

Biological Weapons Testing at Porton Down

*The Strategic Effacement of
Nonhuman Animals, 1947–1955*

Catherine Duxbury

London School of Economics

HUMANIMALIA 14.1 (Fall 2023)

Abstract: This article focuses on the use of nonhuman animals for biological weapons testing by military scientists at Porton Down Defence Science and Technology Laboratory, 1948–1955. After the end of the Second World War and the beginning of the Cold War, the British state and its allies invested in new military technologies which could ensure their superiority in times of conflict. My analysis reveals the partial workings of the Porton Down Laboratory through its historical use of nonhuman animals. I demonstrate that nonhuman animals were simultaneously effaced and made visible during biological warfare experiments. This effacement and visibility was dependent on anthropocentric notions of animal subjection whereby their use in experiments made them “seen” as resources for use, yet paradoxically elicited their nonexistence as subjects. I extend the notion of “strategic ignorance” to develop a novel concept of “strategic effacement” to demonstrate this contradictory relationship which both impacted scientific “objectivity” and contributed to the continued exploitation of animals in the laboratory.

Keywords: *nonhuman animal experiments; architecture; infrastructure; material-semiotic entanglements; ignorance; strategic effacement*

Bio: Catherine Duxbury is a Fellow at the London School of Economics and Political Science, and teaches on the first-year interdisciplinary course there, LSE100. While not quite being able to believe her luck, she identifies primarily as an educator, but likes to dabble in the arts of academia occasionally where she is inspired by the work of many Critical Animal and feminist animal studies scholars. Over twenty years a vegan and a companion to a whole bunch of furry critters of the dog and cat variety, Cathy likes nothing more than going on long walks with her dogs and finishing with a pint in the pub.

Email: c.duxbury@lse.ac.uk

ORCID: 0000-0002-6258-3702

Situated on the Salisbury Plain in Southern England, nestled between an Area of Outstanding Natural Beauty and the picturesque New Forest, lies Britain's most top-secret military establishment, now called Porton Down Defence Science and Technology Laboratory (DSTL). Created in 1916 as a response to the German use of chemical weapons (mustard gas) during World War I,¹ Porton Down remains Britain's most secretive and controversial military research establishment (see fig. 1). Its agenda is to investigate and compile research on warfare technologies to "ensure that the UK's military and wider public benefit from the latest technical and scientific developments. In the interests of national security much of this work is secret."² This top-secret work involves using tens of thousands of nonhuman animals to test the latest military and biomedical weapons. My analysis reveals an aspect of how this secretive establishment operated through its use of nonhuman animals.

To explore this, I focus on the material practices of laboratory animal experimentation for biological weapons at Porton Down between 1947 and 1955 when Porton Down went under the name of the Chemical and Biological Defence Research Establishment (CBDE). It was in this period that Porton Down's biological weapons program was at its peak, and its experimental focus shifted to trials at sea rather than on land. Here, I document Porton scientists'³ five major sea trials: Operations Harness, Cauldron, Ozone, Negation, and Hesperus. The sea trials exposed thousands of nonhuman animals to the noxious agents anthrax, brucellosis, tularaemia, *Brucella suis*, *Pasteurella pestis*, *Vaccinia virus*, and *Venezuelan equine encephalomyelitis* (VEE).⁴

1 Carter, *Porton Down*, preface.

2 Defence Science and Technology Laboratory, "The Truth about Porton Down: Answering the Myths and Misconceptions", *Gov.uk* 27 June 2016, <https://www.gov.uk/government/news/the-truth-about-porton-down>.

3 I use the generic term "scientists" throughout this article and refer to particular people by name, as they appeared in the archival documents.

4 All these viral agents are zoonotic diseases that can pass between animal species ("animal" to "human" transmission). Brucellosis is one of the most common zoonotic diseases worldwide and causes abortion in sheep, goats, cows, and pigs. In humans, it can cause flu-like symptoms to appear. Tularaemia is a plague-like disease that, in humans, is potentially severe and can be fatal. *Pasteurella pestis*/*Yersinia pestis* is the bubonic plague virus,

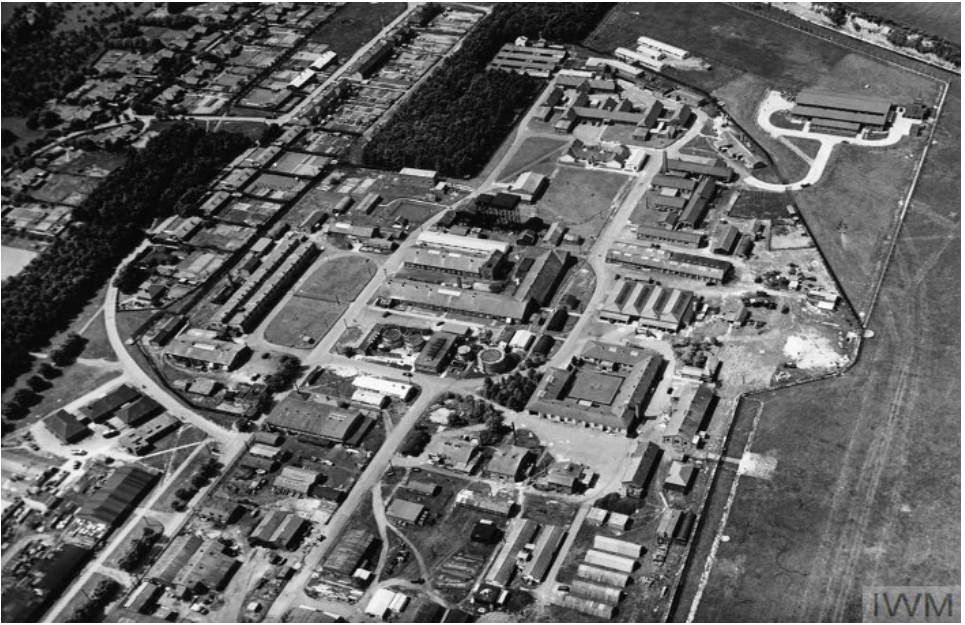


Figure 1:

Aerial view of Porton Down in the early 1950s.
Photograph courtesy of the Imperial War Museum.

Considering the use of nonhuman animals for weapons of mass destruction helps us understand how scientific methodologies and political policies concerning weapons of war have permeated the bodies and lives of nonhuman animals who have served as substitutes for human beings.⁵ The aim is to pay attention to the practices of the Porton Down scientists and make visible the role nonhuman animals play in the histories of the technoscience of war, and also investigate how the treatment of nonhuman animals was framed and justified by this process at Porton Down.

There is a burgeoning literature about animals in war, their use as beasts of burden, and their exploitation and companionship, with much of the research specifically focusing on the frontline roles of horses and dogs in the two World Wars.⁶ There is also a wealth of literature devoted to the history of animal experimentation, with considerable attention paid to its practice and legal regulation in the nineteenth century.⁷ This includes the work of Harriet Ritvo and Hilda Kean, who have documented both the emergence of scientific testing on animals via the professionalization of the disciplines of physiology and medicine and the rise and impact of the anti-vivisection movement in this era.⁸ Other scholars have focused on women's role in the anti-vivisection movement and their relationships to the nascent feminist movements of the nineteenth century. However, there is a dearth of work published on the part nonhuman laboratory animals (unintentionally) play in aiding the violent militaristic tendencies of the modern

and many mammals act as reservoirs for the disease, for example, rats, mice, and gerbils. Flea bites transmit the disease. *Vaccinia virus* is smallpox, and *Venezuelan equine encephalomyelitis* is a neurotropic virus that causes severe disease in humans and horses. In humans, it causes fever, general malaise, and vomiting. The infection can spread to the central nervous system, causing symptoms such as confusion and seizures. Tularaemia, known as "rabbit fever", produces flu-like symptoms in humans. For more detailed expositions of these viruses as biological weapons, see Pappas et al. "Brucella as a Biological Weapon"; Quenee et al. "*Yersinia pestis*"; Wood et al., "Vaccinia Virus"; Dahal et al., "Venezuelan Equine Encephalitis Virus"; and Barras and Greub, "History of Biological Warfare".

- 5 Haraway, *Primate Visions*, 2.
- 6 Nocella, et al., *Animals and War*; Hediger, *Animals and War*; Pearson, "Four-Legged Poilus"; Alexander, "War and Its Bestiality"; Russell, *War and Nature*.
- 7 Rupke, *Vivisection*; Hampson, "Legislation"; Bates, *Anti-Vivisection*; Ryder, *Victims of Science*; Hamilton, *Animal Welfare*.
- 8 Ritvo, *Animal Estate*; Kean, *Animal Rights*; Kean "Smooth Cool Men of Science".

state. Here, I contribute to the growing research about animals in war and draw on extensive historical analyses of animal experimentation to frame my discussion. In doing this, I show how the scientific process of laboratory testing produced nonhuman animals as visible and invisible, useful and useless, and productive and non-productive, which enables the routinized suffering and killing of nonhuman animals.

Writing animal histories is a complex terrain that uses the “pen and ink” of human beings to reveal the hidden lives of animals and their roles in societies, in order, ironically, to decentre the human. Hilda Kean addresses this issue, saying that “a different starting point” is needed, but that this “might not be the subject matter, animals, per se but the historian’s intentions”. Thus, the choices that historians make when (*re-*)*presenting* the past lives of nonhuman animals make their research animal-centred. It is not a question, as Kean goes on to state, of “writ[ing] in’ animals” but of “re-work[ing] given frameworks.”⁹ Reworking normative historical approaches focuses on understanding and analysing the uses of animals in given historical contexts.¹⁰ As Kean explains, this process of writing animal histories mimics the concerns of early social historians such as E.P. Thompson and feminists such as Sheila Rowbotham, who wrote histories of the working classes and their gendered dimensions despite the lack of material written by the people themselves.¹¹

Furthermore, within the animal history paradigm, this article has moved on from the idea of evidencing animal agency to one where the research “use[es] agency as a starting point and map[s] the varied economic, political, social and cultural contexts in which animals are embedded”.¹² Therefore, the conscious boundaries of this article recognize the importance of animal agency. Historian Joshua Specht argues for this:

It seems clear that animals have some form of agency, that is, the ability to shape in meaningful ways the world around

9 Kean, “Challenges for Historians”, s65.

10 Fudge, “Left-Handed Blow”, 7.

11 Kean, “Challenges”, s60.

12 Specht, “Animal History”, 332.

them. But instead of cataloguing instances of agency, historians would be better served developing a more nuanced understanding of how autonomous action operates within and is constrained by surrounding structures. If this is true of humans, it is especially true of animals, which are so often at the mercy of human needs. Animal historians would be well served to treat agency as their starting point of their analysis and lay aside the jargon of agency. Agency should always be the start of the analysis, rather than the conclusion of the argument.¹³

The archival material used in this article contributes to the crafting of stories told about Porton Down.¹⁴ To read for the animal in biological weapons testing, I had to focus alternatively on specific incidences concerning experimental animals written in the documents provided. I had to pay attention to what postmodernists call “ruptures”¹⁵ in the texts to seek out the animal where they had burst forth into existence but where previously they had been made invisible in much chemical and biological warfare research.

The Strategic Effacement of Nonhuman Others

To understand how nonhuman animals were simultaneously rendered invisible as subjects but visible as scientific objects in biological warfare research, I draw on concepts from the sociology of ignorance and philosopher Sophia Efstathiou’s Levinasian notion of “technologies of effacement”. The article engages with and develops ideas concerning non-knowledge (ignorance) and embodied encounters with the Other.

Strategic Ignorance

Anthropologist Michael Taussig asserted that knowing what not to know is an indispensable way to achieve a great deal of social and

13 Specht, “Animal History”, 332.

14 See, for example Carter, *Porton Down*; Evans, *Gassed*; Hammond and Carter, *From Biological Warfare to Healthcare*; Schmidt, “Cold War” and “Medical Ethics”; Balmer, “UK Biological Weapons Programme”, “The Drift of Biological Weapons Policy”, *Britain and Biological Warfare*, “Killing ‘without the Distressing Preliminaries’”, *Secrecy and Science*.

15 Fulbrook, *Historical Theory*.

political power.¹⁶ Scientific knowledge-making is not often linked to the idea of wilful ignorance. The popular perception of science is one of knowledge-creator, truth-sayer and the great revealer of all things factual. It is rarely seen as a practice which also produces ignorance.¹⁷ The scientific production of knowledge is inextricably tied to ignorance, and nonhuman animals of the laboratory are very much a part of this dynamic relationship.

For sociologist Linsey McGoey, ignorance is a generative and performative phenomenon that involves the “mobilization of ambiguity, the repudiation of unsettling facts, the realization that knowing the least amount is often the most indispensable tool for managing risks and exonerating oneself from blame in the aftermath of catastrophic events.”¹⁸ In certain situations, ignorance can be a beneficial and a calculated attempt to obfuscate vital information—and here it is strategic. For example, in her study of licensing an antibiotic drug linked to kidney failure, McGoey demonstrates how key actors sought to show who had the least knowledge of the drug’s safety and side effects. This deliberate concealment happened at various stages of the development process where individual concealment and institutional denial of the dispute over the drug’s efficacy and safety were recurring events.¹⁹ Hence, the value of ignorance for the individual and institution is in its strategic application.

Many other scholars in ignorance studies have documented its role in scientific practice: How results are generalizable to broader populations, how ignorance can aid in selecting specific research problems and facilitate the defence of the outcomes of experimentation. Indeed, Brian Balmer has successfully applied this concept to the biological warfare policy in mid-twentieth century Britain. Balmer, the foremost scholar in the history of the British biological weapons research programmes, has noted how strategic ignorance was apparent when scientific advisors and experts to the British government

16 Taussig, *Defacement*, 5–6.

17 Kourany, “Science: For Better or Worse”, 178.

18 McGoey, “Strategic Unknowns”, 1–2.

19 McGoey, “The Logic of Strategic Ignorance”, 555.

wanted more funding for biological warfare research. Openly admitting to uncertainty about the potential of biological weapons' destructive capacities helped to pave the way for more significant funding for its research.²⁰

There is, however, an acute lack of focus in the literature on the encounters between humans and nonhuman animals in scientific research regarding strategic ignorance's role. Here, I extend the epistemological groundwork done by sociology of ignorance scholars like McGoe and Balmer to account for the embodied nature of ignorance in the effacement of nonhuman animals in experiments.

Levinas, the Face, and Technologies of Effacement

How do our encounters with the Other happen? For French philosopher Emmanuel Levinas (1906–1995), it is through the human face. The face, however, is never what it is intended to be; instead, it is much more than the physical representation of “self” and is irreducible to the “I”. The face is about our corporeal encounters with the Other, a way to disturb us and a means to embrace their inner secret being.²¹ It is fully rooted in a phenomenology of the body,²² and it becomes a way to view the Other's inner secret life by exceeding our *a priori* conceptualization of them. The face goes beyond its physical representation, and the whole body can express the face from the flick of a hand to the “curve of the shoulder”.²³

Philosopher Sophia Efstathiou draws on Levinas's concept of the face and extends it to ethical encounters between humans and animals. For her, the animal's “face” refers to the mode by which an animal conveys their “inner secret being”, that may be expressed in the “body, eyes, movements or other sensescapes (voice, touch, smell, etc) but that is not reducible to these.”²⁴ The face is embodied, and recognizing the face identifies the Other's embodiment,

20 Balmer, *Secrecy and Science*, 73–89.

21 Levinas, *Totality and Infinity*, 43; 66.

22 Waldenfels, “Levinas”, 65.

23 Levinas, *Totality and Infinity*, 66; 262.

24 Efstathiou, “Meat We Don't Greet”, 104.

subjecthood and status. Efstathiou discusses how the infrastructures and resources of the scientific animal testing laboratory act to regulate encounters between humans and animals. In what she calls “technologies of effacement”, Efstathiou describes how these facilities help to “block the face” of humans and animals.²⁵ Technologies of the laboratory include the built architecture, procedures for entering and exiting the building, protective uniforms and equipment, labelling techniques, and experimental conventions. Accordingly, these “technologies” all mediate the encounters between humans and nonhuman animals in the laboratory and act as an impediment to experiencing the Other directly, for instance, wearing protective gloves when handling mice. This modifies the tactile encounter with the Other and, thus, contributes to their effacement.

Here, I use the term strategic effacement to account for the purposive eradication of nonhuman animals’ subjecthood in the experiments used to test biological weapons. For example, Efstathiou describes an encounter between a research worker and a rat whereby the rat had to be handled and microinjected in a series of experiments. The scientist was upset about the impact these procedures had on the rat, the pain it caused, and the effect on the results of the experiments. Consequently, Efstathiou describes this encounter as the “communication of perceived duplicitousness” where the research worker communicates what happens during the procedure as a sham:

He [the scientist] and the animals first go through these distressing injections, and then he is to “put them in the box” and tell them, in a new (happy, teacherly) voice: “Hey, show me what you’ve learned, but don’t let the stress affect you.” The ridicule made of the researcher and his animals, the joke played on them is that they work in a frame expecting them to suffer stress, and *pretend* it does not affect them.²⁶

This “communication of perceived duplicitousness” happens through the conscious denial of stress by the human, in both the human and

25 Efstathiou, “Facing Animal Research”, 140.

26 Efstathiou, “Facing Animal Research”, 141–2. Emphasis added.

the rat: the scientists must *pretend* it does not affect them. This is a form of strategic effacement, which recalls McGoey's conception of strategic ignorance as a "denial of unsettling facts" by the deliberate suppression of the known manifestation of stress in the rat (and human) and, simultaneously, a negation of the subjecthood of the rat.²⁷ Consequently, I take strategic effacement to mean the use of technologies of effacement to maintain and facilitate strategic ignorance in contexts where animal exploitation occurs. Porton Down scientists were simultaneously facing/effacing nonhuman animals in the process of biological weapons experiments, which instantaneously rendered them visible/invisible.

What I mean by the in/visibility of nonhuman animals of the laboratory is akin to Michael Lynch's distinction between the "natural" animal and the "analytic" animal. Lynch describes the bifurcated construction of nonhuman animals of the laboratory as one that transforms them from "naturalistic" animals to "analytic" ones. The naturalistic animal occurs in the "everyday" interactions between scientists and laboratory animals (feeding them, keeping them healthy, etc). The experimentation process transforms the laboratory's nonhuman animals into the "analytic animal". In this manifestation, nonhuman animals become visible or "seen" yet effaced in their subjecthood, as we shall see particularly in the pathological examination of the dead nonhuman body. Nonhuman animals of the laboratory become objects—the methodology of science dictating the terms unto which the scientists inscribe the laboratory animals with meaning to communicate their results.²⁸ They are still in/visible, albeit in a strategically placed manner.

In what follows, I use the notion of strategic effacement to explore the myriad ways nonhuman animals were used to test biological weapons at Porton Down in the period from 1947 to 1955. I also reveal how scientists during the Cold War actively drew on forms of non-knowledge, uncertainty, and ambiguity, which enabled the ill-treatment and exploitation of nonhuman animals to continue.

27 McGoey, "Strategic Unknowns", 1–2.

28 Lynch, "Sacrifice", 267–71.

Biological Warfare and the British State

The British biological warfare tests in the mid-twentieth century at Porton Down were among the largest ever. This was despite Britain's ratification of the 1925 Geneva Protocol, which banned the use of chemical and bacteriological agents as weapons of war. In the protocol, however, biological weapons were marginally affirmed compared to using poisonous gases, which were banned outright.²⁹ The Geneva Protocol instantiated a ban only on the use of biological weapons but not their research and development. This allowed states like Britain to research, develop, and manufacture biological weapons.³⁰

It was not until the 1930s that scientific concern about the dangers of biological warfare (BW) became a serious focus of attention in the corridors of Whitehall. In this period, the government created a Sub-Committee on Bacteriological Warfare as part of the Committee of Imperial Defence to review policy formulations and military strategies related to biological warfare.³¹ In October 1940, the government launched a British biological research programme at Porton Down led by Dr Paul Fildes, a bacteriologist from the Medical Research Council (MRC).³² Fildes was ordered to develop a biological bomb that could be used instantaneously if and when somebody attacked the country.³³ During the Second World War, scientists at Porton Down designed and produced two vital biological weapons: an anti-personnel anthrax bomb and five million cattle cakes laced with anthrax, which were to be dropped on livestock in Germany.³⁴ After the war, the BW programme was expanded, and the BW department at Porton Down was renamed the Microbiological Research Department (MRD).

In the post-war period, the state allowed for the continuation of research into BW in peacetime, and more formalized advisory committees were established to supervise BW research and policy. One

29 Schneider, "Prohibition of Biological Weapons", 179–80.

30 Beard, "Shortcomings of Indeterminacy", 276–79.

31 Hammond and Carter, *From Biological Warfare to Healthcare*, 60

32 Carter, *Porton Down*, 39–49.

33 Balmer, "Killing 'without the Distressing Preliminaries'", 60.

34 Balmer, 60; Millet, "Antianimal Biological Weapons".

was the Biological Research Advisory Board (BRAB) of the Ministry of Supply (MoS), which provided scientific advice on researchable biological problems concerning weapons development. BRAB were accountable to the Advisory Council on Scientific Research and Technical Development of the MoS and provided technical advice to the Chiefs of Staff Biological Weapons Subcommittee. This board consisted of experts from various government departments, including people from the Ministry of State, the Home Office and Ministry of Health, independent scientists, the Admiralty, the War Office, and Air Ministry staff.³⁵ This subcommittee worked with the Defence Research Policy Committee (DRPC) on the strategy and technical aspects of biological warfare research. BW policy became a top priority, and the DRPC soon devised a set of objectives for research and development in this area, including research into defensive aspects of war, how to store and produce biological weapons, and a series of defensive measures to protect the population.³⁶

In 1946, Dr David Henderson replaced Fildes as superintendent.³⁷ Consequently, the research broadened considerably and ranged from basic laboratory experiments to open-air trials of dangerous pathogens on land and at sea.³⁸ The experiments conducted by Porton Down scientists involved animals, and they even had a farm, Allington Farm, which bred and provided animal subjects for the scientists' experiments.³⁹ These were often guinea pigs, mice, rats, cats, and monkeys.⁴⁰ Regarding the BW trials, dangerous viruses would be released to purposely infect the animals and test their immune response to pathogenic organisms such as the plague virus and anthrax. The experiments were all completed under the aegis of the law, whereby animal experiments were regulated to ensure that "the animals shall not be subjugated to unnecessary suffering" — in a letter to concerned antivivisection societies who had heard about the forthcoming trials

35 Millet, "Antianimal Biological Weapons".

36 Balmer, "UK Biological Weapons Programme", 51.

37 Hammond and Carter, *From Biological Warfare to Healthcare*, vii.

38 Millet, "Antianimal Biological Weapons"; Balmer, *Britain and Biological Warfare*; "Killing 'without the Distressing Preliminaries'".

39 Schmidt, *Secret Science*, 49.

40 Balmer, "UK Biological Weapons Programme", 52.

and written to the Home Office, Home Office Minister G.R. Strauss replied that all experiments carried out at Porton applied the principles of the Cruelty to Animals Act of 1876.⁴¹ The Act was a piece of legislation that regulated animal experiments. Scientists and the premises that tested on animals had to apply for a licence from the Home Office to conduct experiments on animals. They also had to prove that their research would advance scientific knowledge and understanding of the investigated topic. The Act stressed that no animals in experiments shall experience “unnecessary pain and suffering”.⁴²

The Sea Trials: Material-Semiotic Infrastructures of Strategic Effacement

From 1948 to 1955, Porton Down scientists, led by chief scientist John D. Morton, conducted a series of sea trials to develop an effective biological bomb. Some of these were conducted in Britain’s colonies, notably in the Caribbean (Operation “Harness”) and the Bahamas (“Ozone”, and “Negation”), while others, Operations “Cauldron” and “Hesperus”, were conducted off the coast of Scotland.

It was in 1947 that the UK Treasury granted permission to the Chiefs of Staff to conduct large-scale experiments at sea to test biological warfare agents.⁴³ The first series of experiments, code-named Operation “Harness”, which took place in Antigua, tested bacteriological agents such as anthrax, brucellosis, and tularaemia. Later, *Bruccella suis*, *Pasteurella pestis*, *Vaccinia virus* and *Venezuelan equine encephalomyelitis* (VEE) were added to the repertoire.⁴⁴ All trials had

41 The National Archives [henceforth TNA], HO 45/25867, G. R. Strauss to Anthony Nutting, 6 December 1948.

42 Duxbury, “Property, Pain and Pastoral Power”.

43 Balmer, *Britain and Biological Warfare*.

44 TNA, Department of Defence (DEFE 5/15): DEFE 5/15/267, BW Trials at Sea— Operation Harness: Report by the Biological Warfare Sub-Committee, 18 August 1949 (“Harness Report”); TNA, War Office WO195/12213, Chiefs of Staff Committee: Biological Warfare Sub-Committee, Ministry of Supply, BRAB, Operation Cauldron 1952, Scientific Report by the Microbiological Research Department, Porton and Naval Report by the Naval Commander (“Cauldron Report”); TNA DEFE 55/256, Operation Ozone 1954: Small-scale Experiments with Biological Agents over Water, Discussion of Results (“Ozone Results”); TNA, DEFE 55/261, Operation Negation 1954–1955, Scientific Report by the Microbiological Research Department and Naval Report by the Naval Commander (“Negation Report”), 3–4.

specific and standardized infrastructural arrangements to manage the animals, monitor them for disease presence, and enable the scientists to perform detailed post-mortems at sea.

For Operation Harness, the former US military base at Parnham Sound in Antigua was chosen as the experimental site to establish a safe distance from the local population. Harness was the first large-scale sea trial of BW, and it acted as a preliminary test case for future trials. After the initial testing of non-pathogenic organisms, scientists proceeded with the toxic trials, and the first agent tested was brucella. Seventeen trials were completed using brucella, tularaemia and anthrax, tested on guinea pigs, monkeys, and sheep.⁴⁵

The method was simple: two landing ship tanks were fitted with a series of sampling points, and each had a rubber dinghy attached, which carried an animal. The crew placed sampling points on the water's surface in an arc formation and then released clouds of biological agents from a bomb or spray device upwind of the animals. The scientists would observe the tests from the designated laboratory ship, HMS *Ben Lomond*. Once complete, infected animals were transferred to one of the landing ship tanks and removed to storage space, and then they sterilized the dinghies and gear. Animals were later transferred to an isolation farm onshore, monitored and once deceased, their corpses were eventually cast away into the sea.⁴⁶

In later trials, Morton streamlined the techniques due to Harness having certain disadvantages: "It required a large number of men and a great deal of equipment, and accurate control of trial conditions could not be exercised."⁴⁷ Consequently, for Operations Cauldron, Ozone, Negation and Hesperus, the floating pontoon containing the animals remained at sea rather than towed away by dinghy, and the infected animals were transferred to HMS *Ben Lomond*, where the team observed the animals and conducted observations and post-mortems.

45 DEFE 5/15 "Harness Report", 2.

46 DEFE 5/15 "Harness Report", 2.

47 TNA, Department of Defence (DEFE 5/47) DEFE 5/47/310, Ministry of Defence Chiefs of Staff Committee, Memorandum—Operation Cauldron, 1952, Summary of Scientific Report by the Biological Warfare Sub-Committee, 7 July, 1953 ("Cauldron Summary"), 1.

The number of personnel present was kept to a minimum, and each person was given a series of jobs interlocked with other team members' roles. The Officer in charge of the procedures was Commander Cowgill of the Admiralty, who accordingly made an "invaluable contribution as 'stage director'". Seven men were on the pontoon during trials; three veterinary surgeons below deck joined the Officer, and all men had to wear full protective rig.⁴⁸

HMS *Ben Lomond*'s architectural arrangements and experimental protocols are key sites of erasure of nonhuman animal subjecthood. Acute demarcation of the physical space into distinct areas for the laboratory ship allowed (non)human animals to be tightly controlled and their movements regulated.⁴⁹ The ship was divided into two main areas: the "clean hold" and "dirty hold", with no free movement for animals allowed, and the flow of personnel between the two strictly inhibited. Animals would be kept in the "clean hold" until they were required for experiment and then brought back to the "dirty hold" for monitoring and eventual post-mortem (see fig. 2).

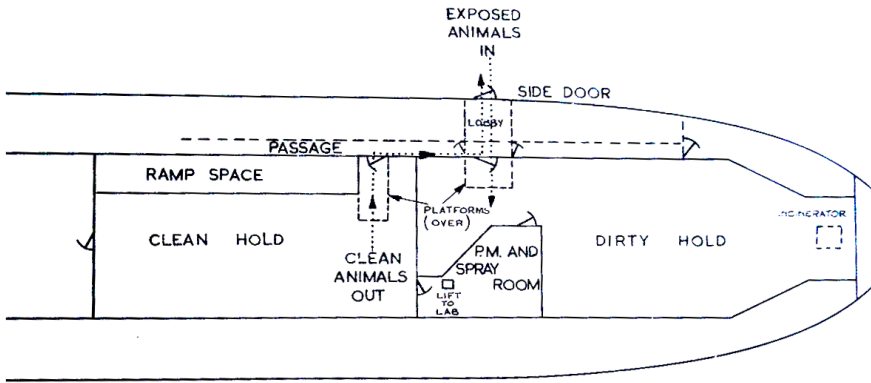
This spatial infrastructure demonstrates two things: how human–animal relations are structured in the trials and how nonhuman animals become strategically effaced because of the infrastructural arrangements meted by Morton, the trials' designer. The built environment of the trials allows for a specific kind of human–animal interaction, one that Efstathiou describes as "scripted". Encounters with nonhuman others are controlled and happen in a distinct way that ensures the animal is not treated as a companion, e.g., by stroking, hugging, or talking to them.⁵⁰ In other words, protocols of experimental design aid in rendering the animal invisible by standardizing their confinement and treatment. During the trials, animals were kept in cages in clean and dirty holds to create a system of procedures that could ensure scientific validity and replicability of results. This scripted event, however, also proscribed certain behavioural expectations of the scientists towards nonhuman animals.⁵¹

48 wo195/12213 "Cauldron Report", 6.

49 Kirk, *Care in the Cage*, 172–73.

50 Efstathiou, "Facing Animal Research", 154.

51 Efstathiou, "Facing Animal Research"; Birke et al, *The Sacrifice*, 38–39.



H.M.S. "BEN LOMOND"
ANIMAL ROOMS

Figure 2:

Diagram depicting the experimental infrastructure of HMS *Ben Lomond*.

Source: TNA War Office [wo 195] wo195/12213, Chiefs of Staff Committee: Biological Warfare Sub-Committee, Ministry of Supply, BRAB, Operation Cauldron 1952, Scientific Report by the Microbiological Research Department, Porton and Naval Report by the Naval Commander.

Refining the experimental infrastructure of the floating pontoons after Harness shows how the “use of compartments below deck meant that several trials could be done in succession and men and non-human animals could remain there during the trials.” The pontoon was nothing more than a “floating box with 24 compartments, 9 of which had to be converted to house diesel generators, pumps and ‘clean’ and ‘dirty’ animal stowage, change rooms, etc.”⁵² Here, non-human animals became part of the infrastructure, resources to be stowed away until use. They were thus recognized as needed to test dangerous pathogens yet placed in stowage as “stock” until required.

As Efstathiou recalls in her discussion of the meat industry, the semantic distinction between the “clean” and “dirty” holds for animals raises a paradox: living animals are seen as dirty, and the dead animal (“meat”) signifies their cleanliness, yet the animal in their aliveness as a commodity must still be considered clean for their bodies to be consumed. Making the animal edible enables their effacement with technological apparatus that helps workers block the face of nonhuman animals and renders their eradication as sentient beings invisible. In this instance, the division of the clean and dirty holds expedited this effacement by strategically labelling them as not-contaminated, which prevents “an encounter with the animal Other, beyond the properties of his [sic] fascia”.⁵³ Workers had to be in full protective rig to encounter the infected, and infrastructural flows helped rationalize these encounters and control human movement and contact with nonhuman experimental animals.

Finding the Right Tool for the Job: The Role of Specific Animals and Ignorance in the Presentation of Results

Central to testing dangerous pathogens was finding the most suitable nonhuman animals to use as experimental subjects. Adele Clarke and Joan Fujimura describe the contingent nature of what is the “right” tool for the scientific problem at hand. This contingency is via the joint articulation of tools (in this instance, objectified experimental animals

52 wo195/12213 “Cauldron Report”, n.p.

53 Efstathiou, “Meet We Don’t Greet”, 107.

and equipment), roles (of both humans and animals in the trials), and claims (made about pathogen viability). During Operation Harness, which animals were best to use in conjunction with specific pathogens was noted. In this case, finding the right nonhuman animal of the laboratory (tool) was a “consequence of the articulation process”⁵⁴ concerning the development of a science of BW testing. This simultaneously demonstrated their visibility as scientific resources but also their effacement. It was reported that Harness:

[H]as provided information regarding the behaviour of new types of bacterial suspensions, which contain experimental animals, and brought out the value of monkeys in this type of research. It will be unnecessary, in future, to rely on such clumsy animals as sheep in the trials with bacterial clouds.⁵⁵

“Clumsy” sheep and “valuable monkeys” demonstrate a particular kind of human–animal relationship, where the scientists get to know the individual animals and state their preference for using, in this case, the monkeys rather than the sheep. At the same time, this is a way of facing and effacing animals. By projecting anthropocentric characteristics onto sheep, the scientists invite the conclusion that they are fully aware of the animal presence, yet, simultaneously, the animals are demarcated as objects (tools) to be used. Although cast as objects to be used for human endeavour, nonhuman animals’ actions also influence the scientists’ assumptions (cf. Clarke and Fujimura’s “claims”). In this context, Vinciane Despret states that human–nonhuman animal relations in the laboratory depend on the researcher’s expectations, which can impact results and how humans and animals interact with one another.⁵⁶

Such expectations contributed to the interpretation of the results of Operation Harness. Indeed, the scientists concluded that the experiments were a success despite their “complete failure” or only partial success. This success depended on the experimental animals used: monkeys and guinea pigs, not sheep! Scientists from Porton

54 Clarke and Fujimura, “Which Tools?”, 18.

55 wo195/12213 “Cauldron Report”, 1.

56 Despret, “The Body We Care For”.

Down validated their work in numerous ways, claiming that the trials:

- (i) confirm and augment the wartime findings in respect of two agents, (ii) show that a third agent can infect animals in the field, (iii) confirm the toxicity of those three agents is many times greater than that of any chemical agent, (iv) support previous laboratory work which has shown improvement between ten and twenty fold in the effectiveness of one agent as the result of modification.⁵⁷

The infectivity of nonhuman animals in the field and the expectations of the researchers on the best animals to use for these trials helped the Porton scientists justify their work despite their weak results. Their justifications were embedded in the coincident facing and effacement of nonhuman animals in the trials, which facilitated strategic ignorance. As Michael Smithson states, there is a practical value of ignorance in the production of scientific facts.⁵⁸ This purposive ambiguity of the presentation of the results from Operation Harness was used to enhance the generalizability of the pathogenic agents being tested with the aid of guinea pigs and monkeys. Simultaneously, it was also a deliberate admission of the uncertainty of results—at once proclaiming them a “complete failure” while also, thanks to some nonhuman animals (monkeys), finding a way to claim their usefulness and the need for more tests. This presentation of results helped reframe knowledge about the trials to construct certainty out of this ambiguity. It also helped to convince the government to fund the further trials—and thus continue with large-scale nonhuman animal experimentation.⁵⁹

For the remaining trials, many of the results were also only considered satisfactory at infecting the animals. In Cauldron, the trials used *Brucella suis* on guinea pigs and monkeys. These gave “reasonably good answers about the efficacy” of the diseases because the “data supporting this were provided by sampling devices used in the trials and it is satisfactory to note that out of a large number of guinea-pigs exposed, a small bomb filling was capable of infecting nearly

57 DEFE 5/15 “Harness Report”, 3.

58 Smithson, *Ignorance and Uncertainty*, 250.

59 Balmer, *Secrecy and Science*, 79–82.

everyone.”⁶⁰ *Pasteurella pestis* was not as great a success with the experimenters, with the BW Sub-Committee remarking that the evidence obtained signified “that it is not an agent of striking potentialities”. The percentage infected with plague was 12% of the guinea pigs and 38% of monkeys; with *Brucella suis*, 85% of the guinea pigs and 59% of monkeys. All in all, 36 toxic trials were done using 3,500 guinea pigs and 84 monkeys, all exposed to plague and *Brucella suis*.⁶¹

After Cauldron and Hesperus and at the request of the British Prime Minister, Winston Churchill, Operation Ozone was carried out during February–May 1954, followed by Operation Negation in 1955 in the Bahamas.⁶² In Negation and Ozone, VEE and *Vaccinia virus* were added to the testing repertoire. Here, the experiments used aerosol sprays, and scientists examined the impact of ultraviolet light on the toxic agents.⁶³ Operation Ozone conducted trials in daylight and Negation at nightfall.⁶⁴

The animals used in these studies were primarily guinea pigs and mice, with fertile chicken eggs added to the Negation mix.⁶⁵ In an interesting turn of events, rabbits were also considered but were not used; instead, they became “doted upon pets” of the scientists.⁶⁶ This paradoxical situating of animal presence illustrates Efstathiou’s ideas concerning “added faces”, which may appear in the spaces of the animal testing facility. “Added faces” represent “some inner, emotional or moral being that humans and animals have or acquire in the lab” and are not part of the experimental process. For Efstathiou, these added faces may be in the form of posters of animals, symbols of nature and wildlife pictures. The idea is to offset the situation’s contrived nature and make it more “comfortable” for the animals and humans.⁶⁷ For Operation Negation, the living rab-

60 DEFE 5/47/310 “Cauldron Summary”, n.p.

61 DEFE 5/47/310 “Cauldron Summary”, (i).

62 DEFE 5/47/310 “Cauldron Summary”, (i).

63 DEFE 55/256 “Ozone Results”, 11.

64 DEFE 55/261 “Negation Report”, 3-4.

65 DEFE 55/261 “Negation Report”, n.p.

66 DEFE 55/261 “Negation Report”, 26.

67 Efstathiou, “Facing Animal Research”, 156–57.

bit became an added face, acting as a symbol of domesticity (for the humans at least) and care, indicated by them becoming “doted upon pets”. Rabbits provided the scientists with a way to face/render visible the naturalistic animal amidst the strategic effacement afforded to the experimental animals.

Eighty-four experiments were conducted for Operation Ozone: twenty-seven with *Brucella suis*, thirty-two with *Francisella tularensis* and eighteen with VEE. The rest were “unaccounted for”.⁶⁸ Operation Ozone demonstrated that ultraviolet light could rapidly decay the pathogenic organism and decrease the infection rate caused by the diseases when released through an aerosol spray, so “their offensive use in such conditions would lose a great deal of its potential effect”.⁶⁹ Hence, Operation Negation aimed to test the pathogenic agents in both sunlight and twilight to compare infection rates and decay of the organisms.⁷⁰

In Negation, the results were seen as lacking validity and were particularly “ill-fated” when testing VEE.⁷¹ However, 880 guinea pigs were used in the experiments and 380 in laboratory tests. The infrastructural arrangements of the trials allowed for the strategic effacement of the nonhuman experimental animals. Nonhuman animals became strategically placed actors in the purveying of ignorance; they were placed in the centre of the trials and rendered simultaneously visible and invisible for the trials to continue. Human–animal relations were scripted according to protocols that retained their status as resources for use rather than as living, feeling beings. The physical structures of the trials also allowed for this paradoxical simultaneity to occur by the differentiation of animal housing into “dirty” and “clean”, complete with a strict procedure for transporting the animals to and from the test site. The discussion and presentation of results rendered nonhuman animals as essential resources and strategic players in creating certitude out of obscurity.

68 DEFE 55/261 “Negation Report”, 12.

69 DEFE 55/261 “Negation Report”, 19.

70 DEFE 55/261 “Negation Report”, 3.

71 DEFE 55/261 “Negation Report”, 13.

All this reflects the notion of strategic effacement: the ability to acknowledge nonhuman animal presence but deny their existence as subjects through careful calculation of their positioning in both experimental practice and theory.

Facing the Effaced: The “Travelling Circus” and the Dead Animal Body

As I have described, there was a vacillating relationship between the human and nonhuman actors in the sea trials: scientists both faced and effaced nonhuman animals in the process of experimentation. As Efstathiou says, “facing animals need not bar killing them”.⁷² This section analyses the post-mortem examinations of nonhuman experimental animals and argues that this, too, served as part of the strategic effacement promoting the science of biological warfare. This was evident in the written reports of the post-mortem results. Yet, the tools and roles assumed by the scientist to conduct the post-mortems contributed to developing a “rational” epistemological interaction with nonhuman Others that helped sustain their invisibility as subjects of a life.

After exposure to a toxic agent, all animals from the trials were held in the dirty hold of *Ben Lomond* for observation. When the results of the assessment of infectivity were calculated, those animals that were *not* infected were killed immediately; they were deemed useless. Those that were infected did, however, have a value—but this was mainly after the scientists had killed them and given a post-mortem examination.

Each toxic agent took different lengths of time to affect the animals. For those infected with *Brucella suis*, animals were observed for twenty-eight days before being killed, and for those infected with tularaemia, fourteen days.⁷³ Then, they were prepared for post-mortem, whereby a series of procedures had to be followed. For guinea pigs and mice, vets and a laboratory assistant entered the dirty hold of the ship and commenced killing the animals one hour before the arrival of the post-mortem team. Groups of 100 to 250 mice and

72 Efstathiou, “Facing Animal Research”, 149.

73 WO195/12213 “Cauldron Report”, 37.

guinea pigs could be euthanized at any one time. The pathology team placed the dead animals on trays, with each tray containing the specific group of animals which were “exposed to the BW agent at a particular point of the layout [pontoon].” A label representing the trial number and exposure point was then attached to each tray. Monkeys were killed and prepared similarly but injected with Nembutal two to three hours before the post-mortem. A two to four vet party (depending on the number of monkeys required) removed the monkeys from their cages, and then “the animal is held extended so that the abdomen is fairly taught” and returned to the cage until dead. The animals were then checked to see if they had deceased thirty to forty minutes after the Nembutal injection.⁷⁴

The pathologists had to follow procedures strictly, and, again, this reflects two key aspects of effacement espoused by Efstathiou: it is a “scripted performance” whereby the task is streamlined and standardized to aid repetition and validate scientific practice. It also engages the staff in a specific relationship with nonhuman animals; the ensuing division of labour between the laboratory workers seeks to abolish the visibility of nonhuman animals’ agency—workers did not have face the Other in all their embodied glory. For example, the procedure for killing the monkeys involved picking them up in a way that enabled distance—holding the monkey away from you in an extended manner until their body is rigid. This may be anxiety-inducing for the monkeys, but it helps to maintain strategic effacement of the Other that is just about to be killed. Strategic, in that it is a calculated display of distance, consciously denying sentient life but at the same time not negating their recalcitrance (recall here Efstathiou’s description of “perceived duplicitousness” with the scientist and mice). Holding them tight reduces the monkeys’ range of motion and display of agency. Doing this helps to “block the animal face”, and they become disembodied.⁷⁵ It allows for a “business-as-usual” approach whereby the procedures embed and enable denials and neutralization of suffering that routinizes and normalizes animal experimental protocols.⁷⁶

74 wo195/12213 “Cauldron Report”, 78.

75 Efstathiou, “Facing Animal Research”, 154.

76 Thiel and South, “Criminal Ignorance”.

Performing Autopsies: The Theatrics of Strategic Effacement

Once the killing was over, the autopsies used a “mass production approach to enquiry”.⁷⁷ Scientists labelled the animals and transported them from the “dirty hold” in *Ben Lomond* to the post-mortem room. The dead animals were passed from one scientist to the next, around a rotating table, in what was described by head scientist Morton as the “travelling circus” (see fig. 3):

- [...] (e) The team prepare the PM table, a round revolving stainless steel table. Clips and chains are attached, beakers containing acetone or lysol are placed in appropriate positions and instruments prepared.
- (f) The *recorder* marks paper towels with the animals’ numbers (showing trial and point number) and places these ready for
- (g) The two *fixers* (Vet. staff) who lay out the animal on the numbered towel on the tray in front of them and clip the animal out by its four limbs. Each animal is thoroughly wetted with lysol before the table is revolved to bring it in front of the
- (h) *Skinner* who opens the animal up from pubes to jaw, laying the skin back on each side. The animal is now moved round to the
- (i) *Exposer* who removes the anterior portion of the thoracic cage, laying bare the heart and lungs, and opens up the abdominal cavity exposing the spleen for the
- (j) *Spleen plater* who removes a small portion of the spleen and smears its cut surface on the half of a plate labelled “S”, handed to him by the
- (k) *Plate handler* who after marking the plate with the animal’s number holds it for the
- (l) *Pathologist* who removes a portion of the lymphatic gland and smears it over the unmarked half of the plate.
- (m) The pathologist reports to the recorder on the condition of the spleen, liver, cervical and bronchial glands in this order. A typical positive is plus, a typical negative –, E indicates enlarged, and A abnormal.⁷⁸

77 *Operation Cauldron 1952*, dir. J.D. Morton, 47 mins., https://youtu.be/CPA_yce0Swg.

78 WO195/12213 “Cauldron Report” 38. Emphasis in original.



Figure 3:

The “Travelling Circus”:
Rotating postmortem table and
vivisected guinea pig.

Still from the instructional film
Operation Cauldron 1952, directed by
J.D. Morton.

The dead animal is first clipped to the table in chains, with an identification number on the paper underneath them. The body is then rotated and passed to the first man, who peels back the animal's skin. The second man exposes the organs, and the third takes a sample of one organ, depending on the disease they seek. All scientists have ascribed a role like characters in a play; they know their place and part. Whether one becomes the "skinner" or the "exposer", one assumes one's role with the utmost scientific rationality and neutrality. Once the dissection is complete, the animals' bodies are removed from the table, put in a dustbin, and taken away to be incinerated.⁷⁹

The procedures imposed in this routinization of mass autopsies help humans block the face of the animal. It allows pathological epistemology to take centre stage over a moral and ethical encounter between humans and animals. The autopsy methodology helped shield the scientists from the idea of animals being sentient, with the allocation of roles strategically helping to render the animals invisible and screening humans from the ultimate paradox of adoring animals (remember the pet rabbits?) and experimenting on them.⁸⁰

Rationalizing Effacement: Fordist-Style Scientific Labour

This scripted encounter between the Porton pathologists and the dead animal bodies signifies a more profound meaning related to the conditions of modernity in which the British warfare state was engaged. Morton's "travelling circus" is paradigmatic of the Fordist-style assembly line in the mid-twentieth century. Initially developed by Henry Ford in the early twentieth century and influenced by his visit to the Chicago stockyards. Each part is passed along a line to be assembled by a stationary person with a specific role; for instance, a person working in a Ford car factory may attach the wheel, another person further down the line would attach the seats, etc. This automated form of the division of labour speeds up the manufacturing process. Still, it also facilitates the masking of distressing activity and amplifies denial of the dead animal body as a sentient

79 wo195/12213 "Cauldron Report", 38.

80 This recalls Efstathiou's description of the meat paradox of "loving animals and loving meat". See Efstathiou, "The Meet We Don't Greet", 109.

being. This provided the Porton scientists with the conditions of possibility for the “will to ignorance”⁸¹ — a process that can also be deadly to human animals, as described by Zygmunt Bauman in his analysis of the Holocaust.

The Fordist-style rationalization of laboratory work thus helps to structure a moral distance between the embodied animal and the laboratory workers. It created a logic for vivisection, which helped shape an episteme that reinforces the need for state violence — in this case, allowing for the imposition of violence on nonhuman animals’ bodies and the perpetuation of a particular kind of brutality that allowed the British state to have weapons of mass destruction that could wipe out human populations.⁸² In this instance, the demotion of ethical treatment of nonhuman animals occurs and is delegitimized, as evidenced by the tossing away of their bodies in bins. Bauman’s analysis of the Holocaust again provides a pertinent example of this censure of morality and the calculated yet wilful effacement of animals in the Porton post-mortems. Bauman argues that “among other things, [the civilizing process] is a process of divesting the use and deployment of violence from moral calculus, and of emancipating the desiderata of rationality from the interference of ethical norms or moral inhibitions.”⁸³ The elimination of ethical consideration towards the corpses of animals is a form of strategic effacement implicit in the practice of the post-mortems on the BW test animals. At one time, their bodies were very much present in the flesh. However, they were also made un-seeable (cf. Lynch’s “analytic animal”) because of the Fordist division of labour, which promotes the elision of any ethical responsibility towards the Other.

The disassembly line of the “travelling circus” enabled the exclusion of nonhuman animals from the moral universe, thus permitting their ill-treatment and reinforcing their status as resources or tools to “get the job done”.

81 Linsey McGoey, “On the Will to Ignorance”, 213.

82 Thiel and South, “Criminal Ignorance”, 338.

83 Bauman, *Modernity and the Holocaust*, 32.

Conclusion

This article reveals the hidden role nonhuman experimental animals have played in creating biological weapons, and it adds to the burgeoning animal studies literature on animals and war. Yet, despite this growing field of research, nonhuman animals of the laboratory have been neglected, and the lives and concerns of experimental animals have received little to no consideration. Historically, many animals of war have been revered for their (unwilling) contributions and even labelled as heroes for their efforts.⁸⁴ However, the historical record falls short when it comes to documenting the lives and deaths of experimental animals in the creation of military hardware such as biological weapons.

I have demonstrated the peculiarity and complexity of the human–animal relationship in these series of biological weapons trials. To do this, I extended the concepts of effacement, as developed by Sophia Efstathiou, and strategic ignorance, as theorized by Linsey McGoey, to posit a novel concept of strategic effacement. Strategic effacement is the purposeful elision of nonhuman subjecthood by individuals, organizations, and state institutions. It is a method by which strategic ignorance is mobilized via technologies of effacement. What produces this calculated invisibility of nonhuman bodies is a confluence of factors, namely, the infrastructures and architecture of an animal experimental laboratory, the presentation of the results of the trials and the continual examination/observation of nonhuman bodies at every stage of the research process until, and after, their death. In this case, strategic effacement was applied in the production of BW to be used, if necessary, by the hands of the British state.

In the sea trials of 1948–1955, the strategic effacement of animals was undergirded by the infrastructural design of the operations, such as the strict demarcation of space on HMS *Ben Lomond*. This effacement was also tied to how scientists acknowledged some of the ambiguous outcomes of the trials. In both cases, nonhuman animals

84 See, for instance, the *Animals in War Memorial*: <https://animalsinwar.org.uk>.

are present in the flesh but also disappear; they become resources used by the warfare state as a means to an end. In this sense, material-semiotic entanglements of experimental design, scientific practice and discourse coalesced to render consecutively nonhuman animals as invisible. Their visibility is precisely the site of their erasure as living beings. For example, in the results of the trials, the nonhuman animal disappears; they become mediators of effect and are strategically employed to create certainty out of ambiguity.

I have also demonstrated the paradoxical yet calculated obfuscation of nonhuman actors in the methodologies employed to euthanize and vivisect animal bodies. For example, the ritualistically performed post-mortem signified the visibility of the (analytic) animal body and their eradication as living beings. It also demonstrated a more profound relation of BW testing to the mechanisms of the modern British state, that of human labour fragmentation and the censor of an ethical relationship towards nonhuman animals. The imposition of the Fordist (dis)assembly line helped create a fragmented human knowledge and activity and a fragmented animal body.

Overall, this article has considered the complex social, ethical and political relationships between humans and animals that went into the research at Porton Down when Britain was preparing for a “hot” war with the USSR. It shows how material-semiotic entanglements of scientific theory and practice help render the experimental animal visible as a key research tool. Nevertheless, their subjecthood is strategically negated to legitimize animal experimentation and help cement military prowess in warfare uncertainty.

Acknowledgements

I would like to thank the anonymous reviewers for their constructive feedback on the article. Their comments and suggestions were incredibly helpful. I would also like to extend my absolute gratitude to Kári Driscoll, whose patience and support through the submission process has been amazing. Thank you!

Works Cited

- Alexander, Martin. "War and Its Bestiality: Animals and Their Fate During the Fighting in France, 1940." *Rural History* 25 (2014): 101–24. <https://doi.org/10.1017/S0956793313000216>.
- Balmer, Brian. *Britain and Biological Warfare: Expert Advice and Science Policy, 1930–65*. Basingstoke: Palgrave Macmillan, 2001.
- Balmer, Brian. "The Drift of Biological Weapons Policy in the UK, 1945–1965." *The Journal of Strategic Studies* 20, no. 4 (1997): 115–45. <https://doi.org/10.1080/01402399708437701>.
- Balmer, Brian. "Killing 'without the Distressing Preliminaries': Scientists' Defence of the British Biological Warfare Programme." *Minerva* 40, no. 1 (2002): 57–75. <https://doi.org/10.1023/A:1015009613250>.
- Balmer, Brian. *Secrecy and Science: A Historical Sociology of Biological and Chemical Warfare*. Farnham: Ashgate, 2012.
- Balmer, Brian. "The UK Biological Weapons Programme." In Wheelis et al., *Deadly Cultures*, 47–83.
- Barras, Vincent, and Gilbert Greub. "History of Biological Warfare and Bioterrorism." *Clinical Microbiology and Infection* 20, no. 6 (2014): 485–543. <https://doi.org/10.1111/1469-0691.12706>.
- Bates, A.W.H. *Anti-Vivisection and the Profession of Medicine in Britain: A Social History*. London: Palgrave Macmillan, 2017.
- Bauman, Zygmunt. *Modernity and the Holocaust*. Cambridge: Polity, 1992.
- Beard, Jack M. "The Shortcomings of Indeterminacy in Arms Control Regimes: The Case of the Biological Weapons Convention." *American Journal of International Law* 101, no. 2 (2007): 271–321. <https://doi.org/10.1017/S000293000030098>.
- Birke, Lynda, Arnold Arluke, and Mike Michael. *The Sacrifice: How Scientific Experiments Transform Animals and People*. West Lafayette, IN: Purdue University Press, 2007.
- Bjørkdahl, Kristian and Tone Druglitrø, eds. *Animal Housing and Human–Animal Relations: Politics, Practices and Infrastructures*. New York: Routledge, 2016.
- Carter, G.B. *Porton Down: 75 Years of Chemical and Biological Research*. London: HMSO Publications, 1992.
- Clarke, Adele E. and Joan H. Fujimura. "What Tools? Which Job? Why Right?" In *The Right Tools for the Job: At Work in Twentieth-Century Life Sciences*, edited by Clarke and Fujimura, 3–46. Princeton, NJ: Princeton University Press, 1992.
- Dahal, Bibha, Shih-Chao Lin, Brian D. Carey, Jonathan L. Jacobs, Jonathan D. Dinman, Monique L. van Hoek, Andre A. Adams, and Kylene Kehn-Hall. "EGR1 Upregulation Following Venezuelan Equine Encephalitis Virus Infection Is Regulated by ERK and PERK Pathways Contributing to Cell Death." *Virology* 539 (2020): 121–28. <https://doi.org/10.1016/j.virol.2019.10.016>.
- Despret, Vinciane. "The Body We Care For: Figures of Anthropo-Zoo-Genesis." *Body & Society* 10, nos. 2–3 (2004): 111–34. <https://doi.org/10.1177/1357034X04042938>.
- Duxbury, Catherine. "Property, Pain and Pastoral Power: The Advent of Animal Welfare in the Review of the 1876 Cruelty to Animals Act, 1947–1965." *Journal for Critical Animal Studies* 16, no. 2 (2019).
- Efstathiou, Sophia. "Facing Animal Research: Levinas and Technologies of Effacement." In *Face to Face with Animals: Levinas and the Animal Question*, edited by Peter Atterton and Tamra Wright, 139–63. Albany: State University of New York Press, 2019.

- Efstathiou, Sophia. "Meat We Don't Greet: How 'Sausages' Can Save Pigs or How Effacing Livestock Makes Room for Emancipation." In *Changing Meat Cultures: Food Practices, Global Capitalism, and the Consumption of Animals*, edited by Arve Hansen and Karen Lykke Syse, 164–84. Lanham, MD: Rowman & Littlefield, 2021.
- Elston, Mary Ann. "Women and Anti-Vivisection in Victorian England, 1870–1900." In Rupke, *Vivisection in Historical Perspective*, 259–94.
- Evans, Rob. *Gassed: British Chemical Warfare Experiments on Humans at Porton Down*. London: House of Stratus, 2000.
- French, Richard D. *Antivivisection and Medical Science in Victorian Society*. Princeton, NJ: Princeton University Press, 1975.
- Fudge, Erica. "A Left-Handed Blow: Writing the History of Animals." In *Representing Animals*, edited by Nigel Rothfels, 3–18. Bloomington: Indiana University Press, 2002.
- Fulbrook, Mary. *Historical Theory*. London: Routledge, 2002.
- Gross, Matthias, and Linsey McGoey, eds. *Routledge International Handbook of Ignorance Studies*. 2nd ed. London: Routledge, 2023.
- Hamilton, Susan, ed. *Animal Welfare and Anti-Vivisection 1870–1910: Nineteenth Century Woman's Mission*. 3 vols. London: Routledge, 2004.
- Hammond, Peter, and Graydon Carter. *From Biological Warfare to Healthcare: Porton Down 1940–2000*. Basingstoke: Palgrave Macmillan, 2002.
- Hampson, Judith. "Legislation: A Practical Solution to the Vivisection Dilemma?" In Rupke, *Vivisection in Historical Perspective*, 314–39.
- Haraway, Donna. *Primate Visions: Gender, Race, and Nature in the World of Modern Science*. New York: Routledge, 1989.
- Hediger, Ryan, ed. *Animals and War: Studies of Europe and North America*. Leiden: Brill, 2012.
- Kean, Hilda. *Animal Rights: Political and Social Change in Britain since 1800*. London: Reaktion Books, 1998.
- Kean, Hilda. "Challenges for Historians Writing Animal–Human History: What Is Really Enough?" *Anthrozoös* 25, sup. 1 (2012): s57–s72. <https://doi.org/10.2752/175303712X13353430377011>.
- Kean, Hilda. "The 'Smooth Cool Men of Science': The Feminist and Socialist Response to Vivisection." *The History Workshop Journal* 40 (1995): 16–38. <https://doi.org/10.1093/hwj/40.1.16>.
- Kirk, Robert G.W. "Care in the Cage: Materializing Moral Economies of Animal Care in the Biomedical Sciences, c.1945–." In Bjørkdahl and Druglitrø, *Animal Housing and Human–Animal Relations*, 167–84.
- Kourany, Janet A. "Science: For Better or Worse, a Source of Ignorance as Well as Knowledge." In Gross and McGoey, *Ignorance Studies*, 178–90.
- Levinas, Emmanuel. *Totality and Infinity: An Essay on Exteriority*. Translated by Alphonso Lingis. Pittsburgh, PA: Duquesne University Press, 1969.
- McGoey, Linsey. "On the Will to Ignorance in Bureaucracy." *Economy and Society* 36, no. 2 (2007): 212–35. <https://doi.org/10.1080/03085140701254282>.
- McGoey, Linsey. "The Logic Strategic Ignorance." *The British Journal of Sociology* 63, no. 3 (2012): 533–76. <https://doi.org/10.1111/j.1468-4446.2012.01424.x>.
- McGoey, Linsey. "Strategic Unknowns: Towards a Sociology of Ignorance." *Economy and Society* 41, no. 1 (2012): 1–16. <https://doi.org/10.1080/03085147.2011.637330>.
- Millet, Piers. "Antianimal Biological Weapons Programs." In Wheelis et al., *Deadly Cultures*, 224–35.

- Nocella, Anthony J., II, Colin Salter, and Judy K.C. Bentley, eds. *Animals and War: Confronting the Military-Animal Industrial Complex*. Landham, MD: Lexington Books, 2014.
- Pappas, Georgios, Paraskevi Panagopoulou, Leonidas Christou, and Nikolaos Akritidis. "Brucella as a Biological Weapon." *Cellular and Molecular Life Sciences* 63 (2006): 2229–36. <https://doi.org/10.1007/s00018-006-6311-4>.
- Pearson, Chris. "'Four-Legged Poilus': French Army Dogs, Emotional Practices and the Creation of Militarized Human-Dog Bonds, 1871–1918." *Journal of Social History* 52, no. 3 (2019): 731–60. <https://doi.org/10.1093/jsh/shx090>.
- Quenee, Lauriane E., Claire A. Cornelius, Nancy A. Ciletti, Derek Elli, and Olaf Schneewind. "Yersinia pestis cafi Variants and the Limits of Plague Vaccine Protection." *Infection and Immunity* 76, no. 5 (2008): 2025–36. <https://doi.org/10.1128/iai.00105-08>.
- Ritvo, Harriet. *The Animal Estate: English and Other Creatures in the Victorian Age*. Cambridge, MA: Harvard University Press, 1987.
- Rupke, Nicolaas, ed. *Vivisection in Historical Perspective*. London: Croom Helm, 1987.
- Russell, Edmund P. *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring*. Cambridge: Cambridge University Press, 2001.
- Ryder, Richard D. *Victims of Science: The Use of Animals in Research*. 2nd ed. London: National Anti-Vivisection Society, 1983.
- Schmidt, Ulf. "Cold War at Porton Down: Informed Consent in Britain's Biological and Chemical Warfare Experiments." *Cambridge Quarterly of Healthcare Ethics* 15, no. 4 (2006): 366–80. <https://doi.org/10.1017/S0963180106060488>.
- Schmidt, Ulf. "Medical Ethics and Human Experiments at Porton Down: Informed Consent in Britain's Biological and Chemical Warfare Experiments." In Schmidt and Frewer, *History and Theory of Human Experimentation*, 283–314.
- Schmidt, Ulf. *Secret Science: A Century of Poison Warfare and Human Experiments*. Oxford: Oxford University Press, 2015.
- Schmidt, Ulf, and Andreas Frewer, eds. *History and Theory of Human Experimentation: The Declaration of Helsinki and Modern Medical Ethics*. Stuttgart: Franz Steiner Verlag, 2007.
- Schneider, Jessica K. "The BWC's Prohibition of Biological Weapons: Reality or Rhetoric?" *Journal of Biosecurity, Biosafety and Biodefense Law* 5, no. 1 (2014): 177–97. <https://doi.org/10.1515/jbbbl-2014-0010>.
- Shukin, Nicole. *Animal Capital: Rendering Life in Biopolitical Times*. Minneapolis: University of Minnesota Press, 2009.
- Smithson, Michael. *Ignorance and Uncertainty: Emerging Paradigms*. New York: Springer-Verlag, 1989.
- Taussig, Michael. *Defacement: Public Secrecy and the Labor of the Negative*. Stanford: Stanford University Press, 1999.
- Thiel, Darren, and Nigel South. "Criminal Ignorance, Environmental Harms and Processes of Denial." In Gross and McGoey, *Ignorance Studies*, 334–44.
- Waldenfels, Bernhard. "Levinas and the Face of the Other." In *The Cambridge Companion to Levinas*, edited by Simon Critchley and Robert Bernasconi, 63–81. Cambridge: Cambridge University Press, 2002.
- Wheelis, Mark, Lajos Rózsa, and Malcolm Dando, eds. *Deadly Cultures: Biological Weapons since 1945*. Cambridge MA: Harvard University Press, 2006.
- Wood, Joseph P., Young W. Choi, Morgan Q. Wendling, James V. Rogers, and Daniel J. Chappie. "Environmental Persistence of Vaccinia Virus on Materials." *Letters in Applied Microbiology* 57, no. 5 (2013): 399–404. <https://doi.org/10.1111/lam.12126>.