scientists. In containing and manipulating the elemental, we learn something about its excesses and specificities whilst also finding a series of moments through which to think through the 'nature of 'difference' and the conditions, locations, and methodologies through which a subject is differentiated' (Colls 2012:435) across the geopolitical sphere. Different scales and intensities are free to emerge in the process and we are perhaps better able to critically interrogate what it means to be geopolitically differentiated subjects as a range of 'forces operate differentially across a range of spatial scales to produce contingent and multiple subjectivities ⁄ differences' (Colls 2012:440). In doing so, our engagements with the geopolitical world, and specifically here the geopolitical volume, might become something that we have not yet known (Colls 2012:440 – see Squire 2017).

5.1.1 Decompressing from Sealab

One of the most significant hyperbaric challenges within the project was in transferring the aquanauts from the seafloor to the Deck Decompression Chamber (DCC) aboard the support vessel and then safely decompressing their bodies (see Figure 43 for images of this process during Sealab II). In the DCC, the aquanaut's bodies were continually mapped, monitored, and charted as they were gradually brought to surface pressure by releasing compressed air from the chamber and slowly altering the air mixture. As this took place, the excess gas molecules that had built up in their cells could be safely exhaled. For Scott Carpenter, however, this process was not straightforward. In his diary Bond describes being awoken at night with news that three of the aquanauts (including Carpenter) had knee pain which is a tell-tale sign of the bends. Bond (1965, entry 13 September):

> ‘faced three mildly apprehensive, recently decompressed aquanauts. Each complained of moderate non-escalating pain in the muscles of the lower thigh, aggravated by motion, and non-boring in character. It seemed significant to me that these were three of four characters who spent the last five hours on their bunker bones in the DDC, playing cribbage. In my drowsy state and with a natural aversion to many more hours of treatment watch, I made an immediate diagnosis of game cribbaticus, and ordered a deep sleep for all hands. Turns out I guessed right; by daylight, they were cured of their affliction’.

Three years later however, in his diary of Sealab III, an X-Ray of Scott Carpenter revealed ‘clear cut lesions; within his knees ‘port and starboard, corresponding all too nicely to the areas of which he complained during decompression, almost three years ago -- and which I dismissed as inconsequential muscle disorders.’

The discovery disqualified Carpenter from participation in Sealab III and led Bond (1968, 13 September) to concede that:

> ‘In any event I must be suspect of a misdiagnosis of Scott Carpenter's case, some years past. In retrospect, this is quite possible. Prior to our program of saturation diving, we were well instructed that bends were never bilateral, and never related to muscle pain, as was the case with Scott. More recently, we have seen more of the muscle pains, which may well reflect a bubble block of an end artery within the bone. This question of end arteries may be a critical area of investigation for the future, considering that a similar situation is found in the inner ear, leading to the Organ of Corti; and we have seen no less than eleven cases of deafness during decompression of saturated divers in the past 22 months. This problem must be investigated, but will not be an easy one’.

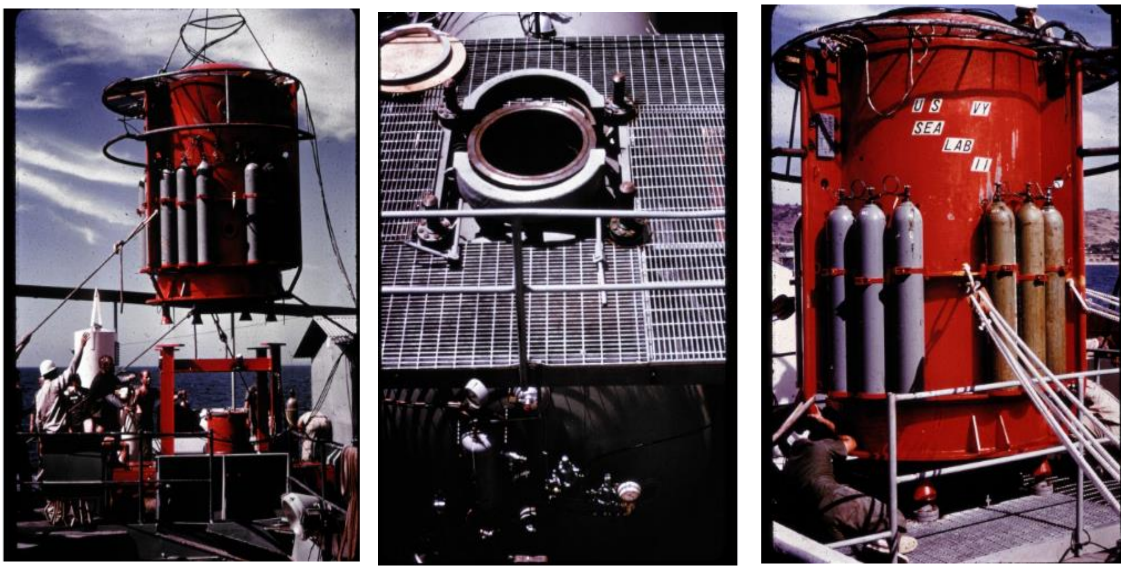


Figure 43: The PTC, with the aquanauts inside, being 'mated' with the Deck Decompression chamber aboard the Berkone. Images courtesy of Kevin Hardy

Figure 44: Walt Mazzone monitors the time and pressure within the DDC. Images courtesy of Kevin Hardy

Contrary to Deloughrey's (2017:33) assertion that 'the sea dissolves phenomenological experience', Carpenter's body and bones here served as an archive of the undersea environment and of the atmosphere he had been breathing. In this case, part of that atmosphere, encapsulated in a bubble, had lodged itself in an artery, preventing the normal circulation of blood and thus resulting in permanent damage. Depth and pressure can leave traces in the body, a relationship not dissimilar to the ways which atmospheres interrelate with archaeological or palaeontological structures that 'capture the vague and diffused temporality that is tied up with the materiality of the past' (Trigg 2016:764). Air in this instance can become something that scars, that is forced out of the cells in a dangerous interaction between changing atmospheres and the body. Despite the tables and temporal calculations (see Figure 42 and 44), air and the spherical bubbles it can form during decompression remained recalcitrant to control. There is, as McCormack (2015:87) and Adey (2015:54) highlight, something forceful about the elemental, and something incalculable in attempts to manage and manipulate an excessive substance that is not easily grasped.

This was reinforced and further elucidated in my own experiences within the hyperbaric chamber, raising methodological questions as it does questions about the nature of 'air' when it is brought into relationship with the body through compression and recompression. Whilst the chamber dive was extremely safe and involved breathing pure oxygen for 9 minutes on route to the 'surface' to help rid the body of compressed air, I emerged from the chamber with the bends. We were required to listen to a presentation for an hour or so on decompression sickness after the dive, in part to complete the course but also to ensure that no one had any adverse effects. During the presentation, I felt a distinct, deep pain in my right knee. Convinced it must have been in my head, I refrained from saying anything. Over the next three days, a skin rash came and went on my torso, I had a headache that I couldn't shift and felt very tired – all of which were tell-tale signs of the bends. Reluctant to be one of the 'bend easy' but with symptoms that would not subside, I sent a sheepish email to the hyperbaric centre and within two hours, I was back inside the chamber for 5 hours to receive treatment for the bends. During this time, I breathed pure oxygen with short 'air breaks' marked in blue in the diagram below. Designed by the US Navy, the dive profile is designed to take your body back to depth, holding it there to allow any excess bubbles to be reabsorbed, before very slowly surfacing to allow the bubbles to be safely exhaled.

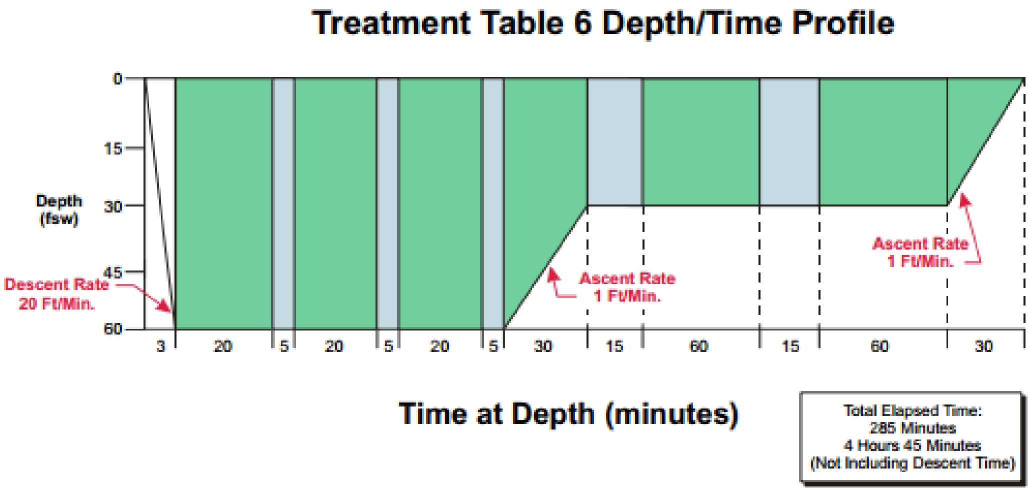


Figure 45: A 5 hour treatment table for the bends used and designed by the US Navy for both recreational and military use (Source https://www.uhms.org/images/DCS-and-AGE-Journal-watch/recompression_therapy_usn_di.pdf)

My body had been inhabited by bubbles – small atmospheric volumes from the dive. Having left it for three days, the bubble(s) began to calcify, thus making them, like Carpenter's, difficult to remove. Treatment requires spending time within a chamber – air had caused the problem but a different kind of air is deployed in treating the adverse effects. Far from being monstrous in scale (Adey 2015), difficult to contain (Philippopoulos-Mihalopoulos 2016:152), and something made 'present' or visible via artistic or aerostatic interventions, air, as demonstrated in Figure 45 was scientifically contained, modified and deployed to purge the body of the micro-volumes of air. Air, according to Philippopoulos-Mihalopoulos (2016:151) is 'heavy' and it 'forcefully pushes in all directions'. The air inside the chamber offers a perfect case study of this as it literally compresses the body. As I was 'enveloped by inhuman dynamics' in the chamber (Tironi and Farias 2015:170), the air became hot and thick, my vocal chords were strained, and as I 'surfaced', new volumes in the form of bubbles emerged from my cells and into my bloodstream. Volumes clearly matter here. In this volume, despite the calculation, precautions, and well-established safety norms, there remained excesses that were incalculable in the collision of my body, the air, and pressure. The 'force of the elemental' (Adey 2015:54) came to imprint itself on my physiology in an unexpected and uncomfortable way and in doing so, demonstrated something of the incalculability of the immersive volume (McCormack 2015:87). There will always be unpredictable, and highly differentiated individual embodied responses[43] to the three dimensional and no amount of mapping, tabling, and calculation (either of the environment or the body) can fully predict of comprehend the intricate and complex relationship that the body forms with an elemental surround

In making my own body a test site, albeit a very different (and somewhat unintentional) and less extreme test site than those involved in Sealab, questions and insights into embodied research are raised. My body emerged as an archive of an elemental atmosphere; in not wanting to appear weak by reporting my symptoms, it became complicit in reproducing the social norms and pressures that I have sought to challenge and withstand in the writing of this thesis; and it became a conduit through which to corporeally understand the 'chamber' as a site of depth, verticality, volume, and measured and excessive air(s). Within cultural geography, Hayden Lorimer's work on herding can further exemplify the insights gained by 'going there' with a 'make do' methodology (Lorimer 2006:497). Lorimer (2006:497) sought to reconstruct the 'entwined biographies of human and animal subjects' through the practice of herding by walking 'a topography of traditional grazing grounds' with past herders (Lorimer 2006:497). In doing so, he argues that he was exposed to 'microgeographies of worldliness' and provided with an opportunity to 'get closer to something of the vital, animate, and lively energies that announce themselves as landscape' (Lorimer 2006:517). Simultaneously, Lorimer's embodied engagement with his subject matter reveals how 'conceptual insights, however modest,' can be generated in making 'something knowable, meaningful, or recoverable' as the researcher makes a 'conscious effort to turn inwards' (2006:515).

This is not to say, however, that researching should become an experience that 'is circumscribed or singular to those who have had the opportunity to inhabit that territory' (Lorimer 2006:516). Instead we might across both cultural and political geography 'envisage

[43] Howkins (2010:517) highlights the importance of recognising how individuals react top external environments, and also in acknowledging that any experiences today will be mediated by new technologies than were present in the past.

a more inclusive sort of intellectual investment: one that accommodates understandings of living in the thick' of the world (516). Geopolitical questions, in this case questions of embodiment, pressures, powers, and air(s), can (as Lorimer argues in relation to cultural geography) be reanimated by intimacy in conduct and encounter' (Lorimer 2006:515). With a geopolitical landscape increasingly attuned to 'embodied experience' and the ways 'geopolitics affects, controls, and constructs bodies as well as how geopolitical constructs are realised through embodied action and experience' (McKinnon 2016:286), taking personal, embodied encounters seriously need not be a troublesome way of writing and researching within political geography.

5.2 'Think Helium!': Monitoring, mixing, and containing

5.2.1 Engineering the right atmosphere

The primary mechanism through which the Navy sought to replicate the results of the chamber experiments was in the maintenance of the air - or atmosphere - within the Sealab habitats. Prior to each Sealab experiment the men received extensive training in atmosphere management. In Figure 46 below, for example, we see aquanauts monitoring air mixtures, refilling cylinders of lithium oxide to 'scrub' the air of carbon dioxide, mixing the air itself using oxygen, helium, and nitrogen, and observing a dial moving slowly clockwise to indicate increasing pressures of air within the chamber.

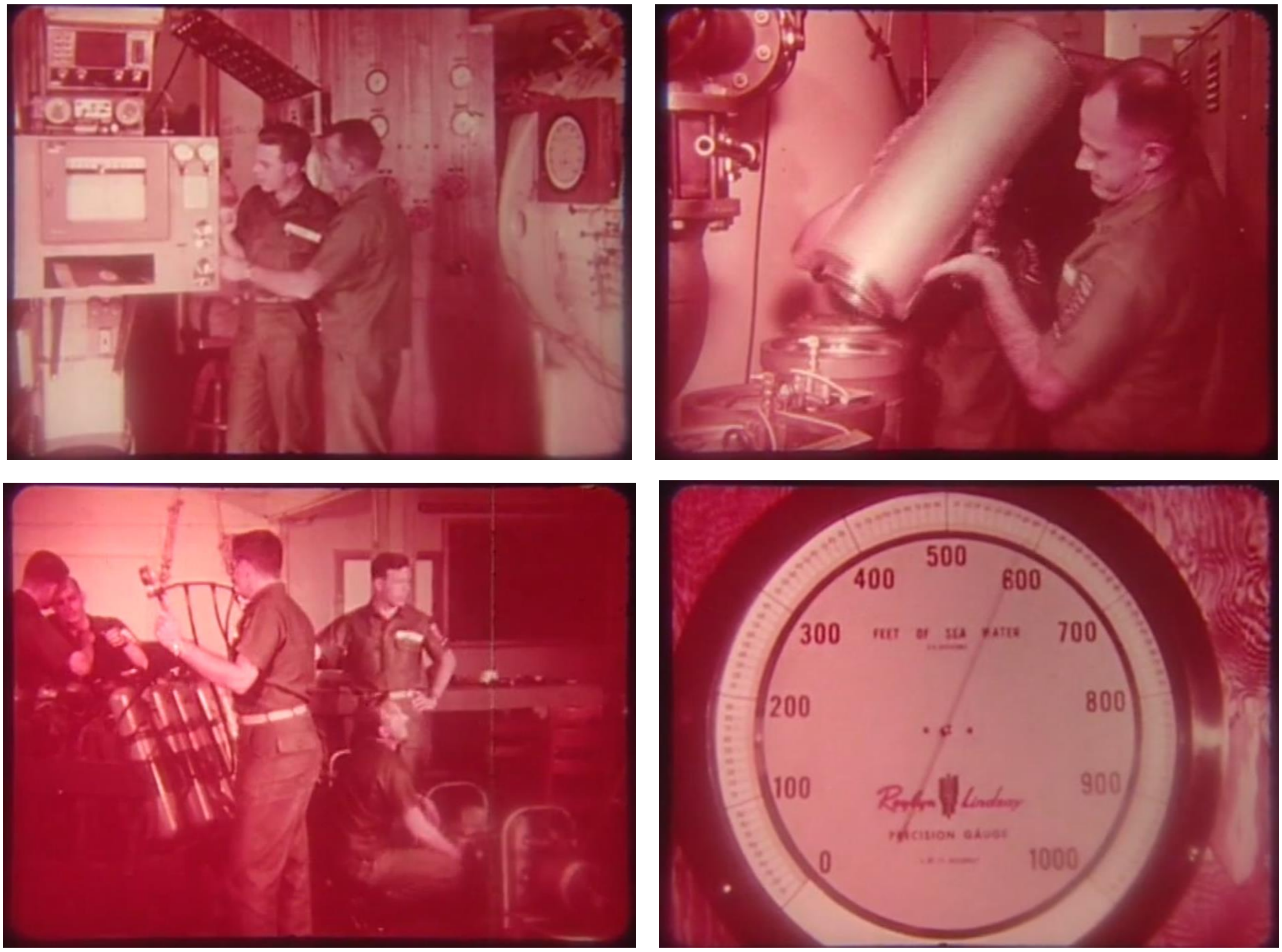


Figure 46: Stills taken from the Navy's public film 'The Aquanauts' showing aquanauts learning how to monitor the atmosphere in a chamber, to load lithium oxide canisters, mix cylinders, and monitor pressure in the habitat.

Whilst those topside were instrumental in maintaining the atmosphere from the surface, the aquanauts also ensured that the habitat was filled a breathable, liveable atmosphere. In Sealab I the pressure stood at approximately 6.4 atmospheres (sea level is 1 atmosphere). As aquanaut Thompson highlighted, that meant they only needed to breathe '1/6.4 as much oxygen percent wise.' The air was heavily compressed providing 'the same number of oxygen molecules for each breath of atmosphere' as on land, and as Thompson stated 'that is all our bodies desire' (1966, entry 26 July 1964). In Sealab II, the added depth increased the pressure to 7.2 atmospheres which required a 'synthetic atmospheric mix' of 80%

Helium, 16 % Nitrogen and only 4% Oxygen[44] (Physiological Evaluation 1965:102) – a cocktail playfully described by Bond (in Barth 2000:17) as 'ocean air' but more commonly known now as Trimix. As highlighted in the previous section, this differs markedly from the air breathed on land which would have killed the men had it been breathed at 62m on the sea floor. As engineer Bill Culpepper explained in an interview (8 February 2016, Mr Culpepper's home), every detail of the interior of the habitat had to be carefully considered as any toxicity resulting from paint and other chemicals common on land could contaminate the atmosphere under pressure. Whilst on the seafloor, the atmosphere in the habitat, much like the body in the chamber, was closely monitored with subtle changes made through the 'umbilical chords' that linked the sphere of the volume of the habitat with the world above. On an hourly basis a number of 'things were to be recorded: Internal pressure of the habitat, partial pressure of carbon dioxide, oxygen, helium, and nitrogen; temperature; humidity; cubic feet of oxygen added; and operation time of carbon dioxide scrubbers' (Physiological Evaluation 1965:20). At least twice a day samples of the Sealab atmosphere were 'obtained in evacuated steel cylinders for analysis topside' (Physiological Evaluation 1965:21).

The atmosphere was held in a fine balance, the sea itself playing in a role in engineering the amount of particular gases needed:

> 'Monitoring of the gas composition revealed that the nitrogen percentage steadily decreased, probably due to solution in the sea water. It was found possible to use compressed air for makeup of oxygen, since the nitrogen seemed to disappear about four times as fast as oxygen. No appreciable loss of helium was noted during the course of the operation.'

George Bond (1964, entry 21 July) also commented on the phenomenon:

> 'Of more interest, perhaps, is the fact that the absorptive properties of sea water can be made to work for the underwater architect, to heat or cool his house, and to provide and purify his atmosphere.'

[44] Air on land consists of 78% nitrogen, 21% oxygen, and a small mixture of other gases.

The sea was absorbing the nitrogen, enabling the use of 'regular additions of compressed air' to meet the requirements of the aquanauts. As a result, 'desired oxygen levels were attained, and the excess nitrogen was soon dissolved in sea water, and thus eliminated, thereby reducing stored-oxygen requirements and simplifying atmosphere control (O'Neal et al 1965:35, see also Thompson 1966, entry 21 July 1964). This 'ambient sea-water scrubbing' mechanism was an unexpected find that 'might be incorporated into the design of future undersea habitats'.. Seawater came to function here as an architectural or infrastructural aid. Much like 'Project Loon[45]' analysed by McCormack (2016), infrastructural value was gained through the intermingling of elements only in this instance, rather than forming part of a 'wider process of capitalistic value generation', 'the dynamics of elemental powers latent in the environment' were territorialised to create a liveable, breathable space (McCormack 2016:13).

In addition to 'scrubbing' the atmosphere, the interface between atmosphere and sea caused problems. As Helmreich (1967b:15) noted, 'the fact that the capsule was open to the water made the humidity inside the capsule uncomfortably high'. With humidity levels ranging from 60-80% (Physiological Evaluation 1965:102, Laverne and Long 1966:1), most aquanauts suffered from ear infections and skin rashes (or 'diaper rash' according to the *Atlanta Journal,* 15 September 1965). In a bid to better understand these 'nagging physical complaints' (Miller et al 1967:255), bacteriological studies were conducted each day with samples taken from the trunk, access area, laboratory space, living quarters, in addition to daily cultures from the aquanauts' ears, nose, and throat (Physiological Evaluation 1965:27). Within this strange engineered atmosphere, the bodies of the men became petri dishes, their ears, noses, and throats becoming sites from which to explore the microscopic, single celled microbes inhabiting and thriving in this 'alien realm'.

We might also think here about how the artificial air produced effects that challenge ideals of Cold War heroism and the hard masculine body. We see in Enloe's work (1993:12) how the archetypal masculinised adult was synonymous with military service. Dean's (2001) work also points to bodies that are muscular, hardened through physical activity and stress. Certain bodily deformities, such as scarring, serve to emphasise this and reinforce the ideal

[45] A project involving a network of balloons at the edge of space to provide internet coverage

of man who has ‘come out the other side’ – the popular figure of Rambo would be a prime example (Enloe 1993). Through the likes of James Bond, we also see a more sanitised Cold War hero, slick and unscarred whether above or beneath the water. A term associated with the creeping malign of communism, popular images of heroic Cold War bodies were never ‘infected’ yet this is precisely what we see in the bodies of the Sealab aquanauts. Rashes, bacterial problems, ear infections, were all common place because of the humid atmosphere. As a Scripps oceanographer who has completed a number of saturation dives explained to me during an interview (19 April 2016, Scripps Institute of Oceanography) you can never get your body dry, pussy rashes cover the body as the water interacts with the skin, and only upon surfacing do you realise quite how bad people smell. Whilst, as chapter 4, demonstrates, the aquanauts were framed as brave Cold War heroes who put their bodies on the line for ‘mankind’, pre-cognitive physiological reactions taking place between skin, body, air, and water also serve to illustrate that even the most heroic, hardened man can still be infected.

As well as effecting the pre-cognitive physiology of the aquanauts, the atmosphere also had a role in creating a sense of well-being as the men became hyper-attuned to the atmosphere within which they were encapsulated. One afternoon in Sealab II, for example, Thompson reported that:

> ‘The atmosphere this afternoon does not seem as good. Andy and Bob Barth are complaining that they do not seem to be able to get an adequate breath. Our carbon dioxide meter registers 0.4%, topside says 0.5% and we have recently run the carbon dioxide scrubber…after replacing the lithium oxide[46] canisters, carbon dioxide soon dropped to 0.1%...I added 300 more litres of oxygen and all seems well with our[47] underwater world now’ (Thompson 1966, entry 26 July 1964).

‘It was noted’ wrote O’Neal et al. (1965:35) that:

> ‘when oxygen levels were held at four percent, or in excess, the aquanauts reported an improved sense of well-being, whereas when levels of three to three and one-half percent obtained, this was not the case. For this reason, and although

[46] Used to remove carbon dioxide from atmospheres
[47] Note the use of ‘our’ expressing ownership.

> electrocardiographs records showed no hypoxia of cardiac muscle at the lower levels, oxygen levels in Sealab I were maintained above four percent (26 percent effective), for most of the exposure. Obviously, this observation must be checked out in the laboratory; but it seems probable that the increased atmospheric density (approximately 1.6 times greater than sea-level air) may sufficiently impair pulmonary ventilation to require added molecular concentration of oxygen.'

Similarly, in Sealab II, Bond (1965, entry 23 September) reflected on complaints that the 'atmosphere just doesn't seem right' with a high number of headaches reported from the aquanauts below:

> 'We are using the most sophisticated techniques available to assure minimal toxic contamination of the breathing mixture; and out daily physiological program looks at nearly one hundred parameters of body function and state of health. Neither of these watchdog systems have uncovered the slightest cause for alarm so we are force to assign a psychogenic factor to the complaint, while maintain a steady vigilance.'

The Aquanauts began, much to the displeasure of those topside, to exert some control over their atmosphere. 'Oxygen bleed-ins' were 'made without notification' and unwanted, 'gratuitous suggestions made on methods of atmosphere control' were delivered to those on the surface (O'Neal et al 1965:47).

Sealab I and II were experiments to establish manned operations on the sea floor, to make man a 'free agent' in the hostile, deadly surround of water. Yet, as has been highlighted throughout this chapter, this was as much an engagement with air – or air(s) – as it was about water. The two, at time worked in conjunction with one another, the sea serving to reduce nitrogen levels, a serendipitous result that meant less artificial air had to be pumped into the atmosphere. The scientists collaborated with the earth's natural processes and molecular specificities to reduce man-made interventions in the creation of an artificial atmosphere (see Yusoff 2013:2800). Moreover, the process of managing the molecular, of curating an air mixture, was crucial in the making of this geopolitical space. In this example, far from being an excessive elemental substance (see Adey 2015), air emerges as a dynamic object to be engineered. There is an abundance of literature dealing with 'air' as a substance that can infused with other elements and mixtures (such as tear gas) to meet certain geopolitical or securitising ends (Feigenbaum and Kannigeser 2015:81), and which emphasises that 'air' is not a singular construction in how it is experienced. As Nieuwenhuis (2015:91) highlights air is 'infused with memories, chemicals and other things of the past'. Moreover, he emphasises that we do not stay passively 'within one air. We are constantly and intermittently thrown into different, new and old airs. All these different airs transcend complicated and diverse geographies of power' (2015:91).

Yet the 'air' breathed in Sealab was different in a very literal sense. In had been engineered, it became malleable, something that could be mixed, 'scrubbed', contained, reduced, increased. The experiment rested upon the appropriation of different elemental, gaseous substances coming together as the pressures of the sea changed the volumetric construction of air forcing the particles closer together at pressure. Working at the edge of 'political possibility' (Yusoff 2013:2806), this malleability, and the ability of the body to breathe and function on this somewhat alien 'air' enabled the territorialising project on the sea-floor to be realised. In other words, mastering the volume of undersea territory and terrain required the creation of an airy habitat – a secondary territory and a micro territorial intervention in and of itself. The 'volume' being territorialised in Sealab was not singular and perhaps we might consider territory more broadly as a series of intersecting, relational, and overlapping volumes. Rather than understand space as either surface or volume, it would be more productive to think through the different and complex *volumes* at play. This would not only enable richer and more nuanced accounts of territory and territorialising practices but would offer a way out 'of the maze of dualisms' (Haraway 1999:316) that has arguably come to characterise writing on surfaces and volume.

Similarly, we might understand 'air' as a more plural phenomenon. The 'air' breathed in Sealab differs from the conventional gaseous surround of the earth's atmosphere yet in taking seriously the geochemical engineering of air – where the air itself is colonised and altered – novel insights into the nature of territorialising practices and the exploration and exploitation of new frontiers may be constructed. As Feigenbaum and Kannigeser (2015:81) assert,

> ‘Accepting air, as an elemental substance that always exceeds or troubles attempts to measure and manipulate it does not mean we should stop short of developing stronger critiques of how atmospheres are designed and produced’.

Exploring ‘atmosphere’ in its literal geophysical sense, and not merely as a means of building on the literatures around affect to explore ‘atmosphere as feeling’ (Jones and Jam 2016:318) would be a productive means through which to extend this scholarship.

5.2.2 ‘A non-relational coolness’?

As Trigg (2016:765) highlights atmospheres can be acted upon as well as ‘being that which acts upon us (as when we enter an insufferable atmosphere and experience it as getting under our skin)’. Whilst Trigg is again referring to atmospheres in relation to the feeling and the concept of *affect*, the same is also true with physical atmospheres and none more so than the Sealab atmosphere composed primarily of helium. McCormack (2014:7) describes helium as ‘that least affective of all the elements: inert, colourless, odourless, tasteless’, it is a noble gas possessing a ‘kind of aloof, non-relational coolness’ (McCormack 2016:6). Reflecting on the Danish film *Helium* (2014) he also describes how helium is a medium through which earth and civilisation can be re-envisioned:

> ‘the air is much cleaner than it is on earth. In that world, little pieces of ground float in the sky, being held aloft by balloons to which they are tethered…And the balloons that hold up the little pieces of territory that are suspended in the clean air of the world to which the boy travels are also, presumably, filled with helium’ (McCormack 2015:85).

For McCormack helium is associated with uplift literally and affectively. In Sealab however, helium allowed the territorial, frontiering, homesteading imaginary to sink beneath the water. In doing so, Sealab demonstrates that whilst maintaining its inert elemental structure, far from being the ‘least affective of all the elements’, (McCormack 2014:611) helium was highly affective, mediating and fundamentally shaping the experiences of the aquanauts on the seafloor.

One area of convergence between Sealab and writing on territories in the sky is helium's recalcitrant nature. As McCormack (2015:86) highlights, it is not a 'cooperative element'; it has a 'radical, gravity-defying levity', a predisposition to 'leave the earth'. 'Left to its own devices, helium escapes' (McCormack 2015:86). This is due to its size and structure - as the second least reactive element it is inert and compared to nitrogen or oxygen has a small atomic mass giving it its 'lightness' and capacity to diffuse through solids at a rate three times that of normal air. As George Bond (1968, entry 28 September) described during Sealab III:

> 'Helium is an elusive and pervasive gas; it will leak in and out of any enclosed cavity. Currently, the best state of the engineering art calls for metal-to-metal seals, with a minimum use of gaskets. Predictably, the helium skipped blithely past the metal interfaces at all points tested…Throughout the past decade, as I have on occasion spoken to industrial engineers, my guideline has been simple: Think Helium! To date, almost no one has heeded this prosaic advice from a country doctor. In consequence, our program has been hurt, delayed, and nearly wiped out. Helium is a rare, costly, and highly unpredictable gas, whether it be found in the human body or in a piece of functional hardware. It deserves a respect which is rarely accorded.'

In Sealab II this caused some practical problems. Mazzone et al. (1967:226), for example, describe how taking accurate measurements was difficult as the helium diffused in an out of sampling syringes. The CCTV cameras, which worked perfectly on the surface malfunctioned. The cameras were taken back to the surface for repair but found to be in working order. When they malfunctioned once more, the engineers realised that the helium was leaking into the protective cases (Bill Culpepper, 8 February 2016, Mr Culpepper's home). The cameras were subsequently placed outside of the habitat in the water and pointed through the portholes to avoid interaction with helium. In Sealab III, the 'lightness' of helium had catastrophic consequences. Whilst on the seafloor at 185m - three times the depth of previous experiments – the atmosphere within the habitat began to leak at an unsustainable rate. Large 'quantities of gas had to be pumped down' to the habitat to keep it dry but by 0900 hours it was losing 9000 cubic feet of gas per hour and increasing (Bond 1969, entry 19 February). Bob Barth and Berry Cannon were sent down to plug the leaks from the inside. The men made two attempts and were unable to gain access to the habitat, the pressure differential meaning that the hatch could not be opened on the outside – ‘vainly Bob sought to force the hatch open, but it was quite impossible against that pressure’ (Bond 1969, entry 19 February). Exposed to ‘thermal stress’ and ‘fast running out of gas’ to sustain the habitat the men tried a second time, but as Bond (1969, entry 19 February) recalls:

> ‘Within seconds we saw a tremendous boil of silt on the TV screen, and now fear became an agony of certainty. No trained diver moves so fast as to stir this type of sediment, unless there is real trouble’.

The attempt proved catastrophic. The hatch remained resolutely shut, the habitat continued to leak, and Berry Cannon died of carbon dioxide poisoning due to a lack of carbon dioxide scrubber in his diving rig (see people and projects).

In addition to affecting infrastructure, breathing and living in a substance with such a small atomic structure had multiple embodied consequences. In the long term, being a saturation diver in the Navy (or elsewhere) can result in permanent damage. When I asked one former Navy saturation diver (anonymous, 9 February 2016) if he, or his colleagues, had suffered any long term side effects of breathing helium during operations he laughed and commented ‘yes, helium gets everywhere, it gets in your bones, nearly all of my diving friends are disabled’.

As with Scott Carpenter in the previous section, this can be due to incomplete decompression, where small blood vessels in the bones become blocked by air bubbles. Helium, is by its very nature, harder to remove from the body than nitrogen. It dissolves more rapidly into the body’s tissues under pressure (a process known as on-gassing) and requires a longer decompression time because the gas has to be removed from the tissues more slowly than nitrogen does to reduce the rate of bubble formation, which could cause "the bends"’ (Naval Research Review 1965:4, see Figures 47 and 48). As Bond (1969, entry 9 February) described:

‘tissues with little or no blood supply…may require as much as five hours to eliminate only one half their total gas load. These are the "slow" tissues which plague us so in saturation diving decompression. The millions of molecules of inert gas absorbed in these areas of the human body can only reach the vascular transport system by the slow process of diffusion; and, once arrived at the bloodstream interface, they may well find the venous highways overloaded with gas traffic emerging from the faster tissues, which respond more rapidly to a changing differential of intracellular gas tensions. In brief, I am presently of the conviction that, in saturation diving, we must concentrate on the slowest possible tissues’.

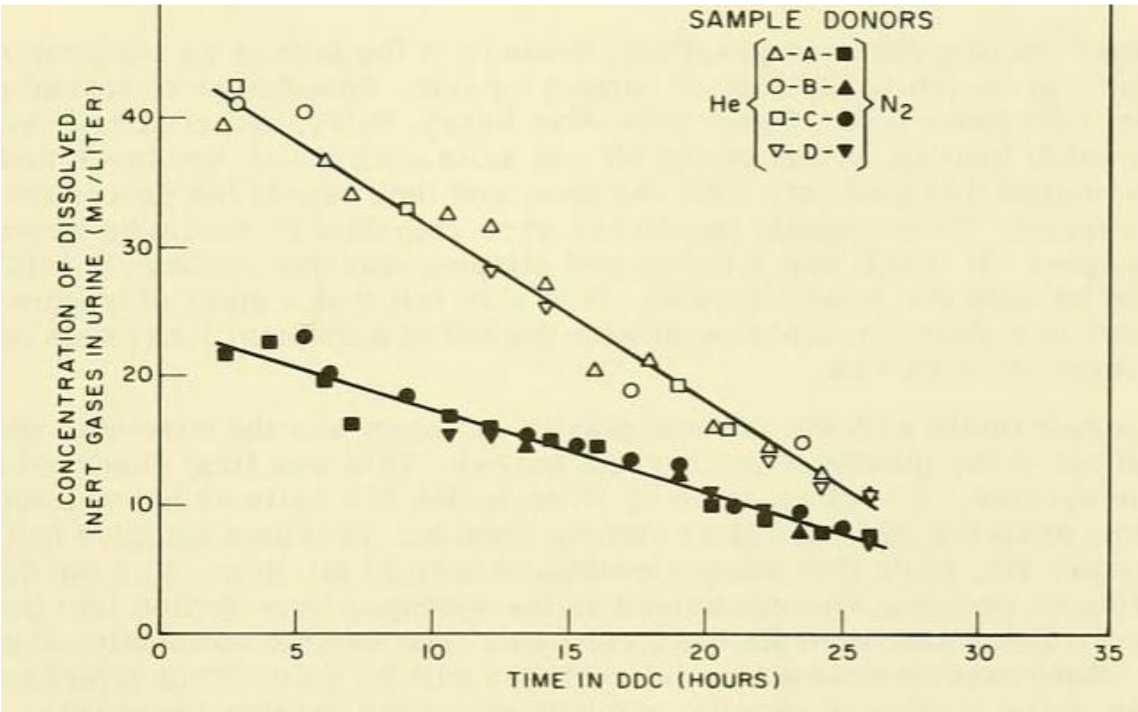


Figure 47: Mazzone et al 1967:226 – ridding body of nitrogen and helium during decompression. Sealab II Team 3, inert gas elimination during decompression

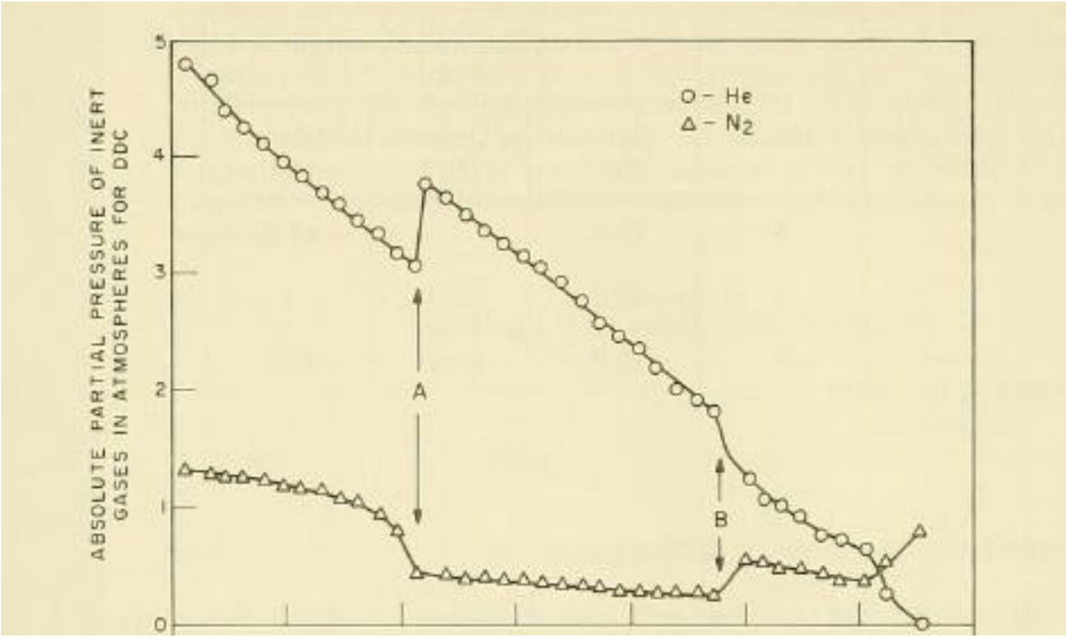


Figure 48: Mazzone et al 1967:224 Figure caption. Sealab II, Team 2 inert-gas elimination during decompression; A –helium purge reducing nitrogen concentration and increasing helium concentration

Far from being in-affective and passive, helium has the capacity to imbricate itself deeply within the structures of the body. As a result, Mazzone and his team had to carefully and scientifically ascertain how the Sealab atmosphere would leave the body and become undissolved in blood during decompression by taking a blood sample every three hours during the decompression process (Mazzone et al. 1967).

In a helium surround, we also see how breathing a predominantly helium based atmosphere changed the men's responses to the more natural breathing substance of nitrogen. Originally in Sealab I 'a compressed air compartment was included in the design' to provide a space free from helium and isolation from high voltage transformers. The compartment was 'charged with compressed air at the equivalent depth of 186ft of sea water…was occupied on frequent occasions by the aquanauts who came directly from the helium-oxygen atmosphere of the living compartment' which consisted of a mixture of nitrogen and oxygen (O'Neal et al 1965:35). It quickly became apparent that transferring from one to the other resulted in 'an immediate and dangerous level of nitrogen narcosis with 'very uncomfortable' symptoms including headaches and nausea (O'Neal et al

1965:21). ‘Briefly the effect of a visit to the compressed air space was equivalent in narcotic impact to a 350-ft exposure in an air filling recompression chamber.’ Bond (1964, entry 21 July) described how the aquanauts became ‘seriously narcotised upon entering the air space’ after 24 hours in the habitat. ‘So much was this a threat that it became necessary to dilute the air in this space equally with helium, and to do likewise with the air in the open circuit SCUBA bottles used by the aquanauts’. O’Neal et al. (1965:18) reported that helium was ‘bled’ into the space with Bond concluding that ‘once the body is essentially purged of its nitrogen content’ then the ‘narcotic effect…is markedly increased.’

A helium atmosphere interacted with the bodies of the aquanauts in other ways, some of which were unexpected. In addition to generalised headaches, two men in Sealab II experienced a sense of euphoria for the first few days, sleep problems were common place (Laverne and Long 1966:3) and Bob Barth (in Thompson 1966, entry 24 July 1964) reported that he dreamed more than normal. Joint pains were reported, whilst Thompson (1966, entry 22 July 1964) described feeling ‘somewhat light-headed some of the time. I believe occasionally that I do not write or think very clearly’.

One observation ‘possibly of considerable importance’ was the fact that ‘subjects of Sealab I, from the moment of their entry into the pressurized habitat, moved at about half speed’ with a ‘clearly defined slowing of all physiological functions under conditions of an undersea environment’ (O’Neal et al 1965:34):

> ‘The slow motion activity, which persisted to a degree for four days in all cases, requires explanation. Psychologically, the subjects might be reacting as animals to a strange but undefined environmental hazard. In such a situation, the animal moves with extreme caution. Physiologically, this effect may represent the impact of a completely new environment on the organism, with general slowing of all metabolic functions such as were observed. Finally, however, the reaction may represent no more than an observation of the fact that, working outside in a medium almost 800 times denser than air, the slowest approach is the most successful. The answer, obviously, awaits further laboratory and field investigation. Man cannot be expected to perform with efficiency such as might obtain in a sea-level, dry-land situation’ (O’Neal et al 1965:37).

Bond (1964, entry 21 July) also described the phenomenon in relation to previous observations in the chamber:

> 'Meanwhile, the subjects live, work, and swim, all at a leisurely pace, which will quicken tomorrow, and again next day, until normal activity is attained on about the fifth day on bottom. Such has been our experience in all past chamber experiments; and such was Cousteau's experience with his two undersea experiments. Perhaps it is a natural conservation of body energy, pending an unexpected environmental emergency, or awaiting the process of acclimatization to a new environment of multiple stresses. Characteristically, most mammals move slowly in face of a potential but undefined threat; and thus it is with man in an unnatural surround'

In Sealab II, a 'slowing of mental processes' was reported (Physiological Evaluation 1965:99). The effects were transient in nature, as Thompson illustrated in his diary:

> 'At 1735 today, the end of our fifth 24-hour day in SL, we note we have all become quite adapted. Much of our initial fatigue has disappeared and we feel much more active in general. The atmosphere seems quite good today also' (Thompson 1966, 25 July 1964)

Notwithstanding this ability to accommodate the alien air, the 'high pressures and exotic gas mixes of undersea living' (Physiological Evaluation 1965:99) was something the aquanauts were clearly preoccupied with. Ever conscious of their artificial elemental envelope, the quality of the air came to affect both body and mind. We might also reflect on the role of temporality in this territorial endeavour. Chapter 4 reflected on the shifting and collapsing temporalities of the project as sites were located and imaginaries projected back and forth through time and we see here the territorial environment come to temporally effect the body. It literally slowed the men down, their body movements, work, and actions went at 'half speed' as the body sought to adjust to a new environmental surround. The temporalities of territory making are extremely significant, suggesting that territory is not only a geopolitical, social, cultural and economic construct but a temporal one too.

Nieuwenhuis (2015:92) describes air as ‘the thin barrier deferring death’ and in Sealab, due to the nature of helium, the air was geochemically thinner than air on land. As a result, living in a helium surround resulted in rapid heat loss from the body due its heat transfer characteristics (Helmreich 1967b, Naval Research Review 1965:4). This was exacerbated when the aquanauts were in the water, a substance which also draws heat away from the body. One aquanaut in Sealab II, for example, described how the cold made him ‘become impatient and more ready to cut corners or leave jobs uncompleted or not attempted, in order to get back to the warmth of the habitat’ (Bowen et al 1966:35). Yet returning to the habitat did not always abate the problem:

> ‘When a thoroughly chilled and shivering aquanaut returned to the habitat, a hot shower soon restored a sense of thermal well-being. Following the shower, the aquanaut would retire to his bunk and cover himself with an electric blanket. Shortly he would commence active sweating accompanied by violent shivering. This ‘paradoxical shivering’ has been cited by Beckman et al (1966) as evidence of confusion in the thermoregulatory centre. In such cases, restoration of normal core temperature may be defeated by the vasodilation caused by the application of peripheral heat’ (Physiological Evaluation 1965:37-38)

One diver explained the experience in his own terms:

> ‘The coldness of the water added to the experience also. The cold creeped up on you very fast. I won’t say it got unbearable – it wouldn’t be to the point that if an emergency rose you couldn’t have stayed there. Now if somebody said ‘ok, this, it’s important, you can stay for 5 minutes’ you could have did it. But you had that feeling of wanting to get back in there…I got the shakes mostly when I came into the laboratory. If I was working out there I wasn’t shaking that bad. I made some 106 minute swims and I wasn’t shaking that bad out there where, like I said, where it was unbearable. But once you got up in the entry-way, like if say you come up and sat down for a few minutes while the pots were being loaded, you’d get started shaking uncontrollably. You weren’t that cold, I mean you weren’t that uncomfortable, but you just couldn’t stop shaking’ (Helmreich 1967b:19-20).

Whilst a newspaper reported that:

He (Carpenter) said 'when we first went down, we would swim 25 or 30 minutes, then shiver so badly it was unbelievable it hurt pretty bad lots of times. Water temperatures are cold – 50 degrees doesn't mean much to people who are not divers. You have to swim in it to realise just how cold.'…he told of waking up at night, 'feeling cold but perspiring, not knowing whether we were hot or cold' (Hillinger 1965, *Los Angeles Times*)

Whilst shivering, for the first four days the aquanaut's had slightly elevated body temperatures. Whilst the reason for this was 'immediately apparent', it seemed 'likely that the higher thermal conductivity of helium is implicated as this would act to increase heat loss. To compensate for the added loss, more heat would be produced, thus causing a new thermoregulatory centre setting. At high rates of heat loss this centre is highly responsive to changes in heat balance' (Physiological Evaluation 1965:37). A later study of the Navy's first 1000 foot dive demonstrated that heat loss through a diver's respiratory tract alone can be significant enough to be dangerous even when the skin is warm (Carter 1977:27). Various technologies were design to try and combat this, from electrically heated wetsuits to the development of a composite 'micro-balloon material' thought to be have more efficient insulating properties as air became trapped in the small spherical volumes (Beckman and Frey 1967:280). As the table below (Figure 49) elements, certain gases such as carbon dioxide would have proved very useful but with the need for stringent control of gases in the habitat and gas cylinders it could not be utilised.

Table 32
THERMAL CONDUCTIVITY k OF GASES
[cal / (sec-cm^2) (°C/cm)]
(Approximate Values at Ordinary Temperatures and 1 ATMA)

Gas	$k \times 10^5$	(k_{gas}/k_{air})
Air (0°C)	5.68	1.
Carbon Dioxide (0°C)	3.07	0.540
Helium (0°C)	33.9	5.97
Hydrogen (0°C)	32.7	5.76
Nitrogen (7°-8°C)	5.24	0.922
Oxygen (7°-8°C)	5.63	0.990

Figure 49: The thermal conductivity of different gases with helium the highest (Beckman and Frey 1967:279).

This being said, the diver's bodies showed adaptation, or 'cold tolerance', with prolonged exposure with most adapting after 2-3 days (Physiological Evaluation 1965:96, Miller et al 1967:267). The Cold was a problem that according to Miller et al. (1967:267) could be overcome 'in the initial selection of divers', the bodies of whom showed large 'individual differences in cold tolerance' - a comment again suggestive of the fact that certain bodies are suited to undersea life over others. Perhaps more importantly within the wider context of Sealab cold tolerance demonstrated the ability of the human body to adapt (O'Neal et al 1965:34).

The aquanauts' voices were also subject to change and adaptation. Sound travels much faster in a helium surround than in air - the molecules are much lighter and smaller, they oscillate faster and therefore a sound wave travels twice as fast through a vocal tract full of helium than they would through nitrogen and oxygen (see US Navy, Aquanauts, no date). The result was a 'Donald Duck effect' (Naval Research Review 1965:4), otherwise known as 'helium speech'. Whilst those unfamiliar with helium initially found the situation 'utterly hilarious' (Miller et al 1967:266) it posed a number of problems. Not only was it a source of irritation but it made communicating complex instructions a challenge as speech was, at times, intelligible. The distorted sounds made localising sounds in the habitat difficult – a problem compounded by the enclosing cylindrical shape of the structure which made sound reverberate. Some of the aquanauts reported that 'their voices did not seem to carry after 2-3 feet' (Miller et al 1967:266). The majority of the men adapted (aside from one who reported that he never got used to the change) by lowering their voices to the extent that they could understand each other. However, when the next teams arrived having only just been exposed to the habitat's air, communication again became a problem, as George Bond (1965, entry 31 August) after visiting:

> 'I was inside SEALAB II. The handshakes and grins were as vigorous and warm as if we had been apart for months; but each face wore a puzzled look as we began to talk. My Aquanauts, down about four days now, had learned to accommodate their speech to the helium atmosphere; but Walt and I, freshly arrived, could not be readily understood. No matter; we were among friends.'

Whilst the aquanauts had learned to lower their voices slightly to accommodate one another, a number of problems arose for those topside. For the psychological team, collecting data on a number of variables connected with verbal communications was 'doomed' by the helium atmosphere (Helmreich 1967b:28). Whilst general comprehension of speech was possible, in part due to the use of 'helium descramblers designed to lower the octaves of their voice and make speech intelligible, (O'Neal et al 1965:19) the 'localisation of speech and identification of speakers proved nearly impossible'. As a result, 'attempts at systematic observation were abandoned' (Helmreich 1967b:28).

The example of helium raises interesting question for our handling of 'air' and the 'elemental' within geography. As Philippopoulos-Mihalopoulos (2016:152) asserts, studying 'air' is challenging:

> 'As a rule, air is boundless. It is not easily contained for either scientific or theoretical scrutiny. Unlike solids or liquids, air partitioning requires significant technological investment both for the initial separation and importantly for its maintenance. On the other hand, air is hard to perceive… The air must be moved, coloured or lit in order to become phenomenologically vibrant within the sensorially controlled circle of one's perception.'

Yet, as is illustrated above, the study of a breathable atmosphere composed predominantly of helium challenges this assumption. Through a 'technical process of experimental spherification' (McCormack 2014:7), the air enclosed within the habitat was incredibly affective at it passed through the aquanauts' vocal tract, altered the way both sound and heat travel through the air, and physically slowed down their movements as they acclimatised to this 'exotic' surround. McCormack's accounts of helium, set within the earth's airy atmosphere, do not account for its behaviour in different geographical contexts. By going underwater and examining 'air' under pressure, it became a scientific construction rather than a naturally occurring phenomenon, demonstrating in the process that it is malleable and producing new insights into the ways that air(s) can condition life through certain technological interventions. In this case study, with less emphasis placed on the ethereal affinities (Adey 2015) and allures (McCormack 2015) of air, and more on the atmospheric technologies, valves, pipes, infrastructures, and molecular composition of the atmosphere, we see clearly how bodies are always interpellated by the environments and states that they produce and are produced through' (Feigenbaum and Kannigeser 2015:83). Whilst the 'elemental' and political vitality of the earth's substances have been the subject of significant attention in recent scholarship (see Adey 2015, Squire 2016a, 2016b, Benwell forthcoming), perhaps there is room to push this further, to dissect broad elemental constructs such as 'water', 'air', 'silt' and home in on their individual components. McCormack (2007:359) has hinted at the potential of this in exploring the relationship between 'affect and the molecular' yet as Protevi (2007) highlights and as Sealab demonstrates, there is a physiological stage before this that warrants attention. In foregrounding the elemental in its geophysical form and composite parts, we can perhaps better explore the relationship between geophysical atmospheres (which may play a role in affective atmospheres) and the inhabitation of certain spaces. As McCormack (2007:360) suggests in relation to affect, this would further complicate and understandings of the ways in which the life sciences, social sciences, and chemical sciences are enfolded into life and, I would argue, the practice of geopolitics. 'Enfolded' is a crucial word here if we are to understand the molecular as a 'constituent force without falling back upon a logic of biological or physiological reductionism' (McCormack 2007:364) or environmental determinisms that plagued early geopolitical thought. In other words, the molecular should not be considered as a deterministic structure, rather it should be considered as a component in a much larger, complex social and political picture if both the engineered and the affective capacities of the elements are to be accounted for across 'various domains of life' (McCormack 2016:3).

This study of an artificial, 'exotic' mix of breathing gases can also work to further complicate our understandings of territory. As described in the preceding sections, we might think of the habitat itself as a territorialising intervention to master the wider territory of the continental shelf as various technologies, bodies, airs, and liquids collided, enmeshing techno-science and the geopolitical in the process (see Whatmore 2013). The concept of the 'cyborg' is extremely useful here. Haraway (1991:291) describes a cyborg as a 'cybernetic organism, a hybrid of machine and organism' in which the distinction between the two is 'thoroughly blurred' (Haraway 1991:165). This serves as a productive metaphor through which to explore territorial practices and interventions, such as the Sealab habitat where the technological is combined with the environmental, the elemental, and embodiment to enable a hybrid, artificial space of inhabitation. As Wilson (2009:499) highlights, 'naturecultures and technosciences…are the domains of cyborgean inhabitation'. The 'cyborg' as a narrative device, he argues, is composed of 'complicated and contradictory associations: of technologies and biologies, virtualities and physicalities, discursivities and materialities', and we can see these multifaceted technical, political, material and elemental complexities enfolded throughout the experimental living and breathing space created in the Sealab habitats. For Farish (2010:242, see also Barnes and Farish 2006) writing about the context of the Cold War, a cyborg referred to 'persons who can free themselves form the constraints of environments to the extent that they wished'. It was something that served the ends of an 'enlargement of function', providing freedom from environmental context. We might traditionally think of divers, or the aquanauts in this way, using technology to roam on the sea floor – indeed Merchant's (2014:124) writing on diving describes how the sea 'drew each prostheticized body under', but it is a metaphor that is also apt for artificial constructions that combine technology, the elements, and the body to enable the inhabitation of extreme spaces such as the sea floor, outer space, or the polar regions where simply dwelling in that space is not possible without technological territorial interventions.

Anthropologist Stefan Helmreich (2007:621) provides further food for thought on how might conceptualise the territorial cyborg in his reflections on a journey in the Alvin submersible[48]. Helmreich describes the Alvin as a 'ball of culture submerged in the domain of nature' wherein the natural environment is displaced by a technological one. He argues that the 'assemblage of the sub and its encapsulated scientists is clearly a cyborg, a combination of the organic and technical' wherein a constant process of maintaining equilibrium and boundaries occurs (2007:622-627). Commenting on Haraway's (1991) seminal work on cyborgs, Helmreich presents the Alvin as a means of 'short-circuiting the idea that a durable 'nature' dictated our destinies' (2007:628). It hints at liberatory practices and imaginaries that further emphasises the highly constructed nature of territory

[48] Alvin is a manned deep-ocean research submersible owned by the United States Navy and operated by the Woods Hole Oceanographic Institution in Woods Hole, Massachusetts.

and territory making processes, opens the door to consider the role of technology in creating inhabitable space, whilst also acknowledging a fluid territorialising osmosis that occurs between technology, bodies, elements, and materials. In doing so, understanding certain territorial interventions – such as the Sealab projects– as cyborgean territorial constructions, or 'cyborg territory' can offer a means to work through some of the complexities that characterise territorialising practices in extreme spaces whilst also offering a further means through which to complicate the surface/volume dichotomy.

5.3 'Intestinal fortitude': Finding the right kind of man

'I have begun to understand that-for historians at least-consideration of extreme environments requires the context of human bodies' (Rozwadowski 2010:521)

'What happens to men who master an alien environment so that they literally live in another world?' (Cowen, *Christian Science Monitor*, 1965)

In addition to many hours spent training, 'diving', living, and 'surfacing' in hyperbaric chambers, and before the aquanauts could descend to the habitat, there were other considerations in preparing the men for sub-marine life. The 'largely handpicked' men were, in Bond's (1965, entry 24 July) words, 'the most highly motivated and best trained group of men available in the US Navy' – a group who 'must see themselves as a breed apart for maximum efficiency'. Similarly, one of the Navy's public films entitled *The Aquanauts* (US Navy, no date) asserted that the ability and stamina of 'a special breed of men…the aquanauts' would be key in 'unlocking the secrets of the sea'. Part of a broad Cold War interest in military psychology and human engineering (Farish 2010:152), achieving this 'new breed' status involved training and understanding some of the complexities of their bodies and personalities. Physically, the Navy ensured that their work and study schedules were 'balanced by daily physical exercise' (US Navy, Aquanauts, no date). Their muscles were 'limbered by calisthenics; stamina built by cross country runs across the California roads of Point Loma; reflexes sharpened by competitive sports' such as tennis (US Navy, Aquanauts, no date). When additional motivation was needed, Bond hatched a 'tricky idea' in his 'furtive intellect' and employed one his colleague's 'charming daughter' to instruct the men in one of their daily physical training sessions. The men were 'pooped' whilst Anna, the instructor, remained 'radiant'.

Described as 'indoctrination' by Bayles (1970:32) and aquanaut Thomson (1966, entry 19 May 1964), the training necessitated spending time underwater and familiarising themselves with both the environment and the equipment. 'Indoctrination swimming and diving' were mainstays of the programme and as Thompson (1966, entry 18 May 1964) described in his diary, this was a particularly affective experience for former astronaut Scott Carpenter:

> 'Indoctrination dives with Scott, Andy, Barth, Campoli (Navy photographer) and myself down to 62 feet… Scott with his extensive experience with test flying, orbiting, etc said diving with us in the dark, 2-3 feet visibility at the bottom, was a 'very harrowing experience' He suddenly gained considerable respect for the divers'.

The men for Sealab I (and II) were selected on the 'basis of individual capabilities and known physiological profile, without any respect to possible psychological incompatibilities' (O'Neal et al 1965:37). Their educational backgrounds ranged from medical degrees to 'less than high-school training' with a broad range of personalities 'from a total extrovert to an extremely sensitive introvert' (O'Neal et al 1965:37). In Sealab II, the mix of eighteen naval personnel and ten civilians added further intrigue to the psychologists topside (Helmreich 1967b:21). As is highlighted in 'Table 23' from Sealab II below, one of the key commonalities shared by the men was their heterosexual status.

Table 23
SEALAB II AQUANAUTS – MARITAL STATUS (AUGUST 1966)

Marital Status	All Teams	Team 1	Team 2	Team 3
Single	1	1	0	0
Divorced	3	1	0	2
Married/No Children	2	1	0	1
Married with Children	22	7	10	7
Total	28	10	10	10

Figure 50: A table of the marital status of the Sealab II aquanauts

Team two and three contained no single men. Commenting on the report Miller et al. (1967:257) state that ‘men in Sealab were family men i.e. married with children’:

> ‘It is interesting to note that the same is true of the two previously mentioned adventurous groups; astronauts and Mt. Everest climbers. Thus it appears that rather than being unencumbered by family responsibilities, the opposite is true of men volunteering for assignments in adventures of this type’.

This heteronormative narrative was consolidated by the men in post dive questionnaires that asked the aquanauts to list the most desirable characteristics of an aquanaut: A ‘desire to get the job done’, someone who ‘doesn’t get too personal’ and someone who ‘has led the same general kind of life you have’ were among the answers (Miller et al 1967:269-270). Set within the context of the Cold War ‘Lavender Scare’ of the 1950’s these comments are not insignificant. A culture of ‘100 per cent Americanism demanded that citizens adhere to a traditional, patriarchal sexual order’ (Dean 2001:66). Within this culture, homosexuality was associated with ‘softness’, ‘weakness’ and ultimately as a ‘vector for the infection of communism’ (Dean 2001:67). Any deviation from the prevailing, highly policed, and political ‘sexual and gender order’ could be determined a security risk (Dean 2001:96). The public performance of ‘respectable masculinity’ and of ‘red blooded masculinity’ thus ‘became an important test of public legitimacy’. As Dean highlights, political and diplomatic careers could be made or broken upon conformity to this orthodoxy (2001:67-68). The phrase ‘red blooded’ is not insignificant – it implies something that can be oxygenated and circulated, something that provides the foundation to life. In Sealab, as has been demonstrated in chapter 4, ‘masculine’ performances were an intrinsic part of the project, and as illustrated above, these engagements were premised on highly political ideals of archetypal homosocial masculinity. Scott Carpenter for example describes how In the sea you have to fight the denser medium (800 times more dense 200ft down than at the surface’ to get around. Working in the water is a very fatiguing thing’ (in Hillinger, 1965, *Los Angeles Times*). He is not simply moving through the sea but actively *fighting*. Part of this masculine ideal, made manifest in military struggles such as the Vietnam War, was the deliberate confrontation of risk and even death (Dean 2001:38). In confronting potentially life threatening situations ‘man’ could experience a ‘homosocial rebirth into a world of male heroes' – a practice that also served as a means for men to 'separate themselves from the world of women' (Dean 2001:38).

We see these risk taking masculinities at play in Sealab and in the wider military diving context. As Biersener and LaRocco reported in 1983 (330), in addition to being more 'autonomous from and less dependent on others', 'more social adjustment problems' and 'lower levels of self-reported negative moods', military divers 'prefer higher monetary risks under simulated gambling conditions than control groups matched for age, rank, and years of military service.' Biersener and LaRocco conclude that divers 'should have distinct personality characteristics' including higher levels of perceived control, lower levels of trait anxiety, and sensation-seeking. There were certainly sensation inducing inherent in an operating environment where 'margin for error does not exist' (Costello, *Navy Times,* 26 May 1965), and where returning the surface would prove fatal. As one aquanaut described:

> 'There is that apprehension there and in the back of your mind you know that you've got to be careful. You know you get a chance to make one mistake out there at that's it. You're at 100 feet and you run out of air or something like this, and boy, you run into real trouble, you can dump your gear and head for the surface. And this is what a diver nearly tends to do…but down here we couldn't head for the surface…'

Another diver puts it more strongly:

> 'You spend 75% of your energy thinking on your chances and the other 25% on what you would do if you had a malfunction and you keep checking your gear. Anybody can make a free ascent from 200 feet to the surface, but after you're saturated you can only get to this little hole and so you think – you can't go no place when you get up (to the surface) 'cause you know you're going to die if you go' (Helmreich 1967b:16).

'An intimate brush with catastrophe' was never far away (Bowen et al 1966:42) and as Helmreich (1967b:16) reported there was 'no doubt of the objective threat of the Sealab environment'[49]. The results of the psychological study emphasised the 'stressfulness of life at 200 feet underwater' with '28 of 28 men' reporting 'higher fear underwater (Helmreich 1967b:32). This being said, the risks and stresses served to reify the manliness of the men involved. One, for example, described the 'constant' and 'real' danger of becoming lost in the dark water before describing the 'most exciting moment', which many would construe as anything but:

> 'we had been following a line out and got well out of sight of the Sealab and the line was buried periodically and all. We were surrounded by scorpion fish and followed out – turned around and the lights were gone and there was all of this turbidity that we had stirred up…So I sank to the bottom and began feeling around for this line and we couldn't find it. So we swam in the direction we knew it should be, through the turbidity, and eventually ran into the visibility range and there was a line that we followed' (Helmreich 1967b:19).

Another reflected on the 300ft dive into the canyon beyond the habitat as his 'highlight':

> 'It was a test of guts, there's no doubt about it. Damn right. It was total darkness – there's no doubt about it – it couldn't have got any darker. It was a nice thing to know that I did have the intestinal fortitude to go out there and do it' (Helmreich 1967b:20).

For the aquanaut in question, this was a very visceral, corporeal experience, a test of his own 'intestinal' fortitude and ability to pit himself against fear, the darkness, and the pressures (literal and figurative) of pushing his body to unknown depths. The men, who had volunteered for the selection for the project had a sense that 'I got myself into this and now it's up to me to prove that I can do the job' (Miller et al 1967:269). This formed part of what Dean would refer to as a 'cultural narrative of volunteer heroism' where 'courage was defined in very narrow and particular ways' and performed by particular kinds of people – namely white, heterosexual American men (Dean 2009: 39, 242). This culture of

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[49] The proposition that first-born and only children would show greater fear and inferior performance in Sealab is strongly supported by the data…First-borns reported significantly more fear and arousal, while logging less diving time and making fewer sorties from SEAIAB (Helmreich 1967b:53)

volunteering for dangerous and potentially deadly endeavours was a significant motivator for the aquanauts. Whilst the 'environment and working conditions' painted 'a dismal picture of Sealab II', 'motivation and morale among the divers was extremely high' (Miller et al 1967:268). 'The knowledge that they were part of a project with unlimited potential and great significance doubtless had an impact on most of the men', as one commented, 'Hell I'm no hero, 10000 other Navy divers would have given their right arm to have been down in Sealab' (Miller et al 1967:268). The 'novelty of the situation' also played a significant role (Miller et al 1967:270) as did the 'complex personality makeups of the aquanauts' (Bond 1965, entry 24 July). They were, in Bond's (1965, entry 21 July), 'prone to development of prima donnish attitudes with minimal provocation'. Furthermore, the men were bound by a sense of sharing a 'common fate' (Helmreich 1967b:34). Bond (in Barth 2000:39) also acknowledged this, stating that 'Navy divers tend to be remarkably clannish' in part because they are 'shunned as a group' but also because they 'recognise the necessity for total loyalty within our small fraternity and cling together literally for dear life'. This attitude was reinforced throughout the interviews I conducted wherein the diving community was described as 'family' with other military communities less likely to understand or appreciate the reasons behind becoming a Navy saturation diver. Helmreich (1967:17) asserts that 'working in the water has its own special character' brought about by the inherent danger and immersive nature of underwater work. Whilst their bodies may have been infected, serving as petri dishes for the study or submarine life and hosts for bacterial microbes, this 'special character' of the water is restorative for the underwater Cold War hero, the difficult conditions providing a context against which to define masculinity as the challenges were met and overcome. The elements here become tied into a gendering – their specificities reinforcing a heteronormative masculinity.

Throughout the projects, the aquanaut's were subject to a range of tests, including the Human Behaviour Program, which involved collecting data on various aspects of the aquanaut's dispositions, habits, and quirks before, during, and after the experiments (Miller et al 1967). Factors such as 'order of rising' in the morning, a location record of where each man was at certain times and their perceived mood, a laugh record, and details of meals – who prepared the, cleaned up, and the mood at mealtimes (Miller et al 1967). Further tests on the aquanauts personalities also included the development of an antisocial behaviour index was constructed to understand how any anti-social behaviour tendencies may correlate with their behaviour on the sea floor. Nine scales, based on previous research of ‘personnel wintering-over in the Antarctic’ (Helmreich 1967b:22) asked the men to indicate their levels of (among other things) insolence, achievement motivation, autonomy, succorance, compulsivity, and delinquency to uncover how the men would ‘react to various situations, adjust ‘to living and working as members of a teams for an extended time in a closed environment’:

> ‘How will they react to the constant vigilance by television monitors? Under the expected constraints and the unpredictable hazards of undersea life, each man must have not only physical strength but also courage and strength of character’ (US Navy, The Aquanauts, no date).

Tests on strength, manual dexterity, co-ordination, group assembly, vision, hearing, and tests on the ability to form spatial relations in the water were also utilised to better understand ‘Man in the Sea’ as the bodies of the aquanauts were brought under the microscope before during and after the program (see Miller et al 1967). This microscopic eye was also extended beneath the skin to map and understand the body in a more molecular, visceral sense. Physiological baselines including pulmonary, circulatory, and brain function baselines were taken in addition to detailed medical histories. ‘Nothing remarkable’ was found aside from ‘the ills peculiar to divers…: past histories of sinus squeeze, decompression sickness, and frequent colds (Physiological Evaluation 1965:19) – again, susceptibility to colds does not fit neatly into the ideal of the Cold War hero. Figures

51 -53 below show these tests taking place involving wires, electrodes, machinery, needles, with the accompanying beads of sweat and pained facial expressions.

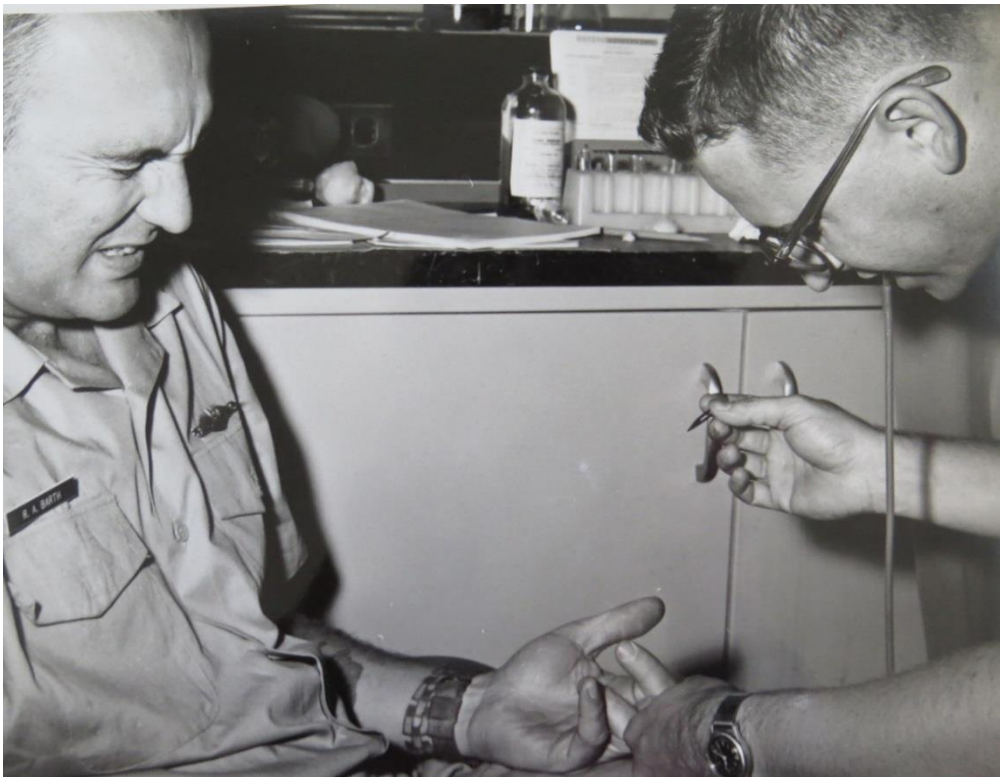


Figure 51: Both Barth has his blood sampled before heading down to Sealab. The grimace on his face expresses his displeasure (Image courtesy of the Man in the Sea Museum).

Figure 52: Coffman, one of the Sealab II aquanauts, has brain telemetry equipment attached to his body to monitor it on the sea floor (Image courtesy of the Man in the Sea Museum).

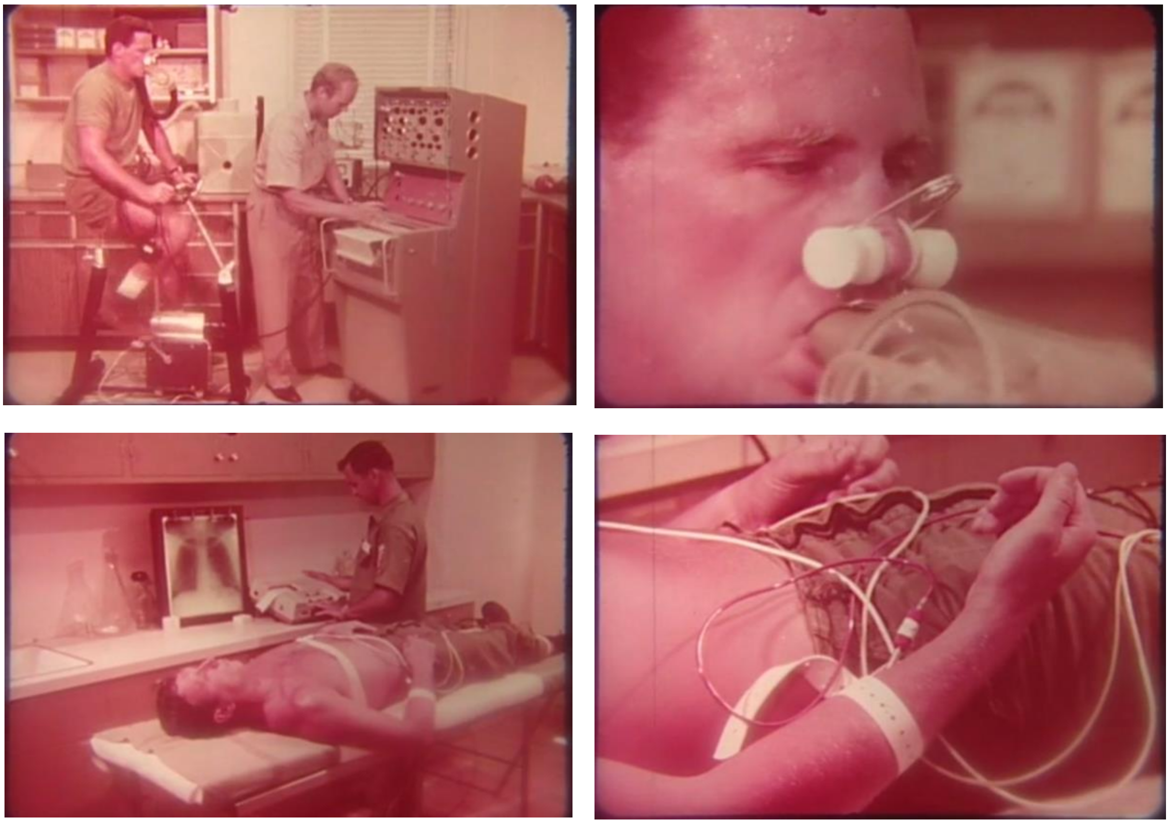


Figure 53: Stills taken from the Navy's 'The Aquanaut's' public film depicting numerous physical and physiological tests on the body of an aquanaut prior to Sealab. Wires and machinery feature prominently as does the idea of 'manpower'

Within the cyborg territory of Sealab, human cyborgean practices formed a significant component of the experiments. As Farish (2010:148) highlights, the 'human component of cyborg hybrids was frequently and vividly understood in military and masculine terms and Sealab was no exception. Creating the 'new breed' of man described above relied on the coupling of machine and human to enable man to live and dwell beneath the sea (see Pickering 1993). In this coupling, we see the desire for environmental mastery and 'total masculinist domination' expressed through the human body (Masters 2010: no page). Within this context, the human body becomes reliant on technological interventions with power located at the intersection between the two in a fluid and transgressive entity that 'is not pure and singular but frequently blurred, multiple, and changing, assembled from diversity' (Barnes and Farish 2006:809). The concept of cyborg here functions to reveal more of the gender politics and pressures at play whilst also serving to demonstrate the assemblage of cyborgean practices that can to dominate the Sealab experiments.

5.4 'Red blooded masculinity'

'The question then is: to what extent can man himself adapt to an oceanic environment?'

(Selvidic 1965:324)

Having established physiological, psychological, and homosocial baselines and norms of the aquanauts, the real test was to see how these changed under the pressures of undersea living. This had significant implications for future undersea projects and Bond (1964, entry 4 July) was keen to emphasise the significance of gathering large amounts of scientific data on the aquanauts' bodies:

> 'Without this data, real progress in undersea experimentation cannot be expected. For all of the fanfare of Cousteau's remarkable experiment in the Red Sea, not one iota of useful physiological information was obtained. Likewise, Ed Link had demonstrated that man could live for a 24-hour period as deep as 400 feet; but no significant data were derived from his exposures. Both of these pioneers had committed a major scientific sin, in accomplishing a feat without recording the events leading up to it. In SEALAB I, we were quite determined not to perpetuate such mistakes'.

In keeping with the rest of the project this process was framed in masculine terms. 'The physiological information' presented in the Physiological Evaluation (1965:i) 'was not easy to obtain'. On the contrary it relied on the 'aggressive ingenuity of dedicated aquanaut investigators and the selfless assistance of men who elected to be subjects for the physiological study phases of the experiment':

> 'These men, dedicated to the successful performance of priceless undersea tasks, were required at unpredicted intervals to alter planned procedures and to submit themselves, body, blood, and mind, as human guinea pigs. This they did without protest' (Physiological Evaluation 1965:i-ii sic).

Over the course of Sealab I over 30 physiological values were derived daily from each man 'covering all useful parameters of blood morphology, blood chemistry, basal metabolic function, body temperature, and general physiological status' (O'Neal et al 1965:34). In each of these measures, multiple aspects of the aquanaut's physiology could be established. Blood morphological values obtained daily, for example, included 'differential counts, white and red cell counts, sedimentation rates, haematocrits, and reticulocyte determinations' with special attention 'directed to any morphological evidence of immature or otherwise abnormal blood elements (O'Neal et al 1965:36). In Sealab II this process only intensified with a demanding schedule of physiological tests. 'An ideal day' for observations topside involved tests from 0630-1900 (Physiological Evaluation 111-112):

> 0630 – Experimenter arises, equipment readied
>
> 0700 – Body temperature, heart and pulse rates, blood pressure, metabolic rate determined on men in bed, men arise, void urine into container. Fasting blood sample taken.
>
> 0800 – Breakfast with fluid and caloric intake measured.
>
> 0900 – Pulmonary function studies. Exercise studies.
>
> 1000 – Ready equipment for swim, other duties. Send up samples. Operational activities.
>
> 1130 – Body temperature, heart rate, blood pressure repeated
>
> 1230 – Chow with calorific intake measured
>
> 1300 – Siesta
>
> 1400 – Prepare for swim. Body and extremity temperatures taken. Swim of various graded intensities of activity for stated periods for selected subjects. Other subjects for operational activities.
>
> 1700 – Other tests, housekeeping, work on swim gear
>
> 1800- Chow with calorific intake measured
>
> 1900 – Repeat body temperature, heart and pulse rate, blood pressure, metabolic rate. Pulmonary and exercise studies.

2100 – Free time

2300 – Lights out

The list was seemingly endless and included: Haematology, blood chemistry, urine volume and chemistry, electrocardiography, electroencephalography (this measures electrical activity in the brain), pulse, and blood pressure, temperature, respiratory function, saliva, bacteriology, and gas uptake and elimination (Physiological Evaluation 1965:14, 21-22). In respiratory function alone 'the following values will be obtained:

> Spirometry, tidal volume, frequency, expiratory reserve volume, inspiratory capacity, vital capacity, functional residual capacity, timed vital capacity, maximum inspiratory flow, and maximum expiratory flow. Pulmonary function studies will be conducted in the morning and afternoon to determine daily cyclic variations' (Physiology Evaluation 1965:22).

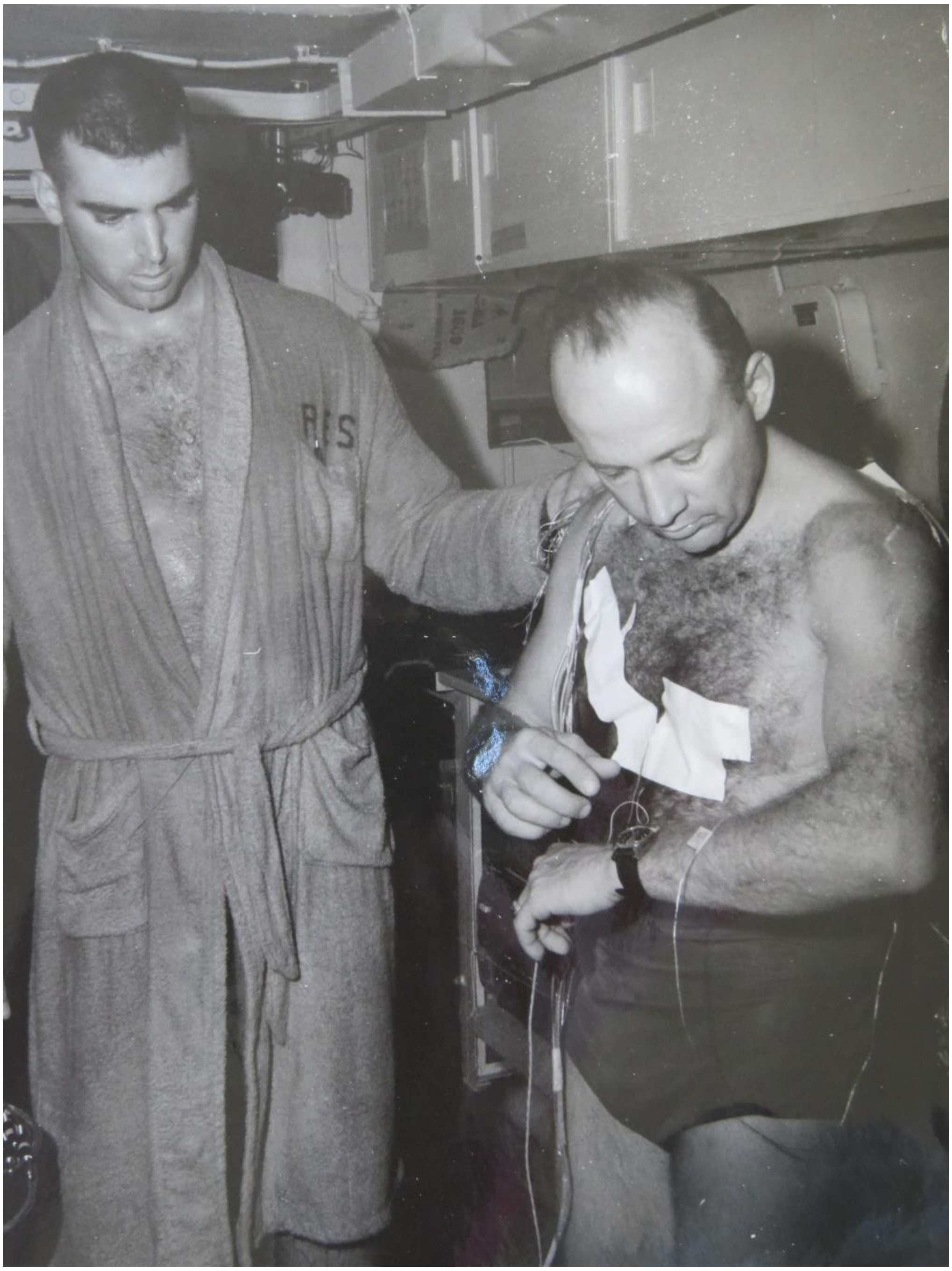


Figure 54: Aquanaut Doctor Sonnenburg attaches EKG measuring equipment to the body of Bob Barth during Sealab II (Man in the Sea Museum).

Figure 55: A blood sample being taken from an aquanaut during Sealab II (Man in the Sea Museum)

As the schedule above demonstrates, these tests had certain temporalities to them, those 'extracting' '20 cubic centimetres of blood daily' (Bond 1967:203), also had to 'obtain urine samples four times daily on rising, 1000, 1400, and 2000' (the result of this is depicted in the large glass jars in Figure 56). Portions were then frozen for later analysis topside. 'Although urine studies may seem excessive' it proved to be only of the most reliable and important substances for 'getting data relating to stress and daily cyclic variations' (Physiological Evaluation 1965:24). Temperature, pulse, and blood pressure were recorded daily on all subjects whilst electrocardiograms were recorded daily on at least 3 subjects (Physiological Evaluation 1965:25). The results were recorded and mapped in the graphs depicted in Figures 57 - 59. Much like the contour lines in chapter 4, these lines depict physiological heights and depths, peaks and troughs as the body comes into contact with a strange atmosphere in the context of the sub-marine. It forms part of a visual culture of thin black lines that depict certainty, structure, and the surfacing of knowledge contained within deep spaces – whether that be the sea or the body.

Given the novel nature of the tests being conducted, and the lack of ‘experience with biological recordings from free swimming divers in the ocean or in a habitat 200ft’ deep, a number of ‘unexpected artefacts were encountered in Sealab II’. In a similar way to the sea water scrubbing the air of nitrogen, it also interfered with biological recordings involving electrical equipment. Salt water ‘would through internal shorting to the body, short out the electrodes more or less completely’. Unexpected readings ‘due to the movement in the ocean as an infinite body moving in the earth’s magnetic field’ were also encountered adding a further elemental entanglement to the projects:

> ‘The electrical signals generated by the waves against the beach were of an order of 10 millivolts. Electrical potentials generated by magnetic storms over Indonesia propagated through the ocean, and arrived at the location of Sealab II between 1700 and 1800 in the early evening. These latter potentials would in the EEG recordings give slow-wave artefacts similar to those generated by some brain tumours or unconsciousness’ (Sen-Jacobsen 1967:237).

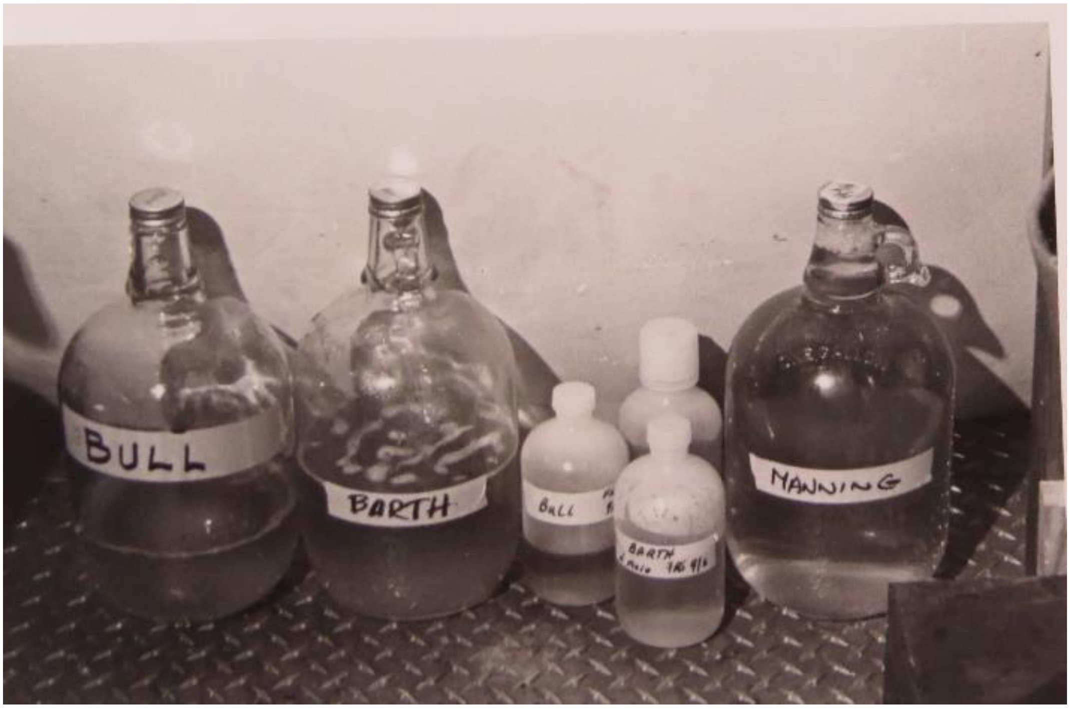


Figure 56: Jars containing aquanauts’ urine during Sealab II for testing. This form of bodily excretion proved to be extremely important in understanding the body-environment nexus(Man in the Sea Museum).

Generally speaking, and notwithstanding interference from magnetic storms, the wide range of tests 'revealed no gross irreversible changes' (Physiological Evaluation 1965:119). Whilst there were 'no long term deleterious effects[50]', 'mild and transitory' changes to the men's physical conditions did occur (Laverne and Long 1966:5). 24 out of 28 subjects had levels of hearing below normal[51] and the single episode of exposure 'to the environmental conditions of Sealab II' resulted in a trend of hearing loss at higher frequencies (Miller et al 1967:265); 'nagging physical complaints' such as the skin rashes and ear infections mentioned previously (Miller et al 1967:255); weight loss of 2kg (Physiological Evaluation 1965:96); a general reduction in mean heart rates when compared to baseline figures (which returned to normal post-exposre) (Phsyiological Evaliation 1965:42); and a general 'decrement in human performance' in the completion of complex tasks (Miller et al 1967:265). Other changes included:

> 'An increase in oral temperature, and decrease in erythrocyte number. Increased pulse rate, increase in systolic pressure, decreased haemoglobin content, increased platelet number, changes in blood electrolytes (elevated serum sodium and serum potassium), transitory increase in serum lactic acid dehydrogenase, increase in urine potassium, phosphorous, and creatinine, and change in responses to cold and exercise were all found, but may with the exception of raised stress indicators, be of limited significance' (Physiological Evaluation 1965:100).

[50] Clearly, this could not have been known at the time as a small amount of time had passed between the experiment and the writing of the report.

[51] 'Hearing levels of divers tend to reflect a pattern of acoustic trauma quite similar to that of personnel exposed to high-intensity noise levels. Hearing ability of divers is also subject to additional deleterious effects from more than the usual amount and degree of ear pathologies (Miller et al 1967:265)

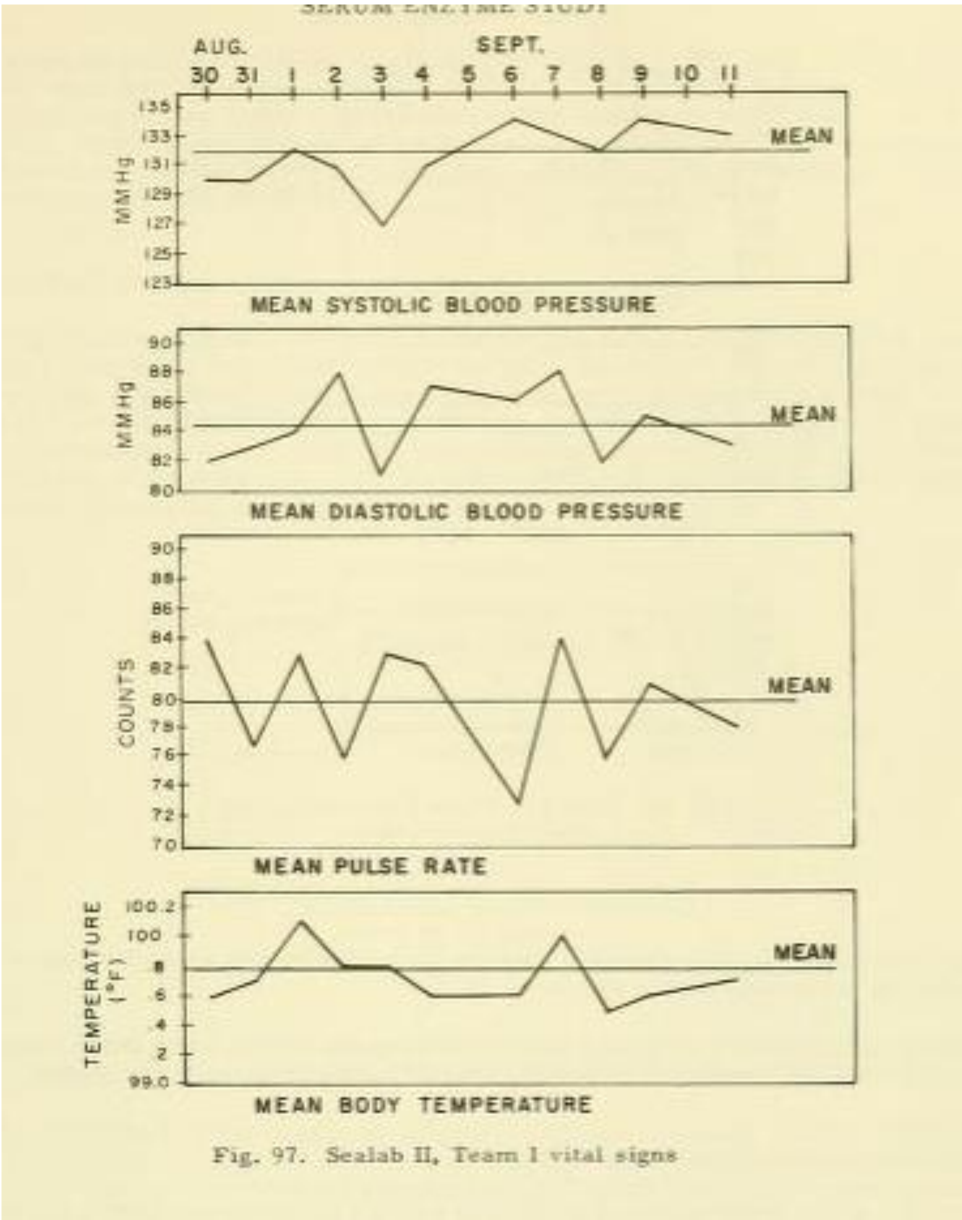


Figure 57: Graphs depicting various physiological phenomenon - enzyme serum studies, blood pressure, pulse rate and body temperature (Mazzone and Bond 1967:228).

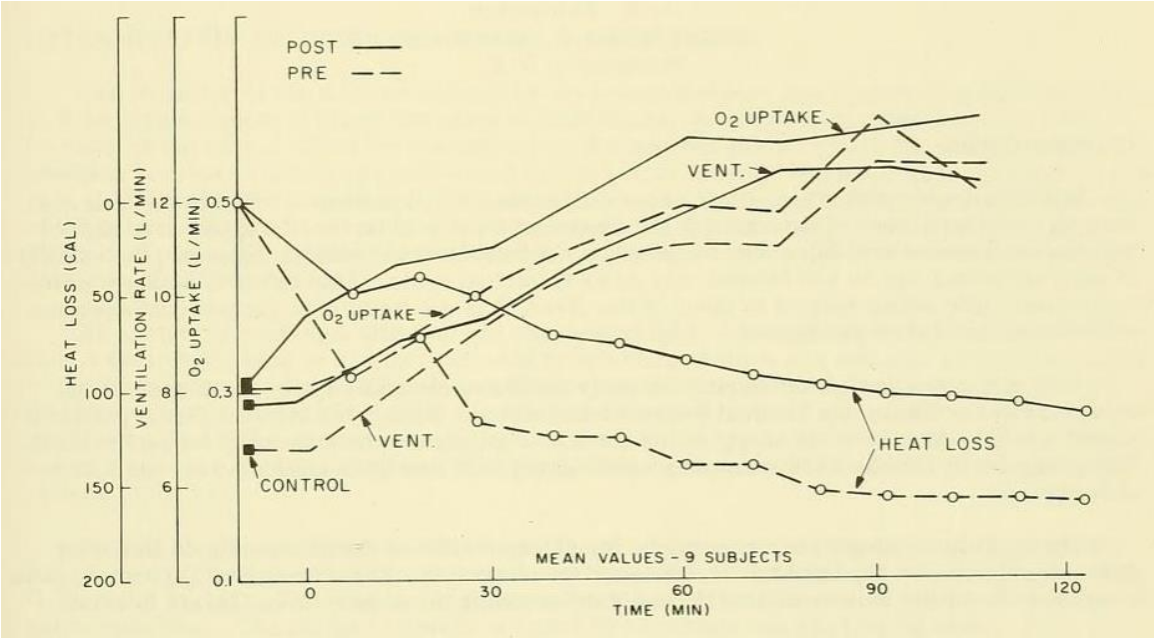


Fig. 93. Predive and postdive cold exposure tests, metabolic reponse

Figure 58: Predive and postdive cold exposure tests including metabolic response (Hovarth and Kasch 1967:19)

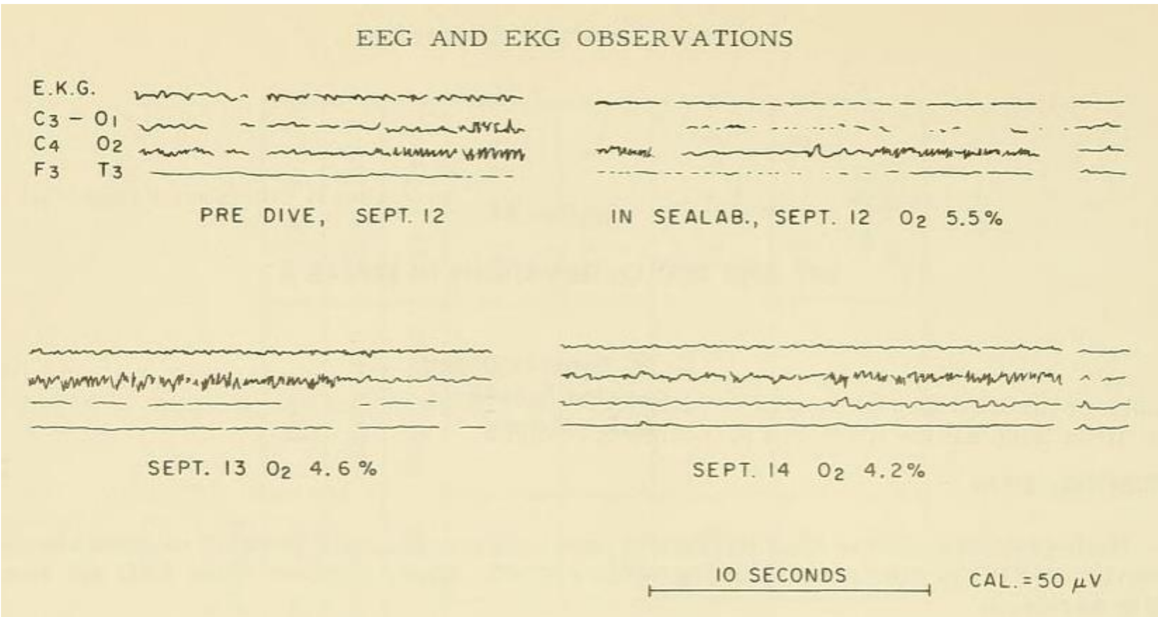


Fig. 100. Increase in Alpha frequency of EEG during Sealab II dive period

Figure 59: Increase in Alpha Frequency of EEG during Sealab II -'The changes in the alpha frequency may be due to acclimatisation. They coincided with subjective difficulty with the

problem solving tasks and mental confusion reported by some participants' (Sen-Jacobsen 1967:238)

There were, however, some tests that Bond suggested warranted further attention in a laboratory. Red blood cell count was one example. Scott Carpenter, who had been exposed 'for 30 days of continuous stay to partial pressures in excess of 200mm Hg of oxygen, showed a linear decrease in red-cell count, although no evidence of cell destruction could be demonstrated' (Bond 1967:203). It was also of note that for the first 3-5 days, stress enzymes and other indicators of stress were 'clearly elevated' (Bond 1967:2013) with stress being the most 'consistent physiological deviant' within the experiment (Physiological Evaluation 1965:119). In spite of the masculine language associated with excitement, 'getting the job done' and 'intestinal fortitude', the aquanauts' bodies revealed a different story. The Physiological Evaluation (1965:65) reported large amounts of 'anxiety and apprehension due to the strange environment' with 'multifactorial stresses brought about by being immersed in an environment that was a 'total departure from normal'. These stresses included high pressure, temperature and humidity issues, poor visibility, 'cold water, strenuous work, and the possibility of helium effects' (Physiological Evaluation 1965:95). Other 'ripples in this sea of tranquillity' (Miller et al 1967:263) were the 'ever present problem of becoming lost' (Miller et al 1967:267), fatigue, dissatisfaction with the amount of time spent doing housekeeping and chores, lack of 'diver to diver communications' and the heightened sense of 'dissociation and isolation' brought about by the 'dense, dark medium' of the sea (Helmreich 1967:56).

One aquanaut (in Helmreich 1967b:17) reflected on the experience:

> 'I think it's a function of stress – I did things in the water that didn't reflect good judgement, good forethought. It takes a long time to do things in the water and I don't know why. You don't move as fast, first of all. You get tired sooner – you get cold sooner. You can't see as well. You've got gloves that interfere with your manual dexterity'.

Feelings of stress were only exacerbated by anxieties about the equipment:

> ‘I don’t feel confident about any piece of equipment that delicate. So I have great respect for the Mark VI (the diving rig) and I am scared of it which is the thing to be’ (Helmreich 1967b:17).

> "Today we completed only one out of 2 simple jobs. I don't understand it at all, but it presently seems to be a fact I have been doing some stupid things, and other people feel the same way. We are trying to be ultra-careful with the MK6's (breathing apparatus), but things still happen such as flooded canisters, and two cases of people going out with their gas off. Once outside, it seems immensely slow--it takes much time to do even simple jobs. We really need about 2 weeks to just get used to this kind of work; again, I don't understand why (Bowen et al 1966:39)

On one occasion, these anxieties were justified:

> ‘I had been out I guess about one half hour- we were placing some more lights. I got a lung full of something – started to cough. I did everything to cough my mouthpiece out. I had to swim back to the shark cage and came in which is a good thing I did because by the time I did I was coughing up blood with it. I was spitting – someone said ‘you’re spitting blood’. I said ‘It can’t be’. When I looked at it was a pinkish colour. It took me a while to realise that I was coughing up blood. It took me a good 10 hours to stop coughing’ (Helmreich 1967b:19).

These technological chinks in the cyborgean armour, uncertainties, and underwater stresses were ‘a major theme running through nearly all the debriefing interviews is a preoccupation with yourself, your location, your equipment and wondering whether everything is going right’ (Bowen et al 1965:38). As one diver reflected:

> ‘So much of your mental capacity is devoted to listening to your exhaust, wondering whether it's working right, keeping in mind how far you are from the laboratory and taking care of your tools. You're spread pretty thin and you don't have much of your mental capacity to devote to the performance of your task’ (Bowen et al 1966:38).

In spite of the difficult conditions, complaining was seen in a negative light. In questionnaires conducted in the aftermath of Sealab II, the men were asked to rank their fellow aquanauts’ ability to lead. There was a tendency ‘not to choose men who complained about the conditions in Sealab or who made frequent telephone calls from the capsule' (Miller et al 1967:264). It was also noted that those who experienced the higher levels of frustration (measured by the number of complaints) also scored higher in the strength tests (Miller et al 1967:265).

Whilst the results were subject to a 'large quota of human error' given the difficult conditions in which the measurements were taken (Physiological Evaluation 1965:199), the data gathered allowed for predictions (for operations like Sealab III) 'of the effects at deeper and longer exposures' (Physiological Evaluation 1965:21-22). Additionally, the tests presented the Navy with an opportunity to 'present intriguing portions of the giant puzzle, in hopes of developing a complete mosaic within our time' (Physiological Evaluation 1965:220). Moving beyond Naval applications, the ways in which the body was brought under a governmental, territorialising surveillance regime raises interesting geographical and geopolitical questions. Firstly, we might re-think Dean's (2001) conceptualisation of 'red-blooded masculinity' to incorporate the role of blood, organs, and other bodily volumes in ascertaining which men could successfully inhabit the deep. We've seen previously how the Navy sought to identify and weed out the 'bend easy', that those who suspected the bends did not come forward in fear of being categorised in such a way, and here, how the inner workings of the body were brought under the microscope to tease out the physiological specifities of successful inhabitation of the continental shelf. As Smith et al. (2016:259) assert, 'bodies can become a proxy for the nation'. In taking the term 'red blooded masculinity' literally, we see how the American Cold War heteronormative ideal of heroism, withstanding pressures, and the culture of volunteerism extended beyond the men's skin and outward appearance, perhaps forming part of a wider Cold War 'visions of bodily and regulation' (Farish 2010:152).

This being said, the tests and subsequent results also enable an insight into the stresses of sub-marine life that were not always vocalised by the aquanauts. In an interview with Bob Barth (7 February 2016, Mr Barth's home), for example, he asserted on numerous occasions that he hadn't experienced stress because their bodies and minds had been trained and were equipped and ready to deal with any challenges that may have arisen. Yet, their bodies revealed otherwise. The consistent elevation of stress enzymes, for example, betrays signs of a stressed Cold War hero even if certain aquanauts would not admit it.

Secondly, the body emerges in this case study as a significant three dimensional entity with its own flows, processes, and complexities to be territorialised and mapped. Practices of territory, such as mapping, are applied beneath the skin in a bid to master and manage the physiological side of territorial expansion and frontiering. As the body inhabits this new frontier, it in itself becomes a frontier as it finely attunes itself in relation to an external environment. Drawing on Protevi's (2009) political physiology, the body functions as a series of networked molecules, substances, and structures that coalesce to produce certain effects and affects as they come into contact with an external environment. This kind of 'subterranean' or subsurface engagement with the body has gained some traction in recent scholarship. McKinnon (2016:285), for example, considers the intimate, physiological geopolitics of giving birth, arguing that substances like hormones shape what is an inherently geopolitical experience. 'The body itself' writes McKinnon (2016:286), 'is the territory to be constructed, claimed, fought over' as the intimate experiences of birth stretch towards the institutions and corporations that define both the dominant discourses and legal frameworks through which maternity care is determined'. Clearly, this case study is contextually very different from Sealab, yet the principle of body as territory warrants further attention. The significance of this interpretation has been hinted at – Smith et al. (2016), for example, seek to reconceptualise the body as a territorial actor in the 'of borders and state territory' as borders are 're-defined at the limits of the body' (259). For Smith et al. whilst valuing 'Elden's (2013) careful delineation between territory (a specific political technology relying on measurement and law) and territoriality (social practices of claiming territory), they also seek to foreground the 'embodied and bodily material manifestations and experiences of territory' whether that be in the act of giving birth, being kidnapped, eating and protesting in urban spaces – Smith et al. (2016:259) argue that each shore up and tear down territories and borders. Yet, as the case study of Sealab demonstrates, bodies not only 'constitute territory and borders', but are in themselves borders to be crossed. The skin is a site to peel back and the bodies inner workings territorialising mechanisms to be understood, with any weaknesses found conceptualised as hurdles to overcome to further the project of sub-marine inhabitation.

Finally, we might also reflect on the implications of these embodied engagements in thinking through the concept of 'terrain'. Chapter 4 sought to unsettle fixed and unchallenged understandings of terrain as a simple engagement with topography, instead arguing that in the case of Sealab, *terrain* was a practice that existed *in* the volume of the sea as well as on the seafloor. Here, it could be argued that it is also a practice and concept that permeates beneath the skin (Squire 2016b). In investigating the physiological implications of sub-marine life, we see language that is most commonly associated within geography with (geo)physical engagements with terrain. Mazzone and Bond (1967:231), for example refer to testing blood 'sedimentation' rate (which measures inflammation in the body), and elsewhere we see references to morphology, uptake, and volume with certain sensing technologies and sampling techniques utilised to extract information. Indeed, Iain Koblick, an aquanaut in projects that followed Sealab, described how 'core samples' were taken from his body (Iain Koblick, 24 February 2016, Marine Lab, Florida). Representationally there are also overlaps as the bodies inner workings come to be imaged and imagined as lines on a graph. Rather than contour lines working their way around the sea floor, these lines depict the elevations, depressions, and morphological changes of the volumes of fluids and molecules circulating within the body, and in doing so they come to make the invisible knowable and manageable. Perhaps most importantly, understanding the body as both *terrain* and *territory* brings to the fore the intricate interactions and intersections that exist, not always consciously, between environments such as the sub-marine, the molecular workings of the body and the subsequent affective experience of corporeal phenomenon (such as headaches, or irritating skin rashes).

5.5 Conclusions

Throughout this chapter, different elements have entangled, mixed, and mangled at varying scales and across different sites. 'When we think of entanglements' writes Collard (2012:24), 'we often think of things conjoined together in space'. The hyperbaric chamber, habitat, and the body emerge through this process as key spaces through which these entanglements take place. From engineering and crafting the right air mixtures and pressures in chambers and habitats, to sampling, monitoring, and managing the minute, elemental and visceral volumes of the human body.

By way of conclusion, there are a number of key ideas that warrant further attention in geographical scholarship. Firstly, the embodied and elemental insights raised throughout the chapter offer opportunities to nuance and enrich understandings of the figure of the Cold War Hero. We see bodies that are cold, infected, suffering from bacteriological problems, covered in rashes, unable to see properly. Their physiology betraying the limits of the human beneath the sea. Simultaneously the elemental context of the sea and the exotic 'ocean air' of the habitat provide redemption – their overt strangeness and hostility providing a context to push against, to overcome, restructuring the narrative from one of discomfort, undignified bodily probing, and stress to one of adaptation, perseverance, and courage. The environment, elements, human body, and microbial bodies become entangled here and in doing so, a different Cold War emerges bearing little resemblance to the cult figures of Rambo or James Bond.

Secondly, the Sealab experiments are a useful prism through which to push literature on the elemental. McCormack (2015) has hinted at the possibilities implicit in exploring the elements as an alchemist or physicist might, and whilst I cannot claim to be either of these, Sealab offers opportunities to take this further. What would be the outcome, for example, of a geopolitical project that sought to analyse the elements on the periodic table to better understand the properties that construct the earth, how they mix, and the geopolitical connotations associated with these processes? What would an elemental geopolitics of substances such as gold, hydrogen, or sodium look like? As McCormack (2016:4) highlights, the periodic table need not serve as a deterministic map but it can function as a basis from which to explore a 'range of scientific practices, devices, and relations' and not merely as a metaphor to understand how the properties and capacities of particular objects, bodies and forms of life are shaped and sustained by bonds, affinities and reactions'. Broken down into its component elemental parts, for example, air in Sealab became something plural and malleable. It was encapsulated, compressed, its molecular formation altered and changed to create a new form of air or atmospheres that could sustain and nourish the body as it might do on land. It became an elemental concoction to be adjusted to meet the needs and feelings of the aquanauts who came to exert control over the make-up of their breathing substance so that it 'felt' good. Helium was the protagonist in this endeavour. Taken out of the context of the atmosphere on land, helium maintained its uplifting qualities and unwieldy propensity to escape yet it also enabled 'man' to live and dwell in depth. It was an engineering of the elemental, a technological intervention that enabled undersea inhabitation and simultaneously raises interesting questions about practices of territory construction in extreme contexts. As this chapter has sought to demonstrate, we might apply scholarship on cyborgs to these practices, the concept of 'cyborg territory' pointing to the intersections of technology and the environment in inhabiting space that may be deemed 'hostile' and threatening to human survival.

Of course, the term 'cyborg' also necessitates an examination of the ways in which the body becomes enfolded in these territorialising practices. It could be argued that the aquanauts served as cyborgs in their own right – the wires attached to their heads and bodies, the air cylinders strapped to their backs in the water, all pointing toward a cyborgean mangling of human and technology. Yet, it is perhaps more productive to consider the ways in which the body formed part of a cyborg territory in an ensemble of cyborgean practices. In the habitat (a technological, volumetric territorial intervention in and of itself), for example, the 'exotic' artificial atmosphere disrupted the men's speech, thermoregulation, and even the speed at which they worked. In order to understand these (and other) effects their bodies were sampled and mapped in much the same way as the sea floor was in chapter 4. Morphological and sedimentation values were ascertained, core samples taken, their bodies becoming volumetric, elemental, testing sites in their own right with various bodily fluids and substances sent to labs to be tested in petri dishes and under microscopes. This being said, we might think of their bodies as petri dishes – a mass of organisms being experimented upon to find optimum conditions for survival and growth in an artificial microclimate or biome. This raises questions for thinking through concepts such as territory and terrain and their relation to the body and external environmental surroundings. We might think of the body as a terrain to be mastered, an unstable and relatively unpredictable volume with its own flows and rhythms to be mapped and made known with contour lines representing heartbeats, temperature, blood pressure (see Figures 57-59 and Squire 2016b). Perhaps it would be more productive, however, to think of territory making, or cybrogean territory at least, as a series of overlapping, enfolding, and interrelating volumes – of bodies interacting with atmospheres and airs, airs interacting with water, water interacting with bodies. Within this framework, the ‘permeable surfaces between human bodies, ecological systems, and political events’ (Bosworth 2016:1) are laid bare and the intricate relationships between the molecular, elemental, and the geopolitical recognised.

Chapter 6

From porpoises to plankton: Animals, the Cold War, and sub-marine geopolitics

> ‘And what the men saw below, for all the tired sophistication that sometimes dogs out civilisation was like a kingdom out of the soaring fantasy of the child and the poet - of man and youth and all the ages of this old planet of ours. Emerald green or zenith blue, depending upon the state of the sky above the kingdom changes its hue and mood. The angel fish and grouper saw such visitors that they had never seen before even in this teeming liquid world of millions of species’
>
> (US Navy 1964)

6.0 Introduction

'Animals are, of course, geographers too'

(Buller 2014:380)

Whilst the majority of this thesis has focused on the human bodies that lived, worked, and made 'home' on the seafloor, this chapter seeks to 'unpack the 'black box' of animal geographies and subjectivities beneath the sea in order to 'enliven understandings' of Sealab and to raise wider questions in relation to sea life, the elemental, volume, and geopolitics (Emel et al 2002:408). Generally speaking, the role of marine life in shaping and making the world is certainly an area that warrants further attention. As Bear and Eden (2011:336) highlight, recent literature on the 'post-human' and animal geographies has focused on warm-blooded animals, paying little attention to fish and aquatic environments that prove recalcitrant to the direct human gaze. Clearly, as with any analysis of the 'deep', to fill this lacuna presents some practical challenges. It is, for example, very difficult – the bodies in question are highly mobile, difficult to trace without certain underwater technologies, and exist within a volume that cannot be penetrated by the human eye from the surface. 'There is a danger' writes Bear (2010:300) 'of leaving lives beyond direct encounter invisible – especially it might be argued in spaces…such as the in the deep ocean'.

This is not to say that marine life is completely absent from the geographical and social science literature, but it has been approached from a certain surficial angle. There have, for example, been numerous studies on tourist activities like whale and dolphin watching (Cloke and Perkins 2005, Neo and Ngiam 2014, Chen 2011), on the interactions of fish and sea life with policy making and regulation (Bear 2012, Ryan 2015, Hannigan 2016, Taylor and Carter 2013), and, with a more direct focus on the embodiment of individual animals, through the glass of an aquarium (Bear 2010). The experimental context of the Cold War and case studies such as Sealab offer a unique opportunity to add 'depth' to these engagements that have thus far been mediated by a surface (whether that be sea, glass, or paper in the form of policy documents that frame sea life as a homogenous object to be protected, claimed, or harvested - see Hannigan 2016). The observations made by scientists and aquanauts during Sealab and the interactions between humans and non-humans throughout the experiments offer a perspective that is situated in 'the deep', offering unique insight into how 'embodied beings, or other elements of nature, actively co-constitute the changing nature' of the sea 'and co-constitute the performances which help to define' it as a place (Cloke and Perkins 2005:903). Far from existing as an empty, material construct, the elemental environment in which the men were operating was very much alive, embodied, and filled with non-human life, that unlike the bodies of the men was perfectly adapted to a life beneath the surface of the sea.

This chapter will explore the relevance of this life to the geopolitics of Cold War undersea living at numerous scales. The structure of the chapter, which descends down the food chain, from the 270lb dolphin named Tuffy to the minute plankton floating through the sea, not only provides a helpful frame but also serves as a reminder that the sea is not merely a social construct (Steinberg 2001). It has its own structures, biorhythms, and ecosystems that exist prior to the social world and which come to act in geopolitically significant ways. As I follow this train of thought throughout the chapter, a number of prominent themes emerge as the bodies of the animals are gendered, studied, trained and experimented upon in a bid to tame and domesticate the extreme and wild. It will begin by engaging with the marine mammals who became co-opted in the bid to master the undersea environment. Under the care of the Navy's newly established Marine Mammal Program (1960-present day), both bottlenose dolphins and sea lions were caught from the wild, trained, and 'enlisted' into the Sealab effort to undertake a variety of tasks. Running tangentially to this program was an independent 'black' project known as Operation Headgear that sought to control the movement of sharks. Whilst the majority of research on large marine mammals in the social sciences can be broadly categorised under two headings: Protection and consumption (Neo and Ngiam's 2014:239), this section of the chapter explore how these mammals were both co-opted into, whilst capable of resisting militarised imperatives. In the process, themes that have emerged throughout the thesis on homesteading, the elemental, molecular, and gender resurface and morph as they outplayed through the bodies of non-humans.

The second section of the chapter engages with the fish that worked to both affect and be affected by the Sealab projects in highly differentiated and nuanced means. As the bodies of fish were sampled and studied (much like the aquanauts and other Cold War bodies in the Arctic) their physiology became part of broader agenda of scientism and sanitising the sea floor so that it was fit for human habitation. Oceanography and science collide here as sea life became embroiled in the Navy's undersea agenda. This being said, the fish also disrupted military plans. The natural world is often framed under militarisation strategies as passive, easily conquered and mastered yet fish such as scorpion fish forced a reframing of this perspective, their stinging capabilities prompting the affectual responses of fear and caution.

Before concluding, the final section deals with sea urchins and plankton. During preparations for the ill-fated Sealab III, sea urchins were highly problematic and the Navy's engagement with these animals raises some interesting questions about the territorialising practices of small animals in bodies of water. Plankton too, became both enrolled in the Navy's agenda[52] whilst serving to enforce a wider public narrative that affirmed man's capability and ingenuity to live off some of the sea's smallest inhabitants. Finally, as the chapter contends, controlling, managing and interacting with sea life was elemental to the domesticating and home-steading project of the US Navy. The experiences demonstrated, however, that whilst the Sealab prayer (see chapter 4) included 'acquiring dominion over the creatures therein', non-human life can prove recalcitrant and challenging to human imperialistic projects. This raises some interesting questions about how we understand concepts such as political physiology (Protevi 2007) in relation to the non-human and how we think about animal geopolitics beyond the earth's crust – where life moves through, covers, floats in the volume of the sea becoming an unavoidable part of the narrative. Perhaps the most significant contribution of this chapter is to demonstrate the rich insights that can be gained into the non-human world when engagements with the sea are not mediated by a surface, whether that be glass, the surface of the sea itself, or policy documents (see Vermeulen 2015). In the process different geopolitical encounters are possible in an elemental volume teeming with both microscopic and visible marine life. Animals, are, after all involved in the construction and shaping of space, place, and geopolitics – they are 'geographers too' (Buller 2014:380).

[52] This was also an area of great interest for Russia during the Cold War.

6.1 Project Arion: Dolphins, the US Navy and the ideology of domestication

In the broad context of the Cold War, marine mammals were of interest to a wide range of geopolitical actors including states such as Russia who sought to acquire knowledge about dolphins and whales to apply in submarine operations. Scientists too were enrolled in the process, American scientist John Lilly for example, experimented with dolphins in attempt to communicate with them. He believed that in doing so, man would be better prepared to communicate with extra-terrestrials when they were inevitably discovered in outer space (Lilly 1961, 1967). The US Navy were one of the key exponents of military marine mammals and Sealab II provided an opportunity to push the boundaries of military/marine intersections. Funded by the Office of Naval Research (ONR) and undertaken by the Life Sciences Department of the Naval Missile Centre, 'Project Arion', sought to 'determine the means by which porpoises could be effectively utilised in scientific experimentation toward naval application' (Wood and Ridgway 1967:408). Sealab II was to be the testing 'ground' for this project with a dolphin named 'Tuffy' enlisted from the Navy's Marine Mammal Program[53] to work for/alongside the aquanauts. In the words of Dr Sam Ridgway, the first veterinarian of the Marine Mammal Program, the Navy believed that dolphins could be a 'natural' addition to the program. Given his proven ability in the Navy's Marine Mammal Program to dive in excess of 300ft, wear a harness, 'home' on two different acoustic devices, and work untethered in the open sea, Tuffy proved to be the 'obvious candidate' for the trials (Wood and Ridgway 1967:408).

Tuffy was caught from the wild in the Gulf of Mexico and taken to Pacific Ocean Park before finally being transported to a Navy facility at Point Mugu (Ridgway 1987). He was one of the first dolphins in the US Navy Marine Mammal Program and gained his name, a shortened version of 'Tuf Guy', after the trainers and scientists involved in the project learned of his feisty and angry temperament - further reflections on this temperament come later in the chapter. The naming process, as Charles highlights (2014:721) is not a politically neutral act.

[53] Initially they were testing hydrodynamics (Kistler 2000), studying dolphin physiology to learn about the bends (Ridgway 1987), and seeking to learn how the animals are attuned to the environment's information package (Interview, Sam Ridgway, 26th April 2016, burger restaurant).

It represents a 'process of indivuation' that is vital in developing inter-species affinity - an affinity further developed through experiments and training exercises on both body and mind.

Dr Ridgway believed strongly that Tuffy 'could teach us something about his world' (1987:122) and set about establishing a series of pioneering experiments that would see Tuffy's body studied, probed, and analysed in order to learn something of his ability to inhabit the water for long periods of time without suffering from decompression sickness upon surfacing, and more generally to understand porpoise behaviour, intelligence, and sonar capabilities. Telemetry was used to study his heart and breathing as he swam, his blood was sampled, temperatures taken, his body was photographed at depth; his ability to distinguish objects in among rocks, sea life, and coral (Kistler 2000) was analysed; and he was trained to exhale into a funnel so that the gas concentrations in his breath could be analysed. Much like the aquanauts in chapter 5, his body was brought under an academic-military governance regime concerned with minute physiological specificities, inner elemental morphologies and environmental adapatations. In a political physiology of sorts, Tuffy's pre-cognitive, molecular bodily workings were co-opted in the Navy's mission so that they might too learn how to inhabit the sea as effectively as the porpoise.

These pre-cognitive experiments took place alongside cognitive training that would enable him to work alongside the aquanauts of Sealab II. Officially, Tuffy's primary task was to simulate the rescue of a lost aquanaut (Wood and Ridgway 1967:407). Given a diver's lack of directional hearing capability and susceptibility to getting lost in poor visibility, the diver would 'summon the porpoise' via an acoustic signal. Tuffy would then carry a line to the aquanaut on his harness that would guide them back to the relative safety of Sealab II. Subsidiary tasks also included the transfer of tools, message capsules, and other small objects (such as Coca Cola bottles) between the surface and bottom and between divers (Wood and Ridgway 1967:408). Tuffy was also trained to carry a bag of fish down to the divers so that they could feed him them in reward for successful completion of a task. As Dr Ridgway explained, 'stroking, or even just human presence' also served to reinforce good behaviour – they 'love the interaction with people' (Dr Sam Ridgway, 26th April 2016, local restuarant)[54] (see Figure 63).

This 'educated dolphin' (*Chicago Daily Law Bulletin* 16 September 1965) was, according to a variety of media sources, 'an aquanaut with fins' (*Oregonian* 14 September 1965), a 'water logged pony express' (Olten 6 August 1965), 'A sea going St Bernard' (*Los Angeles Times* 14 September 1965), a 'Messenger and errand boy' (*Rocky Mountain News* 16 September 1965) and an 'undersea mailman' (US Navy, Press Release Sealab II, 18 September 1965) . Much like the language used in chapter 4 to describe the undersea home, backyard, and residence, Tuffy too was being understood in human and domestic terms. The anthropomorphic language of being 'educated', of assuming roles occupied on land by humans and domesticated animals see Tuffy's role in Sealab drawn into a wider narrative of instilling 'normal' into an otherwise wholly abnormal environment.

Attracting the wildlife with whom they coexisted (Anderson 1995:275), another marine mammal, Samantha the Sea Lion, also became involved in the project although inadvertently. Wild sea lions visited the habitat and were fed by the aquanauts and psychologist, Mike Greenwood, stationed topside began training Samantha to swim to the support vessel on call (Bowler 23 September 1965, Evans 25 September 1965).

[54]Dolphins differ from Sea Lions who are, as I was told, much more like dogs and therefore more motivated by food (Researcher from NMMF, 28 April 2016, bridge overlooking the NMMF complex)

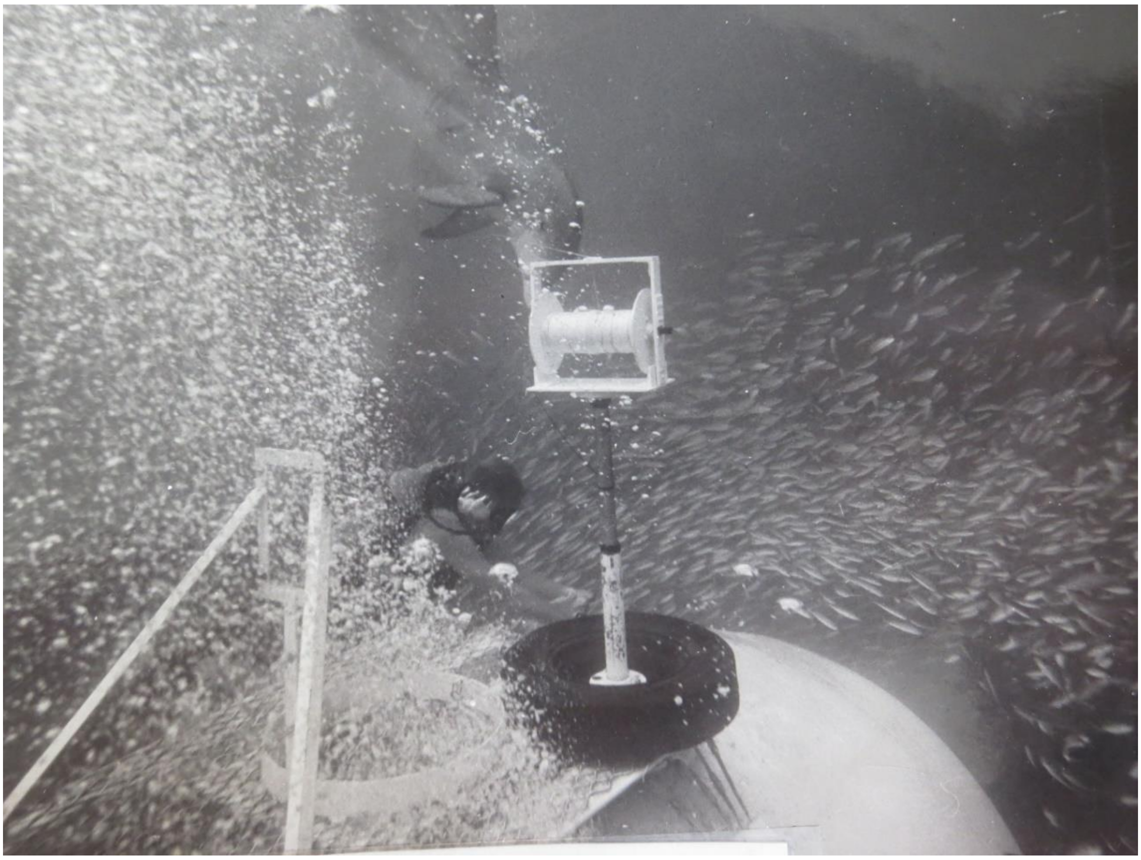


Figure 60: Tuffy approaching a device that will enable him to guide lost divers back to the habitat (Man in the Sea Museum)

After his involvement in Sealab II, Tuffy, along with another porpoise and two sea lions went on to be trained for Sealab III where they would perform similar tasks at deeper depths as the Navy sought to 'determine the behavioural and physical capabilities of the animals' (Sealab III press handbook 1968 5-1-5-2). Tuffy is one of the few dolphins whose time in the Navy is documented (see Ridgway 1987). Dr Ridgway has written about his experiences and relationship with Tuffy and was also willing to tell me more about the dolphin and the program when I conducted field work in San Diego in April 2016. Moreover, Tuffy's involvement in Sealab attracted a significant amount of media attention in the 1960s, the archives of which offer further insights into how Tuffy was conveyed and presented to a mass audience and the associated geopolitical ascriptions that ensued. The result is a rich account of a dolphin who (as his name suggests) resisted human domination, whose body was gendered and ascribed with certain masculine qualities, and whose training and domestication became synonymous with a broader agenda of mastering and, indeed domesticating, undersea space.

Figure 61: The training of dolphins took place along sealions (Sealab III Press Handbook 1968 5-2)

To return to Sealab II, in co-opting dolphins and sea lions into the 'unfolding laws of evolution which made humans lords of creation and animals our organic hosts' (Anderson 1997:464), the bodies of Tuffy and Samantha became embroiled in a domestication project. With both referred to as 'pets' (Bowler 23 September 1965) the undersea environment was being imagined in new ways through their relationship with humans. The Navy extended ownership over an animal whose natural habitat was vast, expansive, and largely unknown. In doing so, Tuffy arguably acted as a proxy for the Navy's ambitions in the sea. 'To domesticate the wild' writes Anderson, 'is to draw it into the boundaries of the know, to 'fix' it into a (it is hoped) secure state'. In their bid to fix, tame, and inhabit the highly mobile, ever changing environment of the sea, porpoises and sea lions became a tangible means through which to express and communicate a sense of ownership of, and control over, a difficult and recalcitrant operating environment. The headline of the *San Francisco*

Examiner (2 August 1965) read 'US undersea pioneers and their porpoise' exemplifying this sense of ownership over Tuffy whilst simultaneously speaking to the 'pioneering' narrative explored in chapter 4 that also sought to project this sense of ownership into the space of the sea itself. We see this notion of 'fixity' play out in the embodied encounters in the following images. In Figure 62 trainer, Wally Ross, attaches a harness of Tuffy's body. He holds the highly mobile body of the dolphin still – a stark contrast to wild animals who are constantly on the move and rarely static. Tuffy, in this image, is submissive to the handling of the human. Similarly in Figure 63, beneath the surface of the sea we see comparable gestures of dominance at play whilst in Figure 64, Tuffy is resolutely fixed, unable to move even if he had wanted to as his body lies on a transportation sling. The juxtaposition of the image is telling – the non-human dolphin fixed by the human expert in a white coat with a military helicopter in the background. Tuffy gets enrolled here in the collisions of science and military mastery that so characterised the Cold War.

Figure 62: Wally Ross, trainer, attaches Tuffy's harness (*The Sun* 9 August 1965)

Figure 63: Tuffy in training (Man in the Sea Museum)

Figure 64: ‘Trainer Wallace Ross covers Tuffy with a wet sheet to keep him from getting sunburned’ (*San Diego Evening Tribune*, 13 September 1965b).

This process of fixing and securing beneath the sea is not exempt from wider social and cultural phenomenon. Anderson (1997), for example, demonstrates that domesticating the 'wild' is inextricably bound up in questions pertaining to issues such as gender and it is not just human bodies that become embroiled in this process. Like the Aquanauts he worked alongside, Tuffy was valorised in the media for possessing certain embodied, and traditionally masculine, heroic, characteristics[55]. Reporting for the *Chicago Tribune*, for example, Bowler (7 August 1965) writes of his 'battle-scarred' body (see Figure 65). The scars, presumed to be inflicted by sharks when Tuffy was a wild dolphin, represent to Bowler Tuffy's 'many successful encounters with sharks'. Other media outlets reported that Tuffy, 'bearing the scars of numerous sharks', would play the role of 'body guard, shark fighter, and rescuer' (*The Sun Baltimore*, 1965. See also *Post-Dispatch* 9 August 1965), and that he would be 'released into the water immediately' if a shark was spotted in the vicinity of Sealab to see if he could 'protect the divers from attack' (*The Sun Baltimore* 1965, *New York Times* 1965). 'His scars' write Olten (6 August 1965) 'and unpleasant disposition' are what earned him the name 'Tough Guy'. Tuffy's 270lb weight and 7ft length were also emphasised along with his ability to 'flash like lightening through water' and send humans 'sprawling' (see Bowler 6 September 1965).

[55] Besio et al (2008:1220) write of how dolphin's bodies come to be represented as either sexually promiscuous or maternal by tourist dolphin watching operators in New Zealand, Tuffy's body was subject to a different kind of gendering.

Figure 65: Tuffy's battle-scarred body – an image widely used in the media at the time (*The Sun* 9 August 1965)

Made an honorary member of Team Two in Sealab by the aquanauts (US Navy, Press Release Sealab II, 18 September 1965, *Houston Post* 19 September 1965) Tuffy's body is drawn into the masculine ideals of this undersea experiment. His scars, like those adorning the bodies of military men, come to act and perform as 'material scars of physical achievement' (Mankayi 2008:35). They confirm 'masculinity in action' (Funnell and Dodds 2015:125) whilst also serving to reinforce heroism and endurance (Dodds 2014). Whilst Tuffy was once wild – 'different from humans and more like nature' (Besio et al 2008:1220) - his body is drawn into cultural and geopolitical gender norms. In doing so, he is used to reinforce a naturalised heteronormativity in a context that is anything but natural – the wild and seemingly unconquerable undersea environment holding out 'a call' to a 'masculinised higher status' for the dolphin (Anderson 1997:480). The sea is once again framed as a masculine space for bodies hardened by military activities with Tuffy's own body, scars, and physical characteristics serving as an archive invoked to naturalise his presence among heroic aquanauts. Tuffy was now involved in the Navy's 'attack' on the hostile environment rather than being attacked himself by the seas natural inhabitants.

It was not just Tuffy's body that was enrolled into this domesticating regime but his personality and affective dispositions too. The Sealab press release (US Navy Press Release Sealab II, 18 September 1965), for example describes how 'the undersea mailman nodded his smiling beak to the waves and shouts of hello' from aquanauts inside the habitat. Bob Barth, one of the aquanauts in question describes how 'there would be a streaking shadow and a giant swoosh, and then this damn big fish would be sitting in front us smiling' (Barth 2000:107, Bob Barth, 7 February 2016, Mr Barth's home). The references to his ability to smile, in conjunction with his scars, are not insignificant – as Jackson (1991:203) highlights, Army recruitment posters utilised phrases such as 'if you can take a few knocks and still come through smiling' to enlist the 'ideal man'. George Bond (in Bowler 16th September 1965) went on to describe Tuffy as a 'wonderfully affectionate fellow', adding in his personal diary that his friendship with Tuffy was 'immediate and I hope enduring' after a 30 minute 'frolic' (Bond 1965, entry 17th September). Similarly, it was reported that Tuffy was 'bound to make friends with the aquanauts' (*Davenport Times-Democrat* 16 September 1965). Furthermore, Bond described how Tuffy 'genuinely enjoys' having his stomach scratched whilst the *San Diego Tribune* (14 September 1965) reported that Tuffy appeared 'well and happy in his new home'.

Some media outlets went further by adopting, or wishing that could adopt, Tuffy's perspective:

> 'Tuffy is a porpoise. He has long been interested in the weird habits and peculiar utterances of humans. He believes they may have an intelligence approaching that of porpoises…(he can do) just about anything, maybe even answer the phone. Come the day when Tuffy reads a treatise to his fellow porpoises in science meeting gathered, he ought to have some interesting notes on these curious people who

think the ocean bed is a proper place to sleep on' (*LA Herald Examiner*, 16 September 1965).

'Of course, it is now news that dolphins are 'smart'. They even seem to be saying something. We hope the code is soon cracked and full communications established. We'd like to tell Tuffy and Flipper[56] and their friends how much we've enjoyed knowing them. As for what they might say, we don't underestimate what a fresh fish perspective could do for the dry face of world affairs' (*Christian Science Monitor*, 20 September 1965).

Humans have long felt that they can possess a 'special bond' with cetaceans (Cloke and Perkins 2005:904) and the ascriptions of human feelings and expressions of an emotional bond with Tuffy is testament to this. The training of Tuffy forged 'sociospatial relations of not only control but also affinity, proximity as well as distance, companionship as well as service (Anderson 1997:478). 'As I watched the dolphins' writes Ridgway (1987:87) 'and saw them looking back with their large dark eyes, I thought I understood why ancient storytellers and modern writers alike usually romanticise the dolphin'. He goes on to describe how:

'this anthropomorphic attitude is difficult to avoid when we observe and work with animals that we come to know as friends. We recognise much of ourselves in other animals, especially in mammals which have warm blood, breathe air, bear live young and nurse them on milk. Dolphins, like humans, possess highly convoluted brains…Moreover, the dolphin's smooth skin, perpetual smile, and exuberant behaviour appeal to human emotions…I could not help believing that some form of silent thought ricked behind Tuffy's large, alert eyes as he stared back at me from his world' (Ridgway 1987:121-122).

[56] Flipper was an American television series running from 1964-1967 in which Flipper, a bottlenose dolphin became the companion of Chief Warden at a fictional marine preserve in southern Florida.

This fascination, sense of empathy, and great affection held for Tuffy by Ridgway and his team is further exemplified in Tuffy's last days as he succumbed to a fatal infection. Ridgway described being 'heartsick':

> 'All of us who had worked with him grieved the loss of this marvellously complex life. For me it was not so much I had lost a valuable research animal, although that was true. Far more important was that I had lost a beloved friend who had helped me to learn more about my world and his' (Ridgway 1987:191).

Figure 66: The 'smiling dolphin', Official photograph, US Navy (Man in the Sea Museum)

Like the elephants described in Lorimer's (2010b:492) study, Tuffy emerged here as the 'companion species par-excellence: too social and sagacious to be objects: too strange to be human'. He came to affect, or as Halloy and Servais (2014) would suggest, enchant those who worked with him and he 'forced thought' (Whatmore 2013:40). In another example, George Bond (1965, entry 17th September) writes:

> 'I was struck with the appearance of his eyes as he gazed on me, for feet down. This was the same look I have seen in the eyes of very old and wise people as they watch young children at play. Somehow, it is not right for the Principal Investigator of a million dollar scientific project to be self-conscious in front of a ten-year old Tursiops Truncatus.'

Much like the scientists 'counting corncrakes' in Lorimer's (2008:398-399) work, the willingness of the scientists involved in Sealab and the Marine Mammal Program to express affection, self-consciousness and even love towards Tuffy is perhaps important. Not only does it, as Lorimer suggests, undermine the 'dispassionate, objective' expertise associated with their respective sciences but it opens up (geo)political space to 'new forms of representation'. Whist the bonds and affective responses described above are usually associated with human-human interactions, or human interactions with land mammals such as dogs, or elephants (Lorimer 2010b) powerful affective dispositions were at play here (Hediger 2013). 'Love across the species' (Cudworth and Hobden 2014:14) existed alongside, and became enrolled in, a geopolitical agenda. Affinity between man and dolphin perhaps further entrenching the idea that the sea could be inhabited much like land, and that its inhabitants could not only be trained to act at the will of humans, but that they could be loved and a mutual sense of understanding bridging an affective divide in much the same way as the animal/human divide is bridged on land.

Yet Tuffy also demonstrates the 'complex and contradictory' nature of domesticating practices (Anderson 1997:478). It is always an 'experimental process…without guarantees of success' (1997:478) and he proved recalcitrant at times to human co-option. Dr Ridgway (1987:37-38) describes one instance, shortly after Tuffy's capture where his trainers (Mo, Bill, and Wally) were attempting to get the dolphin into a sling to remove him from the tank for a health examination:

> 'Unexpectedly the dolphin recoiled. With its snout it swatted Mo on the head, knocking him backwards into the pool. With its tail flukes, the dolphin flailed Marty's shins and knocked him headlong into the water. Bill received serval body blows…the aggrieved dolphin rushed past Wally, knocking him into the water…about ten minutes of thrashes, splashes, bites, and bruises followed. Finally the skinny dolphin with the scar lay still on the rubber pad with four men draped across him…. Fat lips, bloody noses, torn clothing and too many bruises to count proved that the dolphin had shown us who was boss' (Ridgway 1987:37-38).

It was after this event that the dolphin was named 'Tuf Guy'. In another instance, trainer Wally Ross used psychological, affective coercion rather than 'manpower' to bend the dolphins' will. A net, similar to the one used to capture him from the sea was thrown into the pool and the effect was immediate with Tuffy lying 'absolutely still' on the canvas. Sometime after his capture, Ridgway commented, 'he still gets mad' (in Olten 6 August 1965) – 'he hits people with his flukes and then sulks in the corner for 5 minutes'. Expanding on this during an interview (26 April 2016, local restaurant) Dr Ridgway described how a dolphin's body posture changes when they are angry, 'they make a growling sound, and snap their jaws'. In reference to Tuffy specifically, he explained how the dolphin would 'really sulk, he would gnash his jaws, but then in an instant later he would be back to normal as if he forgot it ever happened' (Dr Sam Ridgway, 26th April 2016, local restaurant). Whilst Hobson (2007:263) stresses that she is not claiming that the animals in her study could not verbally express preferences, Tuffy certainly spoke. He was a 'mobile, mutable, and emotional' animal able to express displeasure through body and action (Lorimer 2010:238). Indeed, Bond (1965, entry 17th September) wrote that he shared the view of others that was in fact Tuffy training them and not the other way round as he 'see seeks continually to improve the repertoire of those stupid men-fish who can't even talk at thirty-eight thousand cycles and swim at only 0.8 knots'. We might compare his behaviour to the disobedient aquanauts, framed as recalcitrant whilst simultaneously reinforcing a masculine ideal. As Charles (2014:724) asserts, animals should be understood as 'social actors who make choices and act upon them if they are able'.

In his first runs to Sealab, for example, Tuffy did not do what he had been trained to do. Bond (1965 entry 16th September, see also *Los Angeles Times,* 17 September 1965) describes how

> 'he flipped over and headed straight down for SEALAB II. Four and one half minutes later, he was on the surface, looking disillusioned and anxious to depart the scene, which he did. Shortly, the Aquanauts reported that he reached the bottom, took a long horrified look at the ungodly array of threatening hardware on the ocean floor, and fled ignominiously.'

Sam Ridgway describes how he 'was very cautious at first…it was a very unnatural environment for him with all the wires and lights' (Interview 26th April 2016, local restaurant). This was followed by headlines stating that Tuffy's performance was 'not so hot' and that the 'impish dolphin performed bashfully' (*Davenport Times-Democrat*, 17 September 1965). The official report detailed that the cords, wires, flood lights, and sounds emanating from Sealab had deterred him – the colonisation of his natural environment by humans assaulting his senses. This slightly uneasy relationship manifested itself in other ways too. One newspaper report speculated for example that the training could be reversed to make dolphins attack enemy divers should the time ever come when 'US aquanauts clash with their counterparts from an enemy power' (Bowler 6 September 1965). There were also fears that Tuffy might instinctually push a troubled diver to the surface towards air – something that would prove fatal to the divers saturated bodies (Bob Barth, 7 February 2016, Mr Barth's home, Bowler, 19 August 1965).

Domestication, writes Power (2013:371), is 'a key process through which humans have claimed dominance over nature, including non-human nature'. As Tuffy demonstrates, this is a complex process drawing on a 'mix of moralities; of care and control, as well as mastery and paternalism' (Anderson 1997:478). As Anderson goes on to highlight, it also entails affective responses ranging from affection and love to frustration. In the process, the case study of Tuffy reveals how animal-human relations are shaped similar colonial impulses that exemplify how 'Western ideas of how humans should relate to nature (dominate, commodify, protect)' (Hovorka 2016:7) are operationalised through the body of an individual animal. Indeed, Bear's (2010) assertion that geographers should attune themselves to the stories of individual animals is reinforced through Tuffy (see also Forsyth 2016a). His ‘individual personality quirks and traits’ (Fox 2006:531), in addition to his physical, embodied characteristics are a conduit for wider questions pertaining to colonialism, gender, frontier ideologies and practices, and the nature of ‘man’s’ engagement with the undersea environment.

6.2 Domination and the non-human cyborg

Before moving away from mammals to smaller but no less significant inhabitants of the sea, it is worth noting that at the time of Sealab, marine mammals were being exploited and dominated in far more sinister ways. Whilst Operation Headgear bore no relation to Sealab or the activities of the Marine Mammal Program, the manipulation of sharks that ensued is indicative of a wider agenda that sought to explicitly dominate and exploit, rather than domesticate marine life. During this top-secret covert operation, the Office of Naval Research, in conjunction with Scripps Institute of Oceanography sought to test ‘the feasibility of directing a shark, perhaps carrying a payload, to a target area some distance from its point of release’ (Snodgrass and Gilbert 1971:1)[57]. The tests, carried out at the same time as Sealab, involved inserting electrodes into the sharks’ right and left olfactory bulbs in their head before sending electrical signals through the electrodes to direct their movements. Unlike the dolphins of Sealab II, personality, affection, and affective dispositions were not considerations as the sharks’ were reduced to ‘bare life’ in this Cold War experiment (see Agamben 1998).

[57] This could perhaps be recognised as an early pre-cursor to the ‘development of a precision-strike capability’ described by Gregory (2011) and others in relation to drone warfare.

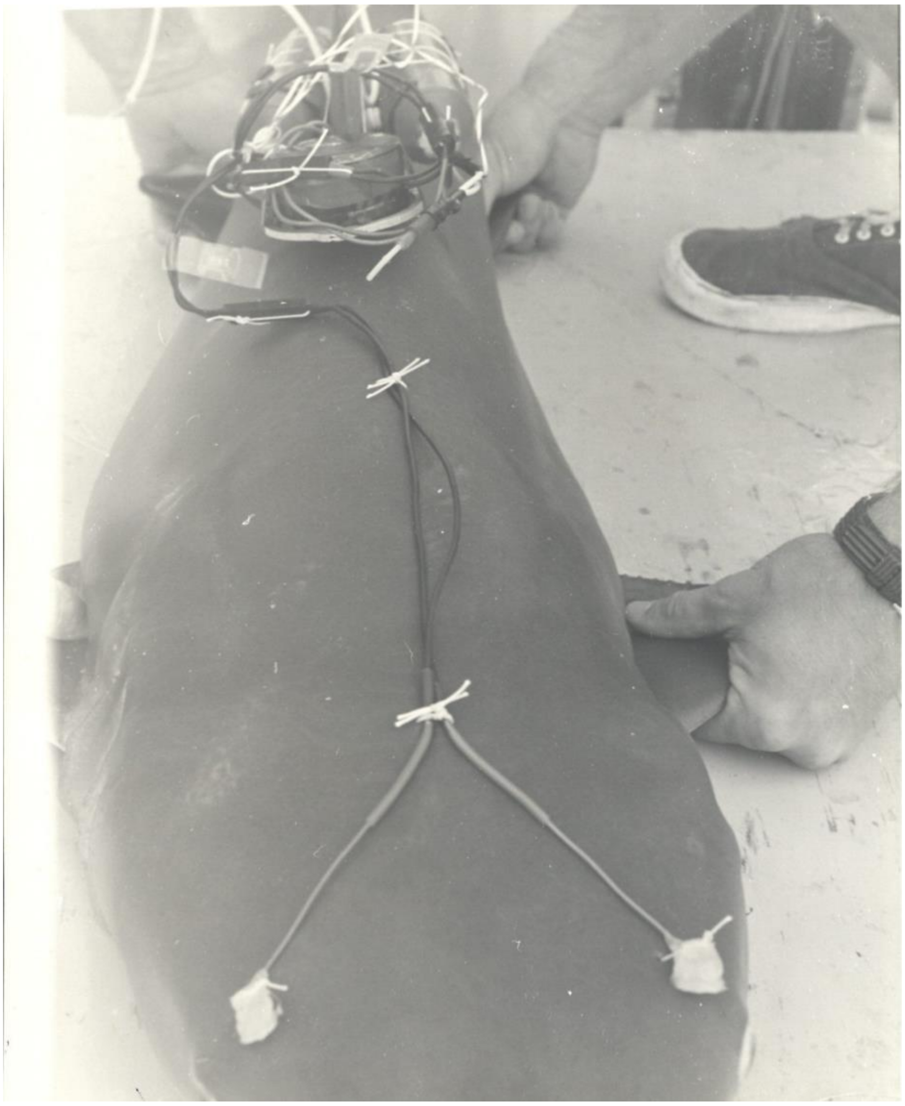


Figure 67: the live body of a shark with electrodes attached its head during Operation Headgear (Scripps Institute of Oceanography archives, UCSD)

The primary objectives of Operation Headgear involved the directing of shark swimming behaviour in the open sea via a control mechanism on board a boat; the studying of the shark to determine the nature of electrical signals and the anatomical location of the electrode placement'; and generating new information about shark hydrodynamics in order to understand how much the animal could carry and the distance and speeds it could travel at (Snodgrass and Gilbert 1971:3-4). Sharks (Tiger Sharks and Lemon Sharks were used in the project) were not chosen incidentally. Rather, they were enrolled because of the characteristics of their physiology. They are, as the report highlights, silent 'and possess no mechanism for sound production' making them undetectable to submarines and divers alike; they could not be identified by sonar 'since they lack the gas bladder that almost all bony fish possess'; they are known to traverse long distances; they can go for long periods without food; their waste products are limited and easily cared for; certain species can be kept out of the water for 30-45 minutes; if the mission should fail a shark is negatively buoyant so would sink; and, in contrast to the activities taking place in the Marine Mammal Program, 'man can intellectually dominate a shark – something he finds much harder to do with a porpoise' (Snodgrass and Gilbert 1971:1-2). In other words, sharks had the potential to be the ultimate in stealth weaponry.

Figure 68: A shark is held down as electrodes are attached to its body during operation headgear (Scripps Institute of Oceanography archives, UCSD).

The testing took place in a number of locations including in waters off Hawaii, Puerto Rico and Florida both in the open sea and enclosed environments (see Figure 69). Whilst the load carrying capabilities of the shark were 'surprisingly limited' the project was deemed a successful illustration in the capacity of marine mammals to be remote controlled. This control, however, had limits and Snodgrass and Gilbert (1971:7) describe how they were 'repeatedly impressed with the shark's inability to respond to prolonged electrical stimulation. Either because of fatigue of habituation to the signal, no instrumented shark made good on a constant course for more than 30 minutes or a distance of 3/4 of a nautical mile.'

Figure 69: The remote testing site for Operation Headgear (Image courtesy of Scripps Institute of Oceanography archives, UCSD).

Figure 70: Attaching the electrodes to the shark's body – a nonhuman cyborg (Image courtesy of Scripps Institute of Oceanography archives, UCSD).

Whilst not directly related to Sealab, this case study is a powerful example of the ways in which animals were enrolled in governance regimes and 'controlled by modes of biopower that designate ways of living and dying' during this time period (Vint 2010:444). The affection and love expressed for the dolphins in Sealab is tellingly absent here as the bodies and physiologies of sharks were studied and mapped in order to control their movements. The Cold War imperative to dominate and master the seas was transferred onto the oceans' inhabitants and made manifest through the electrical impulses interacting with the sharks' brain. The 'fixity' described above takes on new meaning here as the Navy sought to fix and determine the precise mobilities of the shark who's natural habitat would ordinarily be the vast expanse of the sea. We see again embodied examples of this 'fixing' in the images below and above with bolts screwed into the sharks body and the many hands holding the animal in place whilst man-made technology is incorporated into the sharks' physiology.

Feared by many humans and possessing a different kind of 'charisma' (see Lorimer 2007) of their marine mammal counterparts, sharks act as the 'awe-full' to the porpoises' 'awe-some' (Lorimer 2007:918) encouraging highly differentiated interactions and very different understandings in the role of non-human marine bodies in the construction and governing of undersea space. Non-human charisma, argues Lorimer (2007:928) when 'mobilised by key human individuals' can be operationalised to promote conservation and welfare agendas. When this charisma is lacking however, and biopolitical governing regimes are operationalised in the intellectual and physical domination of a species, the affects and effects, as demonstrated in Operation Headgear, are markedly different. We see here the re-emergence of the cyborgean. During Sealab, the 'shark', unlike the dolphin who could man's best friend underwater, was framed as something to fear and shark repellents were developed to keep them away, but when combined with technology and electrodes, the shark becomes a non-human cyborg bent to the will of those controlling it (albeit for a short period of time). In this biopolitical shift that sees an intervention in and manipulation of life itself (Foucault 1990), the cyborgean visions of 'bodily control and regulation' outlined in chapter 5, act powerfully on the non-human body as a wider Cold War pre-occupation with blurring the boundaries between the human and technology, is transposed onto the bodies of sharks for military purposes (Farish 2010:147). Chosen for their physiological properties, the wires, electrodes, and human hands pinning the sharks down, come to function as an example of a Cold War non-human cyborg par excellence as physiology, technology, and military objectives collide in the element of the ocean.

6.3 Observing, managing, and negotiating

'If you are a marine biologist, can you imagine a more ideal aquarium than the sea itself to which you too for a while, belong?'

(US Navy 1965)

The Sealab projects were characterised by 'interspecies entanglements' (Lorimer 2010b:292) at a number of levels from fish through to minute plankton drifting with the motion of the water and this section of the chapter therefore seeks to move down from the mammals presiding at the top of the food chain. The second team of Sealab II in particular provide a productive prism through which to engage with the non-human as they were charged with conducting an array of animal observations and experiments (ONR 1965). Whilst Lambert et al. (2006:486) call for greater attention to be paid to the medium of the sea itself in order to better understand 'perspectives on the world that start, rather than end, at the beach and the port', Sealab offers an opportunity to start within the sea itself. In doing so, the surface of the sea and land are backgrounded, and instead the water column and sea floor come to the fore providing a rich insight into the relationship and interplays between the human, non-human, and elemental volumes during the experiments. As this is cut through with the imperatives of the military and science, we are offered a 'means to critically consider disruptions between the human and non-human' (Forsyth 2013:535) and the challenges raised by the immersive, life filled, volume of the sea.

6.3.1 Fish

Many species of fish played a role in shaping both the outcomes of Sealab and the experiences of the Aquanauts'. In Sealab I for example, Walt Mazzone (in O'Neal 1965:39) described how the 'subjects' (the aquanauts) hope to 'train some' of the 'abundance of fish. Primarily, however, the fish were objects to be studied. This formed one of the major program areas of Sealab II and whilst many of the experiments did not take place due to time and diving constraints (Tolbert and Dowling 1967), engaging with the efforts to understand the sub-marine environment produces some interesting insights into the role of marine life in the Navy's wider geopolitical agenda. Oceanographers, in conjunction with the Navy had multiple plans for studying fish life. The attraction of marine animals to objects placed on the sea floor, the behaviour of sea life around large objects, and a study of how fish on the seafloor reacted to low barriers placed in their way were among proposed studies (Tolbert and Dowling 1967). The media also reported that the sounds made by fish were being recorded and matched to their corresponding species to enable the Navy to improve their underwater detection systems (Corbett 1968b). 'Marine life pyramids' (see Figure 71) were to be constructed to enable these studies to take place. These 'fish houses' (unknown newspaper source) aimed to enable the oceanographers turned aquanauts to take a census of fish populations, to record their movements and to perform more invasive studies to measure the gas pressure and composition in the swim-bladders of certain fish. The aquanauts, according to Bowler (13 August 1965), constructed 'their own zoo' by stacking concrete blocks to create 'tunnels and openings for the fish to use, 'much as conservationists on land build brush piles to attract quail and rabbits…Special attention will be given to tiny organisms which live in holes in the sand' - 'even the insides of the fish won't be safe' as oceanographers sample their gas bladders to determine how they ‘regulate their buoyancy’. The Aquanauts could subsequently watch ‘their charges’ from the safety of the habitat’ much like those topside were observing the aquanauts.

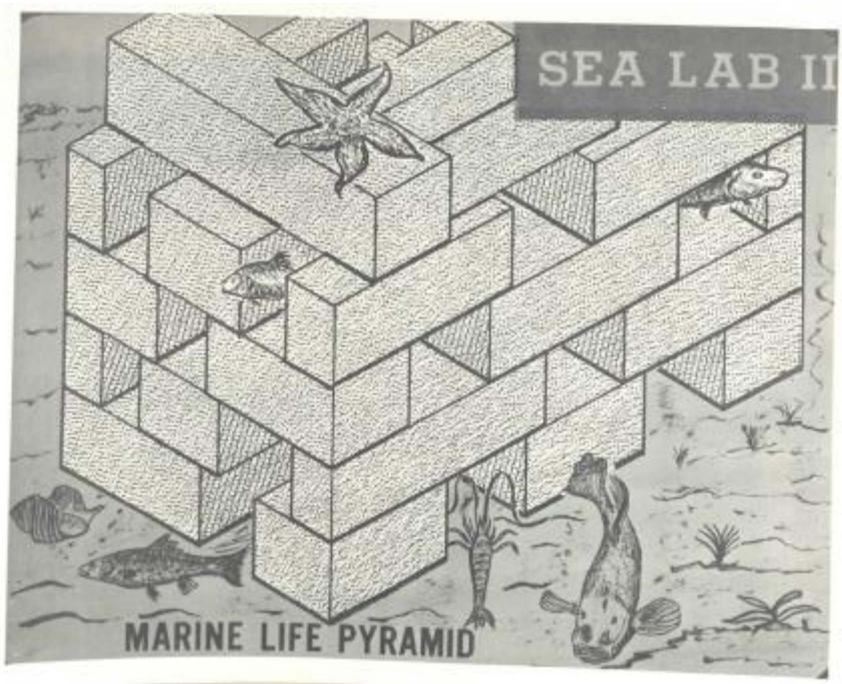


Figure 71: An artist’s conceptualisation of the Marine Life Pyramid (image courtesy of the Scripps Institute of Oceanography archives, UCSD).

Whilst the word ‘zoo’ is not used in official accounts of Sealab, its use in media reports is not insignificant. As scholars such as Anderson (1995) and Whatmore and Thorne (2000) highlight, zoos represent a cultural institution that reflect, not nature itself, but a human ‘adaptation of the ensemble of life forms that bear the name ‘nature’ (Anderson 1995:276). Far from politically innocent social constructions, zoos, writes Anderson, ‘ultimately tell us stories about boundary-making activities on the part of humans’, they are ‘spaces where humans engage in cultural self-definition against a variably constructed and opposed nature.’ Yet, in the case of Sealab, the building of fish habitats for observational purposes had different, but nonetheless significant effects. Far from creating boundaries, the immersive nature of the experiments brought an ‘externalised wilderness’ (Neo and Hgiam 2014:243) that would otherwise be unobservable under the human gaze. The aquanauts, fully immersed in the sub-marine living space, became part of the environment and vice versa. As one anonymous aquanaut commented in a conversation with a psychologist:

‘We would sit and would watch those animals out there by the hour. We also thought we were part of this, this was our little world and all. We were in our own back yard’ (Aquanaut in Radloff and Helmreich 1968:112)

A ‘routinised living space’ (Whatmore and Thorne 2000:193) was created wherein the aquanauts, along with the associated plethora of manmade technology imbricated themselves in the undersea environment whilst simultaneously, the fish too, ‘colonised’ the aquanauts’ sub-sea home. As George Bond (entry 8 September 1965) wrote in his diary:

‘Finally, the third team will enter the now venerable home of the Aquanaut. I think that as they approach SEALAB II near the end of their descent, they will first be struck by the appearance of their new house. No longer a pristine white with gleaming metal-work, SEALAB II by now will have become a natural part of the seafloor topography[58], a slate-gray mass, surrounded and partially inhabited by swarms of marine life, and blending so perfectly into the bottom seascape as to almost escape identification... Just as each generation of ancient cave dwellers left indelible and revealing marks and patterns of occupancy and culture so will it be with SEALAB II, shelter and haven and undersea cave of mankind seeking dominion over the sea.’

In another example, the lights of the habitat, wrote the ONR (1967:18) proved to be a ‘very effective fish attractant’. As Bond elucidates, the lights of the Personnel Transfer Capsule also proved to be very attractive to fish. ‘I was advised’ wrote Bond (entry of 23 September 1965) ‘that a few fish had infiltrated a loose area in the fish screen’ of the PTC. The word infiltrate here suggesting that the fish were somewhere that they didn’t belong in spite of being in the depths of the sea. The fish in question were anchovies and they went on to cause significant issues:

‘The problem of the anchovy-filled PTC is as yet unresolved. Scott does not wish to have the lights turned out, and where there are lights, there too will you find anchovies, first by the gross, then by the curt, and finally by the ton. It further

[58] Interestingly here we see that Sealab is no longer a settler habitat in a frontier locale, but a natural part of the environment.

> follows that within hours you will find dead anchovies, putrid anchovies, and a thoroughly distasteful mess. This bulk having migrated up through the lower grating, presents a very real problem, since the PTC should be at all times ready for occupancy, which it surely is not at present. We plan to flood the chamber by a few feet, then attempt to blow the whole rotten package through the grating and skirt, and out to sea' (Bond entry of 3 September 1965).

In spite of their best efforts to clean the PTC on the sea floor, the anchovies set into motion a chain of events that saw he only safe haven for the aquanauts in the event of an emergency in the habitat removed from the sea floor 'for a thorough cleansing and deodorising' (Bond entry 11 September 1965).

As fish and sea-life were attracted to the habitat, the scientists/aquanauts were able to observe 'predatory and other behavioural interactions' and the 'structure and dynamics of the community of animals' who are attracted to such 'artificial substrates' (ONR 1967:18). As Aquanaut Bob Barth explained in an interview (Bob Barth, 7 February 2016, Mr Bath's home), 'you could sit at the porthole and watch a small fish get eaten by a bigger fish, then the next predator would come along and eat that one, and then a sea lion comes along and eats the biggest fish'. In this 'backyard' interventions in nature became routine, creating an ecosystem 'in which some species…thrive while others lose out' (Anderson 1995:275). As Tolbert and Dowling (1967:362) assert, the habitat 'affected the ecology of a much greater area than had been expected' and this had significant implications for submarine life and, conversely for the life of the Aquanauts. The habitat altered the environment, creating a microcosm of an ecosystem that could be observed by the aquanauts. At the same time, they also confounded the men's ability to observe in the first place. The sheer mass of fish at the portholes made it impossible for the scientists to look out. As Earl Murray, oceanographer/aquanaut commented:

> 'Too many fish here to see out' (Murray journal 9th day 1965).
>
> 'Many fish make observations difficult' (Murray journal 15th day 1965).

Similarly, the *San Francisco Examiner* (3 September 1965) reported that the men were complaining of a lack of light – 'the problem: jellyfish are so numerous they diffuse the light and make visibility poor'.

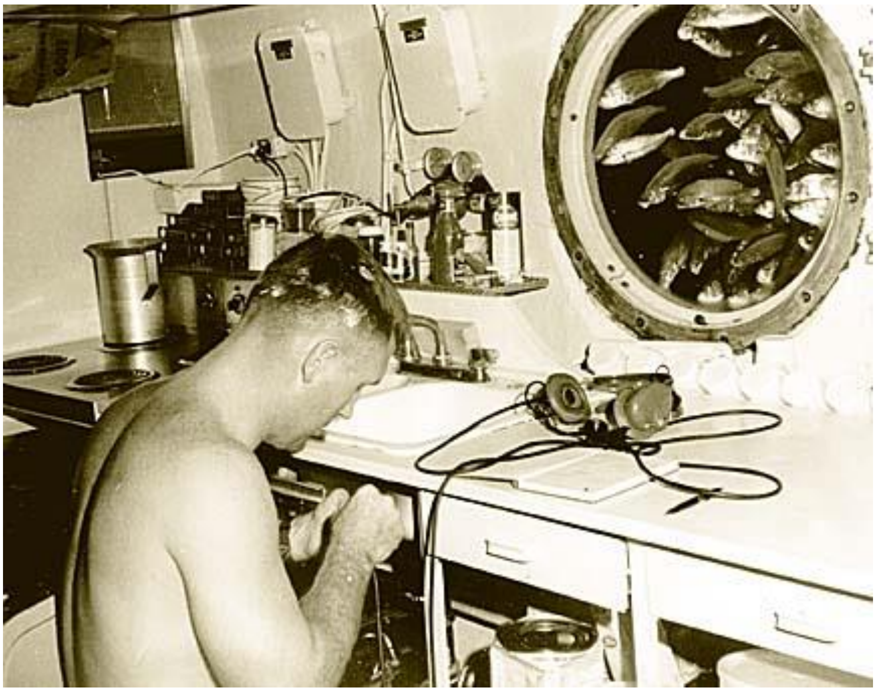


Figure 72: 'The nation's aquanauts in 205 foot-deep Sealab 2 feel like they're in an aquarium on display for curious fish outside the porthole. Berry Cannon is oblivious to visitors while repairing a headset' (*Star News*, 6 September 1965)

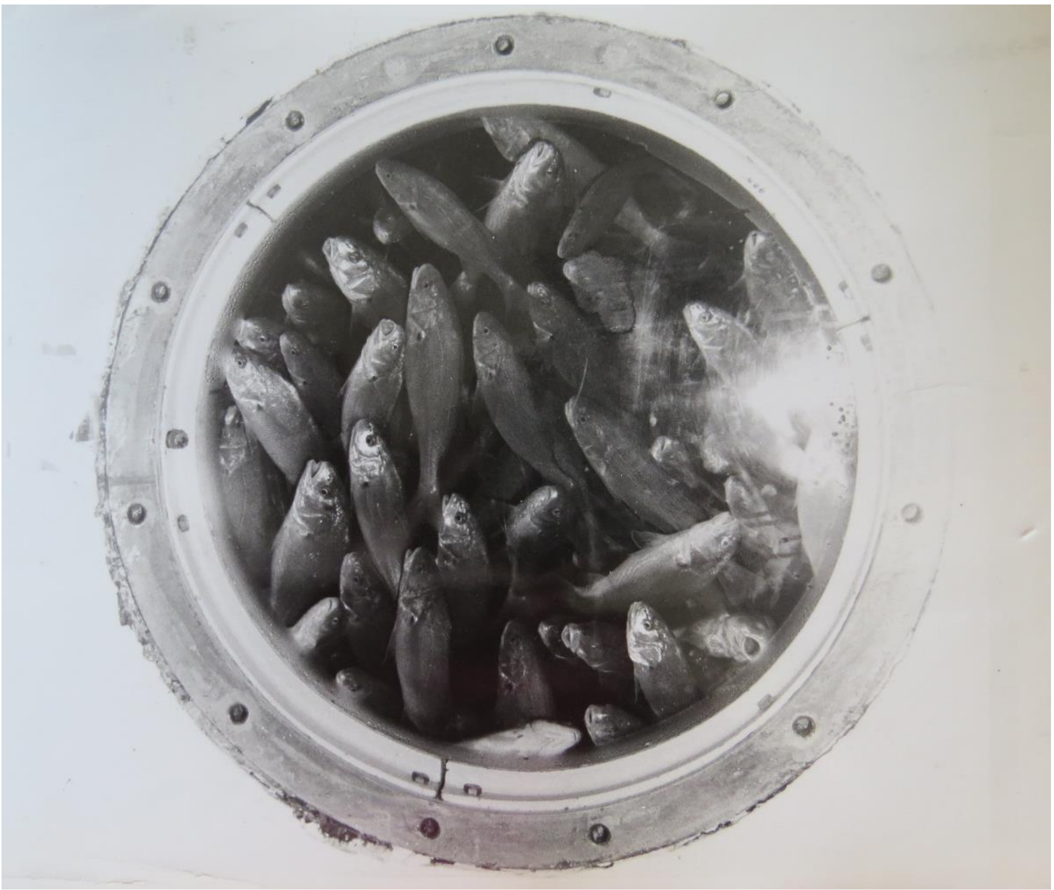


Figure 73: White croakers at the porthole (Image courtesy of the Man in the Sea Museum Florida)

The fish (white croakers), ‘crowded near the portholes’ at night, ‘occurring in such numbers as to completely obscure the port’ (Tolbert and Dowling 1967:355-356). As Murray suggests, at times this prevented the scientists/aquanauts from making observations – human scientific imperatives here become actively shaped and restricted by the life surrounding the habitat. When the portholes were clear, however, the sea-life came to function in another way, inspiring awe and a sense of wonder at the extreme environment. As Tolbert and Dowling (1967:355) assert, porthole watching became the ‘favourite pastime of the entire crew, and many hours were spent observing the antics of our outside neighbours’ whilst Thompson (1966, entry 27 July 1964) described how ‘the Hollywood people could easily film out of this port for a science fiction story of living or landing on another planet’. Another aquanaut described how the views ‘kept you on pins and needles’ (in Radloff and Helmreich 1968:112). George Bond too felt the affective force of the underwater environment:

> 'Once inside, we were both so fascinated by the view, illuminated by 10,000 watts of light, that we spent most of our time watching the fish which were watching us. Probably for the first time, I got a real feel for life on the ocean bottom. And that *sensation will haunt me forever'* (Bond entry Armed forces day, page 5 of typed version 1964, emphasis added).

Similarly, the US Navy (1964) film of Sealab I asserted:

> 'And what the men saw below, for all the tired sophistication that sometimes dogs out civilisation was like a kingdom out of the soaring fantasy of the child and the poet - of man and youth and all the ages of this old planet of ours. Emerald green or zenith blue, depending upon the state of the sky above the kingdom changes its hue and mood. The angel fish and grouper saw such visitors that they had never seen before even in this teeming liquid world of millions of species. The Barracuda, the fearsome creator of one legged men in the pirate legends were on their most benign behaviour for the tourist invasion'.

Whilst a significant proportion of literature relating to animals and geopolitics frames the non-human subjects as passive entities to enlisted, trained, and mastered, the non-human life surrounding Sealab gained its own agency in its ability to affect, fascinate, and even give 'pins and needles'. Lorimer (2008) demonstrates the importance of affectual forces in animal-human relations. Lorimer joined field scientists analysing corncrakes and stag beetles and describes the range of affective responses to the animals. Moved, enchanted, transfixed, repulsed, are among the responses described and nonhumans came to powerfully shape the experiences of human observers. As Buller (2013:311) demonstrates, animals can prompt raw affective responses, 'laying bare ourselves' in extraordinary encounters. Sealab perhaps demonstrates that the non-human has the capacity to inscribe the human rather than being mere passive subjects of militarisation. Whatmore and Thorne (1998:435) assert that the 'wild' occupies a 'special place in the imagined empires of human civilisation…a place populated by creatures at once monstrous and wonderful, whose very strangeness gives shape to whatever 'we' are claimed to be'. Whilst attempts to fix and domesticate the wild through the bodies of animals like Tuffy and the construction of artificial fish habitats, there remains something excessive and unfixable about the undersea environment. Attempts to make this extreme environment 'normal' could not account for the affective

Beyond observation and 'intrusive' behaviour, fish posed other challenges. Scorpion fish, 'which literally blanketed the sea floor around Sealab II' and were 'packed in every cranny around the habitat' posed a constant threat to the aquanauts and affected them in different ways (Bond entry 17 September 1965). Their stings can be painful at best and fatal at worst, with poison that affects the central nervous system. Whilst oceanographer Arthur Flechsig (Scripps Oceanographer aquanaut) described how the 'fish are pretty passive in this whole business…they aren't aggressive or anything like that' (*San Diego Evening Tribune*, 13 September 1965), the aquanauts were constantly aware of the ever present threat lying on the sea floor. Far from being passive the scorpion fish actively prompted affective responses of fear in the aquanauts. As one aquanaut elucidated (in Radloff and Helmreich 1968:64):

> 'I don't like the idea of going out there and getting zapped. I was always in fear of touching the bottom. Then you could see those fish out there – like stones – like a cobblestone street. Wasn't a space of more than 4 or 5 inches from one fish to another'

Other comments included:

> 'I don't like those fish…I was scared of those fish. I don't like the idea of going out there and getting zapped and not knowing if the effects of that fish are going to prevent you from getting back inside the lab because you can get stung like that, go into a type of fit…so I was always in fear of touching the bottom'
>
> 'near the end I counted 27 scorpion fish in one meter square…and this is a carpet of spines'
>
> 'you worry about stepping on the fish' (65)

'Affective energetics' emerge through 'fleshy human-non-human interactions' (Lorimer 2008:397) or in this case, anticipation of potentially painful human-non-human interactions. The capacity of the scorpion fish to incapacitate the human shaped the aquanauts engagement with the environment and prompted affectual, pre-cognitive feelings of fear and worry rather than the wonder described above. Whilst the scorpion fish may have appeared like a ‘cobbled street’, these ever present animals were far from domesticated – something that astronaut Scott Carpenter learned only too well when he was stung, causing painful swelling that was treated by the in-habitat doctor.

As reported by Smith (1968), scientists sought to overcome the problems of the scorpion and other poisonous fish in the next experiment, Sealab III:

> ‘The Navy's San Diego based Sealab III experiment will include an extensive study of poisonous sea animals, it was revealed yesterday. Part of the study will focus on the sculpin, a variety of scorpionfish which temporarily halted Sealab II operations.
>
> Another part of the project will be to prevent swarms of poisonous fish from threatening operations outside Sealab III (like Sealab II). Dr Findlay Russell, Professor of neurology and Dr Paul Saunders professor biological sciences were named by SSC to head the study. Russell told in an interview how the study will have significance for all people and especially those who someday will live on the sea floor.
>
> "Today most of our food comes from the land but in future years this supply may be insufficient to meet the dietary needs of an increasing world population. Man may have to live in underwater stations and farm the ocean floor" This can't occur until we know much more about poisonous and venomous marine organisms. There are about 1,000 different kinds of these already known. Undoubtedly there are others yet to be identified.
>
> The primary aim of the study will be concerned with venomous fish, the biochemistry and effects of their venom, treatment and feasibility of producing antitoxins.
>
> "We plan to collect a number of venomous marine mammals. Venom apparatus' will be removed, frozen and taken back to the lab where the venom will be extracted and studied.'
>
> Russell said that the Sculpin are of particular importance to the study. " We plan to tag those we find in the area or we put sonar devices on them in order to follow

> their patterns, we may find it necessary to use their natural enemies to keep them away from the project'.

The fear, threat, worry and 'wildness' of these animals in Sealab was to be addressed in Sealab III. In studying their physiology and toxicology scientists attempted to fix the previously unfixable to enable 'man' to more effectively inhabit the sea. The use of natural predators (or 'enemies' to use the militaristic language of the newspaper report) to achieve this is also significant. Much like on land where biopolitical solutions are found to eradicate certain pests, the ecosystem of the area around the habitat was potentially going to be altered with new conditions of living and dying imposed on the fish in question. As is illustrated in the article, this was incorporated in a wider, future orientated agenda of living in and farming the sea to meet the needs of the growing population. As in chapter 4, temporal frames collapse as the act of fixing and taming becomes associated with future endeavours as the inhabitants of the sea were scientised and sanitised. Moreover, as we have seen throughout the chapter, elemental entanglements characterise these interactions as 'biochemistry', venoms, and gas bladders come to be sampled, tested and mitigated. Whilst the work of Protevi (2008) foregrounds the human, and McCormack (2015,2016) the atmospheric, it is clear that fish were 'inextricably entangled' in this geopolitical project (Buller 2014). As objects of study, scientists sought to ascertain their buoyancy control mechanisms, gather their sounds, and understand their behaviour. They, like the aquanauts themselves, were brought under a geopolitical, physiological regime, demonstrating in the process the need to look beyond the human when understanding the complexities of certain geopolitical phenomenon.

The Sealab experiments also saw anchovies and other sea life colonise' the man-made infrastructure, white croakers obscured the viewing ports, whilst aquanauts constantly had to avoid the stings of scorpion fish. Their impact was affectual too, prompting fear, wonder, and in doing so, demonstrating that the environment and its inhabitants are not so easily fixed and domesticated. Different species acted in different ways, each having an 'impact on' or even 'co-production of' the practices and spaces of the aquanauts (Buller 2014:379). These highly differentiated non-humans also became embroiled in the domestication agenda that drove Sealab – albeit in different way from the bodies of Tuffy, Samantha, and nameless sharks. Science played a key role in this with scientific practices of sampling, observing, experimenting serving to reign in the extreme, to internalise the wild external. The 'in-sea' perspective of the Sealab projects offers a rich insight into what is to be gained when engagements with the non-human break through the surface. In doing so, we also gain an insight into the distinctive conditions of the immersive volume and the elemental entanglements that ensue. Numerous species of fish proved agential in crafting certain geopolitical conditions – not as a homogenous mass but as individual species each with different ways of affecting and effecting the Sealab conditions. If we are, as Adey (2013) suggests, concerned with the 'things' that fill volume, then non-human life emerges through the bodies of fish as a significant avenue of enquiry.

6.4 The unwanted colonisers: Urchins and plankton

Moving down in size, sea-life including urchins and plankton proved to be important in the Sealab projects. To begin with sea urchins, it was reported in the media at the time of Sealab III that these slow moving, algae feeding, globular animals had the capacity to cause problems for the aquanauts. Corbett (1968a) describes, for example how surveys of the ocean floor, some 620 feet deep, disclosed the presence of the potential danger of a 'possible invasion of a large number of spiny sea urchins'. The language here is important, the word disclose suggesting that the sea has the capacity to deliberately conceal – a characteristic of the enemy element hosting a species ready to 'invade' 'man's' new dominion. In response, (according to Corbett 1968), the Navy began trying 'to fence in the urchins with a variety of materials' – these attempts were unsuccessful, as Hoyt of the Navy Mine Defence Lab commented, 'we just can't seem to construct a fence that they can't climb over'.

The San Diego Tribune (1968) also reported on the invasive, colonising urchins:

> 'The Navy has reported another threat to its trouble plagued Sealab III, this time by sea urchins.
>
> The round spiny cousins of starfish, it seems, have colonised the ocean floor site off San Clemente Island, selected for the aquanauts home by the thousands. Sealab

officers are so concerned they reportedly are considering protective measures such as building a small fence around the site or spreading quick lime in the area.

Tom Cooke, ocean floor coordinator for the Sealab III, said the urchins, up to 10 inches in diameter, could cause series problems for the aquanauts. He explained that the spines could puncture the divers' suits and skin, foul delicate instruments around the habitat. The animals might possibly eat through electric cables and air hoses.

Sea urchins have been multiplying rapidly off the Californian coast in recent years… the urchins are armed with sharp half inch teeth that can gnaw through all but the toughest materials.

Sealab scientists studying the problem estimate that the urchins can travel 30 feet a day. The Aquanauts will occupy their underwater house for 60 days making every sea urchin with a quarter of a mile a potential menace.

Dr Jack Hoyt and Mike Salazar if the Naval Undersea Warfare Centre Lab say that they are testing the effectiveness of model urchin fences now in aquariums in the search for a solution.

They agreed that spreading a small amount of quick lime on the ocean floor would kill the urchins and keep others out of the area for years but this might also ruin the natural environment for marine life studies planned during the experiment.'

Sea urchins figured significantly in the Navy's plans. Their mobilities were mapped and measured to ascertain the parameters of the 'potential menace' and 'model fences' were constructed in an attempt to contain the hazard. As the aquanauts had invasively homesteaded the sea, the fish themselves became the intruders, their 'wildness' 'compromised by proximity' as they (much like scorpion fish) came to 'feature only as pests or invasive' animals (Lorimer 2010:494).

The Mine Defence Lab seemed unable to contain them, the urchin's affinity and natural adaptations to the underwater volume proving a stumbling block to the Navy's plans.

Indeed, sea floor fence building strategies also formed part of Sealab II. Tolbert and Dowling (1967:362) describe how they had planned to 'study the reaction of bottom fish to a low barrier':

> 'It has been noted that certain bottom fish will swim around a barrier that happens to be in their path rather than swim over it. This appears true if the barrier is only one of two feet high, but many feet in length. It was planned to construct a small fence outside Sealab (II) and make observations of the reaction of the fish to this barrier through a porthole window'.

Whilst the experiment was cancelled due to poor visibility and low light levels, the idea that the sea's natural inhabitants, whether fish or urchins, could be fenced out of the area around Sealab II and III is not geopolitically innocent. If, as Bear (2012:25) asserts 'territorialisation is first about the acquisition, definition, and reinforcement of spatial boundaries' then the idea of building sub-marine fences is very much an act of territorialisation, of staking a claim to a piece of seafloor and the surrounding water column. It is a reminder, once again, that this pioneering endeavour over the sea and its non-human inhabitants was shaped by colonial imperatives (see Hovorka 2016:7). Imperialistic processes and practices of domination, commodification, and protection were exported into the sea as the homesteading project sought to shape, craft, and engineer the ecosystem surrounding the habitat. Territoriality, is as Wolfe (2006:388) asserts 'settler colonialism's specific, irreducible element' and we might make comparisons between the attitudes of early American settlers toward native Americans to those of the Navy and the seas' own native inhabitants. The 'idea that colonial Americans, were from outset, beset by an Indian problem' characterised the project of mastering the Western frontier (Harvey and Pearce 1988:3).

> 'Practically, they had to overcome this natural man and live with him; theoretically, they had to understand him…they found in America not only an uncivilised environment, but uncivilised men – natural men, as it was said, living in a natural world. And they knew that the way to civilise a world was to civilise the men in it' (Harvey Pearce 1988:3).

The colonisers saw themselves at the pinnacle of a ‘divine order’ (Harvey Pearce 1988:4) with the natives, and their intimate relationship and complex relationship with the natural environment as a people in need of civilising and controlling. The practices, technologies, and discourse deployed toward sea urchins is not dissimilar as their bodies, naturally occurring in the sea, were framed as invaders and something to be subsumed under the divine order outlined in the Sealab Prayer. The imperialistic nature of the project could perhaps not be better exemplified than in the words of the US Navy (1965) , ‘Man looks to distance planets to plant his flag, across the great born of lonely space while at his very doorstep an unmeasured universe abides.’ Moving further down the food chain, plankton may seem unlikely organisms to be enrolled into a geopolitical project yet they too were significant. Whilst white croaker gathered around the pot holes to obscure the vision of the aquanauts, plankton blooms worked to do the same in the water column. As Earl Murray noted in his diary:

> ‘Bad plankton bloom all yesterday…was the end of light, must use hand held lights to see 2 ft in early afternoon’ (Murray journal, 7th day 1965).
>
> ‘Very fine plankton in the morning made vis bad’ (Murray Journal 8th day 1965).

Whilst the aquanauts had plans to fence out the likes of urchins and some species of fish, plankton, who by definition drift in the water column, cannot be controlled by traditional territorialising practices. Again, the voluminous nature of the water is extremely significant here. Straughan (2011) describes how it supports the weight of the human body, yet it is also inhabited by an incalculable amount of non-human life that supports the entire marine eco-system. This suspended life interacted with the bodies of the aquanauts, causing poor visibility and limiting the observations that could be made. The plankton also interacted with the aquanauts’ bodies in a much more visceral sense as it was digested. The Navy made a point of detailing how the men ‘ate plankton with their meals’. The idea that humans could live off these microscopic organisms was an important element of the Navy’s wider public engagement surrounding Sealab. As the videos produced by the Command Information Bureau (see US Navy 1965) stated, the studies of sub-marine life were an important ‘inventory of a future food supply for the proliferating human race.’ The voiceover describes how the men ate ‘Sashimi – that Japanese delicacy roughly translated as raw fish[59]' before commenting on how the men 'dined on plankton after a dive to 300ft. That floating microscopic life of the sea'. According to the film, the aquanauts reported that it 'tasted like nuts' (US Navy 1965). As George Bond (Entry 3rd October 1965) reported in his diary:

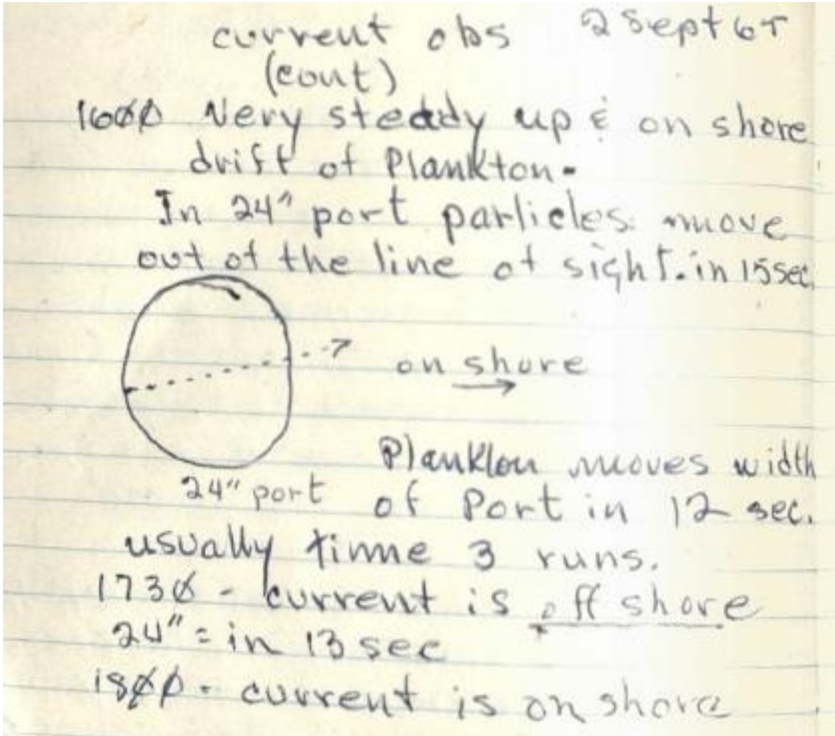
> 'He (Aquanaut Bob Sheates) spoke of eating a handful of these euphausids the day before, and finding their flavour excellent. Plans were developed for a plankton soup dinner later in the day. Being a forager by disposition and training, Bob could easily live off his environment, on the ocean floor as readily as he did years ago in a Jap prison camp. It strikes me that undersea living in the total sense calls for a great deal of woodsmanship which is not easily imparted to a person who does not truly love natural phenomena and who has not spent a great deal of time testing self-sufficiency in the woods.'

As Tuffy the dolphin was used to bring a sense of domestication to this form of extreme living, the domestic, safe, and banal was again brought to bear on non-human life forms. Their ability to nourish and sustain the body became linked with a wider agenda of the ingenuity, or 'woodsmanship' of man, whereby the human, or more precisely, the strong 'outdoors' man, can live off, in and from the sea. It is worth noting here that in settler communities in Western America, frontier negotiators who acted as 'go-betweens' for American colonisers and native Americans were known as 'woods-men' (National Humanities Centre 2009). The woodmanship described by Bond perhaps alluding to the ability of Bob Sheates to act as go-between for nature and man. In the process, the sea once again (see chapter 4) emerges as a space of salvation – with the right skills and knowledge from man, it has the capacity to save the 'proliferating human race' via the abundant life that drifts and floats within its vast three dimensional volume.

At a broader, less corporeal scale, plankton were used a means to measure currents and build a more comprehensive picture of the undersea environment. Oceanographers/aquanauts such as Earl Murray were charged by Scripps (see letter to Earl Murray from D L Inmar, 8 September 1965) with making observations of the movement of

[59] One of the aquanauts had been a prisoner of war in China and therefore introduced the food to the other men.

plankton t analyse the undersea currents, recording how many inches the tiny organisms moved in a certain time frame (see Murray diver log 1965b 4th day, 31st August). As the excerpt from Earl Murray's diary demonstrates, the mobilities of the plankton was mapped and monitored, their bodies providing a prism through which to understand the movement and matter of the sea itself (see Figure 74).



current obs 2 Sept 65
(cont)
1600 Very steady up ē on shore
drift of Plankton.
In 24" port particles move
out of the line of sight. in 15sec.
on shore
Plankton moves width
24" port of Port in 12 sec.
usually time 3 runs.
1730 - current is off shore
24" = in 13 sec
1800 - current is on shore

Figure 74: An excerpt from Earl Murray's diary (1965, entry 2 September) describing plankton drift patters (Scripps Institute of Oceanography archives, UCSD).

The Navy's primary concern, however, lay in the collision (quite literally) of these minute life forms and the increasing proliferation of submarines during the Cold War. Copepods, some of which are planktonic (drifting in sea water), like other life forms in the sea, are bioluminescent and have the capacity to 'betray' the position of submarines as they move through bioluminescent masses. The dangers and opportunities of this were demonstrated during the First World War when, on 9 November 1918, a German submarine was destroyed in the Mediterranean after bioluminescent plankton illuminated its position (Copley and Graham-Rowe 1999). Indeed, Tolbert and Dowling of the ONR (1967:354) assert that bioluminescence has become a 'problem of military significance' since the 'advent of night-time naval operations'. As a result it had received attention from a number of investigations and Sealab II was no exception. Aiming to provide some much needed quantitative and qualitative information on the subject, ‘a portable light-baffled underwater photometer capable of measuring the bioluminescent intensities of planktonic organisms’ was provided to to the aquanauts/scientists. Whilst it proved difficult in reality as the plankton did not illuminate to the extent needed, the Navy were able to gain some interesting insights. For example:

> ‘one interesting observation concerning the occurrence of this phenomenon at these depths is that the most intense displays were restricted to a very narrow (less than 1 inch) region above any exposed surface. Thus by generating a current a diver could see in detail the surface of a rock at the edge of the canyon or small surface protuberances in the darkened exterior areas of Sealab’ (Tolbert and Dowling 1967:354).

An interesting dynamic emerges here between the diver, the water, and the bioluminescent matter. In moving the water, the aquanauts’ vision of certain objects and surfaces increased. The water column, the light contained within it, and the human body emerge here as an elemetally entangled and co-constituting entity. Simultaneously, the Navy’s rhetoric again naturalises man’s present on the sea. Tolbert and Dowling (1967:363) describe their capability to ‘attack’ oceanographic problems such as this. The Navy are framed as the attackers, yet in describing bioluminescence as a military ‘problem’, the natural inhabitants of the water who drift with the currents and provide the foundation of the marine food chain and ecosystem are represented as a stumbling block in realising their undersea ambitions. Sea life once again becomes the ‘pest’, the bodies that can betray, in the ‘hostile’ sea environment.

Plankton and sea urchins proved to be extremely important in the shape and conduct of the Sealab experiments. Much research in animal geography and on animals in political geography focuses on large mammals that are easier to see, demonstrate intellect, and are thus more natural counterparts to engage with. Moving down the food chain and exploring marine life at a variety of scales, however, demonstrates the richness of the non-charismatic, the life that initially has no character to speak of, yet has profound effects on the outcome of geopolitical phenomena such as Sealab.

6.5 Conclusions

Animals are, as Buller (2014) assert, inextricably entangled in the world and the undersea environment is no exception. Through the bodies of dolphins, sharks, various species of fish, sea urchins, and plankton this chapter has demonstrated that animals 'matter individually and collectively, materially and semiotically, metaphorically and politically, rationally and affectively' (Buller 2013:310). Geographical, and more specifically geopolitical engagements with the sea cannot be explored through the case study of Sealab without attending to the life that first inhabited the water column and sea floor – and perhaps it should never attempt to. Far from being a purely social construct (see Steinberg 2001), this chapter (through structure and content) has sought to comment on, and contend with, the 'creative presence of nonhumans in the fabric of social life' (Whatmore and Thorne 2000:186) and more specifically in political life, in the construction of territory and in the elemental entanglements produced in the Sealab experiments. As Francis et al. (2011:185) highlight, it is a particularly important endeavour in 'frontier locales' given the many 'socio-ecological issues and challenges' that arise in the creation of a healthy and functioning society. Whilst the emphasis on the socially constructed nature of the sea has led to an attentiveness to the oceans' materialities, it has also led to a 'foregrounding of human agency and perspective' (Bear 2010:22). This, as Lambert et al. (2006:483) suggest 'makes for a curiously static and empty conception of the sea'. Whilst Lambert et al. (2006:483) continue to suggest that this prevents an engagement with the sea as a lively and energetic material entity in its own right, as a 'pulsating medium', it also works to obscure the agency of the life that moves with and resides in this ever mobile volume. The emphasis on the 'social' perhaps also makes the human the starting point in any analysis of interactions with non-human entities. The submarine perspective afforded through Sealab offers an opportunity to unsettle this human-centric approach. Whilst it clearly deals with the non-human as they relate to the human, the interplays between scorpion fish, anchovies, white croakers, sea urchins, and plankton with the human provide insights into the collision of man and sea-life as they occur and outplay from the sea floor. It also provides insight into the difficulties associated with sea life in the practices of managing life forms that are recalcitrant to human inscription and subordination, and which pay no attention to manmade territorialising practices. Whilst Forysth (2013 and others) refer to the militarisation of nature, we might also think about the capacity of nature and non-human life to resist military inscriptions through their innate behaviour.

Moreover, in being open to animals (from individual porpoises to mass plankton blooms) as relational actors in heterogeneous networks performed 'in and through multiple places and fluid ecologies' (Whatmore and Thorne 1998:437), a number of themes emerge that would otherwise remain concealed. To begin with, in an immersive volume, mediating, controlling, managing and interacting with sea life proved to be an extremely important element of a wider domesticating and homesteading project whilst also demonstrating how the non-human can prove recalcitrant and challenging to human imperialistic projects. To deal with the former first, by engaging with the individual of Tuffy, for example, we see a fixing (both literally and metaphorically) of his body which serves as proxy for taming the sea whilst also valorising the male, strong, scarred body. Moreover, we also see a non-human political physiology outplaying around Sealab. In the same way the minute, cellular workings of the aquanaut's bodies were brought under the gaze of the Navy, so too was the breath of Tuffy, the silence and negative buoyancy of sharks, the gas concentrations in the bladders of fish, the poison in the spines of scorpion fish, the mobilities of sea urchins and the illuminating capacity of plankton. In this domesticating project, attempts were made to fix the animals through science and the scientific practices of sampling, observing, and monitoring. In the process, the minute cellular building blocks of non-human physiology were enrolled into the Navy's agenda.

This being said, this relationship is clearly not a straightforward one. The inhabitants of the sea, much like the element that they live in (Peters 2012), are at times, resistant to human power inscriptions. In the words of Collard (2012:25) animals 'are never entirely under the human thumb'. Stinging fish, blooms of plankton creating poor visibility, Tuffy's temperament are prime examples of this. The nature of the non-human, in spite of the Navy's best efforts with fences and other geopolitical technologies, proves agential and active in the production of the space. Taking a step further, the animals surrounding Sealab affectively influenced the aquanaut's perception of the undersea environment. In addition to the haunting wonder felt by George Bond, the scorpion fish prompted fear, worry, and anxiety as the aquanauts went about their extra-ordinary daily lives. Far from being passive victims of the Navy's imperial 'attack' they also came to act and shape the project in their own right.

The examples analysed above raise some interesting questions about engaging with the non-human *in* volume rather than merely on the earth's surfaces (see work on elephants, dogs etc. Even work on whales involves engaging with them as they break the surface). As elucidated in chapter 3, this is as much a methodological issues as it is ontological. Sealab (and subsequent undersea living experiments and projects) provide examples of the knowledge that can be generated when immersed in an elemental volume. It is perhaps worth considering more broadly within the discipline how this may look and be practiced in other environments (extreme or otherwise) to better understand the role of animals in the construction of space, place, and geopolitics (see Philo and Wolch 1998). In doing so, and as is demonstrated in the rich and diverse case study of Sealab, geopolitics may be better positioned to attend to the 'porous, shifting, and eclectic heterogeneity of ideas, practices, methodologies and associations within a more than-human life/world' (Buller 2013:310) and the complex elemental and territorial entanglements that ensue as the non-human and geopolitical collide.

Finally, it is perhaps important to note the legacies of some of this work today. The Navy's Marine Mammal Program is still going strong and DARPA continue to be interested in learning from marine animals. In 2007, for example, Dr Michael Callahan, Porgram Manager of the Defence Sciences Office, described how Navy Divers could be trained to imitate Steller sea lions who redirect blood flow, reduce oxygen demand, and slow their heart rates during deep divers. It would form part of a physiological 'inner armour'. Further down the food chain and the Navy's support for 'marine bioluminescence research' over the past 50 years continues (Moline et al. 2005:82). The ONR issued a call for research proposals in 2008 to develop a 'navigation aid for underwater vehicles' that will sense if bioluminescence has been triggered an provide the navigator with a 'real-time assessment of detection probability by an above-water observer' (ONR 2008, see also Sahachtman 2008). As a result, the US Navy have sought to acquire the capabilities to forecast whether their submarine vehicles might cause a bioluminescent glow that would illuminate their position. Other countries too are engaged in this research. In 1999, for example, the Ukrainian security service accused four marine biologists of exposing state secrets. The probable reason (according to the BBC 1999 and Copley and Graham-Rowe 1999), was that there research concerned the study of bioluminescent plankton. Marine animals then, remain an important consideration in the conduct and practice of geopolitics and territory making.

Chapter 7

Conclusions: Towards ‘Extreme Geographies’

> ‘H Lawrence diagnosed a specific strain of American dread. ‘Doom! Doom! Doom! He wrote in 1923. ‘Something seems to whisper it in the very dark trees of America’’
>
> (Osnos 2017)

7.0 Introduction

The Genesis and Sealab experiments were a series of extraordinary projects set within a Cold War context that posited that 'man' should have no terrestrial limits, and that there was no frontier too great for the white American pioneer (see Kasier and McCray 2016). In the preceding chapters, I sought to unpack some of the geopolitical interventions that underpinned and drove this sub-marine agenda. I did so via certain actors including George Bond and his geographical imagination, the body and figure of the 'Aquanaut', through the range of sub-marine animals that came to characterise and shape the experiments, and in small ways, via my own body too. In addition to inhabiting a number of bodies and imaginaries, this analysis also travelled through and was oxygenated by the entangling of certain elements whether that be the sea, the fine sand and coarse silt hanging in the water column and shifting along the sea floor, the blood and substances circulating around the body, or the artificial air concoctions designed to support human life and withstand the pressures of the undersea environment.

By way of conclusion, I will briefly draw on some of the bodies, substances, and associated themes that have been analysed throughout the thesis to highlight four key areas of intervention in geographical scholarship. The first will dwell for a short while in the context of the Cold War to explore how the Genesis and Sealab projects might enrich our understanding of the gender norms and politics, the figure of the hero, and engagements with non-human life that characterised the time period. Moving beyond the temporal context of the Cold War, the second section will address the geographical concepts of territory and terrain, tying together some of the arguments in the preceding chapters to discuss, among other things, the notion of cyborg territory; terrains that are three dimensional, temporal, embodied, and ungrounded; and volumes that are brought into being and characterised by overlapping spheres, and non-human bodies. Entangled within this is the third intervention which lies with the elemental. Throughout this thesis, the elemental has emerged as something malleable, something that can be fixed down, mixed, scrubbed, engineered, yet also remaining excessive as certain atmospheres imbricate themselves within the body. Within this elemental melee, certain substances, such as helium, are foregrounded, demonstrating in the purchase of exploring how different elements might function as they interact with different environments, verticalities, and depths. I will then offer brief methodological reflections on how we, as political geographers, might best seek to engage with immersive spaces and questions via making ourselves more open and vulnerable to experimental methods and different atmospheres and surrounds. The second part of the chapter looks forward, highlighting areas for further research and suggesting the concept of 'extreme geographies' to account for the elemental, embodied, and territorial practices associated with inhabiting and making 'home' in environments that might be described as hostile to humans. This will become an ever important agenda as the earth becomes more extreme, more submerged, more susceptible to 'hostile' elemental events as humans continue to intervene in climatic processes.

7.1 The Cold War Hero

As has been highlighted by the likes of Sage (2014), Farish (2010), and Spiller (2015), the Cold War was synonymous with ideas of mastering and taming space, of pushing into new frontiers (whether that be Outer Space, the Polar Regions, or the sea) via the body of the American man for the wider benefit of all mankind. Sealab, whilst relatively undocumented in academic discourse, was another such example and it raises interesting questions about various Cold War constructs. The first lies in the unsettling of the sanitised Cold War hero and the masculine ideals of hardened, muscular, even scarred bodies. The likes of fictional Vietnam veteran, Rambo, became representative of a militarised man, able to cope and withstand environmental pressures and constraints. In many ways, the aquanaut conforms to this ideal and to the ideals associated with the 'volunteer heroism' and associated practices of putting one's life on the line for the benefit of the wider nation (Dean 2001). Their bodies were voluntarily pitted against an external hostile threat and conscripted into a much wider imaginary, an imaginary that framed the sea as a space of liberation and salvation from the pressing demands of terra. During my time with aquanaut Bob Barth, he described the aquanauts as 'warriors'. Their bodies and minds were trained to adapt to and confront the challenges posed by the hostile sea. Mentally, this was particularly important. As one saturation diver told me – 'panic, that's the killer in the undersea world' and as a result they were trained to maintain calm at all times, to think logically with a 'cool, rational gaze' in extreme and dangerous circumstances (Woodward 1998:290). In other words, the aquanauts had to physically and psychologically adapt to the environmental, social, and geopolitical pressures of sub-marine life. We see these norms extended to animals too with the US military dolphin Tuffy valorised for his scars, weight, and feisty nature.

The bodies of the men, and Tuffy, became in many ways superlative archetypes of the ideal Cold War American hero, yet, as was explored in chapter 5, this was not always straightforward and their physiology resisted heroic categorisation. In addition to functioning as a petri dish for homosocial norms and warrior like performances in a confined, pressurised space, their bodies were also petri dishes and breeding grounds for bacteria and infection. Skin rashes, ear infections, and a host of bacteriological problems plagued the projects with the atmospheric humidity providing the perfect environment for bacteria to thrive. Tuffy too would eventually succumb to a bacteriological infection 'never before encountered in a dolphin' (Ridgway 1987:191). Ridgway describes how the infection, thought to be contracted through an 'oozing wound' on his underside, almost paralysed 'the powerful tail muscles that once swept him through the sea'. The environmental pressures of the sea provide a prism through which to explore the nuances and complexity of Cold War heroic bodies, not as the hard, scarred, and sanitised constructs as seen in popular culture, but as vulnerable, fleshy, prone to infection or oozing wounds, and a host to microscopic organisms.

In keeping with the prevailing social and cultural norms of the time, this process was highly gendered. The aquanauts and actors such as George Bond, were, both literally and figuratively, proponents of a red blooded masculinity that saw the Sealab habitats and hyperbaric chambers become microcosms for the American, heteronormative ideal. The men, most of whom were married with children, broke new ground beneath the sea whilst panic stricken, highly emotional women on the surface watched on. Even in the performance of domestic chores, typically associated with the feminine sphere of the 'home' gained complex meanings. As Anderson (2009:826) highlights, 'it would be misleading to assume that this hard-bodied, hegemonic masculinism is performed solely through such stereotypically ‘male’ behaviours and attitudes.' On the contrary, these hegemonic masculinities are far from straightforward or monolithic (Kronsell 2005). Domestication and the acts of cooking, cleaning, ironing, hoovering are integral to military life as soldiers are made 'fit to live in close association with each other' to successfully reproduce a military 'way of life'. Anderson goes on to highlight how the military works to encompass modes of practice 'deemed to be 'feminine' by their virtue of their association with the 'domestic'' by framing such practices as an extension of the masculine – as acts associated with training, discipline, and the maintenance of homosociality (Anderson 2009:827-828). Those who cannot adhere to these embodied routines, fail to meet the required standards of the 'fighting man' and are excluded from the process and the associated 'brotherhood' or fraternity.

Anderson (2009:824) argues that these regimes are performed within and maintained by 'a strict hierarchy of power and subordination'. Its maintenance, he argues, relies on a willingness to be obedient and subservient to authority yet perhaps the example of Sealab reveals something quite different. Far from being obedient at all times, the aquanauts were, as explored in chapter 4, somewhat resistant to topside control. 'You can get a little cocky' explained Bob Barth, 'you feel like you get by without the bastards up there' (7 February 2016, Mr Barth’s home). The environmental context and the enforced, impenetrable distance between the surface and sea floor created a context that disrupted the chain of command. The aquanauts, as pioneers of a new and 'hostile' frontier claimed a degree of authority in the construction of their underwater 'home', expressing feelings of irritation at interference from their superiors 62m up. The geography, in its most simple sense, mattered here with the physical location of the habitat and separation from the surface altering conceptualisations of hierarchy, superiority, and positionality. Hegemonic masculinities emerged from, and were reinforced by this sense of breaking new ground. We see the importance of location in forging hegemonic masculinities in Woodward’s (1998:276) study on the soldier in the countryside. Woodward argues that the countryside consolidates a form of masculinity as their bodies are physically, mentally, and emotionally pitted against a dangerous and demanding space during training and exercises. This analysis could be deepended by considering the role of immersion in a three dimensional space in this process – everything from the topography, the weather and the body facilitate this process. Much like Sealab, the men find themselves immersed in every respect in an abnormal, extreme space that produces certain gendered, social, cultural, political, and embodied effects. An interesting avenue of further research here would be to explore the subsequent undersea living experiments, known as Tektite, which followed Sealab. Tektite II consisted only of women, initially including famed oceanographer Silvia Earle, who were described as 'aquababes' or 'aquanaughties' yet simultaneously demonstrated that women, like men, could live and work beneath the sea. Further exploring the nuances of this process would enrich understandings of sub-marine gender politics and work to unsettle the framing of the sea as an inherently masculine space.

7.2 Territory, terrain, and elemental architectures

‘Territory’ and ‘terrain’ have been threaded throughout each chapter, raising a number of interesting questions about concepts that have been, or are, taken for granted in human geography. To begin with territory, the Sealab projects have been put to work to nuance and unsettle various aspects of the practices associated with territory making. Firstly, as Elden (2013b) highlights, although early understandings of territory as a practice drew on animal ethology and the idea that territory making was an animal like, instinctual human behaviour, scholarship on territory largely overlooks and transcends animals as significant territorial actors. This is something chapter 6 challenged as sub-marine life emerged as being wholly imbricated in both facilitating, challenging, and at times, undermining the Sealab projects and the territorial imaginaries of those propagating an undersea agenda.

The second point attends to questions relating to the temporality of territory. As chapter 2 demonstrated, it is now widely acknowledged that territory is not a natural formation or spatial container (Elden 2013b). On the contrary it is a result of social, cultural, and political interventions to establish boundaries in multiple dimensions (see Elden 2010, 2013), yet the temporal aspect of this remains underdeveloped. Through the shifting temporalities associated with Sealab, we can see that territory is not static in time and that the management of time is crucial to territorial endeavours. In chapter 4, for example, we see how Sealab was imagined as an extension of early American frontiering. Pushing back further in time and it became likened to the exploits of Columbus and Magellan as the aquanauts established routines, breaking their days into specific time slots involving diving, chores, sleeping, eating. In drawing on the past and through establishing time orientated routines in the present, the Navy and media made projections into the future, imagining cities, bases, and civilisations beneath the sea. We see temporality feature in other ways too. Whilst the earth on land is constantly moving and changing as it comes into contact with air, the sea floor shifts at a much faster rate as it comes in contact with water to the extent that personnel topside had difficulties in ascertaining the exact location of the habitat. In another dimension, the body too took on its own distinct temporalities under the sea. The aquanaut's movements slowed for the first few days, their speech simultaneously quickened due to the air they were breathing, and strict timed decompression schedules had to be used to ensure their bodies were safely brought back to the surface. Non-humans also came to be understood in temporal terms with the movement of plankton drifting past port holes used to establish the speed of currents whilst the timings of sea urchin movements were measured to ascertain their menacing potential. Whilst geographical scholarship has established that *territory* is a processual and constantly unfolding, there are perhaps other less linear temporal considerations that warrant further attention. As Deloughrey (2017:37) highlights, water is a good medium through which to consider these temporal disruptions given its recalcitrance to imposed temporalities – it 'distorts time and alters knowledge production' forcing us to think in a different ways as we move alongside an ever shifting entity.

Thirdly, as was explored in chapter 5, the intersections of technology, air(s), water, bodies, animals, science, and the territorial practices associated with extreme environments raise their own distinct territorial questions. The chapter suggested that these could best be understood through the concept of 'cyborg territory' to both acknowledge the role of technology in mediating and facilitating certain territorial interventions whilst also providing a starting point from which to unravel the complex and heterogeneous intersections that characterise these practices. As Farish (2010:148-149) argues, if during the Cold War 'extra-terrestrial environments were both the original and ultimate cyborg vistas' it was quite obvious that cyborgean practices would have 'implications for earthbound exploration as well'. This remains the case for territorialising spaces that are inherently dangerous to humans (see Baghel and Nusser 2015:34).

Moving on to terrain, each chapter raised questions that unsettle this naturalised and relatively unquestioned concept within human geography. As was highlighted in chapter 4, the 'long-established' and 'traditional way' of understanding terrain is via the militarised 'terrain and tactics' approach that privileges the topographical features of landscapes (Woodward 2014:41). Woodward (2014:41) goes further to describe a landscape as 'material, representational and experiential,' and argues that:

> 'The material aspect of the area relates to the patterning and morphology of the terrain; the representational aspect relates to the landscape as text or image and the third experiential aspect relates to the way we engage with landscapes physically and emotionally'.

Yet understanding terrain through the concept of 'landscape' does not account for the complexities present in Sealab – namely that the undersea terrain was three dimensional, embodied with pre-cognitive affects, and inhabited by a range of non-human life. To take the first point, it was not possible for the US Navy to fully comprehend the sub-marine environment or the sea floor via 'landscape'. The sea floor shifted, it was lifted into the water column reducing the visibility for the aquanauts, the water column that surrounded both the aquanauts, the sea floor, and all associated infrastructure was cold and dark drastically affecting the amount of work that could be completed. These specificities also had pre-cognitive affects as the bodies of the men fought to keep warm, as they became (at times) disorientated, and as their sight was curtailed by the operating environment. We can see these pre-cognitive implications at play in other 'hostile' environments too. Baghel and Nusser (2015:26), for example, address the effects of reduced oxygen availability, where the 'body reaches it limits' in the all-encompassing terrain at altitude on the Siachen Glacier. These effects shape and underpin the type of military engagements taking place on Siachen as the three dimensional terrain of the sea did in Sealab. One Everest climber describes this viscerally, recalling how his lungs felt 'like frozen fire'; he breathed, gasping 'like a wild animal in an attempt to devour the oxygen' that seeped into his mask (Grylls 2011:402, see Squire 2016b). These engagements, whether they be in the sea or in the air, work to materialise the territorial volume, uproot terrain from the earth's crust, and re-orientate it towards the body.

The concept of 'dwelling' was used in chapter 4 to help make sense of this as the body is brought into conversation with, and entangled within, the environmental surround in which it is immersed. As Collard (2012) suggests, the word 'entangled' is particularly useful here in understanding the materialities of spaces and their coexistence with the myriad entities that are encompassed by them. Similarly, Sharp et al (2001:1) argue that entanglements are integral to the workings of power - 'wound up in entanglements are countless processes of domination and resistance which are always implicated in and constitutive of one another'. In incorporating the entangled and voluminous materialities of the earth into understandings of terrain, geographers would be better positon to unpick these multifaceted dynamics.

This is an important exercise because, as has been demonstrated throughout this thesis, there are social and political implications. Baghel and Nusser (2015) for example, describe how a few metres of height on a mountain become extremely important in forging a 'heroism against nature narrative' and have significant implications for logistics:

> 'For mountaineers, a difference of a few meters in height might have a disproportionate effect on the perceived accomplishment as it might differentiate a "seven-thousander" from an "eight-thousander". For the army it might mean an altitudinal limit on supply chains. Experientially high altitude imposes a loss of oxygen, low temperature and new threats to the human body' (2015:25).

Taking this one step further, chapter 5 illustrated how we might think of the body itself as terrain to be mapped, managed, and negotiated (see Squire 2016b). The bodies of men living at pressure represented a medical mystery and as such, Navy doctors, physiologists, and psychologists sought to peel back the border of the skin to understand the processes beneath. Much like the sea floor and sea itself, it became a volume with its own flows, rhythms, morphologies, sedimentation rates, and circulations to be understood and mastered in order to combat the external environmental 'threat'. We see similar dynamics at play in Farish's (2006) work wherein the US military carried out experiments on Inuit in the Arctic in an attempt to try and understand their ability to withstand the extreme cold. This is again a highly political act as certain bodies become test sites and subservient to military regimes of control and practice.

Finally, as was illustrated in chapter 6, if we are to understand terrain, and indeed territory, as three dimensional, immersive constructs, then we must also account for the other non-human life that inhabits these spaces. As demonstrated, in the case study of Sealab, animals came to have a significant impact on the practices of territory construction, in understanding the movements and circulations of the sea, in conveying to the public that the seas inhabitants could be mastered and put to work for man, and in the development of stealth weaponry (both in the form of weaponised sharks and in mitigating the bioluminescent qualities of plankton). Sealab was in many ways, a biopolitical project 'perpetually knotted in 'domination/resistance couplets' (Sharp et al 2000:1, Collard 2012). More broadly, the role of animals and non-human life forms in the conduct and practice of territory and terrain is worthy of further consideration within political geography.

Inextricably tied to questions of terrain and territory are those of the elemental and in particular, questions surrounding how to 'account for the participation of non-human forces in the organisation' and practice of geopolitical life (McCormack 2016:3). In each chapter these questions have been central. In chapter 4, the elemental in the sense of an 'environmental milieu' (McCormack 2016:2) was fundamental in shaping the Sealab projects from shifting sediment to cold water; in chapter 5, the elemental took on a 'physico-chemical' form (McCormack 2016:2), to explore the malleability of air(s) and the minute, pre-cognitive affects that both the water and sea had on the bodies of the aquanauts; in chapter 6 we see animals too brought under this regime with cyborg sharks, trained dolphins, and fish, urchins and plankton with the capacity to betray, infiltrate, and incapacitate. Perhaps there is need to consider the elements not as either physico-chemical or environmental (see McCormack 2016), but as one milieu. The environmental shapes the physico-chemical whilst the environmental can be brought under physico-chemical regimes as we see in the case of the hyperbaric chamber and the habitat. The elemental becomes something that is engineered and crafted to create certain elemental architectures that can support and sustain human life. Within these architectures, chapter 5 also demonstrated the value of taking certain chemical elements, in this case helium, in their singular form to explore the effects they have on bodies, materials and other processes and practices. Perhaps, as the chapter suggested, it would be an interesting exercise to explore the geopolitics of other elements contained within the periodic table and their intersections with bodies, environments, and the wider practice and conduct of geopolitics.

7.3 Immersive methodologies

Before outlining areas of further research, the final point of intervention I would like to highlight is methodological. Whilst my use of interviews and archives were largely conventional within the sub-discipline of political geography, the mobilisation of the 'body' as a research tool was perhaps less so and it formed part of a process in which I sought to access geopolitical phenomenon in an alternative way to generate new perspectives and ideas. As Ingram (2012:123) has highlighted, 'interest in alternative forms of geopolitics is growing:

> ‘Frustrated with the apparent limitations of existing critical approaches, geographers are exploring new epistemologies and seeking to forge more practical, constructive and transformative modes of geopolitical intervention'.

For Ingram, these modes of intervention have found themselves in artistic and aesthetic practices and in exploring how 'geopolitics is enacted artistically' (2016:12). In doing so, Ingram (2012:123) argues that geopolitics is opened up for 'reflexive interrogation and creative refashioning in ways that are suggestive for alternative geopolitical projects'. Ingram (2012:132) posits that 'another geopolitics is possible' and whilst I have not sought to put forward an alternative or oppositional geopolitical project, I have sought to explore alternative ways of engaging with geopolitical. We might think, for example, about the role of immersion or autoethnographic approaches as a means of disrupting the notion of an ‘axis’ in discussions on territory and verticality. The act of seeking to move beyond the x or y axis extending horizontally or vertically to a form of dwelling that accounts for our always immersed state in the world is in itself a useful exercise in and of itself in unsettling normative modes of thought and practice. Perhaps then, there is a need for political geographers to be better attuned to anthropological and sociological methodologies as well as paying greater attention to those found elsewhere within geography.

The primary means of doing so has been through the body and this took various forms. Firstly, the bodies of my research community were important. The physiological and psychological components of aquanauts, Sealab participants, and animals, proved to be fundamental to the project. Beyond this, however, my own body was drawn into the process. As Myers (2012:174) highlights, there are 'tacit norms that constrain and enable how practitioners can use their bodies'. Historically, political geography has been characterised by a practitioner who seeks the objective God's eye view, yet personal experience and encounters with various spaces, elements, and people can be fundamental to the 'reimagination of geopolitics' (Ingram 2012:124). Feminist geographers have too been calling for greater attention to the 'body as a site for engaging with a re-problematising geopolitics' (Ingram 2011:218) and within my research this took on multiple forms from reflecting on the implications of various aspects of my embodied appearance (such as gender and size) in shaping the research process to making my body a test site of sorts by immersing myself in environments such as the sub-marine, a hyperbaric chamber and an undersea habitat. This enabled me in the words of Meyers (2012:154) to 'feel through the tensions, forces, and affinities' of the research material, added nuanced textures and tones to the interview I conducted and enabled me to better understand the ways in which the researcher has the capacity 'to move with and be moved by the phenomena that they attempt to draw into view' (Meyers 2012:177).

We might also think of this process in relation to the 'cyborg' and cyborg territory, and how we as researchers can better immerse ourselves in the spaces that we study with the assistance of technology. Wilson (2009:512) addresses this explicitly by calling for 'cyborg geographers to inhabit the spaces where the human and nonhuman are constituted and narrate the conditions that established this entry point'. Whilst Wilson may be referring to the interface between non-human technology and the human, the same can be said of utilising technology to better interrogate certain geographical spaces and conditions. The technology that enables humans to descend beneath the water is one example but we might look further than this to consider the role of virtual reality in immersive research. Bradley Garrett's collaboration with *The Guardian* in 2016 to produce a virtual reality exploration of London's Underground would be a prime example of this where the viewer is invited to become part of a space that would otherwise be inaccessible via the joining of the human and technology. Clearly, virtual reality is not the panacea – it lacks many affective dimensions such as smell and touch but the possibilities of utilising this technology to explore the intricacies of extreme environments, to disseminate research, and to teach students within geopolitics certainly warrants further attention.

7.4 Toward 'Extreme Geographies'

Through the case study of Sealab, a number of themes and concepts have emerged including ideas surrounding embodiment, home, gender, territory, terrain, technology, the elemental, and the methodological. How then to tie these together and where do these strands of research go from here? One means of doing so might be through the concept of 'extreme geographies' – a term that encompasses homesteading geographies that unfold in environments that are deemed to be hostile to 'man' and where both technological interventions and physiological (and psychological) adaptations are necessary to make the space inhabitable. This may include spaces such as the sub-marine, the Polar Regions, deserts, and Outer Space. What would it look like if we were to take extreme environmental contexts in considerations when understanding the 'home'? How do frontiering and homesteading geographies outplay in environments that are unbreathable (water), environments that bite, (frost), blind (snow, sand, water, the subterranean), and disorientate (water, snow, sand, the subterranean).

Whilst not explicitly termed 'extreme geographies', a number of geographers have worked within this paradigm. Matthew Farish's (2006) work on the US Army in the Arctic, Baghel and Nusser's (2015) study of conflict on the Siachen Glacier, and Woodward's (1998) analysis of the SAS and the countryside are prime examples. For soldiers in the countryside, Woodward highlights how one man during SAS selection pushed through the exhaustion and pain caused by the demands of the environment to pass whilst the 'other recruits fail, physically beaten by the landscape' (1998:291). In a different environment altogether, Baghel and Nusser reflect on the effects of the 'coldest war, or the endless war atop the roof of the world' where the conditions cause the soldier's physiology to 'progressively deteriorate' (2015:24-25). As with the aquanauts in Sealab, there are psychological implications to inhabiting the extreme. The Pakistani army refer, for example, to the effects of 'Siachen syndrome' describing the progressive change in personality of its soldiers at such extreme altitudes from normal to selfish, then introverted and finally irrational' (30). This coupled with the cold, exhaustion, boredom, fear, depression, possible frost bite makes the altitude a 'third enemy for both armies as well as climbers' (2015:26). Working in a different space and with a different set of questions, Dunnett (2016:17) has also called for greater consideration of the 'geopolitical cultures of outer space in diverse geographical contexts'.

The geographies of extreme spaces certainly warrant further attention for two key reasons. Firstly, as evidence in the case study of Sealab, working through extreme contexts can generate novel questions, insights, and knowledge that has application beyond the extreme. As an example, the role of non-human animals in the conduct and construct of territory has been understudied yet on the sea floor where life surrounds, imbricates, and acts forcefully, we see very clearly the potential agency of animals to act powerfully in territorial endeavours. The applications for engagements with territory on terra-firma are made apparent and the ‘animal’ highlighted as a territorial actor through its interrelationships with water, bodies, and technologies.

The temporalities to ‘extreme geographies’ are important and whilst this thesis has dwelled in the context of the Cold War, wider historical geographies and geopolitics should also considered and enrolled into our understandings of what it means to dwell in extremes. Rebecca Farley, whilst not attending to the concept of ‘extreme geographies’ perhaps highlights the potential of understanding historical endeavours through this prism. Her work explores the ways in which the body of Ernest Shackleton came to be understood through ‘hegemonic discourses of masculinity and whiteness’ (2005:232). ‘The endurance of physical hardship in harsh landscapes’ she writes, has been fundamental in forming a gendered narrative of ‘adventure masculinity’ whilst also naturalising a ‘right to rule’ over spaces that extend from the extreme to the domestic (2005:237-238). Farley traces the trajectories of public interest in Shackleton, arguing as she does so that he ‘became popular’ in the 1990s ‘at precisely the moment when the popular media were bemoaning a ‘crisis of masculinity’ and a ‘crisis of whiteness’ (246). Shackleton’s body, pitted against the extremes of snow and ice became a medium through which to ‘(re)secure white male hegemony…The romance and heroism of the discourse – the display of courage, strength and endurance culminating in triumph over terrific challenges – both demonstrate and ask for our concession to white men’s leadership’ (Farley 2005:248). As with Sealab, issues of gender, hegemonic masculinities, and the role of perceived ‘crises’ in these constructs find refuge in extreme spaces.

In another elemental and extreme context sits Isla Forsyth’s work on the desert. Through the biography and body of pioneer Ralph Bangold, Forsyth seeks to interrogate the tangled relations between terrain, technology, culture and politics that enabled ‘exploration and the subsequent development of covert methods of warfare in WWII’ (2016b:227). The desert, she argues:

> ‘constrained and enabled scientific knowledge production and particular forms of warfare, in turn; the desert was transformed into a surveyed, mapped and militarised space requiring further study and exploitation’ (Forysth 2016b:234).

As she unravels the ways that the desert shaped exploratory, scientific, and military practices during this time period, Forsyth makes a wider point about understanding the role of ‘particular environments’ in ‘shaping histories of science and technology’ (2016:234). These ‘particular environments’ I would argue, are often found at the extremes, pushing the boundaries of the human body and of technology to achieve certain strategic geopolitical objectives.

7.4.1 Future extremes: climate and exploration

In addition to accounting for the past, the concept of ‘extreme geographies’ may become ever important looking forward to the near and far future. As Haraway (2016) has highlighted, we live in environmentally troubling times amidst large scale planetary devastation. We are, she argues in the middle of the ‘earth’s sixth great extinction event’, ‘engulfing wars’, and the ‘immisertations of billions of people and other critters for something called ‘profit’ or ‘power’ (2016:4). To exacerbate this, the number of human beings on earth is expected to reach more than 11 billion 2100 which in turn imposes further burdens on the environment (Harrway 2016).

As Bradley Garrett highlighted in a fascinating talk at the British Library’s Cold War Geographies conference (2016) this, along with multiple other political and social factors, has left us with a feeling of dread and malaise and provided the impetus for some to literally ‘bunker down’ and prepare for the worst. This is made manifest in the rise of ‘survivalism’ – a practice defined by Osnos (2017) as the ‘practice of preparing for a crack-up of civilisation’ in a context that I would argue is becoming ever more extreme with floods, droughts, heatwaves and unusual and destructive climatic events becoming ever commonplace.

The author H. Lawrence, writes Osnos (2017), ‘diagnosed a specific strain of American dread. ‘Doom! Doom! Doom! He wrote in 1923. ‘Something seems to whisper it in the very dark trees of America’’. Historically, he adds, ‘our fascination with The End has flourished at moments of political insecurity and rapid technological change’. Whilst it is not my intention to unpack the political cultures of survivalists (I look forward to reading Garrett’s work on this), there are spatial implications to this sense that the earth will not sustain us in the future. Much like the fears of resource scarcity and the looming prospect of nuclear warfare, we see once again discourses of human expansion into otherwise extreme and inhospitable spaces. As part of Samsung's 'SmartThings' (2016) initiative, for example, architects and futurists at Westminster University spent five years exploring the concept of future living. They concluded that with urban space in high demand:

> 'we will see exciting advances and innovations in the architecture of the home and shape of our cities. This will include the emergence of super-skyscrapers, sub aquatic and floating communities and a new trend for building deeper into the earth (Samsung SmartThings 2016).

The 'sub aquatic' element to this is not insignificant. Due to the pressures of sea level rise our 'planetary future is becoming more oceanic' (Deloughrey 2017:33-34). It is not only becoming more oceanic but has the potential to become more 'sub-marine' as the sea increasingly infringes on terra firma – suddenly, writes Deloughrey (2017:33-34), the sea is not external to experience'. Whilst I have argued in chapter 2 that this idea of the sea as an externality is somewhat of a misnomer, we are certainly having to engage with oceanic space in new ways as it becomes not only part of the evolution of 'man', but part now of our future trajectory. According to Deloughrey (2017:36) part of this process has been to try and understand the sub-marine environment as an anthropomorphised place rather than an uninhabited and inaccessible entity. Whilst she explores these themes via the installation of underwater sculptures by the artist Jason deCaires Taylor, this idea of understanding futures via the 'place' of the sea can be taken further as the SmartThings project demonstrated.

Just as Cold War pioneers imagined, other futurists beyond SmartThings have also posited that 'humans will live underwater' in the future to circumvent the population, resource, and spatial pressures of land (Anderson 2016). In 1954 Cousteau asserted that 'man has to enter the sea, there is no choice in the matter'. Over 50 years later and the imaginative lure of living and thriving beneath the sea is pervasive with companies such the Japanese Shimizu Corporation unveiling plans in 2014 for a deep sea city, 'Ocean Spiral' (see Figure 75). Drawing on the Shimizu plans, the authors of SmartThings (2016) write that these structures could be sustained via the splitting of water into Hydrogen for fuel and oxygen to breathe:

‘With advances in the efficiency of solar cells it is likely that this free energy source will be used to create sub aquatic communities, breathing the oxygen they create and fuelling their electrical needs through the act of hydrogen creation below the waves. Sub aquatic communities could also draw free energy from the water currents and waves as is already done in wave farms around the world today. Water will be desalinated through mass implementation of solar technology such as the watercone. This will allow communities floating above the waves to continuously cruise to the best climate all year round, never needing to stop on land to restock as they would be growing their own produce ’onboard’ and making their own electricity.’

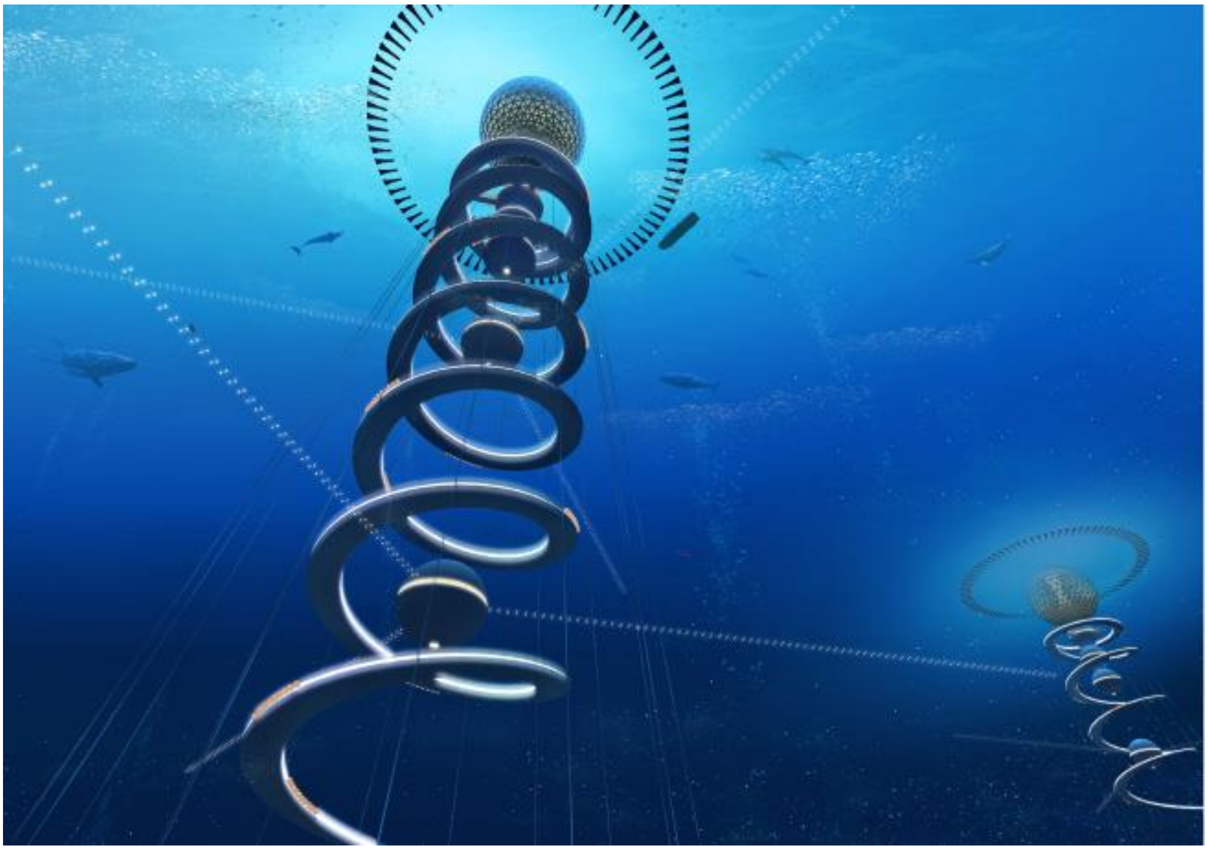


Figure 75: Ocean Spiral (http://www.shimz.co.jp/english/theme/dream/oceanspiral.html)

Whether these ideas are feasible or not, the idea that we need to ‘reseed…our home worlds in order to flourish-again or maybe for the first time- on a vulnerable planet’ (Haraway 2016:117) is pervasive. Whilst for Haraway (2016), the solution lies in tentacular practices of living with one another in 'kin' and in 'staying with the trouble', the desire to reseed humanity to spaces that are somehow 'other' or 'elsewhere' seems to supersede this imperative. Faith in what Haraway (2016:3) describes as 'techno-fixes' or the belief that 'technology will somehow come to the rescue' have great purchase and the practices associated cyborgean territorial interventions (see chapter 5) look set to remain and they extend well beyond the sea. The futurists of the SmartThings report for example believe that:

> 'Ultimately, as we utilise and thus exhaust more of the planet's resources, it will eventually be cost effective to start looking elsewhere in the solar system for the provision of sustainable accommodation and resources. Asteroid mining will become a viable commercial enterprise and with these changes it is very likely that communities will emerge on the moon, testing our ability to live outside Earth whilst staying nearby, then further afield on Mars, where streams of underground water can be found... Climate change, space travel and eventually new planet living will lead to a complete revolution of our social patterns and of our homes. Homes will increasingly become self-contained, autonomous spaces generating their own oxygen and food - we will effectively all be creating our very own little planet Earths.'

Whilst again this seems fanciful, the European Space Agency's plans for a 'Moon Village' (see Figure 76) to support science, business, mining and even tourism has attracted worldwide support and the idea that humans should no longer be bound to terra extremely pervasive (*The Guardian* 2016). As we face a crisis of planetary proportions much like the Cold War threatened to be, the urge to go rehabilitate or reseed mankind underground, undersea, to go out, high, and low to escape the increasingly 'hostile' plateau of the earth is seemingly attractive to many.

Figure 76: ESA's Moon Village
(http://www.esa.int/spaceinvideos/Videos/2016/02/ESA_Euronews_Moon_Village)

7.4.2 Understanding the extreme through the analogue

The spaces and questions raised above exist on a very big scale. One way to approach them and to interrogate these themes further might be via the analogue space – and by this I simply refer to spaces that act as proxies for other more extreme environments in which 'man' might one day dwell. In this thesis, the hyperbaric chamber served as an analogue for the habitat and surrounding pressures of the water yet analogues fulfil a host of functions. Whilst it was beyond the remit of this thesis, NASA were part funders of the second and third Sealab projects, believing that they represented an unprecedented opportunity to explore the psychology of living in an isolated, detached environment where help is not readily accessible in the event of an emergency. Simultaneously, it also provided an opportunity to explore the social dynamics of living and working with a small group of people in a confined and isolated spaces such as the Polar Regions. The seemingly disparate spaces of the sub-marine, Polar, and Outer Space converge here as the elemental is engineered to produce certain extreme conditions. The 'analogue' remains crucial today on multiple scales. Both NASA and the European Space Agency maintain analogue programs with 'cavenauts' and aquanauts working in caves and an undersea habitat in Florida to prepare for Outer Space and missions to Mars or asteroids. Antarctica, volcanoes, and deserts are also drawn into these geographical practices. Indeed, on the mission patch depicted below in Figure 77, the undersea habitat, Polar Regions, and aircraft converge and are encircled by the words 'isolation, confinement, extreme environments'.

Figure 77: The NASA Analog Missions patch (https://www.nasa.gov/analogs/what-are-analog-missions)

Beyond space agencies, analogues are significant on a number of scales. For the Indian army, their presence and training on the Siachen Glacier, serves as an analogue of sorts for other high altitude combat scenarios – indeed their current strategies are derives from a conflict with China in the Himalayas in 1962 (Baghel and Nusser 2015:34). At a much smaller scale, laboratories such as physicists, engineers and other scientists work with small analogues to test equipment and better understand certain earth processes. The FloWave Ocean Simulator, for example, 'combines complex wide-are multidirectional wave simulation with fast tidal flows' to enable research into wave and tidal current interactions (FloWave nd). In a similar fashion, companies such as Aker Arctic Technology use ice modelling to test icebreaking technology. Further unpacking the role of the analogue and the ways in which the elemental is engineered in various ways to enable inhabitation of extreme spaces would be a productive means through which extend elemental scholarship whilst also potentially providing insights into extreme living strategies that could have applications in everyday life.

From the historical geographies of exploration, to the Cold War geographies of experimentation, to future geographies of environmental consternation, I want to end by suggesting that ‘extreme geographies’ might be a productive prism through which to interrogate the multifaceted implications and imaginations of life lived at extremes. With the unfolding effects of climate change, there is a resurfacing and re-oxygenating of Cold War imaginaries that yearn for an escape from terra firma. It becomes easier to imagine an earth that is harsher and where it might become increasingly necessary to inhabit spaces that are hostile, that can bite, blind, and disorientate. Perhaps the legacies of Sealab will become increasingly apparent as the extreme becomes the norm.

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Annexe 1: List of Archives and interviews

Archives

- Scripps Institute of Oceanography, located in the archives of University California (San Diego).
- The Man in the Sea Museum (Panama City Beach, Florida).
- Unofficial archive material held at Kirby Morgan Dive Shop (Panama City Beach, Florida)
- Personal collections held by Kevin Hardy and Peter Bruggeman (San Diego).

Interviews

Name	Date	Location
Bob Barth (Aquanaut – Project Genesis, Sealab I, II, and III)	7.2.2016	Bob Barth's home, Florida
Bill Culpepper (Sealab engineer)	8.2.2016	Bill Culpepper's home, Florida
Crew of the Aquarius Reef Base	23.2.2016	Aquarius Reef Base HQ, Islamorada, Florida
Dr Sam Ridgway, Navy Marine Mammal Program	26.4.2016	Local restaurant, San Diego
Iain Koblick, Tektite projects and habitat expert	24.2.2016	Marine Lab, Florida
Former Navy Saturation Diver (anonymous)	9.2.2016	Panama City Beach, Florida
Former Navy Saturation Diver (anonymous)	12.2.2016	Kirby Morgan Dive Workshop Panama City Beach, Florida
Former Navy Saturation Diver (anonymous)	13.2.2016	Coffee Shop, Panama City Beach, Florida
Kevin Hardy, Sealab historian and ocean engineer	21.4.2016	Mr Hardy's engineering workshop
Researcher from the Navy Marine Mammal Foundation	28.4.2016	Bridge overlooking the Marine Mammal Navy base
Scripps Institute of Oceanography scientist and Saturation Diver	19.4.2016	Scripps Institute of Oceanography