The London School of Economics and Political Science

'To assist, and control, and improve, the operations of nature': Fish culture, reproductive technology and social order in Victorian Britain

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A thesis submitted to the Department of Sociology of the London School of Economics for the degree of Doctor of Philosophy, London, June 2016.

Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

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Abstract

This thesis investigates the development of fish culture technology in Victorian Britain. Fish culture included artificial propagation (breeding, incubation and rearing) of fish, as well as the other material practices, forms of regulation, social organisation and discourses that constituted freshwater fisheries conservation in Britain, circa 1830 – 1870. The approach taken is based in both the sociology of science and technology and social history. Fish culture is viewed as an innovative reproductive technology, and positioned as part of the "pre-history" of modern reproduction. Focusing on the generative interactions of the social and piscine worlds of fish culture, empirical analyses of the social relations or social order of a technology, and its co-constitution with the society of which it was part are conducted. Focus is also placed specifically on social conflicts of different kinds. These conflicts emerged out of existing social and economic tensions connected to the fisheries and the scientific study of fish – which were themselves connected to wider economic, demographic and political developments in British society in which social hierarchies of different kinds were being challenged and thus also defended and remade. Empirical case studies focus on these conflicts as socio-technical processes involving rivalry over scarce goods – ideal and material – and, specifically, how they were resolved or ameliorated such that social orders were achieved, modified and reproduced. The thesis is positioned as a contribution to the social studies of reproduction, to science and technology studies, and to the substantive sociological and historical understanding of a socio-technical practice of historical interest and, in the form of modern aquaculture, of growing contemporary importance.

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A note on the text

All emphases in quotes have been reproduced as they are in the original, unless otherwise stated. Variations in spelling have likewise been kept as they are in the original, with occasional archaisms likely. A footnote style of citations (Chicago Manual of Style 16th Edition (Full Note) has been used in order to minimise interference with the narrative, maintain semblance with conventions for historical scholarship, and because significant amounts of primary sources are cited. Full publication information and dates of books and articles etc., are cited in full in the first instance, with abbreviated references for subsequent citations thereafter. British Parliamentary Papers (PP) are cited in abbreviated form in footnotes and in full in the bibliography. References to Parliamentary Debates (Lords and Commons) are cited with individual volume numbers in footnotes and by series in the bibliography. Bills and Acts of Parliament are cited with regnal year and chapter numbers in the footnotes, but not reproduced in the bibliography. Court cases and patents are reproduced in the bibliography and cited in footnotes in accordance with convention as far as possible. Variations in the format of the historical material require some inevitable citation compromises.

Abbreviations

PP	British Parliamentary Papers
PD	Parliamentary Debates

(Preceded by "PP")

UK (1824) [427]	*Report from the Select Committee on the Salmon Fisheries of the United Kingdom* (1st Report)
UK (1825) [173]	*Report from the Select Committee on the Salmon Fisheries of the United Kingdom* (2nd Report)
UK (1825) [393]	*Report from the Select Committee on the Salmon Fisheries of the United Kingdom* (3rd Report)
UK (1836) [393]	*Report of the Select Committee on Salmon Fisheries* (Scotland)
UK (1842) [522]	*Report from the Select Committee on Salmon Fisheries* (Scotland)
UK (1860) [456]	*Report from the Select Committee of the House of Lords on Salmon Fisheries* (Scotland)
UK (1861) [2768] [2768-I]	*Report of the Royal Commission Appointed to Inquire into Salmon Fisheries* (England and Wales)

UK (1864) [70]	*Nominal return of every salmon fishery in Scotland, and the valuation of each, and the mode of capture practised at each such fishery*
UK (1871) [C. 419]	*Report of the Special Commissioners Appointed to Inquire into the Effect of Recent Legislation on the Salmon Fisheries of Scotland* (The 'Buckland and Young Report')
UK (1873) [285]	*Report from the Select Committee on Game Laws*
UK (1875) [C.1117]	*Report of the Special Commissioners Appointed to Inquire into the Operation of the Tweed Fisheries Acts*
UK (1884) [4431]	*Third Annual Report of the Fishery Board for Scotland*

CUL	Cambridge University Library Archives
NMS	National Museums of Scotland
NHM	Natural History Museum
NRAS	National Register of Archives (Scotland)
NRO	Norfolk Record Office
NRS	National Records of Scotland
PKCA	Perth and Kinross County Archives
TDSFB	Tay District Salmon Fisheries Board
UEA	University of Edinburgh Archives and Special Collections
UGSC	University of Glasgow Special Collections
UPSC	University of Princeton Archives and Special Collections
USA	University of Stirling Archives

DNB	*Dictionary of National Biography*
OED	*Oxford English Dictionary*

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This dissertation is dedicated to my mother.

1. Approaching fish culture as a social reproductive technology

…assist and control, and improve, the operations of nature.
– Piscarius, *The Artificial Production of Fish,* 1852

Technologies are simultaneously products of social activity and contribute to the reproduction of social life. In this sense, all technologies – from mundane material devices and techniques to complex conceptual schemes, texts, discourses and programmes – are reproductive technologies. But artificial reproductive technologies (ARTs), those technologies oriented around intervening into bio-reproductive processes of humans and animals are, arguably, socially re-productive in especially interesting and significant ways. From this point of view, one of the most basic questions that can be asked of such reproductive technologies is: what do they, in fact, reproduce, beyond simply organisms and populations?[1] This broad question frames a social and historical account of fish culture in nineteenth century Britain. Fish culture is taken to represent a particular form of ART, structured around the management of the biological processes and life histories of certain freshwater fish and thus constitutively connected to the social worlds and relations of the human actors associated with them.

This introductory chapter proceeds by providing some substantive co-ordinates, justifications and historical context intended to help orientate the reader for the discussions that follow. Thereafter, I locate my contribution with reference to key literatures, including the social studies of reproduction (especially animal reproduction) and existing social scientific and historical analyses of fish culture. Following this, I introduce constructionist science and technology studies (STS) as a theoretical-analytical resource. I explore methodological tensions arising from the pairing of sociology, STS, and broader a social-historical approach of this research. I develop a distinction in approaches to co-constructionist thought in STS (in which both objects and their contexts are understood to be mutually interactive) that is appropriate to social-historical scholarship and modes of

[1] Drawing especially on Franklin Sarah Franklin, *Biological Relatives: IVF, Stem Cells, and the Future of Kinship* (Durham, NC: Duke University Press, 2014).

explanation. I present the problem of social order as an emerging theme. This overlaps with characteristic concerns in STS about the relationship between epistemic or technical order and social order[2] but also exceeds this by treating order as a problem and provisional achievement, reproduced through activities which collectively make "society" possible[3] by means of establishing agreements and forms of co-ordination between actors with conflicting goals, interests and values. This is followed with detailed methodological discussion of how I sourced, selected and analysed the historical documentary material I used. Finally, I summarise the central arguments of the subsequent empirical chapters.

* * *

While deliberate efforts to cultivate fish by humans per se were not new, the forms these took in the decades around the mid 19th century were distinctive, and have proven historically significant. The fish culture techniques and forms of intervention pioneered during this period are the direct antecedents of contemporary industrialised aquaculture practice, and the origins of much later British nature conservation policy.[4] Some of the techniques developed and used by fish culturalists at this time, moreover, also participated in, if in an attenuated fashion, the genealogy of later innovative artificial reproductive techniques and associated sciences of reproduction, including artificial insemination and IVF.[5] Indeed, fish culture, I suggest, can be situated in terms of a pre-history of "modern reproduction", characterised as the systematic achievement or enhancement of control over reproduction most often associated with 20th century bio-scientific and technological endeavour.[6] Finally, and most importantly, fish culture represents a valuable and interesting study in its own right as a lens onto the social relations of an emerging and developing technology – and a site through which to

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[2] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*, 2nd ed. (Princeton, NJ: Princeton University Press, 2011).
[3] I intend no specific reference to Georg Simmel, "How Is Society Possible?," *American Journal of Sociology* 16, no. 3 (1910): 372–91.
[4] See Colin E Nash, *The History of Aquaculture* (Ames, IA: Blackwell, 2011); Roy MacLeod, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86," *The Journal of British Studies* 7, no. 2 (1968): 114–50.
[5] Compare Franklin's genealogical approach to cloning through the history of sheep husbandry *Dolly Mixtures: The Remaking of Genealogy* (Durham: Duke University Press Books, 2007).
[6] Adele E Clarke, "Modernity, Postmodernity, & Reproductive Processes, Ca. 1890-1990, or 'Mommy, Where Do Cyborgs Come From Anyway?,'" in *The Cyborg Handbook*, ed. Chris H Gray (New York: Routledge, 1995), 140; and *Disciplining Reproduction: Modernity, American Life Sciences, And "the Problems of Sex"* (Berkeley, CA: University of California Press, 1998).

investigate the means by which forms of social order were constituted, maintained and reproduced. As this dissertation will illustrate, in the circumstances in which it arose, was deployed and thus participated in, the history of early British fish culture is characterised by a variety of intertwined social controversies and conflicts, struggles over authority, power and scarce resources of different kinds, ideal and material. These struggles involved disputes over statements about scientific facts and their significance, the rights and duties associated with property ownership and customary privileges, and were connected to matters of economic (in)equality and the apprehension of modifications in patterns of social stratification, including profession, class and especially status. Occurring amongst individual actors and groups within the overlapping worlds and arenas of natural history or science, recreational angling and professional fishing, and the structures and regulatory forms governing freshwater fishing, these struggles offer small windows onto the broader context of socio-economic, cultural and demographic change that characterised early and mid-Victorian Britain.

It is well established that important sources for our understanding of modern reproduction lie in the intensification of husbandry practices and the development of agricultural science, especially in animal breeding.[7] On the farm we find early models and precursors to later efforts at capitalising on reproductive power in the industrialisation, standardisation, commoditisation and economisation of biological lives and life processes. But fish – who exhibit very different properties to agricultural mammals – have often been left out of this story. This dissertation therefore represents, in some ways, an effort to write them back into this broad history. But the emphasis will not be on showing various correspondences between fish and fish culture practices and those specific features considered to be characteristic of modern reproduction – such as increased technological control over or scientific knowledge of biological processes and life courses – but, more specifically, in terms of the prevalence of social struggles in arenas of reproductive concern and action. Such struggles, conflicts or controversies, are, I suggest, albeit that they appear in diverse forms and modes, an ever-present feature of efforts to

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[7] Eg., Adele E Clarke, "Reflections on the Reproductive Sciences in Agriculture in the UK and US, Ca. 1900-2000+," *Studies in History and Philosophy of Biology & Biomedical Science* 38, no. 2 (2007): 316–39; Sarah Wilmot, "From 'Public Service' to Artificial Insemination: Animal Breeding Science and Reproductive Research in Early Twentieth-Century Britain," *Studies in History and Philosophy of Biological and Biomedical Sciences* 38, no. 2 (2007): 411–41. See below.

modernise reproduction. In the cases I will examine, I find fish culture as a reproductive technology emerging out and sometimes responding directly to specific conflicts, though these are in turn connected too wider social processes. I will emphasise that fish cultural technologies were both mobilised as means of mediating or ameliorating conflicts, but also had the capacity to provoke or reinforce them. The successes of fish cultural technologies were also hampered by the existence of conflicts between agents pursuing different ends; these shaped the forms in which the technologies were developed and deployed. Moreover, when successes in the field of fish culture and the freshwater fisheries were achieved, these were typically, I will emphasise, dependent less on the capabilities of the material technologies concerned than on the capacity of social agents to pursue successful strategies of persuasion, coercion and compromise – that is, on politics or political actions leading to the achievement of mutually acceptable and binding agreements between parties.[8] In this way, I bring a particular focus to studies in the history of the "politics of reproduction".[9] I am especially concerned with the means – including linguistic, material, institutional, cultural and economic – by which conflicts are attenuated and resolved. This is not only because this is relevant to elucidating the social relations of fish culture as a developing collective activity and set of technologies. Rather, it is because I am also interested in how social order was achieved and maintained in the specific arenas associated with fish culture and the freshwater fisheries, social order being conceived here then less as a question of structural integration between social parts or as an abstract matter of cognitive order at a general level than as a practical problem of achieving relative civility and harmoniousness in social relations.[10]

1.1 Fish culture, artificial propagation and the social worlds of the *salmonidae*

Fish culture refers to a broad spectrum of practices focused on the conservation, improvement and cultivation of freshwater resources. It is often

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[8] Drawing on Mark B Brown, "Politicizing Science: Conceptions of Politics in Science and Technology Studies," *Social Studies of Science* 45, no. 1 (2015): 3–30.
[9] Eg., Susanne Lettow, "Population, Race and Gender: On the Genealogy of the Modern Politics of Reproduction," *Distinktion: The Scandinavian Journal of Social Theory*, 2015, doi:10.1080/1600910X.2015.1066693.
[10] C.f., Dennis H Wrong, *The Problem of Order: What Unites and Divides Society* (New York: The Free Press, 1994).

used synonymously with the more contemporary term "aquaculture". Indeed one marker of the attention the subject began to receive in Europe and America during the Victorian period was the emergence of the word "aquaculture", which first appeared in the decades around mid-century. In 1863 Frank Buckland, a famous advocate, asked, "[w]ho ever heard of an *aquæ*culturalist or water farmer?"[11] Yet the preferred idiom of the day was the older, more rustic and familiar English expression "fish culture" or, as commonly, the French equivalent "pisciculture".[12] As a subject of study and practice, whatever it is called, it emerged with great force in the decades around mid-century.

A crucial aspect of the development and deployment of fish culture at this time lay in a series of innovative technologies, known collectively as techniques of artificial propagation. Pre-eminent amongst these was artificial fecundation, a method of deliberate, manual insemination of fish eggs. This was perhaps the primary technical and symbolic fulcrum around which the fish culture movement during this period turned, and helped launch what environmental historian Darin Kinsey called, echoing the hubris of his historical interlocutors, a "global aquacultural revolution".[13]

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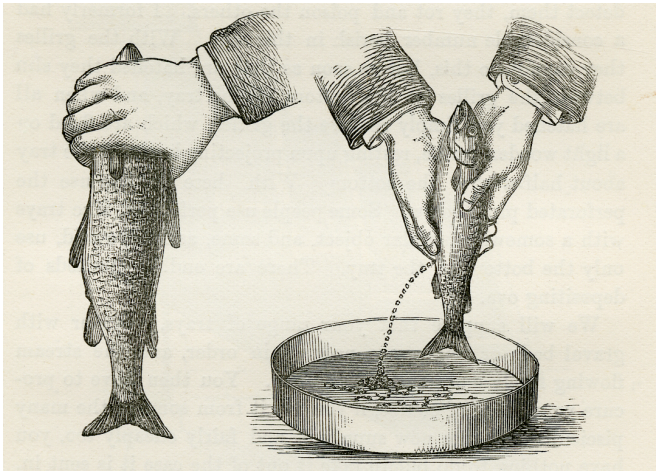
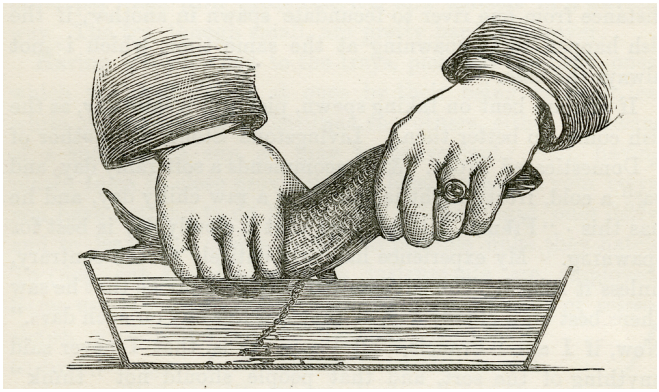
[11] Francis Buckland, *Fish Hatching* (London: Tinsley Brothers, 1863), 5. The *OED* records the earliest usage as "aquiculture", in 1867 (2nd Ed. 1989). But the word was clearly in use slightly early, see also discussion in A Rural D.D., *Contributions to Natural History: Chiefly in Relation to the Food of the People* (Edinburgh: William Blackwood & Sons, 1865), 156.

[12] See Jules Haime, "The History of Fish Culture in Europe from Its Earlier Records to 1854," in *United States Commission of Fish and Fisheries, Report of the Commissioner for 1872 and 1873*, trans. Gamaliel Bradford (Washington: Government Printing Office, 1874), 478. While fish culture and aquaculture are to some extent interchangeable, I prefer "fish culture" to aquaculture. It is both more appropriate historically, and also more accurate as "aquaculture" today usually designates the cultivation of plants and molluscs as well as fish, and only the latter are considered in this essay.

[13] Darin Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution," *Environmental History* 11, no. 3 (2006): 527–66.

The art of propagating fishes





FIGURES 1 and 2: “Artificial fecundation”. From Francis Francis, 1883, *The Practical Management of Fisheries,* London: H. Cox, pp. 58 and 59.

The practice consisted of the bodily manipulation of a parturient or “ripe” female fish and the exclusion of her ova or “roe” into a vessel, followed by like treatment of a fertile male specimen in order to procure seminal fluid, or “milt”. One British commentator attempted to convey the physicality of the process by saying it "may be compared to the milking of a cow".[14] The two reproductive substances would then be gently stirred together during which time “fructification” occurred. This was “hands on” reproductive technology of a distinct kind; a moment, I suggest, in the long history of what Sarah Franklin, following historians of reproductive science and generative biological substances, has

[14] Piscarius, *The Artificial Production of Fish* (London: Reeve & Co., 1852), 11.

characterised as the taking of reproductive processes "in hand".[15] To contemporaries it had, in its promise of systematic control of natural phenomena, the appearance of science. Its deployment was, and has often times since, been imagined in terms of idioms of progress and revolution.[16] As one pseudo-anonymous British writer, Piscarius, wrote in 1852, fish culture's purpose was "to assist and control, and improve, the operations of nature".[17] As with twentieth century artificial reproductive technologies in humans and animals, overcoming natural barriers was presented as a social advancement and a signifier of hope for better human futures.[18] Piscarius, indeed, claimed that fish culture would prove to be

> of practical and commercial, political and social importance,
> inasmuch as it might be made a new branch of commerce,
> which would add greatly to the national wealth,
> give employment to thousands, create an inexhaustible supply of cheap,
> nourishing, and wholesome provisions for all classes of people
> – and be, in short, to rivers and waters what agriculture is to land.[19]

If Carlyle's most famous essay of historical diagnosis had been written two or so decades later, he might have spoken of the artificial of breeding fish in describing the way his age seemed at "war with rude nature; and, by our restless engines, come off always victorious, and loaded with spoils". Instead, he symbolised the growing social commodiousness of the Age of Mechanism with the figure of the "artist" who "hatches chickens by steam".[20]

Artificial fecundation did not originate in Britain, and was perhaps "discovered" more than once.[21] Credit though is universally given to Ludwig Jacobi,

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[15] Franklin, *Biological Relatives: IVF, Stem Cells, and the Future of Kinship*, esp., Chapter 3, p. 133–136, 319 n8; drawing on Clarke, *Disciplining Reproduction*; Hannah Landecker, *Culturing Life: How Cells Became Technologies* (Cambridge, MA: Harvard University Press, 2007); Philip J. Pauly, *Controlling Life: Jacques Loeb & the Engineering Ideal in Biology* (Oxford: Oxford University Press, 1987).

[16] C.F. Culler, "Progress in Fish Culture," *Transactions of the American Fisheries Society* 62, no. 1 (1932): 114–18; Frederic F Fish, "Founders of Fish Culture: European Origins," *The Progressive Fish-Culturist* 3, no. 16 (1936): 8–10; Nash, *The History of Aquaculture* entitles chapters "The Slow Dawn of Science (1450-1900)" and "The Roots of Modern Aquaculture (1750-1880)."

[17] Piscarius, *The Artificial Production of Fish*, 6.

[18] Sarah Franklin, *Embodied Progress: A Cultural Account of Assisted Conception* (Oxford: Routledge, 1997), esp., 94-96.

[19] Piscarius, *The Artificial Production of Fish*, 8.

[20] Thomas Carlyle, "Signs of the Times," *The Edinburgh Review* 49, no. 98 (1829): 422.

[21] More detailed accounts of the history of the technique are given in Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution," 530–32; Nash,

an agriculturalist from Lippe, Germany, who publicised his experiments with the technique, begun in the 1740s, between 1763 and 1765 in the *Hanover Magazine.* Savants across Europe quickly learnt of Jacobi's work. However, his contribution to understanding and controlling the physiology of reproduction was soon eclipsed by more rigorous investigations – particularly those of Luigi Spallanzani, who performed similar experiments with fish and, famously, with frogs.[22] While obscure, Jacobi has not been forgotten in accounts of the sciences of reproduction and development however. In 1899, the influential biologist Jacques Loeb credited Jacobi with showing that direct contact between spermatic fluid and egg was requisite for fertilisation, thus contributing to the displacement of the imaginary "aura seminalis" in favour of a modern physical and chemical conception of fertilisation.[23] The Cambridge agricultural scientist, F.H.A Marshall, in his seminal textbook *The Physiology of Reproduction* (1910) – a book credited with having provided a defining synthesis and foundation for the reproductive sciences as a distinct biological discipline[24] – also wrote: "Artificial impregnation of fish was ova was first employed by Jacobi, and the method which he adopted is practically the same as that habitually practiced at the present day for stocking water-courses with fish"[25], whilst Joseph Needham's history of embryology described Jacobi's contribution as "a practical matter which had a good deal of influence on biological theory."[26] Indeed, there may be a feint yet traceable line of influence to be drawn from practical nineteenth century fish culture towards mammalian reproductive physiology and early experiments in embryo transfer and artificial insemination. Immediate precursors of modern reproductive science like James Cossar Ewart (who was an important influence on Walter Heape and Marshall in Edinburgh and Cambridge) were actively involved with and aware of fish cultural developments: Ewart indeed represented Scottish Fisheries Board in the 1880s, working with Sir

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The History of Aquaculture, 54–56; Noel P Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland* (Dublin: Glendale, 1989), 20–21.

[22] Lazzaro Spallanzani, *An Essay in the Animal Reproductions*, trans. M Maty (London: T. Becket, 1769). Spallanzani initiated his investigations into reproduction around 1771. It has been noted that a Baron Weltheim von Harbke also preceded Spallanzani to artificial insemination, using trout and salmon, by about one year, Ernesto Capanna, "Lazzaro Spallanzani: At the Roots of Modern Biology," *Journal of Experimental Zoology* 285, no. 3 (1999): 189.

[23] See Jacques Loeb, *The Mechanistic Conception of Life* (Chicago, IL: The University of Chicago Press, 1912), 113.

[24] Clarke, *Disciplining Reproduction*, 11.

[25] Francis H.A. Marshall, *The Physiology of Reproduction*, 2nd ed (London: Longmans, Green, and Co., 1922), 176. [First Ed., 1910].

[26] Joseph Needham, *A History of Embryology* (Cambridge: Cambridge University Press, 1959), 211.

James Maitland, the founder and proprietor of the then largest trout breeding establishment in Britain.[27] There are also further connections towards the end of the century between the professionalisation of research in reproduction and development and the emergence of marine biological research stations, partially out of the wider fish culture movement in Britain, the USA and elsewhere.[28]

Jacobi's work however certainly proved highly and more immediately influential in "practical matters". Jacobi had not only described artificial fecundation, but suggested a wooden, box-like device in which the incubation of fertilised fish eggs could be accomplished in running water. Moreover, presciently, he had noted the economic potential of his plan, including the advantages arising from the fact that with it, "it would be no hard matter to breed trouts in a place, where there never had been any before."[29] Indeed, one of the most lasting consequences of artificial propagation was the ability to transport live fish ova large distances, and thence to acclimatize fish in new waters, an object pursued with zeal by Victorian fish culturalists.[30] Jacobi's work was supposed to have been recognised by another German, King George III of England, who awarded him a medal and a pension, and his writings were translated into English as a pamphlet in 1778, and again for the *Dublin Magazine* in 1800.[31] Little however was done on this score in Britain until the 1820s when the great English chemist, Sir Humphry Davy is believed to have attempted it and, briefly describing Jacobi's methods in a

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[27] James Cossar Ewart, "Report on the Progress of Fish Culture in America," in *Third Annual Report of the Fishery Board for Scotland* (Edinburgh: Neil & Company, 1884), 78–91; Also, eg., James Cossar Ewart, "On the Natural and Artificial Fertilisation of Herring Ova," *Proceedings of the Royal Society of London* 36 (1884): 450–641; On Heape, see J.D. Biggers, "Walter Heape, FRS: A Pioneer in Reproductive Biology. Centenary of His Embryo Transfer Experiments," *Journal of Reproductive Fertility* 93 (1991): 173–86.

[28] M. B Deacon, "Crisis and Compromise: The Foundation of Marine Stations in Britain during the Late Nineteenth Century," *Earth Sciences History* 12 (1993): 19–47; P.G Moore, "The Lochbuie Marine Institute, Isle of Mull, Scotland," *Archives of Natural History* 40, no. 1 (2013): 45–51; On the USA, see Philip J. Pauly, "Summer Resort and Scientific Discipline: Woods Hole and the Structure of American Biology, 1882-1925," in *The American Development of Biology*, ed. Ronald Rainger, Keith Benson, and Jane Maienschein (Philadelphia: University of Pennsylvania Press, 1988), 121–50; and on the Continent, Raf de Bont, "Between the Laboratory and the Deep Blue Sea: Space Issues in the Marine Stations of Naples and Wimereux," *Social Studies of Science* 39, no. 2 (2009): 199–227.

[29] S.L Jacobi, "A New Method of Breeding Salmon and Trout," *Transactions of the Dublin Society* 1, no. 2 (1800): 128. This publication combines two of Jacobi's letters from the 1760s in a later English translation, see below.

[30] See Christopher Lever, *They Dined on Eland: The Story of the Acclimatization Societies* (London: Quiller Press, 1992); Michael A. Osborne, "Acclimatizing the World: A History of the Paradigmatic Colonial Science," *Osiris*, 2, 15 (2000): 135–51.

[31] See John Russell Smith, ed., *A Bibliographical Catalogue of English Writers on Angling and Ichthyology* (London: John Russell Smith, 1856), 28; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 21.

book on the appreciation of fly-fishing, advocated its potential uses specifically for experimental zoology, particularly in the study of the different species of *salmonidae*.[32] Soon thereafter Davy's suggestion was taken up in earnest. A gamekeeper in Dumfriesshire led the way with what became the first sustained series of salmon breeding experiments in Britain. The analyses conducted in the substantive chapters of this dissertation begin from this point: the circumstances of this deployment of artificial propagation technologies in debates in salmonid ichthyology are the subject of Chapter 2; the wider social context of this work, its political implications and practical consequences in the world of fishing regulations of these experiments are dealt in with Chapter 3, while attempts to retool the techniques as a force of production in the competitive and divided world of salmon fishing proprietorship are the subject of Chapter 4.

A crucial feature of nineteenth century fish culture, including artificial propagation, in Britain and throughout the Western hemisphere, was its application to a particular family: the *salmonidae*. Whereas deliberate and sometimes highly rationalised husbandry of other freshwater species, namely the so-called "coarse" fish (especially carp) had been a feature of economic life in many European states for centuries[33], the emergence of the new techniques of artificial propagation made it feasible to cultivate trout and salmon for practically the first time.[34] In contrast to the warmer water dwelling coarse fish, many of which will breed unassisted in still water stews, or ponds, trout and salmon are highly exacting in their physiological requirements, preferring cold running water with adequate gravel substrates if they are to breed naturally. Moreover, unlike the coarse species that produce millions of tiny, sticky or floating eggs, trout and salmon produce fewer (although still many), large and heavy eggs, making them physically easier to handle and undergo the techniques pioneered by Jacobi in deliberate, hands on human interventions into their reproduction. The cultivation of carp on the other hand, however extensive, therefore amounted to a form of

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[32] Humphry Davy, *Salmonia: Or, Days of Fly Fishing*, 3rd ed. (London: John Murray, 1832), 80–84. [First Ed., 1828].

[33] Richard C Hoffman, "Carp, Cods, Connections: New Fisheries in the Medieval European Economy and Environment," in *Animals in Human Histories: The Mirror of Nature and Culture*, ed. Mary J Henninger-Voss (New York: University of Rochester Press, 2002), 3–55; Roberts E Strother, "'Esteeme a Little of Fish': Fish, Fishponds, and Farming in Eighteenth-Century New England and the Mid-Atlantic," *Agricultural History* 82, no. 2 (2007): 143–63.

[34] James Owen, *Trout* (London: Reaktion Books, 2012), 85–87 discusses some marginal exceptions to this.

"opportunistic 'captive exploitation'", quite different to the kind of systematic organisation of reproduction promised by the new techniques.[35] Course fish cultivation offered little symbolic, or indeed economic, cache for British fish culture pioneers. Indeed if there was truly a modern, scientific and global fish culture revolution, it was in truth a *salmonidae* revolution. It's novelty and success lay in the pairing of new techniques and new species, and with these new species came key arenas and worlds of social action.

Importantly, salmon in particular were caught and sold commercially as food, but were at the same time an increasingly high ranking "game" fish. Fishing for salmon was a desirable status symbol. In the wake of economic and demographic changes connected to urbanisation and industrial development – encompassing rising levels of wealth, leisure time and ready access to transportation – demand for game fishing, and especially salmon fishing, grew. Compounding this, industrial scale harvesting of salmon for food put the stock (or so it was widely believed) under increased pressure. As the resource was perceived to be growing scarcer, it became more valuable to anglers who could afford to buy or rent fishing rights.[36] During this period salmon properly assumed the name that the so-called Father of Angling Izaak Walton had earlier given them: the "King of freshwater fish".[37] The allure of this aristocrat, albeit gradually, rubbed off on its non-migratory cousin the trout, too. The result was, as explored in detail in subsequent chapters, a context in which, on the one hand, intense popular and scientific scrutiny was placed on all aspects of these fish's life cycles.[38] On the other hand there were increasingly clearly defined forms of social and symbolic stratification amongst anglers that developed in respect to their favoured quarry and methods.[39] Salmon and trout became, in fact, sites of bitter social

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[35] Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution," 530, 532.
[36] Harvey Osborne, "The Development of Salmon Angling in the Nineteenth Century," in *Our Hunting Fathers: Field Sports in England after 1850*, ed. Richard W Hoyle (Lancaster: Carnegie, 2007), 187–211.
[37] Izaak Walton, *The Compleat Angler* (London: Dover, 2003), 78.
[38] A fascination that remains very much with us today, see for eg., Peter Coates, *Salmon* (London: Reaktion Books, 2006); Richard Shelton, *To Sea and Back: The Heroic Life of the Atlantic Salmon* (London: Atlantic Books, 2009).
[39] For social scientific accounts of the evolution of angling ethics, see Richard L Hummel and Gary S Foster, "A Sporting Chance: Relationships Between Technological Change and Concepts of Fair Play in Fishing," *Journal of Leisure Research* 18, no. 1 (1986): 40–52; Richard L Hummel, *Hunting and Fishing for Sport: Commerce, Controversy, Popular Culture* (Bowling Green: Bowling Green State

struggle between individuals and groups, and the focus of intensive regulatory efforts on behalf of proprietors, local authorities and the government. In Britain coarse fish were seldom eaten[40], and only became a significant angling quarry towards the end of the century when the urban working classes, often forced out of the game fishing market by the collective purchasing power of those wealthier than them, took to the sport of recreational fishing in a large way.[41] Fish culture of the genre analysed in this study, for all practical purposes, was thus formed in the space created within and between the social worlds of the salmonidae and their politics, and the arenas of natural history, sport and commerce through which these fish swam.

University Press, 1994); William Washabaugh and Catherine Washabaugh, *Deep Trout: Angling in Popular Culture* (Oxford: Berg, 2000).

[40] See Adrian Franklin, "An Unpopular Food? The Distaste for Fish and the Decline of Fish Consumption in Britain," *Food and Foodways* 7, no. 4 (1997): 227–64.

[41] See John Lowerson, "Brothers of the Angle: Coarse Fishing and English Working-Class Culture, 1850-1914," in *Pleasure, Profit, Proselytism: British Culture and Sport at Home and Abroad, 1700-1914*, ed. J. A. Mangan (London: Frank Cass, 1988), 105–27; *Sport and the English Middle Classes, 1870-1914* (Manchester: Manchester University Press, 1993) and the concluding discussion in Chapter 6.

An artificial stream

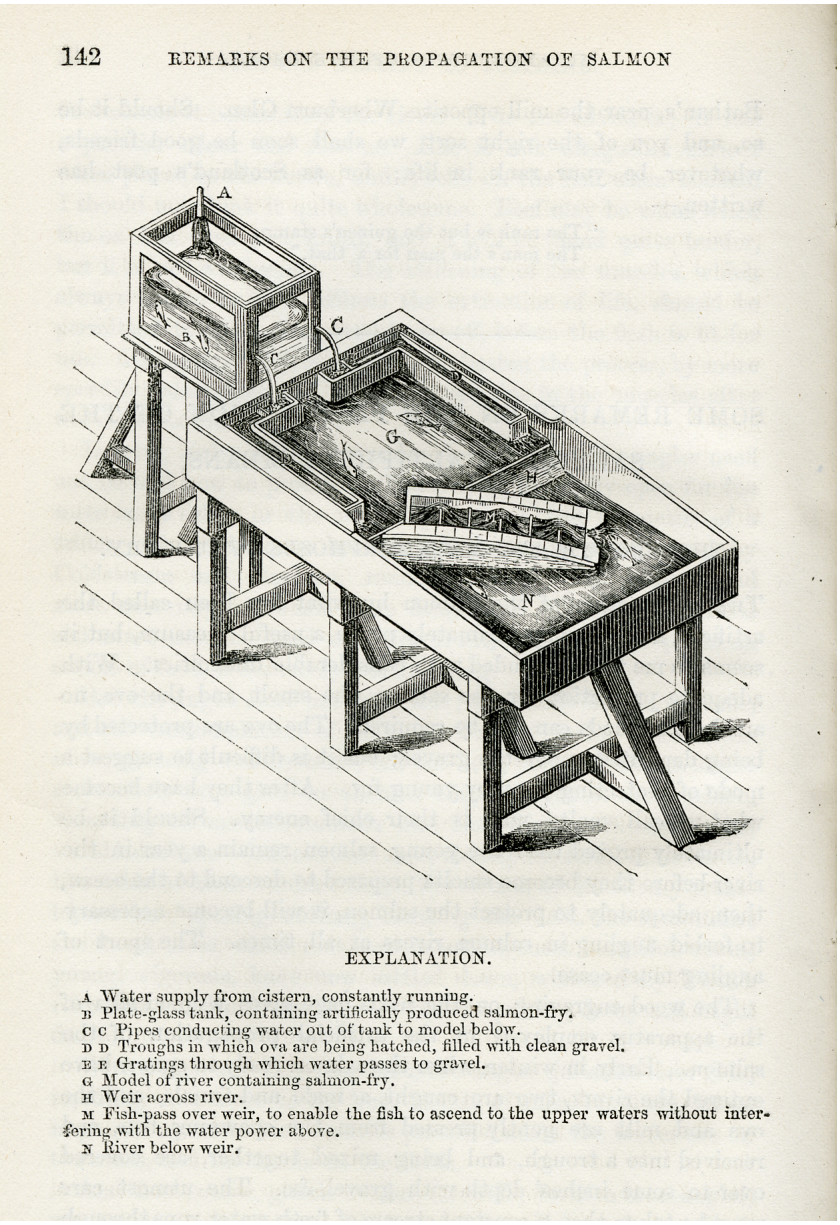

FIGURE 3: "A fish hatching apparatus". Many different designs for incubating salmon eggs had appeared in the mid-1850s. This one, on a hobbyist's scale, is eccentric and unlikely to have depicted a real device: its unique feature is the super-imposition of aspects of a real salmon river onto the device, probably in order to demonstrate how it is intended to work by simulating nature. Robert Knox, 1854, *Fish and Fishing in the Lone Glens of Scotland*, London: G. Routledge, p. 142.

The story of fish culture is thus also connected to a number of broad trends in British social history, including struggles over resources and privileges which arose in the wake of long-term historical transformations, changed patterns in relations of agrarian production, the rise of new classes, pastimes and professions, and political reforms. Additionally, specific legal and social circumstances made

the British freshwater fisheries, and therefore fish culture, a somewhat unique case internationally. One reason for this was the historical existence of a highly stratified system of fisheries ownership and access rights, in which salmon fishing was (somewhat uniquely) a privately owned good, and game fishing generally tended to be the preserve of those with access to the sporting estates which controlled large swathes of river fishing (although regional variations, especially under Scots law and tradition, were common).[42] Consequently, unlike in many other leading fish culture nations, such as France or, later in the century Germany and USA, Britain was unique in that the state – while a crucial actor in terms of setting regulations for the wild fisheries – played no role in sponsoring fish breeding, hatching and stocking initiatives. Development of the arts of artificial propagation, and to some extent also the responsibility to enforce laws and manage a swathe of issues related to river preservation, therefore became issues centrally concerning private enterprise, a matter of substantial historical and also methodological significance to my analysis, as we will see.[43]

This brief discussion has established some of the basic co-ordinates and contexts for understanding the arguments that follow, with many of the substantial issues introduced here being dealt with in greater length at appropriate points. I now turn to providing a sketch of the analytical and methodological framework within which I situate my discussion of British fish culture as a social reproductive technology.

1.2 Substantive and conceptual outlooks and positions

This thesis draws on wide range of historical, sociological and other literatures. In this section I discuss two bodies of work that help locate my

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[42] See eg., Mike Huggins, "Sport and the British Upper Classes C. 1500-2000: A Historiographic Overview," *Sport in History* 28, no. 3 (2008): 364–88; Andy Wightman et al., "The Cultural Politics of Hunting: Sporting Estates and Recreational Land Use in the Highlands and Islands of Scotland," *Culture, Sport, Society* 5, no. 1 (2002): 53–70. Importantly, Scots law differed in respect of salmon to England and Wales in being dissociated from ownership of land and hence a separately tradable commodity. For further discussion, see Chapter 3.

[43] See Nicholas Borodine, "Statistical Review of Fish-Culture in Europe and North America," in *Bulletin of the United States Fish Commission*, vol. 13 (Washington: Government Printing Office, 1894), 193–98. See also Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 34–35; and Nash, *The History of Aquaculture* who offers a general overview of the relative contributions of countries during this time.

analyses substantially and conceptually, and a third that provides additional theoretical-methodological moorings. The first of these is the social studies of reproduction (SSR), with special reference to sociological accounts of animal[44] reproduction; the second is previous historical and other social scientific studies focused on aqua- or fish culture. I suggest that extending the literature on nonhuman animal reproductions to fish and fish culture offers something new to the SSR, while perspectives from SSR in turn contribute new perspectives to the interpretation of fish culture. In the third part, I locate my analysis in science and technology studies (STS), positioning my account with reference to constructionist thinking and the idea of co-production. I propose to extend this with reference to sociological concerns about social order. I also seek to deal with a number of possible objections and alternatives arising from the combination of tools I borrow from STS and the broader social-historical orientation of my research.

1.3.1 *The social studies of* (*animal*) *reproduction*

The SSR, as I understand it, is a broad, interdisciplinary field structured less according to shared models and methods than by common questions and areas of empirical focus. Its roots lie in anthropological and sociological concern with the social and technological organisation of human reproduction, including the experience of undergoing medical reproductive treatments.[45] It has however also developed in close relation to scholarship in the history and cultures of reproductive biology, embryology and heredity.[46] In recent years it has

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[44] Arguments about whether or not fish should qualify as animals in respect of issues of sentience, while interesting in their own right, do not substantially effect the argument here – although I note below that ideas about the difference between sentient land mammals and 'cold-blooded' aquatic organisms is likely to have effected the historiography of their reproduction. On aquaculture and sentience, see esp., Marianne E Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish* (San Francisco, CA: University of California Press, 2015), Chapter 6.

[45] See review by Marcia Inhorn and Daphna Birenbaum-Carmeli, "Assisted Reproductive Technologies and Culture Change," *Annual Review of Anthropology* 37 (2008): 177–96. Important representative citations of what is a vast differentiated literature include: Franklin, *Biological Relatives: IVF, Stem Cells, and the Future of Kinship*; Sarah Franklin and Celia Roberts, *Born and Made: An Ethnography of Preimplantation Genetic Diagnosis* (Princeton, NJ: Princeton University Press, 2006); Marilyn Strathern, *Reproducing the Future: Essays on Anthropology, Kinship, and the New Reproductive Technologies* (Manchester: Manchester University Press, 1992); Charis Thompson, *Making Parents: The Ontological Choreography of Reproductive Technologies* (Cambridge, MA: MIT Press, 2005).

[46] Eg., Landecker, *Culturing Life: How Cells Became Technologies*; Jane Maienschein, *Whose View of Life?: Embryos, Cloning, and Stem Cells* (Harvard, MA: Harvard University Press, 2003); Staffan Müller-Wille and Hans-Jörg Rheinberger, eds., *Heredity Produced: At the Crossroads of Biology, Politics and Culture, 1500-1870* (Cambridge, MA: MIT Press, 2007); Nick Hopwood, Rebecca Flemming, and Lauren Kassell, eds., *Reproduction: Antiquity to the Present* (Cambridge: Cambridge

encompassed increasingly explicit interest in the organisation and scientific understanding of animal reproduction(s).[47] In so doing, it has come at times into close contact with, and drawn on, broad fields dedicated to the study of human-animal relations in history, especially in agricultural production.[48] "Turning to animals" thus also connects this aspect of SSR to wider trends in social scientific and humanistic scholarship including animal studies, emergent new non-anthropocentric conceptualisations of domestication, "hybrid geographies", and various other facets of "post-humanist" thinking.[49]

Yet, for all the breadth and diversity of its sources and connections with cognate areas, the SSR generally, and with respect to the organisation of animal reproduction specifically, maintains a clear strand of thought that remains recognisably sociological in character: that is, it is concerned with how the multiple different ways in which humans intervene into reproductive processes are connected to the production and reproduction of forms of social life or, in the sense that I will explore, social order. Studies of ARTs particularly have revealed the role such technologies play in loosening critical binaries, for instance, between nature and culture or biology and technology. In this way, it has located technological intervention into reproductive processes as so many sites for studying the transformation, construction and entrenchment of basic components of social life and values and how these are thought about, be these family, kinship and sex, or constructs like class, "race", nation and capital, as well as technology,

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University Press, Forthcoming) promises to bring some order to the vast field that is the history of reproduction.

[47] Esp., Franklin, *Dolly Mixtures*; Carrie Friese, *Cloning Wild Life* (New York: New York University Press, 2013). I discuss these and other examples below. Haraway's work is a precursor, Donna J. Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York: Routledge, 1989).

[48] Margaret E Derry, *Bred for Perfection: Shorthorn Cattle, Collies, and Arabian Horses since 1800* (Baltimore, MD: John Hopkins University Press, 2003); Barbara Orland, "Turbo-Cows: Producing a Competitive Animal in the Nineteenth and Early Twentieth Centuries," in *Industrializing Organisms: Introducing Evolutionary History*, ed. Susan R Schrepfer and Philip Scranton (New York: Routledge, 2004), 167–89; Harriet Ritvo, *The Animal Estate: The English and Other Creatures in the Victorian Age* (Cambridge, MA: Harvard University Press, 1989); "Possessing Mother Nature: Genetic Capital in Eighteenth-Century Britain," in *Early Modern Conceptions of Property*, ed. J Brewer and S Staves (London: Routledge, 1995); Wilmot, "From 'Public Service' to Artificial Insemination."

[49] Egs., Molly Mullin and Rebecca Cassidy, eds., *Where the Wild Things Are Now: Domestication Reconsidered* (Oxford: Berg, 2007); Nicole Shukin, *Animal Capital: Rendering Life in Biopolitical Times* (Minneapolis, MN: University of Minnesota Press, 2009); Richard Twine, *Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies* (London: Routledge, 2010); Sarah Whatmore, *Hybrid Geographies: Natures Cultures Spaces* (London: Sage, 2002); Haraway's writing in particular has proven influential in this area, see Donna J. Haraway, *When Species Meet* (Minneapolis: University Of Minnesota Press, 2008).

nature, the biological and indeed "reproduction" itself. Because reproduction is not synonymous with repetition, this may include the production of challenging novelties and social-ethical forms (like "three parent babies", "cloned sheep" or new family norms), yet it also clearly encompasses the reproduction of quite familiar social categories and relations.

Thus, for example, in her cultural genealogy of Dolly the Sheep, Sarah Franklin explained that, methodologically, while influenced by an array "postsocial" perspectives, she nevertheless "retained the idea of sociality linked to older models of social, economic, and biological *order*", and insisted that these "orders" are "structural". Her account of the remaking of animal genealogy in the modern laboratory and agriculture practice insists that the novel forms of life, technical practice and economic activity that emerge are "inextricable from the social values and historical conditions of the human authors".[50] Similarly, Carrie Friese's study of the use of cloning technologies in wildlife conservation is rooted in the idea that "the social organization of human and nonhuman animal reproduction" are "coconsistituted"; or that "animal reproduction [like human reproduction] is interlinked with social forms central human social life."[51] These studies, and others like them, present sites and institutions – like farms, zoos, clinics, laboratories, or funding and regulatory agencies – through which social categories, concepts, identities and histories are produced and reproduced by the collective activity of agents within practical, economic and epistemic worlds of endeavour.

More widely, a concern with what Friese called the "traffic" between human and animal reproduction has been opened up, often on the basis of contemporary knowledge of the biological continuities between human and animal. Reproductive techniques, materials and models circulate and are "transposed" from one to the other.[52] Technologies like artificial insemination and in vitro fertilisation

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[50] Franklin, *Dolly Mixtures*, 10, 7.
[51] Friese, *Cloning Wild Life*, 5.
[52] Adele E Clarke, "Research Materials and Reproductive Science in the United States, 1910-1940," in *Physiology in the American Context, 1850-1940*, ed. Gerald L Geison (Bethesda, MD: American Physiological Society, 1987), 323–50; Carrie Friese and Adele E Clarke, "Transposing Bodies of Knowledge and Technique: Animal Models at Work in Reproductive Sciences," *Social Studies of Science* 42, no. 1 (2012): 31–52; See also Thompson Charis Thompson [Cussins], "Confessions of a Bioterrorist: Subject Position and Reproductive Technologies," in *Playing Dolly: Technocultural*

demonstrate a continuum between farm, laboratory, and clinic.[53] There is cultural or symbolic traffic too: constructions of the meaning of human management of animal reproduction, and understandings of the position of animals in human society generally and with respect of being under reproductive control, in turn, have been seen as reflecting ideas about how social relations are or should be ordered. For instance, historian of animals Dorothy Brantz argued that during the nineteenth century, domestication (of which human control of reproduction is usually understand as central component) functioned as a "marker" of civilization in an age of empire building, and was therefore at the "service of the cultural (re)production of society."[54]

Adele Clarke's sociological history of the formation of the reproductive sciences as a discipline represents an important contribution to contemporary conceptualisations of reproduction and an instance of how histories of animal breeding are integral to this.[55] Showing how the reproductive sciences coalesced out of the fields of physiology, social movements associated with birth and population control and agriculture during the early part of the last century, she also posited the conception of reproduction that emerged as distinctly modernist. Drawing on the historian Phillip Pauly's of notion of "biological modernism" and the "engineering ideal" supposed to be at the root of twentieth century biology, she argued that "modern reproduction" as the object of reproductive science came to be understood in terms of achieving and enhancing purposeful "control" over reproductive-biological processes.[56] The rationalisation of reproductive processes in industrialised farming practices reflects this[57] while at the same time the husbandry practices of earlier eras (while often less based in science than

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Formations, Fantasies, and Fictions of Assisted Reproduction, ed. E Ann Kaplan and Susan M Squier (New Brunswick, NJ: Rutgers University Press, 1999), 189–219.

[53] See Sarah Wilmot, "Between the Farm and the Clinic: Agriculture and Reproductive Technology in the Twentieth Century," *Studies in History and Philosophy of Biology & Biomedical Sciences* 38, no. 2 (2007): 303–315.

[54] Dorothee Brantz, "The Domestication of Empire: Human-Animal Relations at the Intersection of Civilization, Evolution, and Acclimatization in the Nineteenth Century," in *A Cultural History of Animals in the Age of Empire*, ed. Kathleen Kete, vol. 5 (Oxford: Berg, 2007), 75–76; also Ritvo, *The Animal Estate*.

[55] Clarke, *Disciplining Reproduction*; There are analogies in the case of plants and agri-industry Deborah Fitzgerald, *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven, CT: Yale University Press, 2003).

[56] See Pauly, *Controlling Life*; also Clarke, "Modernity, Postmodernity, & Reproductive Processes, Ca. 1890-1990, or 'Mommy, Where Do Cyborgs Come From Anyway?,'" 140.

[57] See also Clarke, "Reflections on the Reproductive Sciences in Agriculture in the UK and US, Ca. 1900-2000+."

proponents may have averred)[58], represented a source and precursor of this shift. Franklin similarly draws strongly on the motif of "control" in her genealogies of the Dolly technique, stem cell science and the reproductive and embryological sciences more widely.[59]

The key to locating my account of fish culture with reference to the SSR lies in this scholarship's insistence on social (re)productivity attendant on human interventions into animal reproduction. I bring this as a lens to my study of the development and deployment of fish culture knowledge and technique. If intervention or ideas about intervention took an especially intensive form during a particular period, one might expect corollary effects in connected social spheres and institutions. "Modern reproduction" represents a summary way of approaching these, an idea developed further below.

1.3.2 *Historical and contemporary studies of fish culture*

Mammals have dominated conceptual and empirical horizons in the SSR and cognate areas, not without good cause.[60] The relative biological similarities of all mammalian reproduction, including human, is one reason for this; others include the obvious economic and social importance of agricultural animals and other charismatic, sentient mega fauna and companion species. It is, after all, easiest to study and to empathise with *land* mammals, rather than aquatic non-mammalian vertebrates.

The biological characteristics of species and organisms dictate the conditions of possible technological intervention into their reproductive lives, for

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[58] See Sarah Wilmot, *The Business of Improvement: Agriculture and Scientific Culture in Britain, c.1770 - c.1870*, Historical Geography Research Series, No. 24 (Bristol: Historical Geography Research Group, 1990).

[59] Franklin, *Dolly Mixtures*; *Biological Relatives: IVF, Stem Cells, and the Future of Kinship*.

[60] The vast range of model organisms used in laboratory science is an obvious source of exceptions to this rule. Prominent instances include, in the related areas of reproduction and genetics, the *Drosophila* fly, the *Xenopus* frog and Zebrafish (*Danio rerio*). Friese's discussion of research into amphibian reproduction for conservation purposes also stands out, Friese, *Cloning Wild Life*, esp., 146-149. Kohler's history of how the characteristic reproductivity of *Drosophila* generated problems and work activity for geneticists in a manner that constituted special kinds of social relations and norms amongst the "fly people" is an exemplary instance, see Robert E Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life* (Chicago, IL: University of Chicago Press, 1994).In agricultural contexts, work on chickens is also important, see eg., Margaret E Derry, "Chicken Breeding: The Complex Transition from Traditional to Genetic Methods in the USA," *New Perspectives on the History of Life Sciences and Agriculture* 40 (2015): 371–93.

instance, directing choice of experimental subjects.[61] With fish, the key enabler for artificial fecundation and incubation techniques (as well as later the conveyance of their living embryos) was their ovuliparity. With most fish, including the salmonidae, fertilization and incubation takes place externally to the body, thus removing key technical barriers endemic to equivalent practices in mammals. This allowed forms of purposeful, "hand-on" intervention to become routine with fish long before anything analogous was possible in, for instance, agricultural mammals.[62] To this extent, as I have been suggesting, the case of fish culture opens up new vistas for a "pre-history" of modern techniques of artificial insemination and its descendants like in vitro fertilization.

How then has fish culture been addressed in scholarly debate? Works by North American environmental historians comprise the largest body of work. With few exceptions, these accounts have focused on recognizable disciplinary and regional interests. In particular, historians have been concerned with the relation between modern cultural conceptions of nature as an object to be managed and exploited and concomitant transformations of American wilderness. The impact of nineteenth century fish culture on ecosystems through the acclimatization and stocking of species have a central theme, as has been the role of fish culturalists and anglers and the institutions they created and supported in emergent conservation regimes.[63] Expressing concern with how human artifice in this field has transformed nature, for instance, Taylor explored the "making" of salmon in the context of offsetting damages experienced during the Northwest fisheries

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[61] See eg., Hopwood's discussion in the context of embyology, Nick Hopwood, "Approaches and Species in the History of Vertebrate Embyology," in *Vertebrate Embryogenesis: Embryological, Cellular, and Genetic Methods*, ed. Franscisco Pelegri (New York: Humana Press, 2011), 1–20.
[62] By way of contrast with mammals, see Franklin's discussion, *Biological Relatives: IVF, Stem Cells, and the Future of Kinship*, 129. Short factual histories or pioneering work in artificial insemination and embryo transfer in mammals is available in, eg., Biggers, "Walter Heape, FRS: A Pioneer in Reproductive Biology. Centenary of His Embryo Transfer Experiments"; R. H. Foote, "The History of Artificial Insemination: Selected Notes and Notables [E-Suppl 2]," *Journal of Animal Science* 80 (January 1, 2002): 1–10. Notably, other forms of reproductive technique, like castration, are challenging in fish – although they were pursued in fish like carp in earlier periods, see Thomas R Forbes, "Castration of Fish in the Eighteenth Century," *General and Comparative Endocrinology* 3 (1963): 437–428.
[63] Dean C. Allard, *Spencer Fullerton Baird and the U.S. Fish Commission* (New York: Arno Press, 1978); Corrine Jennifer Brown, "Trout Culture: An Environmental History of Fishing in the Rocky Mountain West, 1860 to 1975" (Ph.D. thesis, Washington State University, 2012); Donald J Pisani, "Fish Culture and the Dawn of Concern over Water Pollution in the United States," *Environmental Review* 8 (1984): 117–31; William Knight, "Samuel Wilmot, Fish Culture, and Recreational Fisheries in Late 19th Century Ontario," *Scientia Canadensis* 30, no. 1 (2007): 75–90.

crisis[64]; Towle, the artificial "authoring" of Californian fisheries[65], and Halverson the production and exportation of an "entirely synthetic fish" – the Rainbow trout.[66] There is no equivalent literature in Britain, where, by the nineteenth century there was little wilderness left, and there is today correspondingly little or no disciplinary environmental history, per se.[67] Accounts of human interaction with nature in Britain have been generally more closely tied to social and economic history (or, to a lesser extent, histories of government administrative processes, as is the case with histories of freshwaters fisheries reform during the nineteenth century).[68] The only two significant accounts of British fish culture during the nineteenth century follow this pattern: Wilkin's non-academic but highly readable and informative history of mussel and salmon culture in Ireland, and Hill's PhD thesis on Sir James Maitland and his trout hatchery, which is simultaneously an account of the professionalization of fish culture in Britain during the final decades of the century and a contribution to business history and biographical studies.[69] One further account, Nash's *The History of Aquaculture*, touches briefly on the British experience as a part of his much wider ranging survey of aquaculture since the earliest times to the present day.[70] Like Wilkins', Nash's work is not academic in the sense of being embedded in ongoing critical-disciplinary discussions, but is written more as primer for aquaculturalists interested in the history of their discipline.[71]

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[64] Joseph E Taylor, *Making Salmon: An Environmental History of the Northwest Fisheries Crisis*, 2nd ed. (Seattle, WA: University of Washington Press, 2001).
[65] Jerry C Towle, "Authored Ecosystems: Livingston Stone and the Transformation of California Fisheries," *Environmental History* 5, no. 1 (2000): 54–74.
[66] Anders Halverson, *An Entirely Synthetic Fish: How Rainbow Trout Beguiled America and Overran the World* (New Haven, CT: Yale University Press, 2010).
[67] Sverker Sörlin and Paul Warde, "The Problem of the Problem of Environmental History: A Re-Reading of the Field," *Environmental History* 12, no. 1 (2007): 107–30.
[68] C.f., the classic work, Keith Thomas, *Man and the Natural World: Changing Attitudes in England, 1500-1800* (London: Penguin, 1984). Accounts of the politics of fisheries reform from the point of view of recreational angling or the administrative process of Victorian government are cited in appropriated places in the chapters that follow.
[69] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*; Stephen Anthony Hill, "Sir James Maitland and the Howietoun Fishery" (Ph.D. thesis, University of Stirling, 1995). Wilkins' contribution provides rationale for focusing on Britain, rather than the United Kingdom (as then constituted), and Hill's for focusing on the period prior to the 1880s. See further discussion on the historiography of British fish culture in Chapter 6. This review refers to fish culture in the most popular and narrow sense: fish culture as the movement associated with new artificial propagation technologies; other historical texts relevant to freshwater fish and fishing are discussed when appropriate.
[70] Nash, *The History of Aquaculture*.
[71] Indeed, Nash and Wilkins were both industry professionals before they were historians of their trade. They are thus today's equivalent of the 'insider historian' of nineteenth fish culture, from

Reflecting and radicalizing the themes that predominate in the American research, Kinsey's account of the "global aquacultural revolution" is perhaps the most comprehensive scholarly article on nineteenth century fish culture *tout court*. Focused on the influence of French aquaculture on North American initiatives from the 1850s, Kinsey develops Crosby's "ecological imperialism" thesis, describing the fish culture movement at this time as "an inseparable part of a Western ideology of improving nature that became increasingly complex through its engagement of science and state".[72] Thus for Kinsey, fish culture represented a particular case of what he saw as a broader historical-cultural conception of the purpose of human activity with respect to natural resources and living organisms. This essential urge, or ideology, he found also manifested itself in movements like eugenics and, indeed, modern biology.

Environmental sociologist Rik Scarce's study of the management of Pacific salmon stocks argues that "Nature" (his capitalization) is revealed in these activities to be a "social construction" in which nature is transformed into a resource. Developing a reading of Weber's concept of instrumental rationalization, he applies this to what he sees as the highly scientised and economically oriented work of modern hatcheries and fish population managers and biologists.[73] Kelso's work, analogously to Scarce's, tracks the "migration of salmon from nature to biotechnology".[74] To different degrees, these works reflect a generally social constructionist thesis, characterized in environmental history by an idea that modernity entailed the "artificialization" of nature.[75]

Both Scarce and Kinsey, like Clarke and Franklin, also draw on Pauly's notion, based on his reading of Loeb, of "control" and the "engineering ideal" as the guiding idea of twentieth century biology for inspiration (see above). Metaphors of control through techniques of reproduction were central to fish culturalists

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whom much of the knowledge that we have of that period comes (see below methods and materials).

[72] Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution," 553.

[73] Rik Scarce, *Fishy Business: Salmon, Biology, and the Social Construction of Nature* (Philadelphia, PA: Temple University Press, 2000), esp., 8-12, and Chapter 4.

[74] Dennis Doyle Takahashi Kelso, "The Migration of Salmon from Nature to Biotechnology," in *Engineering Trouble: Biotechnology and Its Discontents*, ed. Rachel A. Schurman and Dennis Doyle Takahashi Kelso (Berkeley, CA: University of California Press, 2003), 84–110.

[75] C.f., Michael Bess, "Artificialization and Its Discontents," *Environmental History* 10, no. 1 (2005): 31–33.

representations of their activities; various examples of salmon and other elements being "in control" or "beyond control" appear in my empirical discussions. However, I do not pursue the connection between the "modernist" control of nature in the environmental histories and "modernist" control of reproduction in the SSR directly. This is because the analogy is already quite obvious; and, although transformations in ideas about the natural world, the emergence of conservation ethics, or fish culture's impact upon the environment are all interesting themes upon which my material occasionally aids reflection, these are not central to my present interests.

More recently, scholars of anthropology and STS have turned an ethnographic lens onto contemporary salmon aquaculture. The work of Marianne Lien and John Law represents an important contribution substantively and theoretically, and hence it bears more detailed discussion.[76] Rooted to a large extent in the so-called "ontological turn" in STS and anthropology[77], their work offers an alternative to representationalist paradigms in existing constructionist approaches in STS and, amongst other things, seeks to undermine preoccupation with debates on nature/culture binaries in Euro-American thought, as well as conventional anthropocentric ideas of domestication as a unidirectional extension of human control over animal life.[78] Lien and Law illustrate that ethnographic investigation of contemporary salmon farming are useful springboards upon which to elaborate their quite specific, and growingly influential, theoretical-methodological program.[79]

Both Lien's earlier work based in Tasmania[80] and more recent research (with Law) in Norway focuses on the distinctive, intensive, highly capitalized and

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[76] Esp., John Law and Marianne E. Lien, "Slippery: Field Notes on Empirical Ontology," *Social Studies of Science* 43, no. 3 (2013): 363–78; John Law, "Notes on Fish, Ponds and Theory," *Norsk Antropologisk Tidskrift* 23, no. 3–4 (2012): 225–38; Marianne E Lien and John Law, "Emergent Aliens: On Salmon, Nature, and Their Enactment," *Ethnos* 76, no. 1 (2011): 65–87; Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*.

[77] See Steve Woolgar and Javier Lezaun, eds., "Special Issue: A Turn to Ontology in Science and Technology Studies?," *Social Studies of Science* 43, no. 3 (2013); John Kelly, ed., "Colloquia: The Ontological French Turn," *Hau: Journal of Ethnographic Theory* 4, no. 1 (2014): 259–360.

[78] Compare Juliet Clutton-Brock, "The Unnatural World: Behavioural Aspects of Humans and Animals in the Process of Domestication," in *Animals and Human Society: Changing Perspectives*, ed. Aubrey Manning and James Serpell (London: Routledge, 1994), 26–27.

[79] See also Heather Swanson, "Caught in Comparisons: Japanese Salmon in an Uneven World" (Ph.D. thesis, University of California, 2013).

[80] Marianne E Lien, "'King of Fish' or 'Feral Peril': Tasmanian Atlantic Salmon and The Politics of Belonging," *Environment and Planning D: Society and Space* 23 (2005): 659–71; Marianne E Lien,

technologised mode of salt-water salmon culture developed largely since the 1970s. Here salmon are maintained in captivity through their entire life cycles and therefore in ostensibly complete reproductive isolation from wild populations. Thus it is suggested that salmon farming today offers a chance to study domestication in action, a chance to follow the "newcomers to the farm".[81] The goal in this mode is to breed fish that convert biomass into marketable flesh very efficiently; it is not to supplement wild populations and hence enhance river stock or capacity. This is in contrast to the kinds of salmon culture conducted in the nineteenth century where humans actively managed only the freshwater phase of the fish's life. This distinction is relevant to Chapter 4 especially and will be discussed again there ("ranching" salmon is still practiced in some areas, including the Pacific Northwest, as discussed by Scarce).

A pre-emptive theoretical digression

Lien and Law's conceptual approach, as opposed to their elaboration and use of salmon aquaculture, requires brief elaboration here because, although also rooted in STS frameworks, it represents a contrast to my own. Based on ethnographic description, their work functions through an intensification of verbs such as "making", "doing", "becoming" and "enacting". This language of performativity is connected to their theoretical roots in actor-network theory (ANT) (or its "successor projects", as Law has called these).[82] In their account, for instance, salmon are enacted as "farmed" or "wild": by implication, categories like "nature" are seen as capable of being "done" differently in a variety of local performances. The study of how these differences are enacted is what Law and Lien have called "empirical ontology". As others commentating on the ontological

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"Feeding Fish Efficiently. Mobilizing Knowledge on Tasmanian Salmon Farming," *Social Anthropology* 15, no. 2 (2007): 169–85; Marianne E Lien, "Domestication 'Downunder': Atlantic Salmon Farming in Tasmania," in *Where the Wild Things Are Now: Domestication Reconsidered*, ed. Rebecca Cassidy and Molly Mullin (Oxford: Berg, 2007), 205–27. These works suggest an existing research trajectory of Lien's, and are of interest in their own right. Lien's interests as an anthropologist and her collaboration with STS scholar Law come to fruition in her most recent book.

[81] The title of the authors' and colleagues' collaborative project, now ended. See "Newcomers to the Farm - Department of Social Anthropology," accessed March 1, 2013, http://www.sv.uio.no/sai/english/research/projects/newcomers/.

[82] John Law, "What's Wrong with a One-World World?," *Distinktion: The Scandinavian Journal of Social Theory* 16, no. 1 (2015): 129. It is true that "ANT" has itself become a heterogeneous research tradition, see John Law, "Actor Network Theory and Material Semiotics," in *The New Blackwell Companion to Social Theory*, ed. Bryan S Turner (Chichester: Wiley-Blackwell, 2009), 141–58.

turn in STS have noted, this is a deflationary approach to ontological issues insofar as the word typically designates no longer the philosophical study of the singular structure of reality but the turning or reification of ontology as method into so many everyday things to be studied empirically. Becoming in this way a matter of plural "ontologies", this approach supposedly mirrors the alternatives offered by earlier STS and the sociology of scientific knowledge (SSK) to traditional philosophical approaches to epistemological evaluation.[83]

There are differences of opinion as to whether such "ontological" approaches in STS differ significantly from existing constructionist approaches prevalent in the discipline.[84] But it is clear that there are relevant contrasts to be drawn. For instance, contra Scarce's approach to the social construction of nature via processes of rationalization, and also Kinsey's discussion of the artificialisation of nature, Law and Lien seek to abandon familiar metaphors of social construction and replace them with relational practices. These represent kinds of "heterogeneous engineering"[85], conceived of as performances that instantiate different "enactments" of reality, or what is taken to "actually exist". Another point of significance is the emphasis placed on the recalcitrance of nature or materiality. Both Scarce and Lien and Law use the metaphor of "slippery" to describe dealings with salmon in processes of social construction and relational practices: for Scarce, the salmon's slipperiness signifies an unconstructed aspect of nature, an aspect that goes beyond human control, a "resistance" through which nature "finds a way".[86] For Lien and Law on the other hand, by being "slippery" salmon themselves become agents, participants as it were, in different renditions of themselves.[87] These different renditions are clearly connected to different evaluations of the analytical or explanatory centrality of society, social relations, or

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[83] See Michael Lynch, "Ontography: Investigating the Production of Things, Deflating Ontology," *Social Studies of Science* 43, no. 3 (2013): 450–52. Annemarie Mol's development of actor-network theory in this direction is a crucial influence, see esp., *The Body Multiple: Ontology in Medical Practice* (Durham, NC: Duke University Press, 2002).

[84] Eg., Patrik Aspers, "Performing Ontology," *Social Studies of Science*, 2014, 1–5, doi:10.1177/0306312714548610; Sergio Sismondo, "Ontological Turns, Turnoffs and Roundabouts," *Social Studies of Science*, 2015, 1–8, doi:DOI: 10.1177/0306312715574681.

[85] A popular concept based on Law's earlier work in the actor-network theory tradition, see John Law, "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. Wiebe E Bijker, Thomas P Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987), 111–34.

[86] Scarce, *Fishy Business: Salmon, Biology, and the Social Construction of Nature*, 7, 81.

[87] See esp., Law and Lien, "Slippery: Field Notes on Empirical Ontology."

social processes like "rationalization". It is an approach that seeks affinities, in many respects, with other so-called "post-humanist", "post-social" and "post-constructivist" interventions.[88] Indeed, the relevance of sociological concepts and their intended referents – from interest groups to social structures – are marginalised in Lien and Law, a consequence that follows from the "flat" ontology of ANT that they adopt.[89] In Lien's recent book particularly, this offers a theoretical infrastructure upon which to develop a rejection of familiar anthropocentric models of domestication: no longer seeing domestication as based on a history of increasing human "control" and "confinement" of organisms, it is replaced with a model drawn from accounts of technology development in STS based on concepts of agential symmetry between humans and nonhumans. This enables new metaphors for domestication, including "mutuality", "uncertainty" and "tinkering", as well as what she calls "more-than-human entanglements", to come to the fore.[90]

I wish to stress that my analysis intends little criticisms of Law and Lien's approach, precisely for the reason that mine does in fact differ significantly from theirs in terms of substantive interests, theoretical underpinnings and methods. My contribution, for instance, is not directed at re-theorising domestication (although, positioning fish culture under the aegis of modern reproduction, I do emphasize the importance of metaphors of controlling nature for fish culturalists and as means of symbolizing ideas of the contemporary, as suggested above). Neither is my aim the conceptual deconstruction of nature-culture or related binaries per se, or even elaborating any conceptual history of human-animal relationality (although I hope some of my discussions will be found relevant and interesting to those who are). Similarly, I do not make any deliberate interventions into ongoing debates on "ontological" multiplicity and "turns" in STS and

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[88] For a defence of the latter, see Kristin Asdal, "Returning the Kingdom to the King: A Post-Constructivist Response to the Critique of Positivism," *Acta Sociologica* 48, no. 3 (2005): 253–61.
[89] That ANT espouses a "flat" ontology is well-known; see e.g., "How to Keep the Social Flat" Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), 165–72. A major articulation of this metaphysics remains Bruno Latour, "'Irreductions,'" in *The Pasteurization of France*, ed. Bruno Latour (Cambridge, MA: Harvard University Press, 1988), 153–238. The connections between this outlook, through Leibniz's monism in particular, and Law's (and Lien's) recent project are referred to clearly in, for instance, Law, "Notes on Fish, Ponds and Theory."
[90] Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*, 3 and throughout. There are strong similarities between Lien's account here and Coppin's earlier discussion of agency in confinement practices in hogs, see "Crate and Mangle: Questions of Agency in Confinement Livestock Facilities," in *The Mangle in Practice: Science, Society, and Becoming*, ed. Andrew Pickering and Keith Guzik (Durham, NC: Duke University Press, 2008), 46–66.

anthropology (although I will elaborate some arguments relevant to the much older tradition in sociology that addresses matters that could be interpreted in terms of perspectives on *social* ontology). The salient difference in our approaches, from which most others subtend, lies in Lien and Law's adherence to a "theory-methods package"[91] located in ANT and its union with ethnography. I would like to emphasize this here, although the matters that arise are directly connected to my discussion in the following sections.

ANTs rigorous and ingenious pre-empirical decisions (ie., its metaphysics) – in brief, its excessively relational monism and strong social nominalism – has made it a leading candidate in contemporary philosophical social and "post-social" thought.[92] But this has come at the cost of specificity and emphasis in matters of sociological concern and application of social concepts in research. For instance, hard won social categories (some more useful others, admittedly) – like the society, the state, reproduction, structure, gender, or status, for example – are easily abandoned in ANT analyses and made to appear as though utilizing such abstractions is to commit to assuming or believing that they "actually exist" as such.[93] This functions as a renewed warning to sociologists against committing the fallacy of misplaced concreteness – but this is hardly new; and it is simply not the case that all sociologists, in mobilizing such abstractions, forget that they are implicitly mobilizing *models* or *hypothesis.*[94] Unlike ANT scholars, and in this case Lien and Law, I see no danger in careful use of such social concepts – whilst always

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[91] A term popularised in STS since Joan H Fujimura, "The Molecular Biological Bandwagon in Cancer Research: Where Social Worlds Meet," *Social Problems* 35, no. 3 (1988): 261–83.

[92] See earlier references to ANT metaphysics; also Martin Kusch, "Metaphysical Déjà vu: Hacking and Latour on Science Studies and Metaphysics," *Studies in History and Philosophy of Science* 33 (2002): 639–47; On the social nominalism of leading ANT scholars, see also Theodore R Schatzki, *The Site of the Social* (University Park, PA: Pennsylvania State University Press, 2002), esp., 65-66.

[93] Eg., "Rather than assuming that nature, society, people, market, gender, ethnic groups, and the like actually exist, it [Law's material semiotics and ANT] explores how such realities come into being through relational practices in dynamic ethnographic settings", Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*, 22.

[94] A criticism of essentialist, often collectivist use of concepts in sociology long ago outlined by, for instance, Karl Popper who notes because these concepts tend to be highly abstract we, neglecting their "theoretical" character, compensate for this in a way which means "we are liable to feel that we see [them], either within or behind the changing observable events, as a kind of permanent ghost or essence", *The Poverty of Historicism* (London: Routledge & Kegan Paul, 1961), 136.

bearing in mind that it is also of great value to try and explain how these concepts emerge and concretize out of practical associations of elements in the first place.[95]

Generally speaking, it is hard to conceive of the *social* study of reproduction, with its emphasis on, for example, the national, ethnic or gender stratifications in reproductive labour and ARTs in rigorously ANTian terms. Of specific relevance here moreover, I think that the direction of travel in Lien and Law's work, derived from ANT, serves to concentrate attention on *practices of ordering* generally, rather than on the specific *problems of social order* that interest me. Law developed this interest in earlier work on quotidian organizational practices in modernity[96], but it is also clearly central to the more recent work on empirical ontology. Here, order is understood as an effect of practices of "stabilizing" objects and entities ("farmed salmon", "biomass", etc) in mundane, empirical, socio-technical practices. If order – that is, regularized and predictable patterns of interaction – arises, these are general and potentially relate to all elements that make up the collective natural-social world. My concern, as will be fleshed out more in the following section, is considerably more specific and related to an interpretation of order as a problem of how to achieve a diminution in conflict between *social* agents (human individuals or groups) inclined to be antagonists.

The next difference I would like to foreground is related at ANT and ethnography. The union of these has unquestionably been productive and felicitous. This is unsurprisingly given the methodological injunction in classical ANT to "follow the actors"; that is, to study science and technology "in action"[97], to which the necessary location of ethnographic research (as far as practically possible) in the ongoing present is obviously a responsive ally. But this may leave the historian, especially the sociologically minded social historian, in a quandary. How do we grapple with the sedimentary effects of social interactions as they are built up over time and form, for instance, recognizable social forms, and can these ever, in an ANTian framework, be granted any causal or explanatory power without contradiction, or at least without neglecting the command to investigate

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[95] Something appreciated even by perspectives strongly inclined to be critical of ANTs "flat" ontology, see eg., Dave Elder-Vass, "Searching for Realism, Structure and Agency in Actor Network Theory," *The British Journal of Sociology* 59, no. 3 (2008): 455–73.
[96] John Law, *Organizing Modernity* (Oxford: Blackwell, 1994).
[97] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987).

how these are continuously made and remade in continuous practices of association or network building? As Clarke and Star argue, ANT is "excellent at grasping emergent connections that may or may not gel into social worlds", but is less useful in engaging with the "cumulative consequences of commitment and action over time"[98]. Similarly, Woolgar and Lezaun note, in discussing the turn to ontology as practical performance of which Lien and Law's ANT-inspired work is an exemplar, that while conventional social constructionist approaches in STS may help "describe the social processes that result in durable realities", the former will tend to be rooted in the description of practices producing "ephemeral effects", "in the here and now".[99] This positions ANT analyses as highly adept at recognizing and explicating radical novelty, but less well attuned to tracing and situating dynamics of continuity and change. A source of this apparent difficulty with history lies once again in ANTs strong relational monism and social nominalism. These result in a principled "anti-contextualism" in which, as Lien put it, contexts should appear only as "*outcomes*" of constitutive activities rather than taken as givens[100], and Kristin Asdal has noted in an attempt to re-read the issue of context in historical studies, such that ANT can be re-purposed as a historicizing tool.[101]

This is an issue that touches on wider assumptions in STS, and especially interpretations of co-production as a conceptual framework. I will pick up the discussion at this point in the following section as I work to further situate and clarify my own approach. Here I would like only to illustrate, by means of an example, how the union of ANT-based assumptions and ethnography lead to analyses which, while they may be intrinsically interesting, are not easily compatible with my historical assumptions and method. Neither do they necessarily sit easily with emphasis typically placed in the social studies of reproduction on understanding the historical development of reproductive knowledges and techniques, as responsive to and constitutive of changing cultural contexts.

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[98] Adele E Clarke and Susan Leigh Star, "The Social Worlds Framework: A Theory/Methods Package," in *The Handbook of Science and Technology Studies*, ed. Edward J Hackett et al., 3rd ed. (Cambridge, MA: MIT Press, 2008), 122.
[99] Steve Woolgar and Javier Lezaun, "Missing the (Question) Mark? What Is a Turn to Ontology?," *Social Studies of Science* 45, no. 3 (2015): 463.
[100] Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*, 39; also 22.
[101] Kristin Asdal, "Contexts in Action-And the Future of the Past in STS," *Science, Technology & Human Values* 37, no. 4 (2012): 379–403; Also, Tone Druglitrø, "Writing Radical Laboratory Animal Histories," *Nordic Journal of Science and Technology Studies* 2, no. 1 (2014): 36–44.

Lien's recent (2015) and excellent critique of received anthropological conceptions of domestication furnishes the example.[102] In a revealing anecdote, she describes the temptation of the ethnographer to read the salmon cages in a fjord as a part of the history of agricultural husbandry practices embodied in the sheepfolds also visible on the nearby hills. But, she says, the avenue towards which this conceptual comparison leads should be avoided because it "diverts attention away from the generative agency of people-and-things to the self-sealing metaphysics of conceptual categories." This, I think, is a practical expression of the indispositions of ANT with respect to social concepts; the theoretical-methodological outlook establishes an environment propitious for the recognition and description of novelty and novel world-making practices in the present as opposed to the interpretation of continuity and change in the course of history, or what Lien calls "generative potential" over the perpetuation of "cultural form".[103] Despite a shared concern with the "generative", there is a clear contrast in this example with Franklin's approach to the genealogy of Dolly the sheep and the techniques that created her (discussed above). In Franklin's case there is a specific focus on the production and reproduction of social life in the genealogy of her social-biological-technological hybrid "becoming" in a manner that necessarily privileges historical social context conceived as a medium for continuous and yet changing structures or "cultural forms".

I have gone somewhat beyond the brief of discussing approaches to fish culture, and have begun discussing issues in STS and sociology more widely. Having done this, however, I feel it is relevant to state clearly that, while I do not adopt ANT as a primary theoretical apparatus underpinning my research, I do see it as a relevant and useful tool of description. It is important to realise that while ANT has assumed a position of predominance in European STS especially – indeed, outsiders to the discipline seem often to confuse STS with ANT – ANT is not an "obligatory point of passage" for STS, and there remain various other theory-methods packages that interrelate with and diverge from ANT. These include

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[102] Lien's book, it is fair to note, is far more than a deployment of ANT – although her debt is ANT and its "successor projects" (see above) is nevertheless unmistakeable.

[103] Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*, 19, 18. To be clear, this is an illustrative point and I considered it an insufficient basis to challenge her general argument that the case of salmon aquaculture demonstrates a weakness in conventional theories of domestication (see above). On this point, I am inclined to agree.

social worlds/arenas analysis, on which I draw, and which stems from pragmatic interactionist approaches in US sociology (see below), as well as the feminist technoscience approaches associated with Donna Haraway. While John Law is inclined to assimilate Haraway's material semiotics to his own version of ANT[104], it also has significantly different historical and institutional roots as well as methodological and normative implications. In fact, if we look to major relevant contributions in the social studies of reproduction, reproductive technologies and the turn to animals therein – including Charis Thompson's, Sarah Franklin's and Carrie Friese's – Haraway is a much larger source of influence than ANT. Haraway's work has undoubtedly proven central for many reasons, including her innovative interpretations of the politics of technology, especially with respect to women's bodies, as well as her consistent (and, given the relatively recent "turn" to animals in cognate areas) somewhat visionary realisation of their relevance to social theory and analysis.[105]

Haraway's procedure, whilst hard to summarise, is generally that of creating "figurations", forms of metaphorical "trope-making" that establish new beings via the combination of existing entities, "material" and "semiotic". In doing this, she suggests a relational ontology of her own, in which species (for example) do not precede one another as self-sufficient isolates, but make one another in their meeting. One of Haraway's case studies concerns the bodies and characters of pedigree dogs.[106] These, she indicates, can be seen as a result of selective cultivation according to human cultural preferences, but may also be considered agentive adaptations within the context of such pressures. In this way, dogs might be viewed as having co-shaped the humans who bred them, creating for instance complex new forms of commerce and affective economies based on an ethics of responsibility and love, as well as new forms of social organisation and technical intervention. For instance, forms of sociality and entrepreneurship emerged around the management of genetic diseases that inbreeding has created. Dogs and their people thus "become worldly" together.[107] While I do not adopt Haraway's

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[104] See Law, "Actor Network Theory and Material Semiotics."
[105] Esp., Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science*; Donna J. Haraway, *Modest_Witness@Second_Millennium.FemaleMan_Meets_OncoMouseTM: Feminism and Technoscience* (New York and London: Routledge, 1997); Haraway, *When Species Meet*.
[106] Haraway, *When Species Meet*, esp., Chapters 2, 4 and 5.
[107] Ibid., 41.

methodological outlook as my primary point of departure either, it clearly suggests that other approaches are available that are equally capable of responding in a constitutive, relational manner to questions of the social "(re)productivity" of human relations with nonhumans, but which do not require the excessive social nominalism and relational monism that strict ANT analyses demand – and which come with pitfalls of the sort I have suggested.

In sum, connecting literatures on the SSR and fish culture thus far, I conceive of the SSR in particular as providing a starting point for exploring sociologically the production and reproduction of forms of social life and order in the history of fish culture and, more broadly, a national socio-historical context – a perspective not hitherto emphasized in the literature on the subject. Fish culture and existing literatures thereon in turn offer an opportunity for exploring modern reproduction in new ways and contexts.

1.3.3 *Science and technology studies: Co-production, social order, context*

STS is a diverse field made up of a range of approaches. One of its central insights has been that science and technology are "social", and that technology and science are simultaneously "active" elements in the construction or maintenance of social relations and, as I will suggest, social order.[108] Methodologically, a key contribution has been development of the idea that episodes of controversy or disagreement in science or technological development, in which it is often the case that normal or apparently "orderly" social relations break down to varying extents, are privileged points of ingress into such matters.[109] These are all familiar yet important set pieces connected to the field's constructionist origins. As is also well known, STS has also contributed broadly to theorisations of the materiality of social life, or what in the actor-network theory (ANT) tradition has been characterised as the "agency" of nonhumans – which is to say, the capacity of

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[108] The quotes refer to Sergio Sismondo, *An Introduction to Science and Technology Studies* (Oxford: Blackwell, 2004), 51.

[109] While numerous other citations are possible, two contrasting works, both of which emphasised the methodology of controversy, were particularly agenda setting and representative: Latour, *Science in Action: How to Follow Scientists and Engineers through Society*; Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. [First Ed., 1985].

nonhuman actors to "make a difference" in ways that are sociologically relevant.[110] Out of this conceptual milieu has arisen a family of expressions that describe the relationship between the social and technical, material or scientific, and attempt to avoid forms of determinism based on either. For instance, Mackenzie and Wajcman have emphasised a "mutual shaping" of technology and society[111]; Pickering spoke of the "interactive stabilisation" of scientific knowledge and society, in which no element has "causal priority"[112]; while Sheila Jasanoff suggested the idea of "co-production" as an "idiom" that, whilst retaining specific inflections in her own work, also aptly summarises the wider family of concepts.[113]

A way of characterising what unites many such theoretical approaches in STS is the tendency, in Don Slater's phrase, towards dissolving "objects and contexts" into a "dynamic dialectic" in which neither has the status of objective condition.[114] This is connected in turn to two common dispositions in STS: firstly, a suspicion of macro sociological theorising, often in favour of local actor-centred analyses in which the imposition of conceptual categories or theories unknown to the empirical actors is avoided. As Slater notes in considering STS in relation to sociological theories of modernity, the commitment to challenging this distinction would seem to be contradicted should a macro social theoretical framework be reinstated as a context for interpreting particular socio-technical phenomena. Secondly, STS is typically committed to an ambition to work theoretical positions out cautiously as far as possible through working them through detailed empirical studies, and developing concepts on the basis of their relevance to actors in such studies.[115] Although, as will become clearer below, I am critical of some aspects and implications of these tendencies, these are all nevertheless dispositions I share in many ways, and which characterise analyses throughout this dissertation. The co-productionist thematic in particular is informative: rather than seeking only to

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[110] Latour, *Reassembling the Social*, 71; Edwin Sayes, "Actor-Network Theory and Methodology: Just What Does It Mean to Say That Nonhumans Have Agency?," *Social Studies of Science* 44, no. 1 (2014): 134–49.
[111] Donald MacKenzie and Judy Wajcman, "Introductory Essay: The Social Shaping of Technology," in *The Social Shaping of Technology*, 2nd ed. (Buckingham: Open University Press, 1999), 3–27.
[112] Andrew Pickering, "From Science as Knowledge to Science as Practice," in *Science as Practice and Culture*, ed. Andrew Pickering (Chicago, IL: The University of Chicago Press, 1992), 14.
[113] See Sheila Jasanoff, "The Idiom of Co-Production," in *States of Knowledge: The Co-Production of Science and Social Order*, ed. Sheila Jasanoff (London: Routledge, 2004), 1–13.
[114] Don Slater, "Modernity under Construction: Building the Internet in Trinidad," in *Modernity and Technology*, ed. Thomas J Misa, Philip Brey, and Andrew Feenberg (Cambridge, MA: MIT Press, 2003), 139.
[115] See John Law, "On Sociology and STS," *The Sociological Review* 56, no. 4 (2008): 623–49.

explain, in Jasanoff's phrase, the emergence of forms of "[k]knowledge and its material embodiments" (technologies), I wish emphasise how these are "at once products of social work and constitutive of forms of social life."[116] Indeed, classical constructionist studies of controversies in STS typically focused on how disputes are settled in practice for the purpose of understanding how specific facts and artefacts are produced or get to be deemed successful. In my appropriation of the idiom of co-production however, I wish to read controversies and conflicts involving science and technology in society in more expansive terms as themselves sites of social rupture or dissent, and as such also social change. Such ruptures typically, although not always, require provisional resolutions in processes I take to involve the generation and deployment of, amongst other things, empirical knowledge of the material world, technologies, as well as institutions, interests, beliefs, values and, especially, language and rhetoric or persuasive speech.[117] Studying how conflicts and controversies are settled (or not) through processes involving compromise, consensus and coercion (as well as more quotidian textual and technical interventions), is therefore, I take it, to study the transformation and reproduction of social relations and social orders.[118]

Social order

This juncture offers an opportunity to briefly inspect the idea of social order and what I intend by it, especially since invoking it seems to go against the grain of much contemporary STS. Not unlike "society", with which it is closely associated, the phrase arguably refers to the central object of sociological thought, and yet, at the same time, its usefulness as a sociological concept may be doubted, as methodologically individualist thinkers like Simmel and Weber long ago

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[116] Jasanoff, "The Idiom of Co-Production," 2–3.

[117] My argument is not unconnected to earlier criticisms of the controversy studies tradition in STS, in which it was argued that STS's reticence to engage in normative matters left it neglectful of the relationship between policymaking and matter of "the changing of minds", see Thomas Brante, Steve Fuller, and William Lynch, "Introduction," in *Controversial Science: From Content to Contention*, ed. Thomas Brante, Steve Fuller, and William Lynch (Albany, NY: State University of New York Press, 1993), esp., xi.

[118] Mirroring in some respects an approach to controversies in STS which see them as akin to models for studying social change and conflict generally, as well as, as Nelkin put it, "means of negotiating social relationships and of sustaining certain values, norms, and political boundaries", Dorothy Nelkin, "Controversies and the Authority of Science," in *Scientific Controversies*, ed. Tristram H Engelhardt and Arthur L Caplan (Cambridge: Cambridge University Press, 1987), 284; also Gerald E Markle and James C Petersen, "Controversies in Science and Technology - A Protocol for Comparative Research," *Science, Technology & Human Values* 6, no. 34 (1981): 25.

discovered with respect to "society".[119] The term has been used in many different ways, and is often very broadly construed. Social order might be simply synonymous with "society" or just "social relations"; it may also identify specific socio-historical totalities, such as the Marxist's "*bourgeois* social order". Sociological writers engaged with macro-theoretical accounts of social integration[120], or micro-sociological investigations of face-to-face interactions and the maintenance of "interaction order"[121] could all plausibly claim to be engaged in studying social order. At perhaps the most basic level, and highly abstractly, social order may be simply equivalent to regularity, pattern and predictability in the layout of the components characterising social life. Indeed for some approaches, social order is effectively equivalent to cognitive order, that is to say, how it is that shared understandings of the world are possible such that we can expect regularity and predictability in affairs, ie., the forms of intersubjectivity typically understood as obtaining in the common linguistic capacities of subjects, within social groups or "forms of life" (to invoke the language of Wittgenstein which has been influential in informing this line analysis).[122] As Wrong pointed out, at this level of abstraction, the issue tends to melt into the "general question of how *any* common perceptions of regularities, whether in nature or society, are possible for human beings" at all; when such are deemed dependent on "socially acquired categories of understanding", "the problem of knowledge or epistemology itself becomes a version of the problem of order" – a fate which explains why this means of cashing out the question of social order has been highly influential in the social studies of scientific knowledge.[123] While hugely varied and very hard to disaggregate, it is possible to summarise all such approaches to social order using

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[119] See David Frisby and Derek Sayer, *Society* (Chichester: Ellis Horwood and Tavistock Publications, 1986); See also Liam Stone, "Max Weber and Moral Idea of Society," *Journal of Classical Sociology* 10, no. 2 (2010): 123–36. Of relevance, also Gary Wickham, "The Core Object 'Society' and Sociology's Public Relevance: History versus Theory," *Journal of Sociology* 48, no. 4 (2012): 247–442.

[120] Eg., Anthony Giddens, *The Constitution of Society: Outline of the Theory of Structuration* (Berkeley, CA: University of California Press, 1984); Edward A Shils, *The Constitution of Society* (Chicago, IL: University of Chicago Press, 1982).

[121] Erving Goffman, *Interaction Ritual: Essays on Face-to-Face Behaviour* (London: Allen Lane, 1972); Erving Goffman, "The Interaction Order," *American Journal of Sociology* 48, no. 1 (1983): 1–17.

[122] Wrong, *The Problem of Order: What Unites and Divides Society*, 5, 11–12.

[123] Ibid., 5. See more below.

Theodore Schatzki's term: these all refer to "cognitive-ontological" senses of the expression.[124]

On the other hand, it is also well known that there is an interweaved tradition with ancient roots in thinking about social order, which may be expressed more narrowly as "the problem of order". This descends principally from Thomas Hobbes, and was identified as such for modern sociology by Talcott Parsons.[125] Here, social order is identified with the absence of conflict, possibly, but not necessarily, including physical violence, or, in a more Hobbesian idiom, the checking of universal war, and therefore with civility and "civil" society. Classically, resolutions to the problem of order in this sense have involved theories oriented around coercion (Hobbes), the pursuit of self-interest (Locke), and agreement based on shared values (Rousseau). Often, this tradition is partitioned from the preoccupations of modern sociology and associated with political theory and philosophy. However, this obscures the extent to which the Hobbesian problematic informs and underpins the history of sociological thought as a whole. Hobbes' problem in fact lies at the very root of much classical and current sociological thinking; it is clearly reflected in broad sociological questions such as "how is society possible?" or "what holds society together?".[126] In fact, while this is not always obvious, most "cognitive-ontological" senses of the term largely descend, and are impossible to disaggregate entirely from this legacy. Indeed, "the problem of order" has, since Parson's neo-Hobbesian intervention and attempt to resolve the problem in normative-functionalist terms, often been considered the crucial test for any general social theory, which is to say, all serious theories are required to account for how the pursuance of contradictory ends in society are managed with respect to ideas about human agency or motivation.[127]

The empirically driven, case study approach characteristic of STS seems a world away from macro social and political theory that elaborates concepts of or seeks theoretical accounts of the problem of "social order". Yet, as already noted, it

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[124] Schatzki, *The Site of the Social*, 3–4.
[125] Thomas Hobbes, *Leviathan*, ed. J.C.A Gaskin (Oxford: Oxford University Press, 1996); Talcott Parsons, *The Structure of Social Action*, 2nd ed. (Glencoe: The Free Press, 1949).
[126] Egs., Emile Durkheim, *The Division of Labour in Society*, ed. Steven Lukes, 2nd ed. (Basingstoke: Palgrave Macmillan, 2013); Simmel, "How Is Society Possible?"
[127] Thomas Burger, "Talcott Parsons, the Problem of Order in Society and the Program of an Analytic Sociology," *American Journal of Sociology* 83, no. 2 (1977): 320–39; See also, Robert J Holton and Bryan S Turner, *Max Weber on Economy and Society* (London: Routledge, 1989), 27.

has in fact been a strong factor in STS and the sociology of science. When Merton wrote of the social order of science, he referred to "a peculiar complex of tacit presuppositions and institutional constraints" – or more loosely, the "culture" – that enables the "persistent development" of science.[128] Perhaps the best known articulation of social order in this context is contained in Shapin and Schaffer's famous slogan in the *Leviathan and the Air-Pump*: "Solutions to the problem of knowledge are solutions to the problem of social order".[129] And differing approaches in STS, based in the ANT tradition, have also often revolved around questions of order, as already noted in relation to John Law's work, wherein practices of heterogeneous "ordering" are studied with respect to how these may constitute zones of provisional stability and patterning in socio-material life.[130] In such a view, tensions clearly arise on the basis of the impression created by the word *order,* which suggests singularity, determinateness and closure, hence Law's substituting the gerund *ordering* instead, urging in this way a sense of orders as plural, local and contingent achievements. This is a valuable reminder that social order, however else it is considered, should be viewed as an always partial achievement rather than a "given" aspect of the world described by the term. Indeed, this is implicit in posing social order as a *problem*, rather than a cognitive-ontological structuring or culture, that needs to be constantly resolved by actors in practice, not only theoreticians. Finally, the tension between these kinds of views is well captured in Jasanoff's attempt to characterise co-productionist research as a trend capable of bringing STS into closer dialogue with the traditional concerns of the neighbouring social scientific disciples. The volume she edited on this theme signals its interests in its sub-title: "…*The co-production of science and social order*", the project of which she occasionally refers to as "[s]olving problems of order". But it is unclear in what sense order is meant, sometimes appearing to be

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[128] Robert K Merton, "Science and the Social Order," *Philosophy of Science* 5, no. 3 (1938): 321.
[129] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton, NJ: Princeton University Press, 1985), 332; See also esp., Barry Barnes, *The Nature of Power* (Cambridge: Polity Press, 1988); Massimo Mazzotti, *Knowledge as Social Order: Rethinking the Sociology of Barry Barnes* (Aldershot: Ashgate, 2008); Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, IL: University of Chicago Press, 1994).
[130] Law, *Organizing Modernity*; also, Law and Lien, "Slippery: Field Notes on Empirical Ontology"; see also Schatzki, *The Site of the Social*, 6.

identified with predictability and patterning in socio-technical relations generally, sometimes with the role of more specific organs of governance.[131]

My interpretation draws on both of these as representative variations on the theme, especially that put forward by the historians and sociologists of science with respect to cognition (see Chapter 2). However, it also departs from them to the extent that they both congregate around the "cognitive-ontological" approach to understanding (social) order. I wish to do more than point out the reliance of social order on general problems of intersubjectivity and cognition, and I don't want the specific focus on *social* order to get lost. I wish therefore to emphasise the more conventionally "political" dimension of the problem of order, seeing order, or "social orderliness"[132], when achieved, as reflecting the successful management of discord caused by agents pursuing conflicting ends. That is, as obtaining when peaceable, co-operative interactions between tangible historical social agents, individuals or groups are achieved as a consequence of effectively managing the conflicts and controversies in which they get embroiled. These are also necessarily sites of both social reproduction in a broad sense, as well as the reproduction of social order in this narrower view. Social order thus presumes the centrality of social relations, but also has a specificity that exceeds this general expression. Clearly, though, I do not aspire to general theoretical resolution of "the problem", and I adopt a sceptical view of attempts to do so. Such a resolution would seem to assume society is a bounded totality, a whole or system. My outlook is thus closer to Weber's than to Marx's or Durkheim's, with Weber himself finding it "unnecessary to ask the general question of what holds society together" in favour of recognising that history is composed of a shifting mosaic of conflict, co-operation (if not necessarily) consensus and group formation occurring amongst people "bound by ties of common feeling and belief".[133]

Such emphasis on the *social* of social order/ing may raise eyebrows given the emphasis on materiality, nonhumans, and post-social/post-humanist thinking

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[131] Sheila Jasanoff, "Ordering Knowledge, Ordering Society," in *States of Knowledge: The Co-Production of Science and Social Order*, ed. Sheila Jasanoff (London: Routledge, 2004), eg., 40 and throughout.
[132] Frisby and Sayer, *Society*, 42; also 17-19.
[133] Randall Collins and Michael Makowsky, *The Discovery of Society* (New York: Random House, 1972), 101–2; quoted in Wrong, *The Problem of Order: What Unites and Divides Society*, 222, NaN-226.

in much contemporary STS. However, it is assumed that material or technological elements are also social (and may be deemed sociologically relevant on an empirical case-by-case basis). This said, differences in emphasis are important; as explanatory-analytical features, it will become clear that I place high premiums on ascriptions and apprehensions of social status and other kinds of social hierarchy by human actors, on the establishment of norms (some more obligatory than others) out of the discharge of expectations generated in intra- and intergroup interactions, and the existence of different kinds of self-interest (subjectively defined), individual sources of motivation, and corresponding human emotions such as feelings arising out of beliefs about personal and group honour or shame. Connectedly, I see language and linguistic representations, especially in the form of persuasive rhetoric, as an essential feature in the achievement or maintenance of social order. Coercion, or the imposition of unfavourable choices by powerful groups onto others, is also taken as a significant reality in contexts of problems regarding the allocation of scarce resources.

In emphasising the "political" dimension of the conflicts and controversies I investigate, especially in Chapters 3 and 4, I will also interpret politics in activity-based terms as "purposeful activities that aim for collectively binding decisions in a context of power and conflict".[134] To some extent, this reflects a narrower conception of "politics" than has been common in STS. Here spatial conceptions of politics have often been popular, and these tend to assume spatiality in the sense that politics is *everywhere* and is enacted in all kinds of interactions and relations involving heterogeneous agents, such as reflected in slogans like "science is politics by other means", or in the form of theoretical outlooks like "ontological politics" and "cosmopolitics". I acknowledge then that my approach will often go against the grain of these typically more anti-representationalist approaches in the field.[135] The following section will help to explain and justify further aspects of this outlook.

Co-production and context

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[134] Brown, "Politicizing Science: Conceptions of Politics in Science and Technology Studies," 19.
[135] I do not intend to refer specifically the Nigel Thrift's project, although there are clear similarities and borrowings between it and the STS literature, see *Non-Representational Theory* (Oxford: Routledge, 2008).

Returning then to the idiom of co-production, and given the dissolution of "object and context" in STS that co-productionist approaches are associated with, questions arise with respect to the role of "context" and "contextual analysis". I want to argue, on the one hand, that the problems that occur can be managed by distinguishing two interpretations of or approaches to co-production and, on the other, that adopting a particular kind of "contextualism" – that which is appropriate to historical analysis and the narrative reconstruction of history – does not necessarily adversely effect a co-productive ethos, nor make adherence to some form of social nominalism impossible. I also introduce Clarke and colleagues situational analysis as a perspective helpful in mediating what tensions may remain.

As alluded to earlier, and put simplistically, a difficulty with context, specifically "social context", resides in the idea that reference to a context in the explanation of an event or phenomena may tend to assume the reality of this context rather than demonstrate how it is produced or what makes it stable enough to be a ground for explanation. In this view, context is seen as though it were a substance, both distinct from the particulars of the event or phenomena in question, and yet capable of determining them and hence, by analogy with the philosophical tradition, like an universal or an essence of which the particulars are instantiations.[136] From a co-productionist point of view this seems anathema, since it is precisely the emergence or stability of those "surrounding" aspects of social life that is equally to be explained. In approaching this problem, it is crucial to appreciate the origins and history of co-productionist thinking, and "anti-contextualism" in STS more generally. They are a product of the development of STS since the late 1970s and, in particular, an effect of what the historian of science Robert Kohler called the "peculiar ecology" of the sociology of scientific knowledge during the earlier parts of this period.[137] As is well known to STS scholars today, a

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[136] Hence reference to the alternative philosophical view – nominalism. Hacking observes that all constructivist thought should be nominalist to the extent that it opposes some kind of essentialism; the argument of the "anti-contextualists" here is, effectively, that some constructivist positions are less nominalistic than they should be when it comes to analysis of "social context", or in the use of sociological concepts, *The Social Construction of What?* (Harvard, MA: Harvard University Press, 1999), esp., 80-84.

[137] Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life*, 3. This refers also the influence of Marxism on efforts by sociologists and philosophers to dismantle naturalistic knowledge at this time. Kohler's own approach to the "moral economy" of scientific practices, with that of other historians of science, influences my discussion in different ways in Chapter 2.

form of social constructionism arose in which, critics of it claimed, so-called "social factors" were awarded unsustainable explanatory prominence.[138] In this debate, the problem of social explanation, an epistemological issue, was conceived of as problem of "over-contextualisation", the social context of an entity having been elevated to a high level of analytical or causal priority – especially in connection to the contentious issue of the role of social "interests".[139] It is in response to such sociologisation, and with it a turn in STS more broadly away from apparently intractable epistemological dilemmas towards the study of socio-material practices[140], that the genesis of the idiom of co-production lies – and with it, also, the rise to prominence of avowedly anti-contextualist perspectives like ANT. Indeed, Bruno Latour coined the word "co-production" (or coproduction) in this context.[141] Callon and Latour used it in their celebrated set-too with sociologists from the University of Bath: They wrote that the social constructionism of their sparring partners was

> … exactly as reactionary as one who would start from an unreconstructed definition of nature in order to explain the settlement of controversies. On the contrary, we take as progressive any study that simultaneously shows the coproduction of society and nature.[142]

The general idea is that context and object, or form and content, are always engaged in ongoing interactions of mutual generation: they co-produce one another. This suggestion, under whatever other names it has occurred, has been hugely influential, and a key driver for the expansion of the ambitions of STS. Connected (in the social sciences at least) to an unusually high regard for

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[138] This episode is revisited usefully by author's whose work had been centrally implicated in it, in Steven Shapin and Simon Schaffer, "Up for Air: Leviathan and the Air-Pump a Generation On," in *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*, 2nd ed. (Princeton, NJ: Princeton University Press, 2011), xi–l; Primers in STS, like Hess and Sismondo's, provide detailed discussions of the outlines of this controversy, David J Hess, *Science Studies: An Advanced Introduction* (New York: New York University Press, 1997); Sismondo, *An Introduction to Science and Technology Studies*.

[139] See Barry Barnes, "On the 'Hows' and 'Whys of Cultural Change (Response to Woolgar)," *Social Studies of Science* 11, no. 4 (1981): 481–98; Michel Callon and John Law, "On Interests and Their Transformation: Enrolment and Counter-Enrolment," *Social Studies of Science* 12, no. 4 (1982): 615–25; Steve Woolgar, "Interests and Explanation in the Social Study of Science," *Social Studies of Science* 11, no. 3 (1981): 365–94; Hess, *Science Studies: An Advanced Introduction*, 89–94.

[140] See Sheila Jasanoff, "Beyond Epistemology: Relativism and Engagement in the Politics of Science," *Social Studies of Science* 26, no. 2 (1996): 393–418; also, Andrew Pickering, ed., *Science as Practice and Culture* (Chicago, IL: Chicago University Press, 1992).

[141] See Latour, *Science in Action: How to Follow Scientists and Engineers through Society*, 136.

[142] Michel Callon and Bruno Latour, "Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley," in *Science as Practice and Culture*, ed. Andrew Pickering (Chicago, IL: The University of Chicago Press, 1992), 349.

descriptive analysis, it also influenced historians.[143] It has enabled an idea of co-production writ large, in Jasanoff's words, as the exploration of

> … connections between the human capacity to produce facts and artefacts that reconfigure nature, and the equally human ability to produce devices that order or reorder society, such as laws, regulations, experts, bureaucracies, financial instruments, interest groups, political campaigns, media representations or professional ethics.[144]

Indeed, according to Jasanoff, since the advent of Latour's critique in *Science in Action* particularly, there is actually no STS scholar "worth her salt" today that would not "recognise *social* resources as constructs too".[145] It is hard to disagree with this assessment (although it seems somewhat tautological).

With this background in mind, it is clear that one view of co-production is practically synonymous with ANT and allied theories, which I have already cautiously distanced myself from. It is only from this point of view that context, I think, appears a severe problem – indeed perhaps anathema.[146] This is because of ANTs onto-methodological "flatness", already noted, which compels adherents to reject the idea of "backgrounds" of any kind, in principle.[147] But in articulating a slightly different vision, we must ask, more specifically, what is typically apprehended as "context" in this tradition? I have already noted one key example in the history of STS – social "interests".[148] By extension, "contexts" are in practice most often particular deployments of social or sociological concepts – general ones, such as structure or milieu, or more specific ones, like gender, class or status. The reasons for this have already been described: they were perceived to have

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[143] Dominique Pestre, "Thirty Years of Science Studies: Knowledge, Society and the Political," *History and Technology* 20, no. 4 (2006): 358; On recent re-evaluations of the value of description in sociology, see Mike Savage, "Contemporary Sociology and the Challenge of Descriptive Assemblage," *European Journal of Social Theory* 12, no. 1 (2009): 155–74.
[144] Jasanoff, "Ordering Knowledge, Ordering Society," 14.
[145] Sheila Jasanoff, "Genealogies of STS," *Social Studies of Science* 42, no. 3 (2012): 439.
[146] C.f., the centrality of ANT to essays which grapple with the problem in Kristin Asdal and Ingunn Moser, eds., "Special Issue: Experiments in Context and Contexting," *Science, Technology & Human Values* 37, no. 4 (2012). The issue is also central to the idioms of "performativity" and "enactment" in STS. These are heavily influenced by ANT, though of course not reducible to it, see see Steve Woolgar and Javier Lezaun, "The Wrong Bin Bag: A Turn to Ontology in Science and Technology Studies?," *Social Studies of Science* 43, no. 3 (2013): esp., 324.
[147] For an influential statement, see eg., John Law, "Editor's Introduction: Power/Knowledge and the Dissolution of the Sociology of Knowledge," in *Power, Action and Belief: A New Sociology of Knowledge?*, ed. John Law (London: Routledge & Kegan Paul, 1986), 1–19 on the problem with seeing the social fabric as a "backcloth" to action. See also my comments on ANT above.
[148] Asdal, "Contexts in Action-And the Future of the Past in STS," 384 emphasises the same route into the issue.

taken on unsustainable explanatory proportions and, it is supposed, that deployment of such concepts in language assumes that these "actually exist" as such. (Arguably, these points are connected through the observation that ANT implicitly limits reality to the purely empirical level, and models all entities therein according to an analogy with physical objects: to exist, an entity must be analysable as functioning *like* a relating body that extends in space and time; thus, "material" and "semiotic" are interchangeable and relate on the same plain).[149] But, as I have already said, this is not the case so long as we remember that sociological abstractions are rather like hypothesis, models, or even ideal types. Thus there is little danger of contradiction with a generally socially nominalist outlook, or the view that "society" actually exists as such, in some kind of *sui generis* sense, or outside of the infinity of particulars and their relations that compose it. Thus methodological individualists like Weber or Hayek cannot be easily exposed, despite their use and development of sociological concepts, to the critique of context as a theoretical-methodological problem in the sense described. Put differently, we can say that when we refer to a context, we are simply adopting a kind of shorthand that summarises many relevant particulars.[150] Latour, I think, is thus rash to reduce sociology to what he calls "the sociology of the social", which supposedly assumes the existence of "a stabilised state of affairs, a bundle of ties that, later, may be mobilized to account for some other phenomenon".[151]

Thus, in my view, the problem of context from a co-productionist point of view amounts to a disagreement about the deployment of sociological abstractions (and their supposed "ontological status") when these are understood to be unduly reified or unexamined. One might agree with ANT (and in fact much of STS) that it is valuable in explanations to transfer causal powers from such collective abstractions as "structures" or "society" to individual actors, but not that this implies abstaining from sociological abstractions generally. With this argument made, I think that – at least outside of ANTian strictures and possibly

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[149] See Elder-Vass, "Searching for Realism, Structure and Agency in Actor Network Theory," 470, 471; also, Leonidas Tsilipakos, "The Poverty of Ontological Reasoning," *Journal for the Theory of Social Behaviour* 42, no. 2 (2012): 210–13 who discusses how assuming that language comes pre-loaded with ontological commitments assumes a referential theory of language in which what exists must be "entities", and from thence what is considered to exist and be real will tend to be modelled on "physical objects."

[150] See Schatzki, *The Site of the Social*, 69.

[151] Latour, *Reassembling the Social*, 1. Latour is characteristically vague in identifying precisely *which* sociologists he is taking issue with.

even within them too – there is no essential difficulty in engaging in contextual reconstruction and explanation in the form of historical narrative. If there is a problem here, it lies with specific theoretical interpretations of context in sociology – not historical writing. Great historians, from Hume to Weber, have also been great philosophical nominalists. Perhaps Asdal is right to be concerned that "anti-contextualism" in STS might deny the historian her "most precious tool": context.[152] But I do not see this as a central problem to the mode of STS I envisage nor the vision of co-production I employ.

I can thus propose the existence of another, more flexible and forgiving, conception of the idiom of co-production. This vision is not constrained by adherence to a strongly "post-social" outlook and is more akin to sociological approaches to the "mutual shaping" of knowledge, artefacts and society. It also accepts the role of already constituted or historically sedimented social conditions or "contexts" as simultaneously necessary for understanding the events being focused on, and themselves possibly operating as actors relevant in the situation of enquiry.

This last formulation draws on situational analysis (SA), a "theory-methods" package developed as an extension of the social worlds/arenas approach to grounded theory and often in close in dialogue with STS, by Adele Clarke and colleagues.[153] I have found some of the methodological strategies of SA useful, and I describe it further in the next section. Here, I briefly mention how it has helped me approach the tensions I have been discussing, and puts further flesh on the position I have been trying to articulate. SA's fundamental concept is that of the situation of enquiry: this is considered the primary unit of analysis, and it gets composed from a matrix of everything deemed relevant or consequential in the situation. A checklist includes, for instance: sociocultural, discursive, spatial and temporal, political economic, nonhuman and organizational elements, amongst others. These may be the "conditions" of the situation. But Clarke specifies: they

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[152] Asdal, "Contexts in Action-And the Future of the Past in STS," 381.

[153] Amongst a growing number of prospectuses, see especially Adele E Clarke, *Situational Analysis: Grounded Theory After the Postmodern Turn* (Thousand Oaks, CA: Sage, 2005); Clarke and Star, "The Social Worlds Framework: A Theory/Methods Package"; Adele E Clarke, Carrie Friese, and Rachel Washburn, eds., *Situational Analysis in Practice* (Walnut Creek, CA: Left Coast Press, 2015). A *Forthcoming* edition of Clarke's (2005) introduction *Situational Analysis* is expected in 2016. It is slated to contain an historical exemplar based on a part of my own work.

are not outside, but rather *in* the situation. In fact, writes says: "There is no such thing as 'context'".[154] SA might then be described as "anti-contextualist" approach, but, in my reading, not in the same sense that I have been distancing myself from. Indeed, situations or the elements of which they composed are not viewed as instantiations of social essences. But this view is not – as the partial list of elements that may be present in a situation suggests – extended to a disavowal of the use of sociological concepts on the basis of their supposed capacity to commit the analyst to a view of social ontology. In fact, it seems clear that the provisional use and testing of such concepts – typically as "sensitising" concepts in the symbolic interactionist sense – are central to the SA/social worlds/arenas methodology. These have a purely provisional analytical status, meaning they are like models for probing an unknown reality, and it is taken for granted that they do not have a *sui generis* reality but are rather like bundles of particulars that it is always potentially possible to disaggregate. Yet the analyst holds them together as tools for solving problems at hand. In my reading, this is compatible with the view of social concepts or context functioning as shorthand for the nominalist.

For something to be cogently analysed at all – including social processes unfolding over historical timeframes – it cannot be treated as a totality – that is, all at once. Specific features of it need to be selected for treatment, and for this to be possible other features need to recede from immediate view. When this happens, we can without contradiction call those receding elements "context". This is what the historical narrative as a method always does. At first glance, the SA approach may appear to contradict this principle because it insists that the situation is a kind of whole, a gestalt, as Clarke put it, that is "more than the sum of its parts" and has "a life of its own".[155] But by the very nature of a gestalt, there must be a principle, a special feature included in the whole that gives it this property (or else it would be a haphazard collection of elements). This is what a gestalt analyst analyses, what they select. Clarke appears to find this special feature in the idea of "relationality" (relations are of course included in heterogeneously composed wholes). For my purpose, all that matters here is that it is in principle necessary to select elements: these become operational sociological "concepts"; thus even such abstractions as

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[154] Clarke, *Situational Analysis: Grounded Theory After the Postmodern Turn*, 71.
[155] Eg., Adele E Clarke, "Feminisms, Grounded Theory, and Situational Analysis Revisited," in *Situational Analysis in Practice*, ed. Adele E Clarke, Carrie Friese, and Rachel Washburn (Walnut Creek, CA: Left Coast Press, 2015), 136.

"structures", "conditions" and "processes" can in principle be integrated into the analysis if desired, as Clarke says.[156] With this *logical*, *methodological* and *practical* distinction in view, I think, as indeed Clarke urges, SA can be a useful ally for narrative based social historical research into technologies and their social (re)productivity. Some of the practical operations associated with this outlook, and how I utilised them in empirical analysis, are discussed in the following section.

1.3 Methods and materials: Analysis, history and archive

In this section I describe my materials archive and some procedures of selection and analysis. Overall, my aim is to produce convincing and credible analysis through deployment of historical narrative. But working with historical sources has specific challenges. Bloch famously described historical research as "craftwork" (and Abbott referred to the historian's "obscure but unimpeachable methodology").[157] Without clear objective "rules" of method, historical work therefore demands a pattern of reasoned clarity and pragmatism in issues of data selection and analysis. As Aristotle put it in discussing his own method, "[o]ur discussion will be adequate if its clarity is in line with the subject-matter".[158]

1.4.1 *Analytical tools, practices and experiences*

A major initial challenge I faced with this research was how to narrow down my broad concern with the development of nineteenth century British fish culture as a technology of reproduction into a manageable and meaningful unity of case studies or analytical foci? Historians typically proceed through aligning their broad interests with availability of relevant sources, especially primary archival materials, within a selected timeframe (which will often, of necessity, be arbitrary though not indefensible). This conventional wisdom played an important role in my decisions (and it will be observed that there is a rough chronology to the studies undertaken in each chapter).

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[156] Clarke, *Situational Analysis: Grounded Theory After the Postmodern Turn*, 71.
[157] Andrew Abbott, "History and Sociology: The Lost Synthesis," in *Engaging the Past: The Uses of History across the Social Sciences*, ed. Eric H Monkkonen (Durham: Duke University Press, 1994), 79; Marc Bloch, *The Historian's Craft*, trans. Peter Putnam (Manchester: Manchester University Press, 1992).
[158] Aristotle, *Nicomachean Ethics*, trans. Roger Crisp (Cambridge: Cambridge University Press, 2000), 4.

But such decisions can only be made after an initial and formative methodological experience of immersion and free exploration amongst a diversity of sources. I gleaned knowledge of these, to begin with, from secondary sources and intensive use of indexes, search engines and other library techniques. During these early phases of research particularly, I developed a routine of exposure, partial digestion in the form of taking detailed notes and memos, and re-exposure following new leads and emerging sources. The historical narrative is ultimately the result of reconstructing such experiences in the light of emergent conceptual themes and priorities.

While necessary, such open-ended investigation is also on its own inadequate. In the face of a vast quantity and range of materials that cannot all be given equal attention and are constantly opening up new possible directions, I thus sort further means of introducing order into my procedure in a manner that would not contradict STS's broad disposition towards avoiding conceptual foreclosure through the imposition of overly restrictive macro-theoretical frameworks. As mentioned above, I found some resources for doing so in the combined methods of social worlds/arenas and situational analysis.

These approaches influenced my research in number of ways including: their emphasis on the close partnership of theory and methods; the value of doing provisional analysis through writing memos concurrently with data collection rather than dividing the process up into defined collection and analysis phases; and the usefulness of theoretical sampling and "sensitising concepts" as "analytical entrée".[159] The most important contributions of these methods to my research however lay in how they enabled me, on the one hand, to conceptualise a more systematic approach to the quantity and range of materials available and, on the other, to help me perceive the specific sets of actors and relations that would ultimately crystallise into the subject matter of each substantive chapter, whilst helping me envision the overall shape of fish culture as an arena composed of social worlds interacting and differentiating over time.

Social worlds are defined as "groups with shared commitments to certain activities, sharing resources of many kinds to achieve their goals, and building

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[159] Clarke and Star, "The Social Worlds Framework: A Theory/Methods Package," 118.

shared ideologies about how to go about their business" or, more generally, as "universes of discourse".[160] A necessary component of worlds therefore are the existence of extended channels of communication in which evaluations of self in relation to others can also be made and conveyed.[161] Arenas are broader collective entities; areas of shared "concern" where multiple social worlds connect and overlap. But the relationship between worlds and arenas is fluid: sub-worlds can become worlds, worlds can be become or be seen as arenas and vice-versa. In this light, it was apparent that a relevant question was which particular worlds/arenas constituted fish culture's main audiences or constituencies; that is, which groups were committed to act within it, or would the use of fish culture cause to commit to action? From both my growing knowledge of relevant literatures, I reasoned that the key worlds/arenas were, broadly, commercial and recreational fishing (including the proprietors of fishing and their employees), zoologists or naturalists and possibly the state and, to a lesser extent the wider literate public and consumers. Deploying a sampling model based on awareness of these as probable key communicative channels, I conducted thorough searches of major sporting magazines and related books, agricultural journals, proceedings of learned societies, scientific periodicals and government reports on the freshwater fisheries in order to locate relevant material for analysis. I realised however that not all commentary on fish culture and the freshwater fisheries took place in forums that could be socially delineated in this way. Elite literary and political magazines, general popular interest and illustrated periodicals and even satirical magazines also contained valuable perspectives and information. Likewise, social and national newspapers became essential sources, especially in commentary on specific initiatives, legal proceedings and issues related to legislative reform.

Following these sources strategically helped to ensure a representative and diverse collection of materials were scrutinised over the course of this research. Perhaps most importantly, I poured over the distinct new genre of dedicated pamphlets and treatises on artificial fish breeding, salmon preservation and

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[160] Adele E Clarke, "Social Worlds/Arenas Theory as Organizational Theory," in *Social Organization and Social Process: Essays in Honour of Anselm Strauss*, ed. David R Maines (New York: Aldine de Gruyter, 1991), 131; drawing on Mead's pragmatist philosophy Clarke, *Situational Analysis: Grounded Theory After the Postmodern Turn*, 109.

[161] See eg., Tamotsu Shibutani, "Reference Groups as Perspectives," *American Journal of Sociology* 60, no. 6 (1955): 562–69 on the importance of this in the genesis of social worlds theory.

natural history that emerged around the 1850s (see also Chapter 4). These texts, I considered, constituted an essential communicative basis and resource for an emergent practical sub-world within which the identities of participants would be shaped. Arguably, these texts formed a key basis for the professionalization of the fish culture as the century progressed. Sourced through catalogue work in libraries and international digitization projects, I considered a detailed reading of all texts of this category as were available and published in Britain during the nineteenth century to be essential. Further details on recruitment of published materials, including notes on working with historical material in a (partially) digitalised environment, can be found at Appendix 1.

The social worlds arenas framework is one component of situational analysis (SA). SA proposes a series of analytical mapping exercises intended to "open up" data through recording, querying and tracking the relations between worlds and arenas, human and nonhuman elements, as well as social historical processes present in a given "situation of enquiry" (see above). Focused on the meso level of collective action, social worlds/arenas maps are means of conceptualising actors within their respective or shared worlds and arenas of discourse and commitment. Situational maps on the other hand lay out all elements that may be relevant to a situation of enquiry in way that encourages systematic questions to be asked about their relationships and forms of co-operation, negotiation or struggle engaged in between them. I used each kind of map as an exercise repeatedly at different stages in order to encourage reflexivity with regards to my own changing perspective as to what is important as my research progressed, as well as at different scales of abstraction and historical moments in order to track changes in key actors and their relationships within fish culture as it evolved over time. Seeing how clusters of connected phenomena emerged and held together helped me perceive how the initial confusion of actors and concerns I found expressed in the historical data could be shaped into separate yet connected case studies and arguments.

Importantly, it must be stressed that these are *analytical exercises*, not typically outputs or conclusions intended for inclusion in research reports. However, I have included some examples of my working in Appendix 5, and these will give a good indication of how they were used. These processes of analysis helped me begin to describe central themes I would later pursue in detail,

eliminate others, realise what needed further investigation, and what would ultimately be reconstructed as the substantive narrative of each chapter.

1.4.2 *My archive*

The preceding comments suggest that I am influenced by a dynamic vision of documentary and historical social research, in which documents are viewed both for what they *do* as for what they *say.* As Prior puts it, documents are not simply receptacles of evidence, but "active agents in episodes of interaction and schemes of social organisation."[162] This means that I consider documents both for what they allow me conclude about historical occurrences external to themselves, but also acknowledge they work as actors involved in the creation of communicative resources within which shared horizons of discourse are established and by means of which social worlds, and their associated patterns of practical activity, are formed and sustained.[163] Individual archives, books and pamphlets when considered relevant, were included in situational and relational mapping exercises – as was the information obtained from reading them.

This said, it is obvious that to be able to say anything significant about the historical past, documents must be treated as sources of evidence as well. Thematic analysis, in which focus is placed on the evaluation of recurring themes in texts, was therefore critical to me, as it for most social historical research.[164] Without standardised procedures to guarantee reliability and validity, I also attempted to follow a number of well-established guidelines. These included paying heed to local contexts of production and circulation of texts, and their connections to wider societal patterns, and being cognisant of issues relating to document authenticity, credibility, and representativeness of the genre, and the forms of inference which different kinds of documentary evidence permit.[165]

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[162] Lindsay Prior, "Repositioning Documents in Social Research," *Sociology* 42, no. 2 (2008): 824.
[163] There are analogies here with Asdal's approach to documents in her work on cod aquaculture and democracy, see Kristin Asdal, "On Politics and the Little Tools of Democracy: A Down-to-Earth Approach," *Distinktion: The Scandinavian Journal of Social Theory* 9, no. 1 (2008): 11–26; "Enacting Values from the Sea: On Innovation Devices, Value Practices, and the Co-Modifications of Markets and Bodies in Aquaculture," in *Value Practices in the Life Sciences and Medicine*, ed. Dussauge, Isabelle, Claes-Fredrik Helgesson, and Francis Lee (Oxford: Oxford University Press, 2015), 168–85.
[164] Catherine K Riessman, *Narrative Methods for the Human Sciences* (Thousand Oaks, CA: Sage, 2008), 63–67.
[165] Drawing on Jennifer Platt, "Evidence and Proof in Documentary Research: Part I, Some Specific Problems of Documentary Research," *Sociological Review* 29, no. 1 (1981): 31–52; Jennifer Platt,

The latter point relates to the conventional distinction deployed in historical research between primary and secondary sources. Typically, the former refers to unpublished, archival sources and "naturally occurring" forms of evidence, and the latter to printed and published sources. Primary sources tend to have epistemological priority on the assumption that they are most proximate to historical events and not reflected through the subjective opinions of individuals.[166] However, this distinction can be tenuous, and what is rightly primary and secondary to some extent depends on the questions being asked.[167] For me, it is clear that published sources are extremely important, as "actors" themselves, and also because analyses of how writers chose to represent fish culture and other relevant groups and worlds in the fish culture or fisheries arena are of critical importance to the arguments I make about rhetoric and political mediation. Moreover, I am at times unavoidably compelled to interpret published personal commentary in terms of its reliability as evidence. Thus, "my archive" consists of both the gamut of published sources (mentioned earlier) written on or closely connected to the subject, as well as a limited amount of classic "archival" primary sources.

Of course, unpublished archival sources retain a special status, and license forms of inference that other kinds of evidence often do not. With regards to this dissertation, the major determining factor of what unpublished material is extant and available was the institutional order of nineteenth century fish culture. Since there was no official state sponsored hatchery initiative, there was no central, dominant organisation of the sort that would have produced official records to be maintained in public repositories. The private enterprises that existed, almost always on a small scale, had no obligations to keep records for posterities' sake. Consequentially, what relevant and publicly accessible records that have survived are few and scattered amongst collections with different primary purposes. The one major exception to this rule is the Howietoun Fisheries archive at the University of Stirling, although its records are only relevant to the later nineteenth

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"Evidence and Proof in Documentary Research: Part II, Some Shared Problems of Documentary Research," *Sociological Review* 29, no. 1 (1981): 53–66; John Scott, *A Matter of Record: Documentary Sources in Social Research* (Cambridge: Polity Press, 1991).

[166] See Louis Gottschalk, "The Historian and Historical Documents," in *Documentary Research*, ed. John Scott, vol. 1, 4 vols. (London: Sage, 2006), 43–83.

[167] C.f., Landecker, *Culturing Life: How Cells Became Technologies*, 23.

century and the arrival of professional commercial trout culture initiatives, and thus are not dealt with extensively here (but see my concluding discussion in Chapter 6).[168] In Chapter 2 though, I draw on a variety of archival sources associated with relevant individuals, mainly well-known zoologists. These are housed largely in university archives and public institutions, and are crucial to my analysis of early salmon breeding experiments, including discussions of the beliefs and motivations of social actors, and to understanding their intimate relations and opinions of one another. In Chapter 3, however, no unpublished sources at all are cited (I did however spend time searching for original relevant case records at the National Records of Scotland offices in preparation). Chapter 4, on the other hand, engages with the material from the Perth and Kinross County Archives, the Burgh of Perth being a prominent proprietor of salmon fishing on the Tay and contributor to the Stormontfield salmon hatchery from the early 1850s. Importantly however, records cited in the present narrative are not definitive of all records viewed in the course of research. I provide a detailed account of all archives investigated, whether directly cited or not, as well as locate other potentially relevant archives in Appendix 2.

1.4 Chapter overview

Chapter 2 brings together two central strands of this dissertation: social order and development of fish cultural technologies. I do this through analysis of a dispute in natural history. I show that the first sustained programme of salmon breeding in Britain took place in the context of a highly specific controversy amongst ichthyologists about the identity of a particular fish: the parr, or, *Salmo salmulus.* The controversy centred on whether or not this fish was in fact a species *sui generis* or in fact no more than the young of the salmon at a certain developmental phase. My analysis focuses on dynamics of social status and identity in the context of efforts to maintain group boundaries and scientific standards. I study these through the lens of a local articulation, amongst ichthyologists, of a wider "moral economy" of natural-historical empiricism.

[168] I did however spend many days pouring over its records. During his research into Howietoun and its founder, Sir James Maitland, Hill wrote to all county archives in the vicinity of a known commercial hatchery to enquire after records, finding nothing prior to 1940, see Hill, "Sir James Maitland and the Howietoun Fishery," 14.

Artificial propagation technology as an experimental technique, I show, emerged in response to both the scientific problem per se, but also as a means to overcome a trust bottleneck amongst differently stratified social actors. The empirical focus is the story of John Shaw, a Scottish gamekeeper, who in the mid-1830s alleged astonishing new facts about parr, which were doubted by the scholarly elite. To convince them he was no usurper, he needed to navigate and be integrated into the moral economy of empiricism that structured the social and epistemic world of the ichthyologists. Experiment was one aspect of this; so also was the use of language, the cultivation of certain forms of social interaction, and the demonstration of adherence to specific norms, especially forms of deferential behaviour as maintained and demanded by the relevant group.

In Chapter 3 the "situation" changes: the previous account of the parr controversy is contextualised in terms of wider issues related to the ecology and politics of the salmon fisheries, and certain consequences of this are demonstrated. As the consensus that parr were actually salmon hardened, it became increasingly obvious that fishing for them should be regulated as such (salmon being a valuable resource to which rights to fish for were privately owned). In the context of widespread concern over declines in the salmon population, unregulated parr fishing on the basis of supposedly customary privileges were concerning, and this resulted in conflict between groups with different interests. I explore how science and law mediated these conflicts, as well as how these institutions interacted. I suggest that a formal institutional resolution was necessary, but insufficient in resolving the controversy, and that changing attitudes to the cultural practice of killing juvenile fish (parr) and, importantly, changing evaluations of what participating in such a practice signified about social status and personal honour within the worlds of angling, were important in making fishers willing to forego the practice. To this end, I offer a social history of representations of parr fishing and fishermen in connection to developing trends in the worlds of angling and the wider salmon fishing arena. In this way, problems of social order again – although in quite different ways – emerged, were dealt with, modified, and reproduced. Analytically, I adapt EP Thompson's famous understanding of the "moral economy of the crowd" into a form in which its central feature is its rhetorical or persuasive efficacy, its "legitimatising function", in a struggle over scarce resources. Here, I argue that moral economies are not special properties of socially, economically or

politically weaker groups or actors – in this case, those apparently threatened with dispossession of fishing privileges – but rather all participants, including social elites, regulatory modernisers and, importantly, proprietors of salmon fishing property. These agents argued, successfully, that the better preservation of the salmon resource was ultimately in the best interests of "society" as a whole, a formally equal and opposite representation of the common good to those arguing for the preservation of customary or "community" privileges.

Chapter 3 introduced the Stormontfield experiments, an initiative amongst salmon fishing proprietors on the River Tay in Scotland from 1853. These experiments continued those of John Shaw and, like Shaw's earlier work, provided evidence of the identity of parr that were considered in court cases that tested the legality of catching them, as well as contributing expertise to commissions of enquiry that ultimately led, in the early 1860s, to legislative changes effecting the subject and the regulation of the salmon fisheries more widely. In Chapter 4 I turn attention to an effort to transform artificial propagation into an economic proposition, a technology of (re)*production.* In this case, the central social conflict occurred exclusively between salmon fisheries' proprietors. Longstanding enmity amongst these actors was at this time compounded by the perception that salmon populations were declining, that competition was leading to "overfishing", and this was contributing to historically low rentals; the pursuit of private interests in the exploitation of a common stock tending towards a "beggar they neighbour" situation. In this context, forms of voluntary co-operative social action to manage the damaging effects of competition were sought – but were very hard to achieve. Legislative interventions, following legal challenges and lobbying campaigns, were designed to manage conflicts and were crucial, but were finally again incapable of resolving these conflicts in the long term. In response to this situation artificial propagation technologies looked attractive: by restoring the stock and through particular organisational arrangements, it was hoped, they could defray tensions and share the costs of conserving the population through taking some the costs of reproducing it in hand. However, as I will show, the technical capabilities of salmon culture at the time, combined with the material habits of salmon, the geography of salmon rivers and existing fishing regulations, worked strongly against Stormontfield or like initiatives being successful at any large scale. The project remained embroiled in the mutual jealousies and contradictory interests of

the proprietors and their clientele. This situation also encouraged additional, unsuccessful, efforts to find technological solutions to the problem of lack of co-operative collective action or social order.

A central component of this argument, as in the previous chapter, is a discussion of the major social processes effecting nineteenth century salmon fisheries in Britain: in this case, the growing relative value of recreational salmon angling compared to declining commercial rentals. I will suggest that a flaring up of tensions on the river around mid-century was connected to a trend toward equalisation in the political and economic power of those associated with these economic factions. Noting that this trend is itself connected to wider changes in consumption and lifestyle opportunities – associated with economic growth generally and the rising middle and professional classes especially – the case gives us pause to consider a commonality, despite all their differences, between the chapters. In different ways, each case reflects the effects of a kind of movement towards relative social homogenisation and equalisation, or at least the ambition of being equal. These, in terms either of material or ideal resources or opportunities (be these rents, fishing opportunities, or a sense of social honour), tend to provoke competition as more people compete over the same goods. Thus, equality will make some appear as usurpers on others rights, and encourage demand for creating new and reproducing old social distinctions. Social order seems in practice to refer in each case to efforts to manage the fallout caused by this. In Chapter 5, my conclusion, I draw together the threads comprising speculation related to this theme, as well as re-state its connection to the question of social reproduction and my contributions to the various literatures I have borrowed from and developed. Finally, I will outline my contribution to the history and historiography of fish culture in the nineteenth century itself, and make an effort to demonstrate where gaps in this still lie, outlining the new lines of enquiry inspection of these would open, and what interests pursuing these may hold not only for the historian of fish culture, but also for STS scholarship and the social studies of reproduction.

2. The parr controversy, part I: Status, experiment and the moral economy of *salmonidae* ichthyology

> An exact manual of salmon controversy would be a curiosity of literature; and one of the most curious chapters of the work would be a resumé of the parr controversy.
>
> – "Up and Down a Salmon Stream", *Sporting Gazette*, 1868

2.1 The experimental origins of British salmon culture

Many of the questions that surrounded the natural history of the fish known as "parr" had existed, said the Scottish journalist and editor Alex Russel in the *Quarterly Review*, "in one shape or another" for over 200 years. The fish in question was small – at the largest eight or nine inches long, usually smaller – and considered of no commercial significance. The public, insofar as they thought about this little creature at all, appear most often to have thought of it as "a distinct fish of the minor or dwarf kind."[1] Ichthyologists were intrigued by it however, most believing it to be a distinct species of trout. As a species however, they sometimes admitted, it was "dubious".[2] The origins of modern British salmon and fish culture lay in what became known as the parr controversy, in particular, via a series of experiments aimed at uncovering the mysterious identity of this little fish.

The parr was problematized as an object of scientific knowledge within a specific historical milieu in which it became a matter of "concern" as well as of "fact".[3] The Scottish angler and scholar William Scrope was responsible for initiating proceedings when he wrote a letter in 1824 to the Chair of a Commission of Inquiry formed to investigate the state of the salmon fisheries. In it he argued that, despite both the opinion of naturalists and the public to the contrary, parr

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[1] Alexander Russel, "The Salmon Question," *Quarterly Review* 113, no. 226 (1863): 393.
[2] Eg., Robert Knox, *Fish and Fishing in the Lone Glens of Scotland, with a History of the Propagation, Growth and Metamorphosis of the Salmon* (London: G. Routledge & Company, 1854), 84.
[3] Bruno Latour, "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern," *Critical Inquiry* 30, no. 2 (2004): 225–48.

were in fact "the young of the salmon" and that their destruction was habitual amongst various sections of society. Therefore, the matter of the parr was of grave consequence to the prospects of salmon fishing.[4] Scrope was not alone in airing concerns over this disputed species. Important public figures in literary and scientific circles, like Sir Walter Scott and Sir Humphry Davy, were aware of the dispute and its significance.[5] The Scottish poet James Hogg, an acquaintance of Scrope and a friend of Scott, penned an important account of the problem in the *Agricultural Journal* of the Highland Society in 1832. Although the experiments he undertook were accused, from a scientific point of view, of "having taken the license of poets in general", his argument that the destruction of parr was in fact the wholesale slaughter of young salmon and therefore "worthy of legislative interference" turned out to be prescient.[6] The consequences of this argument at the level of lawmaking and its effects on the mobilisation and interests of different social agents are explored in detail in Chapter 3. In this chapter, the focus is on the narrower question in natural history to which these matters were inseparably connected: were these fish young salmon, or were they not? And, connected to this, what was known with certainty about the early life history of the salmon itself?

Chronologically and historically speaking, the parr controversy represents the first significant site in the career of artificial propagation technologies in Britain and therefore has a special place in this essay. It was in response to this problem of the parr that "scientific" fish culture in Britain emerged. While the question of the parr itself emerged as an issue of concern in the context of rising levels of anxiety about the salmon population and the productivity of the fisheries, artificial propagation as a form of production did not in fact arise as a direct response to this, as accounts of fish culture have tended to assume. Rather, as an experimental technology, artificial propagation techniques were first deployed in the demonstration of crucial "matters of fact" relevant to a debate in natural history. In this chapter, however, I do not examine the controversy only to understand the contribution of fish culture to the settlement of particular facts.

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[4] The letter is reprinted in William Scrope, *Days and Nights of Salmon Fishing in the Tweed*, 2nd ed. (London: Edward Arnold, 1898), 20–23. [First ed. 1843]
[5] Davy, *Salmonia: Or, Days of Fly Fishing* [First ed. 1828]. Walter Scott, "Salmonia, or Days of Fly-Fishing," *Quarterly Review* 38, no. 76 (1828): 503–35.
[6] James Hogg, "On the Preservation of Salmon," *Quarterly Journal of Agriculture* 3, no. 15 (1832): 447. Alexander Russel, *The Salmon* (Edinburgh: Edmonston and Douglas, 1864), 37.

Rather, I explore it for its "co-productive" effects, including how it opened up new material and cultural practices and created and reproduced certain social relations. In particular, I analyse it as an example of the intertwining of science and social order in two senses: as the culture and social relations enabling and framing a particular kind of epistemic activity and as a model of a social dispute requiring management. For the latter, what is of central importance is the perception of usurpation of rank when an actor of a certain social identity and status entered the controversy, thus posing as a nominal equal to incumbents in the field whose specialism was supposed to grant them priority.

Sir Davy had originally drawn attention to the fact that the techniques proposed by Jacobi (see Chapter 1) might be used to study the life history and relations of fish. It is probable that he was one of the first in Britain to experiment with the technique of artificial fecundation when he did so with his scientific friends in the early 1820s.[7] He noted in *Salmonia* in 1828 the possible utility of such experiments for understanding the *salmonidae* family: "I hope", he wrote of the subject, "it will soon be taken up by some enlightened country gentleman, who in this way might make not only curious but useful discoveries."[8] This ambition for the technology, I show in this chapter, was fulfilled within a few years. The primary agent in this, and the empirical focus of this chapter, was the work of John Shaw, the Head Keeper of the Duke of Buccleuch at Drumlanrig Castle in Dumfriesshire, Scotland, from the mid-1830s. I argue, moreover, that Shaw's decision to adopt the reproductive techniques of fish culture was not a purely technical response to the epistemological issues presented by the parr as a problem in natural history. Rather, it emerged as a part of an ensemble of elements through which Shaw attempted to construct his scientific case in opposition to displays of distrust and scepticism of his ability and reliability by the scientific establishment of his day. The successes of Shaw's matters of fact were dependent on the acceptance of his testimony and therefore his personal credibility. For a gamekeeper or "practical man", this implied negotiation with a particular culture of natural history and a

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[7] Boccius, a Hammersmith engineer of German descent, claimed to have learnt the technique as early as 1815 on a visit to Leipzig, and to have known Davy at the time of his experiments, see Gottlieb Boccius, "Artificial Breeding of Salmon and Other Fish," *Journal of the Society of Arts* 2 (1854): 256.

[8] Davy, *Salmonia: Or, Days of Fly Fishing*, 79–80. A paper by Sir Davy was also appended to an earlier report *Report from the Select Committee on the Salmon Fisheries of the United Kingdom* in which he discussed Jacobi's technique, see PP, UK (1824) [427], Appendix III, 144-145.

social world to which he did not easily belong. Drawing particularly on the work of Steven Shapin, my interpretation suggests Shaw had to manage a subtle equilibrium of instruments, values, affective responses, as well as literary and other practical witnessing strategies to achieve this.[9] For his facts to be realised, he needed to be at least partially accepted within a specific ethical community of empiricism, namely that which, adopting the same phrase as historians of science such as Shapin, Lorraine Daston and Robert Kohler, I call a "moral economy" of nineteenth century *salmonidae* ichthyology.[10] In this it is considered that shared values amongst participants are a part of what shapes scientific work, emotional relations may not be irrelevant, and that knowledge of facts is always at least partially dependent on knowledge – and hence perception – of people. Status, expressed in the terms of analytic sociology, is therefore a key variable because it acts as signal of underlying quality. Moreover, reliance on status signalling is likely to be especially high when there is doubt about underlying quality, or ambiguity with regards to the social position of an actor.[11] Use of unfamiliar methods might heighten the problem of achieving social recognition, although in this case it was deemed also essential to overcoming the barriers to such recognition.[12] As I will show, all of these factors are present in the case of John Shaw. I recognise also that status is often closely connected to other forms of stratification, including social class, but see status as the most empirically and analytically salient feature.[13]

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[9] Steven Shapin, "Pump and Circumstance: Robert Boyle's Literary Technology," *Social Studies of Science* 14, no. 4 (1984): 481–520; Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life*; and especially Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*.

[10] Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*; see also Lorraine Daston, "The Moral Economy of Science," *Osiris* 10 (1995): 2–24; Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life*; For recent evaluations and extensions of these perspectives, see Dussauge, Isabelle, Claes-Fredrik Helgesson, and Francis Lee, *Value Practices in the Life Sciences and Medicine* (Oxford: Oxford University Press, 2015).

[11] See Joel Podolny and Freda Lynn, "Status," in *The Oxford Handbook of Analytical Sociology*, ed. Peter Hedström and Peter Bearman (Oxford: Oxford University Press, 2011), 544–65.

[12] C.f. W.O. Hagstrom, "Gift-Giving as an Organizing Principle in Science," in *Science in Context: Readings in the Sociology of Science*, ed. Barry Barnes and David Edge (Milton-Keynes: Open University Press, 1982), 26.

[13] "Class" as a sociological concept (rather than as one word amongst others used by contemporaries to describe social differences as they perceived them) is reserved here, in Weberian terms, for instances in which it is specifically differences in achieved positions between agents *vis-à-vis* the *market* that are at stake. See Max Weber, "The Distribution of Power within the Community: Classes, Stände, Parties," trans. Dagmar Waters et al., *Journal of Classical Sociology* 10, no. 2 (2010): 137–52. My thinking about status here and elsewhere (Chapter 3) is also influenced by Barry Barnes reading of Weber's notion with respect to scientific collectives, see Barry Barnes, "Status Groups and Collective Action," *Sociology* 26, no. 2 (1992): 259–70; Barry Barnes, "Catching

Fish culture as an experimental technique was an agent in these affairs. By focusing attention on defining species in terms of sexual reproduction and descent rather than categorising physical characteristics, it helped marginalise doubts about Shaw's quality, specifically his ability to accurately identify parr physically or anatomically. In detaching parr and salmon from the river and their natural mode of breeding, fish culture provided means to observe their development from the moment of fertilisation, through hatching up to the point of migration. By "enclosing" the fish in culture, so to speak, it offered reliable means to procure specimens to present to scientific witnesses, and to engage in the forms of social exchange appropriate to the local culture of natural history and that would in turn raise Shaw's status. This argument need not imply a reduction of scientific knowledge to social order, but should suggest their co-construction.[14] Thus the dynamics investigated are viewed as imbued with the possibility for various socially binding effects.

2.2 A natural social history of the controversy

> *Is it worthwhile writing the history of an animal which perhaps exists not as a distinct species? In this case, I think it is.*
> - Robert Knox, *Fish and Fishing in the Lone Glens of Scotland,* 1854

2.2.1 *The* Salmo salmulus

To approach the parr controversy as a question in natural history it is first important to understand the condition of the genus *Salmo* of the family *Salmonidae* as it was in the first half of the nineteenth century. This was, as the eminent Dr Günther of the British Museum would later describe it, a great "labyrinth of confusing variations".[15] Inhabiting it however was a small fish known to natural history as the *Salmo salmulus*, commonly named parr.

From the vantage point of the present day, only two species of *Salmo* would be seen as relevant to the parr debate. These are the Atlantic salmon (*Salmo salar*)

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up with Robert Merton: Scientific Collectives as Status Groups," *Journal of Classical Sociology* 7, no. 2 (2007): 179–92.

[14] See Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, Massachusetts: Harvard University Press, 1993), 25–26; also Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life*, esp., 3-4, 11-13.

[15] Albert C.L.G Günther, *An Introduction to the Study of Fishes* (Edinburgh: Adam & Charles Black, 1880), 642. James Murie, of the Zoological Society, used the same turn of phrase, "Additional Memoranda as to Irregularity in the Growth of Salmon," *Proceedings of the Zoological Society* 38, no. 1 (January 1870): 49.

and the common Brown trout (*Salmo trutta*). The latter occurs in two variants: one lives only in fresh water (*Salmo trutta* morph *fario*): the other, the sea trout, like its cousin the salmon, is migratory (*Salmo trutta* morph *trutta*). But, in the 1830s, significantly more kinds of *Salmo* were said to exist. Variations, like *trutta* and *fario,* were often interpreted as species, and these could be enumerated on the basis of regional disparities in appearance and local custom.[16] Dr Fleming's typical account of the *Salmo* in 1828 included *S salar, S hucho* ("bull trout"), *S albus* ("finnock"), *S salvelinus* ("torgoch"), *S alpinus* ("case char"), *S eriox* ("grey or bull trout"), *S trutta,* and *S fario.*[17] The ichthyologist Richard Parnell even believed on the basis of his investigations on the Solway Firth "that five or six species of sea trout have been confounded under one name, *Salmo trutta*."[18]

It is possible that the very many common names these species accrued contributed to the proliferation of taxonomic designations. This was the opinion of the young but influential Louis Agassiz, himself engaged at this time in observations of European fishes at Lake Neuchâtel in Switzerland. He contended with "systematic authors" in Britain that they, having

> allowed themselves to fall into error through the prevailing opinions circulated concerning the vast multitude of species of this genus, have been investigating the characters of a great number of merely imaginary species.[19]

Indeed, the Salmon Act for England and Wales of 1861 came to cite no less than fifty-four "migratory Fish of the Genus Salmon" by name.[20] Agassiz, expressing a trend that would develop as the century did, thus wished to rationalise or 'lump' the *Salmo* into fewer, more encompassing categories. As Russel would later express this urge, "merely local experience" should not be considered a solid basis for nomenclature and knowledge of species.[21] The parr

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[16] "Future enquirers have yet to determine the number of the true species of British Salmonidae", wrote the fish culture pioneer Robert Ramsbottom. The effect of "local causes", he noted, might produce gradual change in the appearance of species. "A disregard to effects of this natural law" moreover, "has resulted in the classification of mere varieties as separate species." Ramsbottom, *The Salmon and Its Artificial Propagation* (London: Simpkin, Marshall & Co, 1854), 8.
[17] John Fleming, *A History of British Animals* (Edinburgh: Bell and Bradfute, 1828), 179–81.
[18] Letter, Parnell to Jardine, 14 June 1836 (NMS ,GB 587 WJ 4/101).
[19] M [Louis] Agassiz, "Remarks on the Different Species of the Genus Salmo Which Frequent the Various Rivers and Lakes of Europe," in *Report of the Fourth Meeting of the British Association for the Advancement of Science (Edinburgh, 1834)* (London: John Murray, 1835), 621.
[20] "The Salmon Fishery Act (England and Wales)" 1861 (24 & 25 Vict.), c. 109, paragraph 4. (See Chapter 3 for discussion.)
[21] Russel, *The Salmon*, 32.

controversy figured in this way as one amongst a number of taxonomical debates occurring amongst naturalists studying the *Salmo*, a genus which, as artist and ichthyologist Sarah Lee put it, appeared in as much "uncertainty and confusion" as it had ever been during the crucial years of the middle and late 1830s.[22]

In any event, it was the case that amongst these multitudes there was to be found the *Salmo salmulus,* vulgarly referred to as brandling, fingerling, skegger, skirling, gravelling, laspring, sparling, samlet and, most commonly in Scotland, parr. It was first named *salmulus* by the naturalist Willoughby and his famous collaborator Ray in the seventeenth century, a designation recognised by Pennant in the eighteenth, and later by Baron Cuvier himself.[23] This was the orthodoxy of the learned into the mid-1830s when, amongst others, Parnell, Sir William Jardine, James Wilson, Leonard Jenyns, John Selby, William Yarrell and Jonathan Couch – a collection of very distinguished naturalists in Scotland and England, many of them frieds and close peers – defended the description in various ways. Wilson described the parr's habits in the *Encyclopaedia Britannica* thus:

> It is an abundant species in all the clear running streams in England and Wales, and the south of Scotland [...] It frequents the clearest streams, delighting in the shallower fords having in fine gravelly bottom, and hanging there in shoals, in constant activity apparently both day and night.[24]

Jardine wrote in 1835 that "[a]mong the British salmonidae, there is no fish where the habits are so regular, or the colours and markings so constant." "I have no hesitation" he said, "in considering the parr not only distinct, but one of the best and most constantly marked species we have, and that it ought to remain in our systems as *Salmo salmulus* of Ray."[25] In the same year Jenyns, a friend of Jardine's, claimed it was now "pretty well ascertained to be a distinct species."[26]

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[22] Letter, Lee [Bowdich] to Jardine, 27 September 1837 (NMS, GB 587 WJ 1/22).
[23] Thomas Pennant, *British Zoology*, vol. 3 (London: Eliz. Adams for Benjamin White, 1769); Francis Willughby, *De Historia Piscium* (Oxford, 1686) of which Ray was a contributor; On the authority of Cuvier especially, see Mrs T. Edward [later Lee Bowdich Sarah], *The Fresh-Water Fishes of Great Britain* (London: Printed for the Authoress and R. Ackermann, 1828), no page numbers available.
[24] James Wilson, "Ichthyology," *Encyclopaedia Britannica* (Edinburgh: Adam & Charles Black, 1842). This article was originally published in pamphlet form in 1838, James Wilson, *Introduction to the Natural History of Fishes* (Edinburgh: Adam & Charles Black, 1838).
[25] William Jardine, "Observations upon the Salmonidae Met with during an Excursion to the North-West of Sutherlandshire, in June 1834," *The Edinburgh New Philosophical Journal* 18, no. 35 (1835): 57, 58; also, William Jardine, "Notice of the Parr," *History of the Berwickshire Naturalists' Club* 1 (1834): 82–84.
[26] Leonard Jenyns, *A Manual of British Vertebrate Animals* (Cambridge: Pitt, 1835), 427.

However, despite such confident assertions, the reality was that authors also tended to admit that much of its history was actually mysterious and contested. Indeed a number of theories vied over the true identity of the parr. Jardine himself wrote of the difference of opinion among all our ichthyologists, or rather "the difficulty which they appear to have in forming one, whether this fish is distinct, or only the young of some others".[27] Wilson agreed, noting that its true history was "obscure"[28] Indeed, the controversial Edinburgh anatomist Robert Knox called the parr "the most abundant of all our fresh-water fishes of the trout kind; of all, the least understood."[29] The most important theory of the parr was indeed the *sui generis* conjecture of the *Salmo salmulus*; but there was also the position that claimed it was no more than the young of a common Brown trout. Others appeared content to believe it was a hybrid or mongrel of no fixed kind. Agassiz was one who held the former belief.[30] Humphry Davy adopted the hybrid position, as did Knox, who claimed the question of the parr to be "one involving the highest questions in animal physiology, and explicable, in all probability, only by an appeal to the laws regulating hybridism and transcendentalism in animal life."[31] And then there was the resurgent notion ventured by the anglers' Hogg and Scrope: that this fish was in fact no more than the young of the *Salmo salar.* Most ichthyologists however – indeed, with the exception of John Fleming in 1828[32] – were dead set against this position. As Jardine wrote, while he could continence the idea that it was merely the young of a variety of *trout*, "with the migratory salmon" he insisted, "it has no connection whatever".[33]

2.2.2 *Identifying and breeding parr*

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[27] Jardine, "Observations upon the Salmonidae Met with during an Excursion to the North-West of Sutherlandshire, in June 1834," 56–57.
[28] Wilson, "Ichthyology," 208.
[29] Knox, *Fish and Fishing in the Lone Glens of Scotland, with a History of the Propagation, Growth and Metamorphosis of the Salmon*, 81.
[30] Agassiz, "Remarks on the Different Species of the Genus Salmo Which Frequent the Various Rivers and Lakes of Europe," 622.
[31] Davy, *Salmonia: Or, Days of Fly Fishing*, 68–69; Knox, *Fish and Fishing in the Lone Glens of Scotland, with a History of the Propagation, Growth and Metamorphosis of the Salmon*, 84. On Knox's transcendentalist outlook and its possible relation to his views on parr, see Appendix 3.
[32] Fleming thought that parr were "generally agreed" to be either a young salmon or young sea trout, see Fleming, *A History of British Animals*, 180.
[33] Jardine, "Observations upon the Salmonidae Met with during an Excursion to the North-West of Sutherlandshire, in June 1834," 57.

How was this orthodoxy possible, and how was it undermined? I attend to these questions by addressing some of the problems around which learned disputation on the *salmulus* and the salmon clustered. These can be grouped around two inter-related areas: the first concerned the overall physical appearance of the fish; the second involved problems in the understanding of its mode of reproduction, or, in Wilson's words, that "its breeding has not yet been discovered".[34] I suggest that conventional modes of investigating natural history, principally descriptive anatomy, struggled to produce a consensus, and often fell back on less empirical, more logical-deductive forms of reasoning, which cut against the grain of empiricism and were hence as undesirable as they were obligatory. While in a sense the fish themselves contributed to this, their being difficult to distinguish and highly variable in appearance, so also did the peculiar social and spatial organisation of the natural history of British freshwater fishes.

Natural history in general has often been viewed as the "bucolic science", a practice friendly to the participation of specialists and rustics alike. But it has also been pointed out that this is often an image created by its popularisers. In fact, its integrity could be subject to internal and external policing as intense as in the experimental sciences. This was marked in the nineteenth century, and registered in the shifting meaning of the word "amateur": where it had once signified "connoisseur", it came increasingly to suggest "dilettante".[35] Such tensions are visible in the networks of Victorian ichthyology, where various kinds of "boundary work" took place.[36] Jenyns for instance professed support for an upcoming publishing venture of Jardine's provided it promised to "uphold the dignity" of botany and zoology. "Far too much", he said, "has been sacrificed to popularity of

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[34] Wilson, "Ichthyology," 208.
[35] Jean-Marc Drouin and Bernadette Vincent-Bensaude, "Nature for the People," in *Cultures of Natural History*, ed. Nicholas Jardine, James A Second, and Emma Spary (Cambridge: Cambridge University Press, 1999), esp., 410-411, 417, 418; For other accounts of complexity of the "professionalisation" of natural history, see for instance David E Allen, "The Early Professionals in British Natural History," *Archives of Natural History* 1 (1985): 1–12; Aileen Fyfe and Bernard Lightman, eds., *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago, IL: University of Chicago Press, 2007); For a sociological contribution to understanding the "professionalisation strategy" in science, see Steven Shapin, "History of Science and Its Sociological Reconstructions," *History of Science* 20 (1982): 157–211; The word "scientist", incidentally, is first recorded in 1834, see Sydney Ross, "Scientist: The Story of a Word," *Annals of Science* 18, no. 2 (1962): 65–85.
[36] Thomas F Gieryn, "Boundary-Work and the Demarcation of Science from Non-Science," *American Sociological Review* 48 (1983): 781–95.

late years".[37] In this context too Sir Humphry Davy – President of the Royal Society and perhaps the most eminent scientist of his day – was deemed to be "a great chemist and philosopher, though, I believe, no naturalist".[38] Knox, himself an acquaintance of continental luminaries Geoffroy Saint-Hilliare and Cuvier, also bemoaned the lack of respect shown to zoology. He too believed Davy not to be "competent" on the question of salmon and parr because he was chemist not an anatomist, while at the same time he zealously impugned the testimony of "amateur anglers and fishmongers" on the subject.[39] Indeed, the scientific opinions of "Billingsgate naturalists" of all kinds were much maligned, not least because of their association with trade and money. Yarrell complained to Jardine in 1836 that he could not find anyone to attend and "take reports of occurrences at the different Societies – the men who would be tempted by money to attend for such a purpose, know nothing of Nat. Hist. and make such hard work with the long and hard names that their reports are useless – and those who are Naturalists enough to be au fait at the nomenclature, are not to be tempted to take data for a report."[40]

In the case of fish the general problem was especially acute as a consequence of how much naturalists in fact depended intimately on the expertise of people associated with fishing and the fish trade. For instance, they relied upon them as means to procure specimens and interpret matters such as fluctuations of fish populations in the rivers and other forms of fish behaviour throughout the year. The letters sent to Jardine by the likes of Selby, Parnell and Yarrell reveals how important trips to the fish market and conversations with professional fishermen were to their work as naturalists.[41] (Yarrell lived in London and had little access to salmon streams). This, if unavoidable, could prove regrettable: Knox apologised for delving into matters of "trade or the usual business of life" and hence being forced as a result to mix the "practical details" with "the scientific

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[37] Letter, Jenyns to Jardine, 5 February 1836 (NMS, GB 587 WJ 2/56)
[38] Thomas Jenkins, "Observations on the Young of the Salmon," *The Magazine of Natural History* 4, no. 40 (1840): 163.
[39] Robert Knox, "Observations on the Natural History of the Salmon, Herring, and Vendace," *Transactions of the Royal Society of Edinburgh* 12, no. 2 (1833): 462, 498.
[40] CUL, Add. 9839/13/322.
[41] NMS, GB 578 WJ 4/101, 6/145. For instance, Yarrell reports seeing sea trout at market for the first time in six months, and Parnell used a network of contacts to send him bi-weekly samples of parr caught on the Tweed. Selby promised to ask his tenant on the Tweed (owned netting stations there) to collect specimens of Bull trout, Whitling, etc. for Jardine, Christine E Jackson, *Prideaux John Selby: A Gentleman Naturalist* (Stocksfield: Spreddon Press, 1992), 132.

part" in a paper before the Royal Society of Edinburgh.[42] Indeed, being permeable, the lines drawn around legitimate natural historical knowledge of fish life were as such negotiable and therefore problematic.[43]

It is necessary also to understand the material problems presented to those who would differentiate parr accurately. The first of these was that, to most observers, *all* young *Salmo* looked *distinctly similar*. Distinguishing between the various kinds was an esoteric task, and opportunities for errors of identification, confusion and fraud were numerous. The most prominent physical characteristics of the fish were the so-called parr marks, a series of dark blotches or bands on the fish's flanks. These are clearly visible in Figures 4, 5 and 6, reproduced below, and Figures 7 and 9 later.

The *Salmo salmulus*

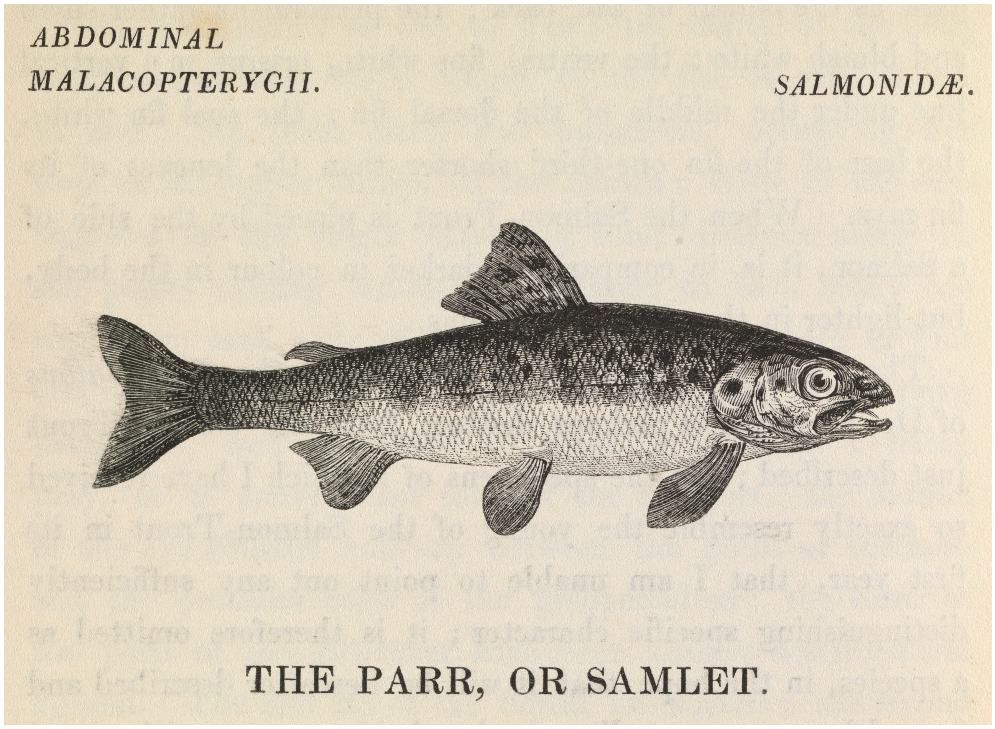

FIGURE 4: "The Parr, or samlet". Yarrell's *Salmo salmulus*, with citations. From William Yarrell, 1835, *A History of British Fishes,* Vol. 2, London: John Van Voorst, p. 42.

[42] Knox, "Observations on the Natural History of the Salmon, Herring, and Vendace," 462.
[43] Müller-Wille details a similar state of relations in the botanical exchange networks of Linnaeus, "Nature as Marketplace: The Political Economy of Linnaean Botany," *History of Political Economy* 35, no. Annual Supplement (2003): 154–72.

Comparing *Salmo* (1)

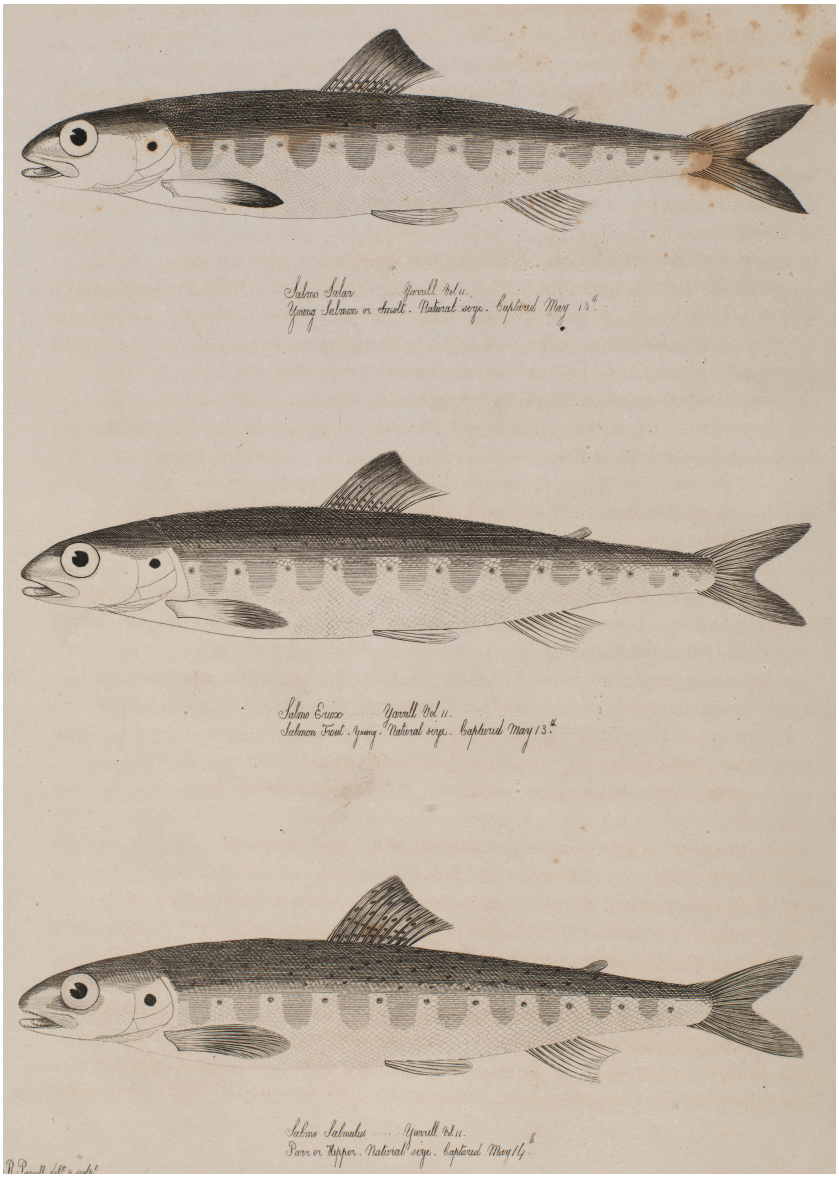

FIGURE 5: "*Salmo salmulus* compared to juvenile *S Eriox* and *S salar*". A young salmon (*S salar*) (top) is compared to a young a *S eriox* (middle), and a *salmulus* (bottom), all caught in mid May. *Eriox* ("Bull trout") is now considered a form of common trout. Richard Parnell, 1840 [1837], *Transactions of the Royal Society of Edinburgh,* Vol. 14, Issue 1, Plate VII.

Comparing *Salmo* (2)

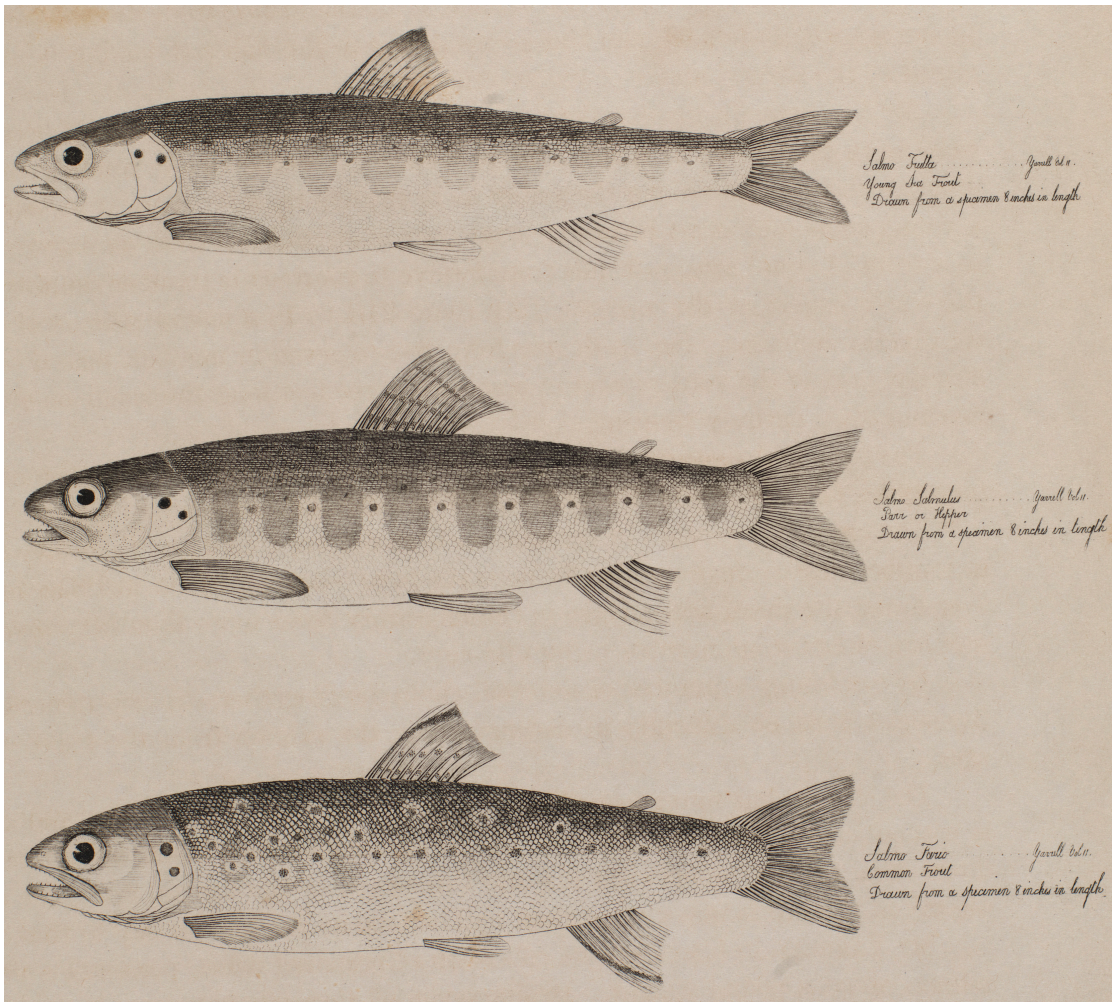

FIGURE 6: "*Salmo salmulus* compared to *S fario* and juvenile *S trutta*". The parr is contrasted to an adult common trout (*S fario*) and a young sea trout (*S trutta*), with which Parnell believed it was also commonly confused. Richard Parnell, 1840 [1837], *Transactions of the Royal Society of Edinburgh,* Vol. 14, Issue 1, Plate VIII (detail).

The marks appear like brands made by the digits of a human hand, hence the generic name of "fingerlings".[44] The difficulty with these marks resided in the fact that the young of *all Salmo* bore them – a problem compounded, as Yarrell complained, by the fact that at least "three of four" of the genus were "indiscriminately called Parrs" themselves.[45] The *salmulus* therefore was understood to be an adult or "perfect" fish, but outwardly similar to the young of other species in the same genus.

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[44] See Coates, *Salmon*, 41.
[45] William Yarrell, *On the Growth of the Salmon in Fresh Water* (London: John Van Voorst, 1839), 4.

The immediate implications of this are obvious. As Parnell wrote: "it [was] from the want of some constant specific character that the parr has been so often mistaken for the young of the salmon".[46] Having abandoned the category of *salmulus* (along with many of its congeners), today we need in practice to make only a binary decision about a given specimen in a British river: is it a juvenile trout or a juvenile salmon?[47] But the task was clearly not so simple for much of the nineteenth century when a multitude of parr-marked fishes would have met the eye including "the young of various species or varieties of trout, in company with the young of the salmon, with the *Salmo salmulus* or parr, and with different varieties of the common fresh-water trout".[48] Although fishermen were supposed to have long favoured the parr markings themselves and a "black spot on the operculum" as indicators for it, it was admitted, "the same kind of mark is also observed in the young salmon, the sea-trout, the bull-trout, and the common fresh-water trout."[49] In fact, no particular colour, shape or anatomical marker ever gained unequivocal traction in the debate.[50] Couch rightly claimed as late as 1865 that so similar do the marks make the "true parr" and other fishes appear that even "eminent naturalists" have "declared their inability to distinguish them".[51] Indeed, Yarrell described how knowledgeable persons, believing they were marking the "young of the Parr" found that when these fish were retaken as adults, they had become "Grilse, Grey Trout, Salmon Trout, and River Trout"; and Jardine noted that

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[46] Richard Parnell, "Account of a New Species of British Bream, and of an Undescribed Species of Skate," *Transactions of the Royal Society of Edinburgh* 14, no. 1 (1837 1840): 154.
[47] For example, D.H. Mills et al., *Atlantic Salmon Facts* (Pitlochry: The Atlantic Salmon Trust, 2003), 10–11, publish photographs and clear guidelines marking out the major differences for anglers, but it is acknowledged that even this can be challenging.
[48] Richard Parnell, "Natural and Economical History of the Fishes, Marine, Fluviatile, and Lacustrine, of the River District of the Firth of Forth," *Memoirs of the Wernerian Natural History Society, for the Years 1831-37* 7 (1838): 300.
[49] "Account of a New Species of British Bream, and of an Undescribed Species of Skate," 155.
[50] The same was true even of attempts to bring "deep anatomy" to the subject on both sides of the argument. For instance, David Brewster compared their eyes on a request by Scrope; their caecal appendages were counted, dentitions compared; relative lengths of fins measured, as well as lengths of sexual organs (see for examples Jenkins, "Observations on the Young of the Salmon," 162; Knox, *Fish and Fishing in the Lone Glens of Scotland, with a History of the Propagation, Growth and Metamorphosis of the Salmon*, 89; John S Milton, "Observations and Experiments Proving the Parr or Branding to Be the Young of Salmon," *Quarterly Journal of Agriculture* 6, no. 29 (1836): 69–71; Parnell, "Account of a New Species of British Bream, and of an Undescribed Species of Skate," 155; Scrope, *Days and Nights of Salmon Fishing in the Tweed*, 24–25.) Typically, assurances were disputed and the characteristics appeared either too irregular, or disagreement arose about the underlying categories being addressed.
[51] Jonathan Couch, *A History of the Fishes of the British Islands*, vol. 4 (London: Groombridge & Sons, 1865), 246.

"only a few persons at the present time" are capable of pointing out "the distinctions which separate [the parr] from its congeners".[52]

However challenging, defining characteristics of various kinds were nevertheless found and comprehensive descriptions of the *salmulus* were enumerated. The parr, for instance, were said to appear "more delicate" and "more muscular" than the trout, and possessed of greater "comparative power of the pectoral fin" than the salmon.[53] Somewhat paradoxically, according to Wilson, the "true parr" was even easy to distinguish from a young salmon or other varieties of trout, "the external aspect being so distinct that any observer will without difficulty separate them when seen together".[54] Many noted a pinkish or yellowish hue on the adipose fin; moreover, as I have quoted, Jardine himself had described the parr as "one of the best and most constantly marked species we have".

We are fortunately not obliged to resolve this paradox regarding how readily contemporaries could identify parr. But some of its consequences can be suggested. For one, it was notably difficult to reach any kind of consensus on the issue. It seems to have been easy to raise doubts about an adversary's ability to accurately and consistently identify the fish. In this context, judgements about another's reliability and skill were critical. A premium could be placed on the rarefied and scholastic talents necessary to identify the true parr, and these could in turn function as a mark status and group membership. In a circular reinforcement, a scientific background, with the appropriate props of training and social connections could help to guarantee this in the eyes of others. Institutional affiliations were presumably crucial in the forming of judgements about legitimate contributions.[55] The occasionally socially heterogeneous yet inclusive nature of the debate, as noted above, could make these problems acute: As Yarrell expressed it, the basic problem lay in the "want of power among *general observers* to distinguish

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[52] William Yarrell, *A History of British Fishes*, 2nd ed., vol. 2 (London: John Van Voorst, 1841), 83; Jardine, "Notice of the Parr," 82. Marking experiments usually consisted of making distinct marks on the fins of juvenile fish and hoping that they would be caught again as adults.
[53] Jardine, "Observations upon the Salmonidae Met with during an Excursion to the North-West of Sutherlandshire, in June 1834," 57; idem Jardine, "Notice of the Parr"; Parnell, "Natural and Economical History of the Fishes, Marine, Fluviatile, and Lacustrine, of the River District of the Firth of Forth" is the apogee of such descriptive analysis.
[54] Wilson, "Ichthyology," 208.
[55] C.f., on role of high status scientific institutions in mediating exchange relations Podolny and Lynn, "Status," esp., 52-553.

between the young of closely allied species."[56] On the one hand, the likes of "practical fishermen" could be untrustworthy, perhaps due to their professional interests. On the other, they may be merely incompetent, their "prejudice and gross ignorance", as one put it, being no basis for science.[57] Perhaps even their perceptual competence could be doubted, their "coarse" vocations having a "coarsening" effect on the senses?[58]

Issues with the physical identification of parr were compounded by difficulties associated with the limitations on what was known about the breeding and early development of the *salmulus* and the salmon. Where and how the fish bred was mysterious, whilst a great deal about the progress and developmental growth of salmon was also disputed (an "inextricable mess of confusion" Knox called it.[59]) This, accompanying attempts to visually distinguish the different species, prompted a range of logical and speculative arguments to be brought in support of the *salmulus'* existence (or lack of this property). One argument was that it was observed that *salmulus* or the true parr were found in rivers where salmon were never known to occur – a "good logical argument" in favour of a *sui generis* theory, said Wilson.[60] But this presumed accurate identification in the first place (they might be young trout), and there were always possible reasons as to why young salmon may have found their way into such rivers (for instance, through unobserved fissures in the geology, or by other means of dispersal such as via the attachment of eggs to the legs of birds, or by the elements, etc).

The major issue however concerned the fact that parr were universally found to be present in the rivers all year round, and were even especially noticeable in summer and autumn. Since it was also believed that salmon migrated to the sea in spring, usually April and May, the interpretation was that these remaining fish could not therefore be young salmon. In this scheme, salmon were believed to mature very rapidly once their eggs hatched in early spring, growing quickly into silvery fish upwards of eight inches in length, and ready to migrate a

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[56] Yarrell, *On the Growth of the Salmon in Fresh Water*, 2 emphasis added.
[57] The quote is from William Brown, *The Natural History of the Salmon* (Glasgow: Thomas and Son, 1862), 19. The sentiment was common.
[58] On the attribution of perceptual competence see Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, 75–78. This early modern prejudice is known to have lasted into the nineteenth century.
[59] Knox, "Observations on the Natural History of the Salmon, Herring, and Vendace," 468.
[60] Wilson, "Ichthyology," 208.

mere few weeks later.[61] At this stage their appearance transformed from the banded parr look to that of the smolt, and they gathered in large, unmistakable shoals in anticipation of their descent to the sea. This transformation occurred quickly, leaving few opportunities to observe any intervening stage in between the "banded" form and the "smolt" form of the salmon. (A glossary of terms relating to the life course of salmon can be found at Appendix 4).

Crucially, nature was accepted to be consistent in this: salmon all hatched at roughly the same time of year, matured collectively, and migrated to sea and returned to the river more-or less as one. The idea that salmon varied in their habits, some remaining small, living in the river all year round, whilst others of the same age migrated, grew large feeding on marine organisms and returned to breed as adults all whilst their siblings were still mere inches in length, was not countenanced.[62] Of the late summer parrs, given the presumption of rapid growth, it appeared therefore impossible to "reconcile their imputed age with their actual dimensions".[63] Thus, while salmon achieved "considerable bulk" before they began to breed, the *salmulus* were understood both "male and female" to breed "of their common size" – meaning as small but otherwise fully matured adult fish.[64]

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[61] Although the idea was widespread, Knox presents the finest discussion of this orthodox belief on the timing of salmon migration. Knox, "Observations on the Natural History of the Salmon, Herring, and Vendace," 481. It was also claimed that fishmongers believed that salmon hatched in as little as forty eight hours, during which time their mothers watched over them, before immediately escorting them down river to the safety of the sea, see eg., A Rural D.D., "Salmon and Pisciculture," *The Journal of Agriculture*, no. 56 (1857): 636.

[62] Thomas Garnett, "Facts and Considerations on the Natural History and Political Impropriation of the Salmon Fish," *The Magazine of Natural History* 7, no. 39 (1834): 205 was an exception. Prefiguring what would be a central pillar of the arguments of later experimentalists, he said that "the fry of salmon are much older, when they leave the rivers, than seems to be generally supposed."

[63] Wilson, "Ichthyology," 208.

[64] Pennant, *British Zoology*, 3:254.

Parr and smolt

FIGURE 7: "Parr marks revealed underneath smolt scales". Scrope noted this phenomenon in the 1820s. Here, the illustrated specimen came from Shaw's ponds in 1842. William Scrope, 1843 [1898], *Days and Nights of Salmon Fishing,* London: Edward Arnold, frontispiece.

This issue related to another problem: disputes surrounding the sexual maturity of parr or *salmulus.* This was the tricky matter of what have come to be known as "precocious" parrs.[65] Clearly, it is fundamental that for a population to constitute a true species male and female individuals within that population must reach sexual maturity; they must produce viable young, and establish some degree of reproductive isolation. Whether this actually happened in the case of the *salmulus* was at the centre of the debacle.

It was widely accepted that, especially at certain times of the year, it was common to discover *male* parr veritably flowing with milt, the seminal liquor

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[65] The earliest use of the term I am aware of is Russel, *The Salmon*, 42–43. Francis Day provided one of the most comprehensive nineteenth century discussions of theories of the origins of the "precocious parr", Francis Day, "On the Breeding of Salmon from Parents Which Have Never Descended to the Sea," *Transactions of the Linnaean Society of London*, 2, 2, no. 15 (1885): 449–52. The "precocious parr", an adaptation with evolutionary implications, is today a well-studied phenomenon .

necessary for impregnation. This observation provided a powerful ally to those who argued that parr must be considered a *sui generis* species. Why else would a juvenile fish be found sexually mature? But, on the other hand, it was repeatedly observed that gravid *female* parr, expressing developed roe (or "ova") were rare or absent. This was the root of the problem of the precocious parr, and provided room for both sides of the argument to manoeuvre and speculate. Some theorised the preposterous: that parr were a "species" consisting only of males[66]; others insisted that female parr containing ova might still be procured, or already had been (a few even claimed they were common), while naysayers challenged them to prove it.[67] Reports might come in from far away rivers on the subject, but these could never be easily believed or verified. Moreover, how could the *non-existence* of a gravid female parr, and therefore the *salmulus,* be definitively proved anyway?

The matter of precociousness contributed to the perception that there was something highly anomalous about the parr in general, especially if considered in terms of an identity with salmon. Firstly, there was the possibility that two fish, of which one might be orders of magnitude larger than the other, could be the same age, as suggested above. But, secondly, even more strangely, if the smaller were male, it might be in a position to impregnate the eggs of this potential age or brood-mate of many times its own size. Such an eventuality was considered, in the words of the editors of the *Agricultural Journal,* to be "against all analogy".[68] It is within this context that theories about parr being hybrids – and therefore already somehow anomalous by nature – arose. Indeed, for Knox, precocious parr were "so extraordinary" as to make it impossible to expect that such a phenomenon should be found "in any pure species of fish".[69]

In summary, without physically observing each stage in the breeding, incubation and development of the young fish (let alone following the salmon

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[66] Pennant, *British Zoology*, 3:254 called this view "vulgar."
[67] As Russel said of one (Andrew Young of Invershin): "Did he ever see two parrs spawning? Did he ever see a female parr with a developed roe? He never did, and never will.", Russel, *The Salmon*, 39. (On Young, see below and Chapter 4). Parnell cited the dissection of Dr Heysham of Carlisle, who claimed to have found hundreds of female parr in the "forward state", see Parnell, "Natural and Economical History of the Fishes, Marine, Fluviatile, and Lacustrine, of the River District of the Firth of Forth," 302–3. In a later instance, Dr Günther explained the anomaly by suggesting that these ova had been found in the stomach: they were really undigested spawn upon which the dissected specimen had been feeding, see "Letter from Frank Buckland," *The Field*, June 22, 1862, 581.
[68] Writing in response to Hogg, "On the Preservation of Salmon," 449.
[69] Knox, *Fish and Fishing in the Lone Glens of Scotland, with a History of the Propagation, Growth and Metamorphosis of the Salmon*, 86.

through their sojourn in the sea) the assertions regarding the parrs' true identity admitted of doubt in myriad ways. Combining the problems of breeding with the difficulty of physically differentiating parr from the young of the other *Salmo*, it is apparent how conventional modes of descriptive natural history were limited. Empirical experience in the form of detailed and direct observation of the character and habits of the fish was a widely shared ideal, but in practice it was not always attained. A very great deal of knowledge about parr was based on the authority of diverse kinds of experts; scope for theorising on insufficient data was large, and opportunities for collective witnessing relatively small. In these circumstances much trust in the capabilities of other participants was, presumably, necessarily to establish the slimmest of facts, and a high premium was placed on rare observational skills[70], and therefore the statuses that marked out quality of this kind. I assume achieving this to have been especially challenging given the social heterogeneity of practical salmon ichthyology at the time. In these conditions, without the instrumentation, the inscription devices, reliable textual means to articulate and conserve factual statements, or the controlled social space of a laboratory, local assertions could not be easily universalised.[71] As I show in the next section, it was to the credit of John Shaw's programme of experimental fish culture and, importantly, his writing style, that a reliable path out of these various *culs de sac* was found, at least to the satisfaction of many.

2.3 The "sedulous devotions" of John Shaw

It is not surprising, given the state of the debate, that by the mid-1830s there was growing demand for new methods to investigate the life history and relations of the *Salmonidae.* John Shaw was neither the first nor the only investigator to reflect this demand, but between 1836 and 1840 his contributions proved by far the most important. Mr George Hogarth, described as having once been the "greatest lessee of salmon-fisheries in Britain", had submitted evidence before a Select Committee in 1825 in which he described how he had hatched

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[70] C.f., STS literature on tacit knowledge and experience in observational skills in science, eg., Michael Lynch and John Law, "Lists, Field Guides, and the Descriptive Organization of Seeing: Birdwatching as an Exemplary Observational Activity," *Human Studies* 11 (1988): 271–303. Also Lorraine Daston, "On Scientific Observation," *Isis* 99, no. 1 (2008): 97–110.

[71] I draw on the language of science studies eg., Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, 2nd ed. (Princeton, NJ: Princeton University Press, 1986); and Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life*, esp, Ch. 6.

fertilised salmon eggs in a tumbler after scooping them up from redds on the river Don.[72] Thomas Garnett published opinions that hinted at conclusions very similar to Shaw's in 1834, but claimed to have performed breeding experiments even earlier.[73] In another example, a Professor Jones caused to be exhibited at a meeting of the British Association, "an apparatus [...] in which it was proposed to confine the fish, in order that observations might be made upon them in their various stages of growth".[74] Milton's account too leaves no doubt that a range of less celebrated practitioners were, prior to 1836, experimenting with the idea of keeping young salmon in captivity in order to monitor their development. For instance, he tells of a Mr Peat, "farmer to the Earl of Lonsdale's fisheries" who experimented on parr in the hope of submitting his findings to the consideration of learned societies and "remedying the evil of the destruction of the spawn of fish".[75] But while Shaw was not alone in his efforts, his contribution was distinctive for its rigour, argumentation, and the meticulousness with which he recorded it, or as Russel later put it, "his measurements, his plates, and his dates", his "careful and repeated experiments".[76]

In this section I describe in detail Shaw's pioneering experimental fish culture practices and scientific writing. I establish how his practices responded not just to available weaknesses in the evidence for *Salmo salmulus,* but more specifically as a means to negotiate or offset difficulties placed in his way by the scepticism levelled at him by the ichthyologic elite of his day. These raised some valid criticisms of Shaw's conclusions. But I argue that it was relevant that they doubted Shaw's ability as a "practical man" to perform the kinds of discriminating scientific work they deemed necessary to contribute to the high question of the existence or not of a species, and from thence the honour of the scientific status group.[77] Thus, this is a story of Shaw's efforts to present credible testimony in the

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[72] James Wilson, "Fisheries," *Encyclopaedia Britannica* (Edinburgh: Adam & Charles Black, 1855), 604. For Hogarth's statement, PP, UK (1825) [393], 92.
[73] Garnett, "Facts and Considerations on the Natural History and Political Impropriation of the Salmon Fish," 205.
[74] R Jones, "Some Observations on an Apparatus for Observing Fish (Especially of the Family of Salmonidae) in Confinement," in *Report of the Ninth Meeting of the British Association for the Advancement of Science (Birmingham, 1839)* (London: John Murray, 1840), 133.
[75] Milton, "Observations and Experiments Proving the Parr or Branding to Be the Young of Salmon," 64. Peat claimed before an official enquiry some time later that he had "no doubt that parr are salmon", see PP, UK (1861) [2768] [2768-I], 340.
[76] Russel, *The Salmon*, 37.
[77] See Barnes, "Catching up with Robert Merton: Scientific Collectives as Status Groups."

face of his encounter with a specific "moral economy of scientific civility".[78] Drawing especially on Shapin's triumvirate of literary, material and social technologies of testimony, I argue Shaw's experiments and his language were equally parts of this.[79]

2.3.1 *John Shaw: status and vocation*

It is possible that John Shaw, being a gamekeeper, was directly motivated to understand the parr question because of its implications for conserving the fishing of his employer. However, very little is known about his life or incentives. He was, after all, only a gamekeeper on a Scottish estate. Census records confirm Shaw's position at Drumlanrig Castle in the parish of Durisdeer; we know also that he was married, the head of a household, and aged 53 in 1851.[80] Stoddart, an angling writer and parr commentator who visited Shaw some decades after his first experiments, wrote of his cottage "overlooking the valley a short way beyond the ducal castle, and commanding a stretch of landscape to which, with all appropriateness, the term 'magnificent' may be applied."[81] Such anecdotes however reveal little. Nevertheless, it is important that we try to understand, accepting the paucity of evidence, something of Shaw's status and social connections in order to see how these may have conditioned his strategy and to contextualise the way his results were first received.

Shaw published his contributions in elite metropolitan forums, *The Edinburgh New Philosophical Journal* and *Transactions of the Royal Society of Edinburgh*.[82] His results were considered sensational: eventually, both scientific

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[78] Daston, "The Moral Economy of Science," 16.
[79] Shapin, "Pump and Circumstance: Robert Boyle's Literary Technology"; Also Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* esp., chapters 2 and 6; Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* esp., chapters 2 and 5.
[80] "1851 Census, Parishes of Dumfriesshire, Kirkcudbrightshire and Wigtownshire," accessed November 7, 2013, http://www.dgcommunity.net/historicalindexes/census.aspx. The Valuation Rolls state that Shaw lived at Drumlanrig in 1866–7, but he died at that time. He is buried at Penpont Churchyard, where his gravestone reads: "Sacred to the memory of John Shaw who died at Drumlanrig Parks 13 March 1867 aged 70 years." I am indebted to Catherine Gibbs of the Dumfries and Galloway County Archives for this information (Personal Correspondence, 7 November 2013).
[81] Thomas T Stoddart, *An Angler's Rambles and Angling Songs* (Edinburgh: Edmonston & Douglas, 1868), 288.
[82] Shaw's other work consisted of: "Experiments on the Development and Growth of the Fry of the Salmon," *The Edinburgh New Philosophical Journal* 24, no. 47 (1838): 165–76; and "Account of Experimental Observations on the Development and Growth of Salmon-Fry," *Transactions of the Royal Society of Edinburgh* 14, no. 2 (1839 1840): 547–66. The latter was also published as a pamphlet, see *Experimental Observation on the Development and Growth of Salmon Fry* (Edinburgh:

and literary luminaries fêted him for his contribution. Yet Shaw was a gamekeeper, a "practical man", and not a naturalist. The major naturalists working on salmonidae were mostly bound into close networks in which specimens and illustrations were regularly exchanged, and other shared projects undertaken. These relations were often attended also by intimate friendships and shared pleasures engaged in, presumably, as social equals – particularly angling, a habit almost universal amongst them. Ichthyology and angling (the contemplative man's field sport) were often considered to have a natural affinity. But the point here is the sociability it afforded: both published and manuscript materials related to key actors in the controversy, including the likes of Wilson, Yarrell, Selby and Jardine, leave little doubt of this.[83] Notably, status as learned men, comporting according to the relevant conventions of scientific discourse and practice, was also marked by memberships of scientific societies. In Edinburgh, (the centre of gravity for much debate), this included the elite Royal Society of Edinburgh and its splinter group, the Wernerian Society. In London, the Zoological, Linnaean, Ray and Royal societies were prominent affiliations. For example, Sir William Jardine – probably the most important node in ichthyological networks in the 1830s – was a Fellow or member of all six of these, as well as numerous other regional and national bodies. Via the Edinburgh societies, he shared ranks with most published authors interested in the natural history of parr and salmon, prominently Sir Davy and his brother John; Fleming; the journalist Russel; as well as Wilson, Parnell, Robert Hamilton and others – all notable zoologists, ichthyologists or writers on the salmon and salmon fisheries. Membership of the London societies' Jardine shared with, including many of the above, also Jenyns, Yarrell, Couch, Selby and other contributors such as the naturalist John Hogg and Albert Günther, later curator of fishes at the British Museum. The British Association was another forum of interaction for these gentlemen. Where personal ties were offset by professional

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Adam & Charles Black, 1840). Shaw also published one article on sea trout ("*Salmo trutta*"), see "On the Growth and Migration of the Sea-Trout of the Solway (Salmo Trutta)," *Transactions of the Royal Society of Edinburgh* 15, no. 3 (1844): 369–75.

[83] Jardine, Wilson and Selby went on an angling-come-natural history field trip together to Sutherlandshire in 1834. The results of this trip formed the basis of writings on salmondiae in the 1830s. See particularly, Christine E Jackson and Peter Davis, *Sir William Jardine: A Life in Natural History* (London: Leicester University Press, 2001), 58, 86–90; Jackson, *Prideaux John Selby: A Gentleman Naturalist*, 107–15. On Jardine's circle, and their significance to the parr controversy and other matters piscatory, I am indebted to this extensive study of Jardine's social and professional relations. I would like to acknowledge the encouragement of Professor Davis in regards to further pursuing this subject.

differences or antagonism, these contexts of mediation would have provided places of contact, exchange, and signs of scientific status.[84] (For further biographical information on these and other contributors and their relations, see Appendix 3).

Shaw, on the other hand, despite his work being presented in their august transactions, was neither a Fellow of the Royal Society of Edinburgh, nor the Wernerian, nor associated with the British Association.[85] Others communicated his work to these on his behalf. Unlike most of the naturalists cited above, he has no entry in the *Dictionary of National Biography,* and I know of only one local obituary.[86] Therefore, as far we can tell, he was somewhat distanced from these and related structures of social organisation in ichthyological research, and his social position presumably made him obscure to them. It can therefore be expected that he would also be less subject to the opportunities for the forms of interaction, exchange and approbation that they presumably afforded. In this context, his lack of scholarly credentials and his vocational circumstances were likely to have been relevant.[87]

Further light might be shed on Shaw and his motivations by speculating on the influence and connections of his employer. It is not implausible that the techniques promoted by Davy, and the agenda of the likes of Scrope and James Hogg specifically, found their way to Shaw via the Dukes of Buccleuch and their fisheries concerns. For one, the 4th Duke of Buccleuch had been on intimate terms with Hogg and Sir Walter Scott. (Hogg, in fact, was settled by the Duke on a farm near what was once Altrive Lake on the Yarrow Water in the Scottish Borders in 1815.) His son, Walter Francis Montagu-Douglas Scott, the 5th Duke of Buccleuch and 7th Duke of Queensbury, was Shaw's master. If not on as personal terms with Hogg and Scott as his father had been, the Duke would nevertheless have been acquainted with them and moved in similar social and political circles to the

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[84] Eg., in the case of the controversial Robert Knox who was an apparent adversary of Parnell's and possibly other's in Jardine's circle (see NMS, GB 587 WJ 4/101 and below); Knox was mentioned in letters to Jardine from Edinburgh in other, mostly unfavourable, circumstances eg., in the correspondence of the naturalists Greville and Johnson (UEA, 6.20/123,164), see also Appendix 3.
[85] I would like to thank Denise Anderson of the University of Edinburgh Special Collections for confirming Shaw's absence from the rolls of the Wernerian Society. *The Edinburgh New Philosophical Journal* was a title associated with the Wernerian's founder, Jameson.
[86] "Provincial [Obituary of John Shaw]," *Inverness Courier*, March 21, 1867.
[87] Drawing on Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, esp., 38-41, 83-86, 93-95 and 223-228.

latter.[88] He was also a member of the Royal Society of Edinburgh, and President of Highland Agricultural Society between 1831 and 1835, both forums in which debate on the parr took place. He was moreover a known agricultural reformer and a passionate preserver of his extensive salmon fishing in southern Scotland. According to fisheries writer Bertram, he rented some of the best water on the Tweed, was known in those parts as "something of angler", and to have "vigorously interest[ed] himself" in salmon protection in the Yarrow and Selkirkshire districts, near to Hogg's old residence. At the Duke's other seat of Bowhill on Tweed, a gamekeeper there, James Kerss (Kerse) "instituted some interesting experiments as to the growth of salmon smolt in freshwater" in the 1850s.[89] These experiments sound similar to Shaw's, and this is not unlikely given that Kerss had interested himself in the parr question around the same time as Shaw had.[90] In the light of all this, although we cannot be certain of direct involvement in these matters by the Duke, either at Bowhill or Drumlanrig, it is plausible that he knew of them, or even encouraged them.[91]

What little we know of John Shaw therefore suggests he was placed at best ambiguously in relation to the social worlds and institutions of learned natural history. On the one hand though, he was a professional in the employ of a very important aristocrat, and possibly this may have opened some doors to him. On the

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[88] On Hogg's residence, see Daniel Robins and Nicholas Hahn, "Altrive Lake," *The Oxford Guide to Literary Britain & Ireland*, 2008, http://www.oxfordreference.com/10.1093/acref/9780198614609.001.0001/acref-9780198614609-e-68. It is intriguing to think that Shaw may have met Hogg. However, the distance between the Duke's various estates was considerable and, although Hogg and companions were known to go fishing and hunting in the district of Drumlanrig, and Hogg's wife was from Dumfrieshire, I have found no evidence of them actually meeting. Hogg, moreover, died in 1835. Hogg scholars and biographers confirm this impression, and also suggest the relative terms of intimacy in which Hogg lived with the two Dukes (Personal Correspondence with Valentina Bold, Nov 15 and 17, 2013, and Gillian Hughes, Nov 16, 2013). See also Appendix 3.

[89] James G Bertram, *The Border Angler* (Edinburgh: John Menzies, 1858), 84, 98 122.

[90] See Letter, Selby to Jardine 18 August 1836 (CUL Add. 9839/13/144); "Communication from James Kerse, Fisher, Bowhill," *Magazine of Zoology and Botany* 1 (1837): 503.

[91] A much later source claims "[t]he 'par question' (sic) had even […] become a burning one, all over the borders of Scotland". Here the writer said it attracted the attention not only of Scott, Hogg, John Wilson (James Wilson's brother, famous Conservative critic and writer with Hogg at *Blackwood's Magazine*), Scrope and Davy, but also "Shaw's notable master, his Grace the Duke of Buccleuch". See, A Scottish Ichthyologist, "Trout Breeding in Scotland," *Baily's Magazine of Sports and Pastimes*, July 1, 1881. This is suggestive, but likely unreliable. The source is also not clear which Duke is being referred to. I have examined some available papers of the Buccleuch family at the NRS in order to discover more about these possible connections, but without success. Various items in the collection (NRS GD224) previously held at the NRS have been returned to the owners and are no longer available to the public. NRS GD224/577/24 (The Drumlanrig Game Books), confirm John Shaw's other duties as Keeper involved the slaying of many Muir fowl, pheasants, fish and other kinds of game.

other hand, his vocation could have implied in the eyes of others a sense of constraint in his ability to either report matters of fact objectively or be perceptually competent to do so at all. We will at any rate see that Shaw felt that scholars subjected his work to unfair criticism, and that this was connected to his being a "practical man", non-scientific in background or training or, perhaps even unduly interested in the outcome.

2.3.2 *The Drumlanrig Experiments*

I turn now to look in detail at John Shaw's material and linguist efforts. His first article on the subject, "An Account of some Experiments and Observations on the Parr" (1836), established Shaw's key positions. He began it confidently (perhaps over-confidently which, as a sign of pre-determination, might endanger his credibility) by claiming that previous writing on the topic of parr had "been unsatisfactory and fanciful". His work promised however to eschew system building and speculation by being based only on "many years sedulously devoted to the study of the subject." "The whole of my life", he said, "has been spent on the banks of streams" where he had made "unremitting and laborious" endeavours to discover the "true history of this fish".[92] Statements about experience and objectivity were a powerful reminder of the central values of British empiricism and an ongoing theme in Shaw's work. There is no doubt that as values these were widely espoused by all of those learned naturalists who would come to disagree with Shaw: as one of his fiercest critics declared the "multitude of unsettled points in science" on the parr issue could not be "cleared up by mere conjecture or hypotheses, but [only] by slow accumulation of facts, and the unsparing correction of error."[93]

Although he does not mention his name, it is likely that Shaw was responding to Knox's earlier admission that nobody had thus far proved "by direct experiment, performed in vessels placed under their immediate observation" the connection between the eggs produced by salmon and the fish (smolt) that migrated in April and May.[94] Knox, as mentioned previously, had defended the

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[92] John Shaw, "An Account of Some Experiments and Observations on the Parr," *The Edinburgh New Philosophical Journal* 21, no. 41 (1836): 99.
[93] Parnell, "Account of a New Species of British Bream, and of an Undescribed Species of Skate," 155.
[94] Knox, "Observations on the Natural History of the Salmon, Herring, and Vendace," 494. Knox certainly believed that his monograph was the "exciting cause" of Shaw's work, see Robert Knox,

standard idea that young salmon matured rapidly and performed this migration only a few weeks after hatching. Shaw's work tested this directly. His results suggested that young salmon mature very slowly and that it took up to *two years* for them to exhibit migratory behaviour and assume the livery of the smolt. This assertion of a lengthened period before first migration was fundamental because it undermined a key tenant of the argument in favour of the *sui generis* parr. It provided a rationale for there being young salmon (or parr) in the river *all year round*, even in the summer and autumn when, according to the original theory, they should have been absent due to having migrated in spring.

The paper itself mainly consists of the description of a series of investigations involving a progression "backwards" through moments in the fish's passage towards maturation. Firstly, with parrs already expressing the banded appearance; then with the younger alevin; then with already fertilised eggs; and finally in the act of fertilising the eggs themselves artificially. At each moment, the duration under which the fish, eggs or ova are controlled and observed is extended and, Shaw felt, the opportunity for errors of identification minimised. Beginning in summer, July 1833, Shaw describes capturing seven parrs from the river Nith and placing these in ponds separated entirely from the river. On May 17, 1834 he recaptured these fish and "satisfied every individual present that they had assumed the perfect appearance of what is called salmon-fry" (meaning smolt) of about six inches in length (note that Shaw was already explicitly relying on multiple witnesses).[95] The following spring (March 1835) he repeated the experiment with twelve parrs. These fish, like their predecessors, were characteristically barred when procured and around six inches in length. But by the end of that April he says, they too had turned into "salmon-fry", "the bars being overlayed by the new silvery scales."[96] On this basis Shaw inferred a long maturation time, claiming "that there can be no room to doubt" that the large parrs found in autumn, winter and spring "are in reality salmon-fry", and that the "small or summer parr" that appear from May "must remain another year, before they depart in the character of salmon-fry". The fact that the *transformation* between

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"Recollections of the Researches into the Natural and Economic History of Certain Species of Clupeadae, Coregoni, and Salmonidae," in *Report of the Sixteenth Meeting of the British Association of the Advancement of Science (Southampton, 1846)* (John Murray, 1847), 80.

[95] Shaw, "An Account of Some Experiments and Observations on the Parr," 99.

[96] Ibid., 100.

the banded appearance and the smolt appearance occurs very rapidly amongst fish of the previous year's brood, Shaw pointed out, should not be mistaken for rapid development from hatching, through the alevin stage to readiness-for-migration.[97]

It seems that Shaw was aware of the weaknesses in his argument. It begged the question of what a parr really was by assuming that he had correctly identified the banded fish he had originally caught in the river correctly (ie., they might have been young salmon, not "true parr" – the circularity of the problem is an artefact of the conclusion, once drawn). Shaw though was confident that he had: his problem, as he saw it, was demonstrating a material and indisputable connection between these fish and true salmon. Nevertheless, in May 1834 Shaw undertook minute investigation of the redds where, he said, salmon (and only salmon) had previously mated. There he found and captured a number of alevins in a gauze net. These he held in a pond, where they grew independently of access to the river. By the following May, they had achieved around three inches in length and "corresponded in every respect with the parr of the same age to be found in the river". One year later again, in May 1836, they had assumed the livery of smolt, and "not the slightest difference could be perceived" between them and those migrating in the Nith at that time.[98] But Shaw recognised this did not quite conclude the issue: he still needed to prove beyond doubt that he was not "mistaken in [his] opinion that this fish is produced from the ova deposited by the salmon the previous winter."[99] In other words, his techniques thus far did not prove that the alevin he collected were *salmon* alevin of that season's brood. So, he resorted to collecting and incubating the eggs of two true adult salmon that he witnessed mating one day in January in 1836. These he placed in a convenient streamlet, watching them mature and hatch and, within 140 days, develop into tiny fish measuring one inch in length and clearly exhibiting the banded parr marks.[100] But, as Shaw later acknowledged, since other kinds of fish frequented the Nith, it was hard to be *absolutely sure* that the eggs he collected actually belonged to the salmon he'd witnessed mating. This was, he felt, the missing link "in the chain of evidence".[101] He had, in fact, allowed three days to elapse between watching the coition and scraping up the eggs with a

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[97] Ibid.
[98] Ibid., 101, 102.
[99] Ibid., 103.
[100] Ibid., 104–5.
[101] Shaw, "Experiments on the Development and Growth of the Fry of the Salmon," 165.

shovel and a canvas bag.[102] What other matings may have occurred there in the interim, or had other eggs been already secreted away in the gravel that could prejudice his results? Shaw then played his trump card.

The deployment of artificial fecundation appears to have been fundamental to Shaw's success in the eyes of his admirers. He himself, quite modestly, noted that the experiment was "interesting as well from its novelty, as from its tendency to corroborate in part the results of the former."[103] To perform it, Shaw captured a male and female salmon in the act of spawning with one another. Then, holding them "side by side" over a trench, previously prepared with water flowing through it, with his hands he "pressed the ova and seminal liquor out of the bodies, which mixed freely together in the stream." The eggs eventually hatched, producing young fish apparently identical in appearance to the fish seen in the earlier experiment.[104] Although perhaps not technically the first to attempt it, in these simple operations Shaw had begun the most influential fish-breeding programme in Britain up to that date. It is remarkable that this occurred only as a consequence of the rather limited goal of establishing to the satisfaction of his critics the real parentage of his subjects. As A Rural D.D. (pseudonym for Charles Esdaile) wrote,

> *by being pressed to establish the fact* that the spawn he [Shaw] had taken from the river, when producing the parr, *was the spawn of salmon*.
> It was then only that he took to a plan that seems almost miracle-working; imitating by human agency the creative powers of nature and Mr Shaw resorted to it with little hope, but as a desperate endeavour to put to cavillers to silence.[105]

Shaw did indeed have cavillers, as we'll see. Note, also, how Shaw's work served to displace the problem of identification from arguments oriented around the appearance of the banded "parr" stage towards questions of the fish's development and lineage. Marginalising visual identification and arguments to morphology in favour of observations about parentage, age and the pace of growth, Shaw's work suggested conceiving of relatedness on the basis of sexual descent as

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[102] Shaw, "An Account of Some Experiments and Observations on the Parr," 103.
[103] Ibid., 106.
[104] Ibid.
[105] A Rural D.D., "The Salmon-Its Preservation and Increase," *The Journal of Agriculture* (New Series) (March 1853): 624.

the source of correct knowledge of the parrs' "species".[106] These were astute moves given the apparent unreliability of the physical features of the fish.

Through artificial fecundation (which guaranteed parentage) and rearing (which demonstrated development of fry through the alevin, "parr" and smolt stages of life), Shaw justly felt he had supplied the "deficiency of information so much complained of by most authors in treating of the early history of the salmon."[107] But that it resolved the question of whether or not there was a distinct species called parr, as Shaw contended was a consequence of these observations, in fact remained a contentious issue. The demonstration that parr transformed into salmon smolt when observed in controlled conditions might appear to constitute prima facie evidence that parr are salmon. But this is to forget the difficulties of variation and similitude already discussed: in fact, the entire issue continued to hinge upon whether or not Shaw, or someone like him, was considered competent to judge the difference in character between what *he* called parr, and the supposed "true parr" or *Salmo salmulus*, that were believed to exist out there amongst their congeners in the rivers.

Shaw's second paper, published in 1838 in the *Edinburgh New Philosophical Journal* but presented also at the Royal Society of Edinburgh, consisted largely of attempts to refine his experimental system in response to critics. These were numerous, many focusing on, in Couch's words, the "strange, and perhaps unnatural, circumstances in which [the fish and eggs] had been placed". These included differences of temperature of the ponds and the river, and the kind of food the young fish in captivity ate, both of which may have "materially influenced their subsequent appearances and habits".[108]

To secure his system, Shaw performed a critical inspection of his ponds, draining them to ensure no fish were left over from previous broods and isolating them entirely from the main river to ensure no unwanted incursions could take place. He looked too to ameliorate concerns that the conditions of captivity

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[106] In this, genealogists of the biological episteme might detect a link to wider transformations in knowledge of life that occurred, according to Foucault, in the nineteenth century as the "grid of knowledge constituted by *natural history*" was broken to reveal the depths of continuity and variation amongst organisms, Michel Foucault, *The Order of Things* (London: Routledge, 2002), 139.
[107] Shaw, "An Account of Some Experiments and Observations on the Parr," 110.
[108] Couch, *A History of the Fishes of the British Islands*, 4:246.

themselves could induce behaviours or artefacts prejudicial to his conclusions: "Every precaution has been used not only to exclude error, but to place the young fry in circumstances as nearly resembling the state of nature as was consistent with their preservation."[109] He moreover doubled up on the experiment, using two sets of ponds (and "families" of parr), each fed by a different source of water.[110] Such attentions also applied to the process of artificial propagation itself. In this his second attempt, Shaw used a separately prepared stream for incubation, and performed the fecundation in an earthenware bowl, not directly into the gravel.[111] No unintended ova or milt of unknown provenance was believed to be present, already in the gravel he later transferred the eggs to for incubation, or in the water he used. No accidental impregnation could take place. He also insisted that the parent fish used in the experiment should be taken "at the very moment when they are mutually engaged in propagating their species" for the reason, he said, that "[t]o take a female from one part of the stream and a male from another, might not give the same chance of successful issue to the experiment."[112] Shaw similarly broadened the scope of his recording practices and "virtual witnesses". He preserved the skins of the parent fishes so that others could more easily check *their* identity, and provided detailed line drawings and measurements of the layout of his ponds. He was also diligent at recording differences in temperature between his incubation streamlet, his ponds, and the river. Shaw acknowledged that temperature differences might affect maturation rates, but insisted that in his case these could have no material effect on the final outcome of the trial.[113] In sum, he developed strategies at the level of experimental system to restrict the range of arguments that could be used against him, provided means by which much of what he did could be witnessed by others, and illustrated in the process his own character and abilities. Some of these precautions may appear pointless in retrospect, but the accumulation of refinements within the narrative form Shaw used was a powerful way of conjuring a system that others could believe in without witnessing first hand. Russel later noted that, in neglecting such details, everything that was "valuable and interesting" in Shaw's work was omitted from

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[109] Shaw, "Experiments on the Development and Growth of the Fry of the Salmon," 166.
[110] Ibid., 172.
[111] Ibid., 167–68.
[112] Ibid., 168.
[113] Ibid., 172–73.

Andrew Young's slightly later but otherwise similar experiments.[114] Shaw's implicit or explicit acknowledgements of weaknesses in his system – that is his own fallibility and honesty – were also, as I suggest later, potentially important signals of reliability within his heterogeneous credibility building work.

These material efforts were continuous with Shaw's rhetorical strategy. Both were intended to diffuse criticisms of him and his system by playing off of each other and the values espoused for an empirical-experimental methodology. Shaw had began his paper by claiming that the native difficulty of the subject, the "medium in which observations must necessarily be made, the migratory habits of the fish" is compounded by "the proneness of scientific men to rear systems upon partial and insufficient data, rather than to acknowledge the want of that correct information upon which alone systems can securely rest".[115] "These difficulties," he says, "alike beset the path of the learned and the unlearned",

> but there is another difficulty which more particularly presses upon the latter, and that is, the scepticism with which his observations are generally regarded by scientific inquirers. This scepticism must obviously be met by increased industry and caution, and by an accumulation of evidence so conclusive as to overbalance the disadvantages of a defective education.[116]

[114] Russel, *The Salmon*, 46.
[115] Shaw, "Experiments on the Development and Growth of the Fry of the Salmon," 165.
[116] Ibid.

The Drumlanrig experiments

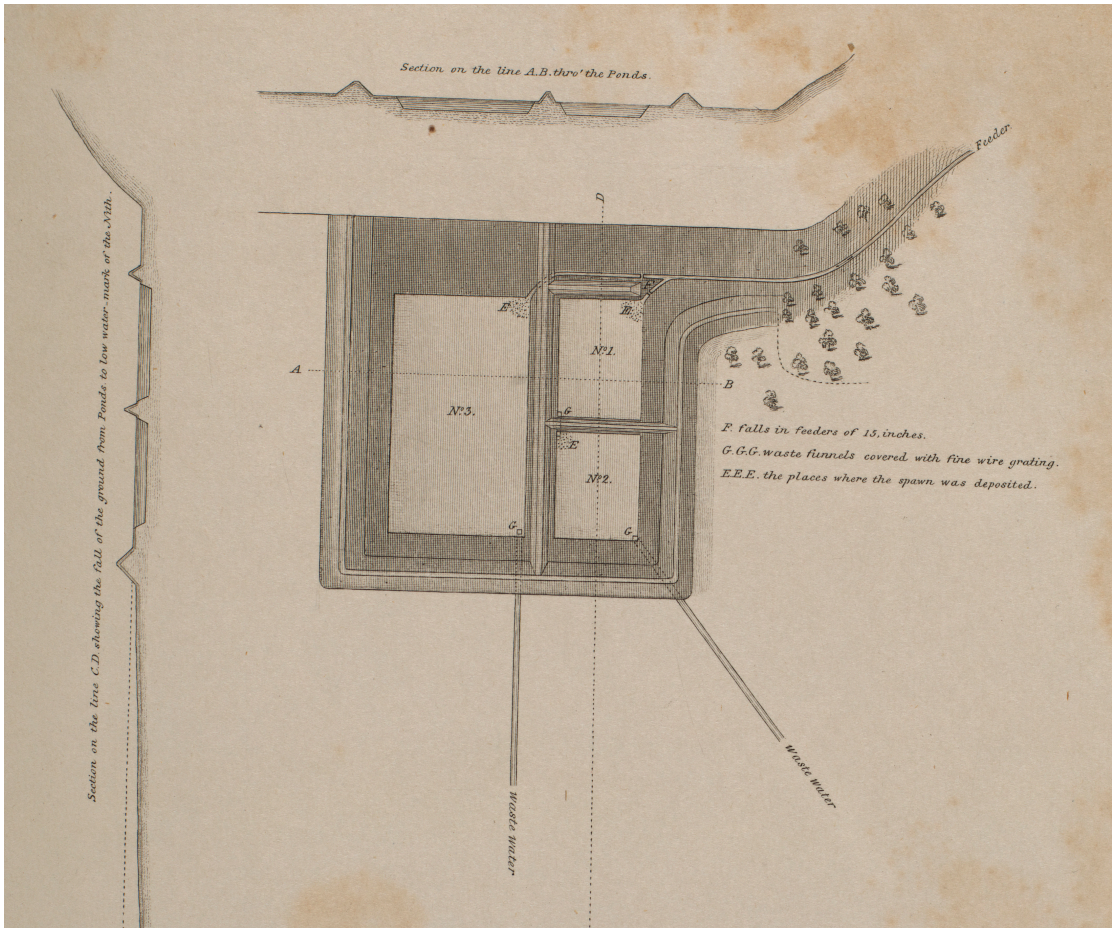

Figure 8: "Diagram of John Shaw's ponds". The image shows three ponds, a feeder stream and drainage outlets. Fertilised spawn was deposited in each pond where the water flowed in. The waste funnels were covered with a fine mesh to stop fish moving between the ponds or swimming up the funnels from the River Nith. John Shaw, 1840 [1839] *Transactions of the Royal Society of Edinburgh,* Vol. 14, Issue 2, Plate XXI (detail).

This is both revealing and dissimulating. On the one hand, it expresses very well how the technical improvements to his system were at once a response to weaknesses pointed out by critics and to a specific kind of prejudice directed at him. The correct response, Shaw knew, was to humbly gather more data. As he followed up: "I have therefore continued to proceed with that circumspection and exactness, necessary alike to convince the incredulous and to protect myself from the charge of crude observation." On the other hand, it disguises the fact that this was not his only stratagem: the other was the very rhetorical appeal that such language was performing. Central to this was a petition to the values of empiricism, including emphasising observed matters of fact rather than purely personal authority. However, Shaw concluded his paper speaking again of himself and his intellectual modesty: "as I make no pretensions to scientific attainment", he

said, "I am entitled to the indulgence of scientific men. I claim only to be considered a careful practical observer, and an honest inquirer after truth."[117]

Such language is again strongly in evidence at the introduction to Shaw's third and most influential paper read before the RSE in 1839. In it he inserted an epigraph from Sir John Herschel's *Discourse on the Study of Natural Philosophy*:

> Experience, once recognised as the fountain of all our knowledge of nature, it follows that in the study of nature and its laws, we ought at once to make up our minds to dismiss as idle prejudice, or at least suspend as premature, any preconceived notions of what might or ought to be the order of nature in any proposed case, and content ourselves with observing, as a plain matter of fact, what is.[118]

In context, it appears here that Shaw was attempting to align the value placed on direct experience in empirical science with the familiarity afforded by the practice of his everyday work, and against that of "theoretical" natural history and apparent prejudice directed at practical men and the unlearned. These were varieties of prejudgment that should be outlawed by definition of unbiased investigation and scepticism of proof by authority, as had long been central to English empiricism.[119] The strategy, which implied an opening up to questions of his vocation, was risky but not uncommon: for example, an earlier salmon controversialist used it when he wrote of himself "[m]uch cannot be expected from a mere salmon-fisher, *qui devient barbouilleur de papier malgré lui*, in whose hand an OAR would suit much better than a pen. All he can pretend to is experience of the fishery."[120] Here practical experience and a lack of pretence are intended to recommend themselves as a basis for trustworthy testimony.[121]

Before turning however to the important arguments and experiments of Shaw's last paper on the parr, it is necessary to consider the reactions amongst the ichthyologic elite to the revelations in Shaw's first two essays between 1836 and 1840. In this argument it is less important whether Shaw actually was on the

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[117] Ibid., 175.
[118] Shaw, "Account of Experimental Observations on the Development and Growth of Salmon-Fry," 547.
[119] See particularly Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, esp., 121-124.
[120] Murdo MacKenzie, *View of the Salmon Fishery of Scotland*, 2nd ed. (Edinburgh: William Blackwood & Sons, 1860), 3. [1st ed., 1834].
[121] See Shapin's discussion of early modern maxims such as this and, in certain circumstances, these might validate practical expertise, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, 218–21.

receiving end of prejudice on the basis of his lack of learning, status or reliability than it is that he felt as though he was. But I suggest nevertheless that he did have some grounds for pique.

Shaw's claims were understandably controversial and surprising. Soon after his first paper appeared Leonard Jenyn's inquired of Jardine's opinions of Shaw's work in 1836 stating that "[h]is observations go […] contrary to all that has been previously entertained on the subject".[122] William Yarrell's response is particularly suggestive of the reception of Shaw's work however. It is clear from the first edition of his *History of British Fishes* that he believed the parr was *sui generis* in 1836.[123] In fact, he told Jardine in March of that year that he had been taken to task for doing so.[124] Later in 1836, he discussed a sample sent to him by Couch as being a "skirling of Pennant […] which you and I should say was a parr."[125] He soon critiqued Shaw's experiments in print, pointing specifically to problems associated with the size of pond, supply of food and water temperature, elements considered to introduce unnatural and prejudicial circumstances into the system, and thus muddle the experiment. He sent a copy of his *Supplement to the History British Fishes* to Shaw in 1839 in which these objections were explained. In it he wrote that, he was "willing to believe" Shaw on the two-year migration theory, but that there was however as yet no "conclusive evidence of the non-existence of a distinct small fish, to which the name of Parr ought to be exclusively applied". This is crucial. Experiments to the contrary, he claimed, rather showed "the want of power among general observers to distinguish between the young of closely allied species".[126] In response, he told Jardine that Shaw sent him some specimens and "two long letters".[127]

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[122] Letter, Jenyns to Jardine, 9 July 1836 (NMS, GB 587 WJ 2/56).
[123] William Yarrell, *A History of British Fishes*, 1st ed., 2 vols. (London: John Van Voorst, 1835). See also Jackson and Davis, *Sir William Jardine: A Life in Natural History*, 64.
[124] Letter, Yarrell to Jardine 11 March 1836 (CUL, Add. 9839/13/232).
[125] Letter, Yarrell to Jardine, 28 December 1836 (NMS, GB 587 WJ 6/145). Pennant's skirling was a *Salmo salmulus*, see above.
[126] William Yarrell, *Supplement to the History of British Fishes, in Two Parts*, vol. 2 (London: John Van Voorst, 1839), 4; also quoted in Yarrell, *On the Growth of the Salmon in Fresh Water*, 2.
[127] Letter, Yarrell to Jardine, 18 August 1839 (NMS, GB 587 WJ 6/145). The fact that the two corresponded is significant. Unfortunately, the whereabouts of these letters is not known. The most likely site, the Yarrell Archive at Princeton (UPSC, C0603) was checked for the purposes of this project, but to no avail. I would like to thank Sandra Calabrese of the Special Collections Department for her help.

Probably the most vociferous opposition at this time however came from Richard Parnell.[128] Between Shaw's publications of 1836 and 1840, Parnell waged a campaign in Edinburgh scientific society in favour of the *salmulus* and his own view of the *salmonidae*. He was also concerned with the problem of "[p]ractical fishermen, [not] being acquainted with the characters by which the *parr* is distinguished".[129] Although he does not mention Shaw by name in print, it is nevertheless clear from his correspondence with Jardine that he included Shaw in this category. Like Jenyns, he enquired in June 1836 after Sir William's opinions of Shaw's "endeavouring to prove it to be the young of the salmon". "It is evident enough", he wrote, "that he does not know the parr from the young salmon. Did he ever see the two fish side by side of the same length and taken in the month of June or any other period, he would never maintain his opinion again; they are as different from one another as the salmon is from the fresh water trout".[130] Parnell records meeting Shaw in 1837 and having had a "short conversation" with him in Edinburgh, but insisted he "will never succeed in what his object aims to prove". In fact, Parnell appeared committed to seeing that he wouldn't. Early in 1838, he expressed dismay that Jardine had not intervened at a meeting at the Royal Society when Shaw's paper was read, leaving the audience, felt Parnell, to mistakenly believe that both he and Jardine agreed with Shaw. He worried, moreover, that the gamekeeper had already succeeded in "converting nearly the whole tribe of amateurs".[131] He wanted to set the matter straight, and this required specimens. His letters between 1836 and 1838 suggest a constant demand for them, and increasing levels of frustration when reliable specimens proved hard to procure. In particular, he struggled to find a female parr with roe in an advanced state. He also doubted, it shouldn't surprise us, the discriminating powers of his contacts amongst fishermen on the Tweed who would send him samples. Yet he also found cause to doubt his naturalist friends. He complained of a specimen sent by Jardine proving not to be an "S salmulus" after all. "Nor does it compare", he wrote, "with

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[128] I am indebted in this discussion to Davis and Jackson's work on the Jardine archive. Their discussion covers a portion of the same ground in less detail, see esp., *Sir William Jardine: A Life in Natural History*, 63–65. Also, Jackson, *Prideaux John Selby: A Gentleman Naturalist*, 130–33.
[129] Parnell, "Natural and Economical History of the Fishes, Marine, Fluviatile, and Lacustrine, of the River District of the Firth of Forth," 303.
[130] Letter, Parnell to Jardine, 14 June 1836 (NMS, GB 587 WJ 4/101).
[131] Letters, Parnell to Jardine 9 June 1837 and 5 January 1838. Another letter mentions Jardine having invited Parnell to visit Shaw's ponds, but it is not clear whether Parnell ever did so (NMS, GB 587 WJ 4/101).

the Parr of Wilson which is undoubtedly the true parr." He dissected a specimen preserved by Yarrell that was supposed to contain roe, but on doing so found that Yarrell has mistaken roe for milt (the female with the male sex cell). Parnell continued nevertheless to believe in the existence of "true parr" however, despite these disappointments, asking Jardine to look out for specimens exhibiting the relevant characteristic.[132] Unlike the case of outsiders, trust amongst these actors, who we take to be peers, was maintained without debilitating friction in the face of apparently obvious imputations against their reliability. Indeed, the discrepancy is remarkable, and could be interpreted as evidence that high status in the group and relative social proximity therein acted as signals of quality capable even of overriding evidence to the contrary.[133] The troubles as Parnell saw them at this stage were merely logistical: what was necessary was to find reliable specimens, at which point reliable gentlemen could have no difficulty in agreeing with his identification. He tells of an incident at a meeting of the Royal Society where *salmonidae* research was to be discussed: to this meeting a number of men from the Tweed, including three tacksmen, were apparently "introduced by Dr K. [Knox] to endeavour, as one of them explained it, to <u>smash</u> my observations." But he reported with confidence that, with specimens before them that have even "puzzled naturalists to identify" it would not be possible for "practical fishermen [to] over turn matters of fact, for before we thought to argue on the habits of an animal we must first be able to discriminate it when having it before us."[134] This he clearly doubted such men to be capable of. Discussing arrangements for the exchanging of specimens at the upcoming meeting of the British Association in Newcastle, he mentions Yarrell's confidence that "the naturalists will this time muster strong", and that he promised to bring with him specimens of "Parrs, young

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[132] Letters, Parnell to Jardine 3 October 1836 and 17 January 1838 (NMS, GB 587 WJ 4/101).
[133] This episode is reminiscent of the effects of status on scientific output suggested by Merton "The Matthew Effect in Science," *Science* 159, no. 3810 (1968): 56–63 and subsequently observed in a variety of sociological contexts.
[134] Letter, Parnell to Jardine, 17 January 1838, Sadly, we do not know what theory Knox's supposed proxies may have been promoting in this instance. A letter from the same month (26 January) tells of a triumph, in which Parnell claimed, on the basis of what specimens he did have, he astonished the gathered gentlemen, and Knox had nothing to say in response, (NMS, GB 587 WJ 4/101). Around this time, the controversial Knox was also engaged in heated controversy with elements in the Royal Society regarding the food of herring and salmon, in which harsh words were heard in the Society's halls. Those connected to Jardine's circle were undoubtedly drawn in, see Henry Lonsdale, *A Sketch of the Life and Writings of Robert Knox* (London: Macmillan and Co., 1870), 190–93.

sea trout, and salmon fry" that would, he claimed, in any event "amuse those who are non-scientific".[135]

Looking back on the debacle, it is apparent that others felt that Shaw had been misused in the reactions to his work. In his defence, A Rural D.D. for example, lambasted the elitist attitude of the *Edinburgh Review* who, he says "ignorant themselves", "should have experienced no nobler feelings towards him than to *sneer* at 'the practical man'".[136] Similarly, reflected Russel of the ichthyologic establishment, no sooner had the "head-keeper to the Duke of Buccleuch" appeared "and almost instantly the whole tribe turned on him as a common enemy."[137] "Shaw's blood getting up", wrote the patriotic A Scottish Ichthyologist some decades later, making him determined to "effectually shut up the mouths of 'the scientific'".[138] Although post-hoc reconstructions, such examples tend to support the idea that it was not solely the "rational" arguments of his critics that stung Shaw into perfecting his experiments.

Thus, while Shaw's initial use of artificial fecundation undoubtedly responded to a genuine weakness in his system, criticisms of him were also gilded by expressions of distrust, and these continued after his effective resolution of the parentage problem. As noted, the most extreme forms of scepticism hinged on doubt as to whether Shaw or other "practical" types were competent in distinguishing, physically and visually, the "parr" from the young salmon. If Shaw was adjudged not to be, he might seen as having proven nothing at all about the real or "true parr". Rather, he stood accused of merely proving the obvious: A Scottish Ichthyologist again puts this criticism colourfully:

> 'My good man,' said one of the learned, 'you have only proven what we all know, and have long known, that salmon produce salmon. You have simply collected the eggs of the salmon and they have in due time grown into like fish; any person could do that.'[139]

In this view, the entire operation of artificial fecundation and captivity missed the point, saying nothing about the "true parr" that may still be roaming the rivers. Although expressed with more subtlety, as in the case of Yarrell and Parnell

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[135] Letter, Parnell to Jardine, 13 August 1838 (NMS, GB 587 WJ 4/101).
[136] A Rural D.D., "The Salmon-Its Preservation and Increase," 622.
[137] Russel, *The Salmon*, 38.
[138] A Scottish Ichthyologist, "Trout Breeding in Scotland," 250.
[139] Ibid.

above, this was essentially the scientific consensus around 1839. And this critique was not only aimed at Shaw. As Milton relates of another gamekeeper, Mr Peat (see above), who performed similar experiments: "doubting the individual's knowledge of the characteristic and distinguishing marks of the fish confined" might censure the results of his experiments from the beginning.[140] Thus, speaking of himself, Milton felt compelled to assure his reader, he had "not an iota of speculation to advance, or one circumstance to relate, that cannot be substantiated by persons of undoubted veracity".[141] In his demonstration of the lengthened migration time then, Shaw might be admired for having shown something interesting about salmon (eg., that they took longer before migrating than generally thought). But the "additional proposition that the *Parr* does not exist", as one reviewer of the controversy put it in 1840, "is extremely questionable".[142]

The last of Shaw's papers I consider marks a crucial turning point. The paper, communicated to the RSE by James Wilson, related in detail the arguments of those that preceded it. By extending his earlier claims through additional curatorial practices, Shaw provided opportunities for others to judge, as far as possible, his reliability, the reliability of his statements about the parrs' growth and parentage, *and therefore* the parr's identity. The printed version of the paper included again plates of the layout and construction of the ponds at Drumlanrig, as well as a series of meticulously coloured illustrations of the development of young salmon in "various stages from the ovum to the age of two years".[143] When it was read, Shaw caused specimens from each stage of the process to be displayed at the Society, and were later adopted into the Society's museum, where members might examine them at leisure.[144] Additionally, concerned about the "idea that has been entertained that unscientific observers are in the practice of confounding the progeny of the whole of the migratory species indiscriminately" Shaw also

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[140] Milton, "Observations and Experiments Proving the Parr or Branding to Be the Young of Salmon," 63. This work was communicated to the journal by Knox.
[141] Ibid., 64.
[142] "Bibliographic Notices," *The Annals and Magazine of Natural History* 4, no. 25 (1840): 330.
[143] Shaw, "Account of Experimental Observations on the Development and Growth of Salmon-Fry," 566.
[144] James Wilson, "Natural History of Salmon and Sea Trout," *Blackwood's Magazine* 53, no. 331 (1843): 644–45; These specimens were later displayed at the British Association for the Advancement of Science, whence it was reported that "he felt anxious that those who might still entertain doubts upon the subject should have an opportunity of removing those doubts by the examination of a suite of specimens prepared by that ingenious observer [Shaw]." See James Wilson, "On the Salmon Fry," in *Report of the Tenth Meeting of the British Association of the Advancement of Science (Glasgow, 1840)* (London: John Murray, 1841), 133.

contrived to display a series of preserved specimens of "salmon trout", or sea trout.[145] These too had been produced by "artificial impregnation", and were "accompanied by the skins of the parent fishes". Moreover, alongside these, he presented a young common trout.[146] Thus observers had the opportunity of viewing the three most relevant "species" at once, with the assurance that, at least in the case of the sea trout and the salmon, they were the genuine articles. Presumably it was now harder to cavil without disputing the accurate identification of *adult* salmon and trout, which were never in dispute.

The most innovative experimental aspect of Shaw's paper, however, concerned the male parrs that expressed sexual maturity, those "precocious and anomalous" fish that concerned commentators.[147] As discussed earlier, the existence of these parrs had been interpreted as evidence that parr were *sui generis*. Shaw argued that these small fish, whilst immature relative to the full size and appearance of the adult form of the salmon, were not as young as had been previously conceived. Rather, they were the male salmon that, having not migrated, had remained in the river for over a year after hatching. Moreover, he noted that they were to be "at all times found in company with the adult female salmon" on the redds.[148] Now it was just this possibility that had always made the precocious parr problematic because it implied, in Russel's words, a "marriage between couples where the husband measures only about as many inches as the wife measures feet". Even admitting the subject might therefore have been considered harmful to Shaw's account. But his being prepared to address the issue (which like the two-year migration theory he had not set out to explore specifically but apparently encountered in the course of his work) may have served to recommend Shaw as an honest, modest and credible inquirer.[149]

Shaw had in fact discussed the precocious parr previously.[150] He had even offered a "speculative solution" as to what their purpose might be as they swarmed around the egg-laying salmon: perhaps, he thought, "the female salmon, like a queen-bee,

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[145] Shaw, "Account of Experimental Observations on the Development and Growth of Salmon-Fry," 557–58.
[146] Ibid., 558.
[147] Russel, *The Salmon*, 42–43.
[148] Eg., Shaw, "Account of Experimental Observations on the Development and Growth of Salmon-Fry," 561.
[149] This at least was Russel's favourable opinion, Russel, *The Salmon*, 41–42.
[150] See Shaw, "An Account of Some Experiments and Observations on the Parr," 107–8.

has the aid of a plurality of males in propagating her species?"[151] But in his third paper he turns the problem into an asset in an argument that supported his core cause to great effect. Via artificial impregnation, Shaw successfully bred these fish with adult salmon, showing that they resulted in normal, healthy parr, and that these, as usual, became salmon smolt in due course. In so doing, he continued to connect the grand dogma of species integrity – that like produces like – to his observations. So extraordinary did this result seem even to Shaw that he felt it necessary to ensure that he was not "deceiving himself". He conducted therefore no less than eleven "distinct experiments" on the precocious parr, involving both fish from the river and fish from his ponds, before the fact could not, he claimed, any longer be said to "admit of doubt".[152]

[151] Shaw, "Experiments on the Development and Growth of the Fry of the Salmon," 175.
[152] Shaw, "Account of Experimental Observations on the Development and Growth of Salmon-Fry," 564.

From ova to salmon smolt

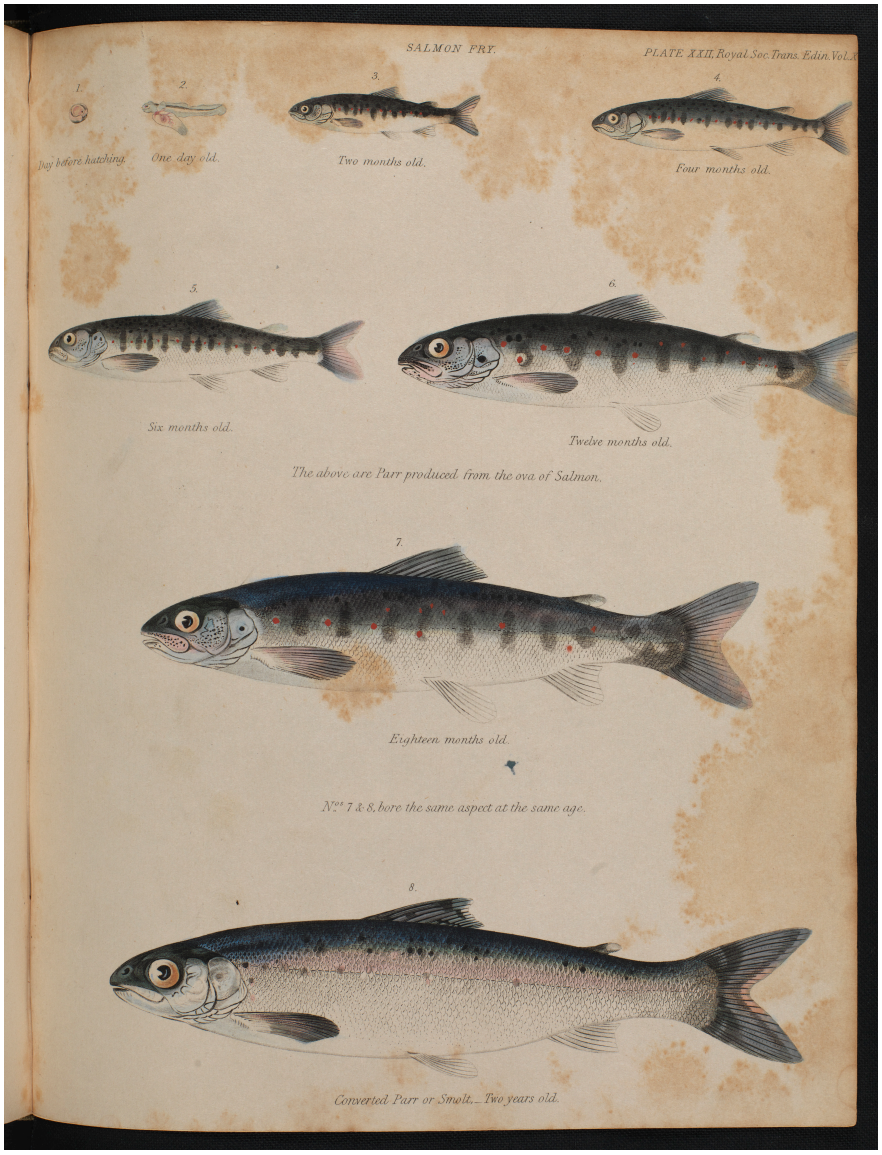

FIGURE 9: "Salmon fry". A developmental series showing salmon ova a day before hatching until the converted parr or smolt phase. John Shaw, 1840 [1839] *Transactions of the Royal Society of Edinburgh,* Vol. 14, Issue 2, Plate XXII.

One of these experiments was of particular significance. In it Shaw used the milt of a parr from his ponds. This particular fish's parents had themselves been an adult female salmon and a precocious parr. In other words, the young parr was fertile in just the same way as its apparently immature male parent had been. The fact, as Shaw exploited it, was critical in rebuffing the argument that in breeding parr with salmon, he had only succeeded in producing a hybrid. By showing that the offspring of such a union was fertile, Shaw again connected what was considered, in his words, "a law in the economy of nature" – that hybrids are infertile, a necessary measure to prevent confusion amongst the species – to his

argument that "the *parr* and salmon are really identical in species, as proved [by] the young produced between them having actually the power of reproducing their kind."[153]

In sum, Shaw's demonstration of the two-year migration theory was especially important because it provided a rationale as to why "parr" were found in the river all year round. There could be little doubt after this that *at least a great many* of what were considered to be parr by most observers were in fact young salmon – ultimately, this was probably the most significant thing arising from Shaw's work because it suggested an immediate, instrumental problem for fisheries owners and reformers (see Chapter 3). It did not however *necessarily* imply anything about whether "true parr" existed or not. In principle, the same should be true of the precocious parr experiments – unless Shaw could prove that what he was breeding with salmon were what those who opposed him called "true parr", hence the importance of his curatorial practices. Still, logically, this could threaten to revert the whole problem to where it had begun, as it was hard to agree on what the characters of this fish actually were: the inter-subjective and consensual moment of all empirical knowledge is starkly revealed here. Yet, something clearly did shift in the opinions of important commentators after these experiments.

2.4 The "operation of language and experiment"

The contribution made by Shaw's experiments was soon recognised in relevant quarters. Despite Parnell's contrary testimony, the RSE awarded Shaw with a prestigious Keith Medal in 1840, made of gold and said to be of "intrinsic value of sixty guineas".[154] Three major figures in Wilson, Yarrell and Jardine, appear to have adjusted their views of the parr around the time of the appearance of his last paper. Wilson certainly transformed into a firm Shawite, writing favourable articles in *Blackwood's Magazine,* defending Shaw at the British Association, and rescinded his earlier opinions in his contribution on the subject to

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[153] Ibid.
[154] Scrope, *Days and Nights of Salmon Fishing in the Tweed*, 41; "Appendix. Keith Prize," *Proceedings of the Royal Society of Edinburgh* 58 (1938): 306.

the 1855 edition of the *Encyclopaedia Britannica*.[155] Yarrell delayed the publication of the second edition of his *opus* on British fishes in anticipation of the outcome and reception of Shaw's last set of experiments, and Jardine also appears to have supported Shaw by the time his *British Salmonidae* appeared in 1841.[156] In 1838 Jardine had visited Drumlanrig and, wishing to satisfy himself on certain of Shaw's point (he clearly harboured some suspicions to begin with) begun his own experiments at Jardine Hall soon after.[157] Wilson reporting that by 1843 Jardine had "corroborated" Shaw's observations.[158] A variety of other credible defences also appeared, and scientific luminaries such as William Buckland and Louis Agassiz visited Shaw too.[159] It is tempting to apply Harry Collins' notion of the "core set" to this apparent, and quite rapid, emergence of consensus amongst key specialists.[160]

The condescension shown in such attempts by authorities of high status to avail themselves of the opportunity to witness Shaw's matters of fact at first hand were, I think, as important as any "replications" that may have been achieved subsequently. Whereas I have already described various literary and technical strategies used by Shaw to circumvent prejudice and navigate the scientific "moral economy", what is notable here is the development of Shaw's social integration

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[155] James Wilson, "Shaw on Salmon Fry," *Blackwood's Magazine* 47, no. 294 (1840): 531–43; Wilson, "On the Salmon Fry"; Wilson, "Fisheries."

[156] See William Jardine, *Illustrations of British Salmonidae* (Edinburgh, 1839) [Published in two parts, 1839 and 1841, bound 1861]; Yarrell, *A History of British Fishes*, 1841, 2:esp., pp. 83–84. See also Jackson and Davis, *Sir William Jardine: A Life in Natural History*, 63–64. An illustration credited to "Mr Yarrell's artist" of a "Parr Samlet of Pennant" appears in a collection of papers at NHM (Z 88 q Jar, No. 4). These were intended for use in Jardine's *British Salmonidae*. But no illustration of parr appeared in that book however, probably because Jardine no longer recognised the species.

[157] Jardine knew of Shaw's work prior the publication of the latters first article in 1836, having been informed of the progress the experiments by John Bushnam, a Dumriesshire surgeon, as early as February of that year, see CUL, Add. 9839/13/295, 296.

[158] See Jackson and Davis, *Sir William Jardine: A Life in Natural History*, 64–65; Wilson, "Natural History of Salmon and Sea Trout," 643.

[159] See eg., John Blackwall, "Notes on the Salmon," *The Annals and Magazine of Natural History* 11, no. 72 (1843): 409–14; Robert Hamilton, *British Fishes*, 2 vols., The Naturalist's Library (Edinburgh: W.H. Lizars, 1843). On Buckland and Agassiz's visit, see George H. O. Burgess, *The Curious World of Frank Buckland* (London: John Baker, 1967), 96. Shelton, *To Sea and Back: The Heroic Life of the Atlantic Salmon*, 118 says that the visit occurred in 1844. However, it may also have occurred during Agassiz's geological excursion to Scotland with Buckland in 1840. This coincided with a meeting of the British Association at Glasgow were Shaw's work was discussed. Wilson claimed to have challenged Agassiz by inviting him to visit Drumlanrig after the meeting, see Wilson, "Shaw on Salmon Fry," 535.

[160] Caution might be exercised though: the concept is somewhat anachronistic here, intended as it is to apply to the small, highly specialised groupings of modern scientific practice that are mobilised in the settlement of controversies during periods of unusual debate over the existence or non-existence of phenomena, see H.M. Collins, "The Place of the 'Core-Set' in Modern Science: Social Contingency with Methodological Propriety in Science," *History of Science* 19 (1981): 6–19.

into the realm of an authoritative status group and the forms of social exchange this implied. These represent mechanisms of exchange in which perceptions of status are brokered and raised; of integration into relevant worlds of discourse and society, and thus of stabilising Shaw's participation as a credible witness in certain sorts of scientific affair. Further evidence of this is found in his correspondence with Jardine in 1840 and 1841. In his letters, Shaw discusses the progress of his experiments, the health of broods, and other wider observations of fish life. The two also engage in various forms of practical exchange, Shaw sending specimens to Jardine, and Jardine using Shaw's sea trout captives as models to illustrate his book on British *salmonidae* (Shaw had initiated a parallel set of investigations into the habits of *trutta*). Together they also organised that Jardine would arrange for the progeny of a parr and salmon mating to be painted. In an interesting episode, Shaw offers his opinions on some species of bird (Jardine was also a famous ornithologist), and brokered access to another interesting specimen shot by another gamekeeper and in the Duke's possession, while remaining deferential to the authority of Jardine when it came to naming the species.[161] Shaw also thanked Jardine for his kindness in introducing him to various scientific gentlemen. By the early 1860s, we find Shaw inscribed, not in the Fellowship rolls of the RSE admittedly, but at least as an ordinary member of the regional Dumfriesshire and Galloway Natural History and Antiquarian Society, of which Jardine was President.[162] These incidents, in which Shaw further demonstrated his reliability, may seem trivial, but I read them as important evidence of the healing of breaches in the moral economy caused by destabilising the deference hierarchies to which it was connected.

I have suggested that material, social and literary technologies all played a role in conjuring new matters of fact and relevant associated forms of sociality simultaneously in a context in which there remained something essentially irresolvable about the controversy – as it was typically framed. Indeed, there is further support for this in the reception of Shaw's work in the suggestion that his

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[161] See especially the letters, Shaw to Jardine, of 10 April 1840, 18 and 23 May 1840, and November 1841 (NMS, GB 587 WJ 5/118). The discussion of creating plates presumably relates to sea trout, which Shaw was also culturing by this stage. Jardine thanked Shaw for his kindness, and noted that he used exactly the same technique on these fish as he had in breeding salmon, Jardine, *Illustrations of British Salmonidae*, no page numbers available.

[162] See "List of Members," *Journal of the Proceedings of the Dumfriesshire & Galloway Natural History and Antiquarian Society* 2 (1864 1863): 11–12.

control of literary style specifically was understood to be as important for contemporaries as his experimental demonstrations. The Cornish ichthyologist Couch, who actually doubted Shaw's results, acknowledged sardonically that so "powerful has been the operation of Mr. Shaw's *language and experiments* on the minds of some eminent naturalists" as to lead them into error.[163] Or as a more effusive Scrope summarised Shaw's influence in 1843,

> [Shaw's] papers are *written* with such candour, and all his experiments conducted with such *care and ability*, and so often *repeated* with similar results, *without any effort of intention to make them bend to a favourite story*, that every one [...] must consider [...] that the question is so far set at rest for ever.

Further suggesting how the remnants of scholasticism on the subject were being routed out, Scrope concluded, "all *reasoning*, [...] on this subject is now become superfluous".[164] Before the "scientific" application of fish culture to the problems of salmon development, Esdaile claimed, the "philosophers" had imposed on "public credulity" for a time, but he implied, this era was ended with Shaw.[165] By the "sagacious and observant disposition" of a man with "no pretension to philosophical or scientific knowledge", believed Wilson, the "*opinions"* of learned commentators must now be allowed to give way to the "*facts*" of Shaw.[166]

Of course, Shaw continued to have some scientific detractors. Knox was one of the most ardent. He claimed before the British Association in 1845 that, as far as he was concerned, "no fact had been added to the natural history of the salmon" by the Drumlanrig experiments.[167] Regarding the potency of the milt of parr, he said, the matter had been remarked upon by Willoughby in the seventeenth century, and while "curious enough physiologically" was "otherwise of no practical importance".[168] Later, he maligned the integrity of the experimental work on salmon, claiming that while it was probable that it produced fish *like* salmon, he did not believe that they were really "true salmon". Regarding the fertility of the precocious parr he claimed "[t]hey do not prove the male parr to be a salmon. On

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[163] Couch, *A History of the Fishes of the British Islands*, 4:247. Emphasis added.
[164] Scrope, *Days and Nights of Salmon Fishing in the Tweed*, 28, 35. Emphasis added.
[165] A Rural D.D., "Salmon and Pisciculture," 636.
[166] Wilson, "Shaw on Salmon Fry," 531, 537.
[167] Knox, "Recollections of the Researches into the Natural and Economic History of Certain Species of Clupeadae, Coregoni, and Salmonidae," 80.
[168] Ibid.

the contrary, the growth of the milt in the parr is an unnatural and abnormal phenomenon, proving directly the contrary, proving it not to be the true salmon."[169] Insinuating that the Duke of Buccleuch himself had an interest in allowing Shaw to pursue the question, Knox also later noted approvingly that "[s]cientific continental naturalists, finding persons engaged in controversies who are not scientific men in any sense of the term, stand aloof."[170] In another example of dissent, Jonathan Couch wrote as late as 1865 that, while Shaw was to be praised for his "perseverance" and "honesty in stating his results", the question itself "appears to be just exactly where he found it".[171]

While Knox was widely read, amongst scientific commentators views such as his were increasingly a minority after 1850, and especially after the Stormontfield experiments began churning out salmon from 1855. These experiments, sponsored and undertaken by salmon fishing proprietors and fishermen on the River Tay, were widely reported on in the press, and followed keenly by the British Association of the Advancement of science (see discussions in Chapters 3 and 4). John Davy, Sir Humphry's brother, wrote a commentary on "the question, the vexed question" of the parr in 1854 in which he summarised the stalemate of the earlier period before concluding that, post-Shaw, it had become clear that the terms of the debate had changed. He asked: "what is the evidence that all parties would probably hold to be satisfactory or conclusive?" To his question he replied that it could only be that "the asserted distinct species, propagates its kind, and that in due season, and at the same time, the male and female fish are to be found with roe and milt mature".[172] Since Davy considered this never to have been adequately observed, he concluded, reversing the burden of proof, that it was not sufficiently proved that *the parr* was a distinct species.[173] The great works of piscine systematics later in the nineteenth century, such as Günther's *Catalogue* and *Introduction,* and Francis Day's *The Fishes of Great Britain*,

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[169] Knox, *Fish and Fishing in the Lone Glens of Scotland, with a History of the Propagation, Growth and Metamorphosis of the Salmon*, 84, 85.
[170] Robert Knox, "On the Growth of the Salmon, from the Egg to the Adult," *The Zoologist*, August 1855, 4796.
[171] Couch, *A History of the Fishes of the British Islands*, 4:247. Boccius raised similar doubts to Couch, stating also that a distinct, parr-marked fish found in Germany and Cornwall could not be equated with salmon because it was found in rivers that were without salmon, Boccius, "Artificial Breeding of Salmon and Other Fish," 257.
[172] John Davy, "Some Miscellaneous Remarks on the Salmonidae," *Transactions of the Royal Society of Edinburgh* 21, no. 2 (1854): 253.
[173] Ibid., 254.

deny the *salmulus* and any other theory of or designation for the parr as a distinct species or a hybrid variety, and credit Shaw with putting this vision on a strong scientific footing.[174] "Parr" would become merely generic name for a stage that all true salmon and most *Salmo* pass through.

The fact of the *salmulus* appeared to have evaporated, at least for a key group of naturalist observers, in lieu of positive proof of *its* existence. Can it be concluded therefore that, from the point of view of a "scientific" controversy, the parr controversy was effectively closed? Strictly speaking, this line of finality is very hard to draw. Shaw's early critics had a point. There *could* in principle always still be a small fish of parr-marked appearance, mixing perhaps with the young of its very similar-looking relatives and therefore easy to mistake, that could be described as a distinct species or perhaps a mixture of species. Breeding experiments with salmon might have nothing to say about this possible fish. Indeed, Shaw's main competitor in the field of experimental breeding of *salmonidae*, Andrew Young, manager of the Duke of Sutherlandshire's fisheries, worked on the subject around the same as did time Shaw, did not apparently draw the same conclusion as Shaw did on the basis of very similar investigations, appearing still to equivocate on the possibility of the existence of the *salmulus.*[175] Even Shaw came close to conceding this in 1838 when he acknowledged that even if he had failed "in convincing naturalists about the identity of the parr and the young salmon", he had surely contributed something valuable from a "scientific or economic point of view" to the matter of understanding *salmon.* Because young salmon took longer than was hitherto believed to migrate, the conditions existed for what he called, echoing Scrope and Hogg before him, the "indiscriminate

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[174] Francis Day, *The Fishes of Great Britain and Ireland*, vol. 2 (London: Williams & Norgate, 1880), 77–78; Günther, *An Introduction to the Study of Fishes*, 638–39.

[175] Young is not explicit on his beliefs in his own writing. Others have occasionally credited Shaw and Young as the joint discovers of the parr's true identity by virtue of the fact that their experiments were similar. However, contemporaries (like Russel, see above) clearly viewed Young as opposing Shaw on this issue. The angling writer Ephemera (pseudonym for Edward Fitzgibbon) collaborated with Young in a thorough rejection of Shaw's parr-salmon thesis in 1850 and defended the *Salmulus* theory, Ephemera, *Book of the Salmon* (London: Longmans, Green, & Co., 1850). Selby was present at a dissection at what must have been Young's place in Sutherland in which Jardine's opinions at the time about the identity parr being a *salmulus* were confirmed, see Letter , Selby to Fox, 24 March 1835 (UGSP, GB 2047 f68). Also, Andrew Young, "On the Growth of Grilse and Salmon," *Transactions of the Royal Society of Edinburgh* 15, no. 3 (1844): 343–438.

slaughter of the fish" because people killed salmon under the guise of parr all year round, and were relatively free from restraint in doing so.[176]

It is obviously not feasible to disprove a negative in principle; nor, in principle, is it the case that theoretical positions must necessarily change in the face of new evidence. But as controversy studies in the sociology of scientific knowledge and practice have often shown, controversies are seldom settled in principle, or through absolutely decisive experiments alone: they are managed, transformed and assuaged in local arrangements and cultures until such time as keeping them alive is to simply too costly or too difficult.[177] It is possible that both the breeding of parr with salmon and the two-year-migration theory may indeed have had nothing to do with the existence or not of "true parr". But both of these contributions were nevertheless critical to the question: they suggested adequate alternative interpretations that fitted the data that the *Salmo salmulus* and related conjectures had thus far been considered necessary to describe. The requirement to posit the *salmulus* as a reality diminished, and doing so in practice became immensely difficult – as the troubles exhibited by Parnell to procure specimens and human witnesses reliable enough to maintain the contrary on the basis of physical or anatomical description illustrated. Once the burden for proof was displaced onto those defending the *salmulus*, the defence starts to appear almost silly. Difficulties of identification could, for instance, be put down to the inherent variability of the appearance of all young *Salmo,* or the occurrence of parr in rivers unconnected to the sea easily explained by their being really misidentified juvenile trout that do not require access to salt water. Put differently, it begins to become obvious how much utility was to be had in accepting that parr *sui generis* didn't exist, from both a "scientific and economic point of view." The parr's status had thus changed radically, from being of little interest to being an object of some public concern. After Shaw, as Wilson put it, "[t]he value of the parr and the propriety of a judicious application of our statutory regulations to the preservation

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[176] Shaw, "Experiments on the Development and Growth of the Fry of the Salmon," 174.
[177] Sismondo, *An Introduction to Science and Technology Studies*, 98–99, 105–7 provides a concise summary of this claim and the mechanisms usually found to perform "closure." For debate and controversy between sociologists and epistemologists on the philosophical grounds for these ideas, see esp., James Robert Brown, *Scientific Rationality: The Sociological Turn* (Dordrecht: Springer Science+Business Media, 1984); Tristram H Engelhardt and Arthur L Caplan, eds., *Scientific Controversies* (Cambridge: Cambridge University Press, 1987).

of that small, and, as hitherto supposed insignificant fish, will be obvious without further comment".[178]

2.5 Conclusion

An empirical goal of this chapter has been to supplement the arguments of historians of fish culture who have stated that modern fish breeding techniques were taken up in Britain in the context of a productivity crisis and a perceived decline in wild salmon stocks.[179] I have argued that, while not incorrect, this in fact occurred in the beginning via a highly specific and relatively local debate: the parr controversy. Even more specifically, the introduction of "scientific" salmon culture and artificial propagation particularly, to Scotland at least, occurred as a part of an ensemble of social, literary and material technologies deployed in overcoming a trust bottleneck, and connected in turn to perceptions of usurpation of status and hierarchies of deference which underpinned what I have understood as a scientific moral economy.

The chapter therefore has detailed the early emergence and deployment of a new reproductive technology; its role in the unfolding of a controversy in which specific phenomena and relations were fabricated and clarified; and, in combination with many other actors, in generating particular forms of association, action and social order. Broadly speaking, this suggests key themes in science and technology studies, including that the conditions of emergence of technologies are seldom predicted by their ultimate deployment; that they shape and are shaped by local relations and cultures of practice in tension with broader social and economic forces, and may therefore have various and unexpected socially constitutive effects.[180] Demonstrating a theme remarked on before in histories of the empirical sciences, new social actors tend to become the focus of intense scrutiny by the in-

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[178] Wilson, "Natural History of Salmon and Sea Trout," 642.
[179] Hill, "Sir James Maitland and the Howietoun Fishery"; Nash, *The History of Aquaculture*; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*.
[180] Donald MacKenzie and Wajcman, eds., *The Social Shaping of Technology*, 2nd ed. (Buckingham: Open University Press, 1999).

group, and they tend to bring with them or invent new techniques.[181] In this case, this had to do with managing doubts about ability and reliability.[182]

The parr controversy can also be seen as a story involving the articulation of social and biological forms of reproduction. John Shaw's cultures – his ponds and his essays so to speak – produced both actual living organisms and fairly resilient knowledge of their life histories and character. The investments into ways of intervening into animal reproduction that this involved, in turn, were connected to particular forms of social organization. While understanding the means by which knowledge of salmon and parr was shaped in the controversy has been vital, this chapter has not been generally preoccupied with questions of epistemology. It has been more concerned with the co-production of society and science or nature, or in Jasanoff's phrase, with "people's *knowledge of the world* and their organization of *life in the world,* for each is constitutive of the other": what is at stake is "the production of mutually supporting forms of knowledge and forms of life."[183] This was thematised in the reactions of natural historians to Shaw's work, his means of distinguishing and validating himself and his testimony, and the integration of both him and his matters of fact into a community of practice, discourse and values, partially transforming it and the kinds of knowledge it validated.

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[181] Eg., Harry Collins and Trevor J Pinch, *The Golem: What You Should Know about Science*, 2nd ed. (Cambridge: Cambridge University Press, 1998).
[182] Esp., Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*.
[183] Jasanoff, "Beyond Epistemology: Relativism and Engagement in the Politics of Science," 397.

3. The parr controversy, part II: Property, privilege and the preservation of the salmon fisheries

> Too often there is perplexing obscurity relative to rights in fisheries
> – whether they are free, belonging to the public, or private,
> belonging to individuals. An enlightened and patriotic man,
> and an angler, maintains as a principle, that 'virtually speaking,
> salmon belong to the people; that their careful protection is a popular right'.
> – John Davy, *The Angler and his Friend,* 1855

3.1 "Community" and "society"

On the 20th of January 1858 in Dunblane, a commotion took place on the streets after the local Small Debt Court dismissed a case relating to fishing rights. Andrew Shaw, a labourer from the Bridge of Allan area, had stood accused of an infraction of the laws regulating the wilful capture of salmon and all "fish of the salmon kind".[1] His defence had argued that he not done so. What he had caught, and intended to catch were, in fact, rightly and generally considered *parr*, and the laws that pertained to the protection of salmon fishing did not extend to that kind of fish. The Dunblane "parr trial" makes clear that the controversy surrounding the little fish was far from settled as a social and legal issue in which the scientific question of the parr was also deeply implicated.

Despite the fish being so small, the matter was seen as being of some moment. People celebrated in the streets in a display of approval of the verdict, and of defiance towards those proprietors of salmon fishing that had brought the action. A newspaper reported that "[s]oon after the result was known, great excitement took place in the village". "Joy", it said, "seemed to beam on every face". As the representative of the failed prosecution drove through town, his carriage was "assailed with fierce shouting and yells, accompanied by some blows which nearly smashed the windows." A band playing music struck up and began to march,

[1] "Galbraith v. Shaw," *Law Chronicle* 2 (1858): 124–26.

> preceded by a large crowd, some of them bearing flags,
> one of these with the inscription 'Let liberty flourish';
> while others bore fishing rods with parr dangling at the end.

"Altogether", it was said, "the excitement was intense, and as such as we have seldom witnessed in Dunblane."[2] The sentiment in the crowd, the symbolism of the dangling parr, and the language of the banners, suggest a febrile atmosphere surrounded this case. Indeed, as the newspapers said, its outcome must "rejoice the hearts of anglers in all parts of the country".[3] For these people, and many more like them, the future of certain of fishing privileges was perceived to be at stake.

The Dunblane trial, and others like it (for, as we will see, there were others like it), became trials of contemporary ichthyology. At the centre of the case in Dunblane lay an attempt to prove that parr were indeed young salmon and thus bring the fish under the salmon laws. In fact, the prosecution framed their case so as to attempt to compel the court to adjudicate on a matter it considered outside of its province: that is, as the Sheriff-Substitute saw it, on a "very onerous" matter of science.[4] In court, a paper by John Shaw, the experimental fish culturalist, was led as evidence by the prosecution to the effect that parr should be considered salmon. Expert witnesses from the nearby Stormontfield fish culture ponds, where experiments like Shaw's were being repeated, also testified. But the matter was clearly no longer a matter of natural history only. The parr controversy was a social conflict between interested groups with varying degrees of access to economic, political and other institutional means, including scientific representation. Rather than focusing on the social relations of a scientific controversy as in the previous chapter, the present one shifts attention to a "social" controversy as a "laboratory" for studying how scientific knowledge gelled with legal institutions, and how science and law combined with specific forms of social action and interaction in order to bring about an enforceable agreement between dissenting factions in a dispute involving conflicting claims over resources.[5]

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[2] "Important Fishing Case," *Glasgow Herald*, January 25, 1858.
[3] Ibid. This report, originally from the *Stirling Journal,* was republished in newspapers across Britain, including in London (in *The Morning Post, The Standard* and *Daily News*).
[4] "Galbraith v. Shaw," 125.
[5] Jasanoff, "Genealogies of STS," 439; also, Sheila Jasanoff, "Making Order: Law and Science in Action," in *The Handbook of Science and Technology Studies*, ed. Edward J Hackett et al., 3rd ed. (Cambridge, MA: MIT Press, 2008), 761–86.

In Dunblane, the revelations of the salmon breeders supported the contention of the Proprietors of the Salmon Fisheries in the River Forth, who had brought the action. For the pursuers, the immediate objective was securing a precedent that would bar people from fishing for fish they, and many others, claimed were juvenile salmon. There is little doubt the proprietors were protecting their interests. However, their supporters claimed, more than private fishing rights were at stake. Indeed, the salmon stock and the productivity of the salmon fisheries themselves as a national resource was, apparently, being menaced by people catching the protected salmon under the guise of their being parr. The parr were thus politicised; how it was defined scientifically had became more salient to increasingly numbers of people, and a struggle between competing groups. The situation was also thoroughly *political*, in the sense of comprising of "purposeful activities that aim for collectively binding decisions in a context of power and conflict".[6] From this question there was no easy exit: it is not equivalent to kinds of disagreement scientists engage in. Agreement of some kind would *have* to be found, conflictual relations regulated, and privileges forgone by some or other party.

Those who supported the verdict at Dunblane were usually fishermen who possessed no formal fishing rights, and were often – but not always – of modest means. For them, keeping the dispute over the parr's identity open was a way, in their case, of protecting what they considered had been a customary privilege of the communities to which they belonged since "time immemorial". Advocating local understandings and vernacular beliefs about the fish's identity helped to ensure that, as the judgement in a later parr trial stated, the "lucky parr" continued to "escape through the meshes [of the] legal net".[7] Technically, all fishes of the river were wild animals and hence could not be owned. However, the *right to fish* for salmon and the migratory trouts was an exclusive private right. Practically speaking therefore, it could be taken that "salmon are private property", as the angling writer Bertram put it, while (non-migratory) "trout are not".[8] With parr considered an undecided form of non-migratory trout, it is understandable if the artificial propagation of salmon was, for a brief time, considered an instrument in

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[6] Brown, "Politicizing Science: Conceptions of Politics in Science and Technology Studies," 19.
[7] "Blair v. Miller (1869)," *Journal of Jurisprudence* 14 (1870): 627.
[8] Bertram, *The Border Angler*, 7.

the conversion of *ferae naturae* to private property.[9] It was possible on this basis to believe that parr were being enclosed through the power of a certain class in league with state powers and new techno-scientific instruments. The impact of recognising that parr were salmon, in the words of one pamphleteer (a procurator from Dundee no less), would be to the advantage only of a "select coterie of private individuals" who possessed a

> [s]tatutory right to kill them to increase their own amusement, sport, and profit, to the entire exclusion of the community at large, and particularly those humble members of it to whom a few small fish for dinner, or even breakfast […] would be most acceptable.[10]

According to the same author, the benefits of operations like Stormontfield would flow only to "those who can go to market with well filled purses".[11]

In this light, those who opposed actions intended to end free access to parr fishing expressed attitudes connected to norms and values, including conceptions of fairness, community, tradition and ancient rights, and so forth, that reflect aspects of the EP Thompson's articulation of the moral economy idea. What the social historian called "the moral economy of the crowd" was the presence of a "legitimising notion", "grounded upon a consistent traditional view of social norms and obligations, of the proper economic functions of several parties within the community".[12] This, he clarified, essentially constituted the "political culture" or even "*mentalité*" of groups of people engaged in actions with respect to forces affecting their economic lives.[13] At the root of the idea, as the anthropologist Chris Hann summarised, is the thought that local values and beliefs inform "a popular consensus of right and wrong in a subordinated part of society."[14] In Thompson's most famous case of what he also called "the old paternalist moral economy"[15],

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[9] Historians have described the belief that wild animals cannot be owned as a frequent source of social strife, see eg., Thomas, *Man and the Natural World: Changing Attitudes in England, 1500-1800*, 49.
[10] Henry Flowerdew, *The Parr and Salmon Controversy*, 1st ed. (Edinburgh: T. & T. Clark, 1871), 134.
[11] Ibid., 141. See C.A. Malcolm, "Scottish Legal Periodicals: Past and Present," *The Scottish Law Review* 45, no. 435 (1929): 156–57. Flowerdew was the founder and editor of the *Law Chronicle* (Dundee), a short-lived law journal in the late 1850s.
[12] E.P Thompson, "The Moral Economy of the English Crowd in the Eighteenth Century," *Past & Present*, no. 50 (1971): 78, 79.
[13] E.P Thompson, "The Moral Economy Reviewed," in *Customs in Common*, ed. E.P Thompson (London: The Merlin Press, 1991), 260.
[14] Chris M. Hann, "Moral Economy," in *The Human Economy*, ed. Keith Hart and Jean-Louis Laville (Cambridge: Polity, 2010), 190.
[15] E.P Thompson, *The Making of the English Working Class* (New York: Vintage, 1966), 66.

which consisted fundamentally of feelings towards popular community customs and rights, the crowd was engaged in contesting the role of market forces in setting the price of grain. The moral economy idea though has become widespread and variously applied, including, for instance, efforts to understand responses by local fishermen to the impact of privatisation and enclosure initiatives in present day fisheries.[16] In the case of the parr, it might indeed be possible to frame the discussion in terms of there being a propertied elite who were perceived as overstepping the bounds of tradition and disturbing good community relations by appropriating a common resource.

However, in this form, there are weaknesses in taking a moral economy approach to the parr question. Whilst criticisms of the concept as a species of *Gemeinschaft* critique of modernity are legion[17], the primary difficulty relevant here is its tendency to assume that only, as Hann put it, the "subordinated" or "underdog" sections of society have relevant action-informing values. Economic elites, by way of contrast, are seen as "value-less"; they pursue simply their rational interests (which are associated with the market); their actions are, as Thompson himself said, perhaps not "de-moralised", but at least "disinvested of intrusive moral imperatives".[18] This seems incorrect or over-stated. As Hann points out, "elites have moral norms too"; moreover, "the distribution of norms and values in any particular social context is complex". For example, "some citizens may sincerely believe that the market and private property offer the best moral guarantees available."[19] Authors in the classical political economy tradition (including Adam Smith, Adam Ferguson and John Stuart Mill), in fact, were clear that they valued private property not simply as economically efficient means to allocate resources, but *because* they believed it was best guarantor of the interests

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[16] Eg., Evelyn Pinkerton, "The Role of Moral Economy in Two British Columbia Fisheries: Confronting Neoliberal Policies," *Marine Policy*, 2015, doi:10.1016/j.marpol.2015.04.009.
[17] Thompson's rebuttal of many of the early criticism levelled at him is important, see "The Moral Economy Reviewed"; I found Booth's review helpful in understanding the broader context of "moral economic" claims, "On the Idea of the Moral Economy," *The American Political Science Review* 88, no. 3 (1994): 653–67; A summary of the related debate concerning Polanyi's "substantivism" in economic anthropology, see Barry L Isaac, "Karl Polanyi," in *A Handbook of Economic Anthropology*, ed. James G Carrier (Edward Elgar: Cheltenham, 2012), 13–25.
[18] Thompson, "The Moral Economy Reviewed," 268.
[19] Hann, "Moral Economy," 196, 197.

of individual liberty, and through this, the maintenance of civil society.[20] (Thompson himself conceded that an "absolute segregation between a moral economy and market economy" would be absurd.[21]) Arguably, all economic arrangements and actions, and particularly property, have a justificatory component, or depend on forms legitimation that that are normative or "moral" in some sense.[22]

With this in mind, we can proceed with the methodological assumption that claims made by reformers in the parr controversy are formally symmetrical to the "legitimising notions" of those who opposed them. In the case of salmon and parr, the language of reform revolved around the idea of conservation in the wider public interest.[23] Based on the increasingly accepted belief that parr were salmon, it was argued that keeping down parr fishing would mean better conservation of the "monarch of the brook". The loophole allowing these fish to be caught without effective restrictions was understood to be destructive to the salmon population, the health of which many different kinds of actors in society – including some fishermen, anglers of different kinds, proprietors and consumers – had a long-term interest in preserving. Thus killing parr as such was perceived as infringing upon a sense of "popular right" (as Davy put it in the epigraph of this chapter) at least as much denying access to them where once this had been an historical privelege. In fact, the question was not that parr fishing was to be appropriated from one group for another: it was that parr fishing *tout court,* even for those owning private formal salmon fishing rights, should be stopped, entailing equally curtailments on how proprietors disposed of their property. Thus it might be said that there were two "moral economies" at work. Moreover, I approach these primarily in terms of their rhetorical function in justifying the claims or actions of different parties, but also in mediating the conflict through ameliorating the harder edges of the demands being made by opposing interests. Indeed, the different sides mobilised

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[20] See also discussion in Chris M. Hann, "Introduction: The Embeddedness of Property," in *Property Relations: Renewing the Anthropological Tradition*, ed. Chris M. Hann (Cambridge: Cambridge University Press, 1998), 14, 23.
[21] Thompson, "The Moral Economy Reviewed," 272.
[22] C.f., Marion Fourcade and Kieran Healy, "Moral Views of Market Society," *Annual Review of Sociology* 33 (2007): 285–311; William Davies, "Ways of Owning: Towards an Economic Sociology of Privatisation," *Poetics* 40, no. 2 (2012): 167–87; Also Andrew Sayer, "Moral Economy as Critique," *New Political Economy* 12, no. 2 (2007): 261--270 for more a radical/critical deployment.
[23] C.f., MacLeod, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86" discussed in more detail below.

prima facie equally plausible yet contrasting visions of the common good and how it should be realised in their struggle. The one side founded on a language associated with the justness of traditional privileges and implied notions of the liberty and the "community", the other on rational conservation and the wider good of "society" via the augmentation of existing conservation mechanisms, and by way of this the preservation of particular formal rights.

A wide-angle view of the interests of this chapter can then be summarised as an exploration of the interaction of "moral economies" in the resolution of an historical conflict. How did each relate to key institutions, including the authoritative knowledge of science, the popular knowledge of communities, and the different branches of law? To what social processes in the salmon fishing and angling arenas were they connected, and through these how were they politically influential? Overall, with mutually incompatible claims threatening it, I consider how the social order was regulated, reproduced, and maintained. While the institutions of science and law were clearly central to this, I will also show that subtle inter-group relations, including questions of social hierarchy, status, perceptions of self and others, ideas about sporting ethics, notions of a "good society", and conservation played roles in making any resolution binding and enforceable. In conclusion, I situate the discussion of the conflict in terms of modern reproduction and social order, and illustrate how my discussion differs from some alternative interpretations.

3.2 "The Salmon Question"

Since at least the second decade of the nineteenth century, there had been a sense across Britain that the salmon fisheries were in an increasingly parlous state. Historians generally agree with contemporary opinion that this period witnessed significant increases in pressure on salmon populations – although the full extent of the supposed decline, and its specific causes, are hard to assess.[24] The sentiment however grew pressing during the middle decades of the century. As a writer in

[24] See A.J Lee, *The Directorate of Fisheries Research: Its Origins and Development* (Lowestoft: Ministry of Agriculture, Fisheries and Food, Directorate of Fisheries Research for England and Wales, 1992); Iain Aitken Robertson, "The Tay Salmon Fisheries in the Nineteenth Century" (Ph.D. thesis, University of Stirling, 1989); J Sheail, "The Tweed Fisheries: An Historical Perspective," *The Science of the Total Environment* 210/211 (1998): 469–82.

the periodical *All The Year Round* put it in 1861, around the time that attention on the subject reached fever pitch,

> A few years, a little more over-population, a few
> tons of factory poison, a few fresh poaching devices
> and newly-invented contrivances to circumvent victims,
> and the salmon will be gone – he will become extinct.[25]

Indeed, official commissions appointed to inquire into the salmon fisheries of Scotland in 1860 and England and Wales in 1861 described a number of contributory factors.[26] Industrial pollution and the effects of agricultural improvement, causing deleterious runoff and rapid level fluctuations, were amongst these. Dams, mill weirs and other kinds of obstacle blocking the ingress of salmon where also understood to be of great consequence.[27] But the key issues for those administering the salmon fisheries related to the regulation of various fishing practices and the competing interests associated with them.

The great salmon producing rivers of Scotland and northern England had been seized with a strong spirit of competition since at least the turn of the century. On the Tay for example, Britain's foremost salmon river (and my particular focus in the following chapter) the number of operators had grown in proportion to their attempts to outdo one another, and these became increasingly vigorous as they sought to supply rising demand for salmon in the cities on the back of what Russel called "the improved condition of the mass of the people".[28] Improvements in packing and transportation technology radically expanded the salmon market and were key catalysts. The arrival of ice and steam meant that large numbers of fresh salmon could be sold inland for the first time. Steam vessels plying the coasts tamed the vagaries of wind and current from the 1830s; trains began departing for London filled with fresh Tay fish from about 1850.[29] But

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[25] "Salmon," *All the Year Round*, July 20, 1861, 405. Coates attributes this article to Dicken's himself, possibly erroneously, see Coates, *Salmon*, 11. The author may have been Frank Buckland, whose is known to have contributed to Dickens' other journal, *Household Words.* The author lists of Dickens' famous journal have sadly been lost however. (Personal correspondence with John Drew, University of Buckingham and Dicken's Journals Online, 11 April 2013).
[26] See PP, UK (1860) [456] and PP, UK (1861) [2768] [2768-I].
[27] See esp., Lee, *The Directorate of Fisheries Research: Its Origins and Development*, 14; also, MacLeod, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86," 115–18.
[28] Russel, *The Salmon*, 216–17. Also, Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," esp., 86-90.
[29] Lee, *The Directorate of Fisheries Research: Its Origins and Development*, 14; Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 228.

despite a picture of increased demand and correspondingly high prices for salmon, most salmon fisheries were experiencing declines in value. Average total rental per year for the Tweed in the earlier part of the century is reputed to have fallen, says fisheries writer James Bertram, from £20 000 to £3 300 "within a few years".[30] Later, total rental on the Tay fell from £14 000 in 1828 to £10 150 in 1836. By 1852, its nadir, it was only £7973.[31] While rental averages can disguise as much as they reveal about actual river productivity, there is no question that such figures were cause for alarm, and were promoted by effected agents to suggest a picture of real overall declining stocks – an issue of great relevance in the following chapter too. That there were genuine decline in many cases cannot be doubted though: on the Tweed for instance, around 100 000 fish, sometimes over 200 000 per year were often reported prior to 1820; however, the average for the period 1845 – 1859 was reported to have dropped to 77 860, declining still further after 1860.[32]

Against this backdrop, at the centre of this great "salmon question", as Russel called it, there emerged a succession of what many considered defective enactments intended to manage competing fishing interests and preserve the salmon stocks.[33] In fact, such was the proliferation of Bills, Acts and Commissions of Inquiry that Sir Robert Peel is supposed to have remarked that he "never recollected a Session of Parliament without a Bill for Amendment of Grand Jury Laws of Ireland, or the Salmon Fisheries of Scotland", and the same is mostly true of England and Wales.[34] The result was extraordinary complexity and confusion. By the early 1860s, says historian of British government and science Roy Macleod, the accumulated "mosaic of protective legislation defied analysis".[35] But, after sustained agitation from fisheries interests, two sweeping Acts of reform and consolidation were passed in the early 1860's.[36] These formed new foundations for the regulation of salmon fishing in England and Wales (1861) and Scotland (1862), and their basic principles remained in place for the rest of the century. One

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[30] James G Bertram, *The Border Angler* (Edinburgh: John Menzies, 1858), 10.
[31] Russel, *The Salmon*, 112; See also Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 285.
[32] Sheail, "The Tweed Fisheries: An Historical Perspective," 473.
[33] Russel, "The Salmon Question."
[34] PD, Commons, vol. 81 (5 June 1845), col.178.
[35] MacLeod, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86," 117.
[36] "The Salmon Fisheries Act (England & Wales)" 1861 (24 & 25 Vict.), c. 109; "The Salmon Fisheries Act (Scotland)" 1862 (25 & 26 Vict.), c. 97.

Scottish advocate complained in 1869 that recent legislation was still "frequent and complicated".[37] But, nevertheless, these reforms were usually considered to be more technically competent, based on empirical observations, and far-reaching than any that had preceded them, even if they could not address some of the central problems facing the fisheries (see Chapter 4). The problem of the parr and its regulation was one small element in these reforms.

3.2.1 *Perspectives on nineteenth century reform of the salmon fisheries*

The limited secondary literature on nineteenth century salmon reforms contains divergent views. Macleod argues that a key feature was the way in which "'special professional knowledge'" (scientific and bureaucratic) was "used administratively by the state to conserve and protect the wealth of the nation." Indeed, science was increasingly the creed of modernizing commentators in this area. ("Without some knowledge of how, when, and where the fish breeds, dwells, and feeds", as Russel put it, "it is useless to speak and unsafe to act".)[38] Moreover, Macleod emphasised, the reforms included some of the earliest attempts by the state to "regulate private property in the public interest", and that they became the historical basis for future British "nature conservancy policy".[39]

Understandably, this resulted in severe objections to reform by various incumbents who wished to remain at their liberty to use their property as they so wished, and who tended to defend laissez-faire approaches.[40] However, it was usually recognised that some regulation was necessary because, in the area of salmon fishing, the exercise of sovereignty by one owner necessarily impacted upon that of another, and thus became an equity issue. As Russel put it, "[i]t is a peculiarity of fishing property that it cannot be used as absolutely at the owner's disposal, to 'make the best of,' like some other kinds of property". Rather,

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[37] Charles Stewart, *A Treatise on the Law of Scotland Relating to Rights of Fishing* (Edinburgh: T. & T. Clark, 1869), 4.
[38] Russel, *The Salmon*, 31.
[39] MacLeod, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86," 114, 115. By way of comparison, economic sociologist Dobbin provides a valuable discussion of British economic and political culture with respect to individual sovereignty and the "public interest" in the area of nineteenth century industrial policy, see Frank Dobbin, *Forging Industrial Policy: The United States, Britain, and France in the Railway Age* (Cambridge: Cambridge University Press, 1994), 163–65.
[40] In the House of Lords, the Earl of Malmesbury was one of the most implacable critics on this score. He expressed very deep concerns regarding "respect to the liberty of the subject and the rights of private property", PD, Lords, vol. 163 (31 May 1861), col. 346 – 350.

> a man who exercises his ingenuity and industry to take as many fish as possible out of his fishery, these fish being travellers, and neither natives nor residents, makes a proportionate deduction from the share naturally falling to his neighbours.[41]

In such circumstances, the possibility of "beggaring thy neighbour" made the necessity of limiting the fishing rights of proprietors quite patent, or else competition between unchecked fishing interests might destroy the stock for everyone in a tragedy of the commons situation.

Moreover, during this time, the situation of the nation's food supplies, especially meat, were (accurately or otherwise) widely said to be at risk, especially given the demographic background of a growing industrial population.[42] Indeed, political rhetoric surrounding reform of the fisheries held that in this context the salmon was essential for the national good. As Mr Fenwick, MP for Sunderland, put it in 1861, whereas salmon had once been the "food of the people" (the phrase was a cliché), it was "now confined to the opulent classes".[43] The price of salmon was regularly compared to that of a Southdown sheep, and was by the early 1860s considered by official enquiries to be expensive beyond the means of most.[44] The notion of rapid increases in price and scarcity was so strong that a story was constantly cited, and repeated to effect in Parliament, of earlier times of plenitude in which salmon had been so cheap and abundant that a clause in indentures had been required to limit the amount of times masters were allowed to feed salmon to their apprentices per week! One correspondent to *The Field* newspaper insisted that he could "produce credible evidence" that farmer's servants on the Solway Firth had "formerly rebelled in their hiring's against salmon altogether, by reason of the almost daily repetition of them."[45] The story may be apocryphal, but was

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[41] Russel, *The Salmon*, 142.
[42] David Esdaile, for instance, wrote of the importance of making the people "ichthyophagous to an extent as yet unknown", see A Rural D.D., *Contributions to Natural History: Chiefly in Relation to the Food of the People*, 155; For further examples of this discourse, including enquiries into the deficiencies of the poor man's diet, and a proposal of better fisheries as a remedy for them, see Joseph Brown, *The Food of the People* (London: Longman, Green, Longman, Roberts, & Green, 1865).
[43] PD, Commons, vol. 162 (22 March 1861), col. 212 – 4212.
[44] Eg., MacLeod, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86," 115; His source is Russel, "The Salmon Question" but the example, and sentiment, was common. Osborne says that price of salmon in the cities rose "twenty-fold between 1820 and 1850", Osborne, "The Development of Salmon Angling in the Nineteenth Century," 198.
[45] Republished with further "evidence" of this sort in "Salmon," 405.

repeated so often, that it took on the status of a verity and a call to arms to preserve the salmon.[46]

In this context, the argument that there was a public interest dimension to salmon reform was clearly powerful. Although focusing on a different set of freshwater fishery reforms (namely the coarse fisheries in the 1870s), Peter Bartrip's analysis has common cause with Macleod. For him, the central issue in the freshwater fisheries in general, including salmon reform, was also the challenge reforms represented to the "paramountcy of private property and the legitimacy of laissez-faire". He reads them therefore as part of a wider historical shift during which the absolute association of political power with property ownership *declined*.[47] The fundamental strategic challenge of reformers – and this clearly applied to salmon fisheries as well – was "establishing the national importance of leisure and food resources" in the public and political consciousness.[48] This implies a communicative struggle between actors to impose a specific definition of the situation.

These readings are perhaps not so acute on the social history and the local interpretations and effects of reform, however. Other commentators emphasise more sectarian dimensions to the question looked at "from below", recognising that during the nineteenth century salmon fishing was in fact largely controlled by social elites, sometimes including consortiums of commercial fishers, but typically landed interests and increasingly wealthy anglers, professionals, industrialists and financiers with the pretentions of gentry.[49] It is certainly true that the image of the "salmon and the rich man" become firmly entrenched in the public mind during the Victorian period. Peter Coates cited Robert Blatchford in his radical tract *Merrie England* (1893) declaring:

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[46] Lord Stanley of Alderley felt it unlikely a time would return in which it would be necessary to ban masters from serving salmon "oftener then three times a week", see PD, Lords, vol. 164 (23 July 1861), col. 1345 – 1346. The writer of "Apprentices Indentures and Salmon," *The Field*, June 22, 1862, 581 found little evidence of the so-called Totnes Indentures, but nevertheless felt "there is little doubt of their probability." Years later, Frank Buckland was not dismissive of the story, though he too had searched fruitlessly for the evidence, Francis Buckland, *The Natural History of British Fishes: Their Structure, Economic Uses, and Capture by Net and Rod*, 2nd ed. (London: Society for Promoting Christian Knowledge, 1880), 321–313.

[47] Peter Bartrip, "Food for the Body and Food for the Mind: The Regulation of Freshwater Fisheries in the 1870s," *Victorian Studies* 28, no. 2 (1985): 299.

[48] Ibid.

[49] See eg., Coates, *Salmon*; Lowerson, *Sport and the English Middle Classes, 1870-1914*.

> Is it not true that the salmon and all other delicacies are monopolised by the idle, while the coarse food falls to the lot of the worker? Perhaps under Socialism the salmon might be eaten by those who catch it.[50]

In this context, Harvey Osborne has argued that the Salmon Acts of the 1860s in England and Wales in fact "contributed to a strengthening association between the salmon and landed interests". Osborne points out that many interpreted salmon reform as an "appropriation of fishing rights" and, importantly, discussed how this involved the subdual of traditional fishing methods.[51]

Such readings of the fisheries laws also serve to put fisheries reforms in the context of wider narratives of the transformation of rural Britain. The history of salmon reform indeed may be seen as also connected to trends in land ownership during the nineteenth century, including in particular "the acquisition and appropriation of wilderness areas for elite field sports."[52] As agricultural historian Overton writes, processes like these were imagined, on the one hand, as "taking food from the poor and giving sport to the rich", and on the other, a "custom to crime" thesis underpinned by a "growing intolerance by the gentry of the customary rights of the poor". These themes have, indeed, often been constructed in terms of a breakdown in an erstwhile paternalist "moral economy".[53]

David Kent's analysis of fisheries reform on the River Tweed in the late 1850s, for instance, agrees with Osborne's assessment, but argues more forcefully that reform hinged on "class-based legislation". Kent's focus is on the local Tweed Acts of 1857 and 1859, pieces of legislation designed to apply to the specific circumstances of the River Tweed, the Border between England and Scotland (whose laws with respect to the ownership of salmon fishing differ in important details).[54] Kent interprets these events "in the spirit of the Game Laws". By this he

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[50] Coates, *Salmon*, 108.
[51] Osborne, "The Development of Salmon Angling in the Nineteenth Century," 202, 204.
[52] Ibid., 211. Esp., in the Scottish highlands, Huggins, "Sport and the British Upper Classes C. 1500-2000: A Historiographic Overview," 374; and Wightman et al., "The Cultural Politics of Hunting: Sporting Estates and Recreational Land Use in the Highlands and Islands of Scotland," 57.
[53] Mark Overton, *Agricultural Revolution in England: The Transformation of the Agrarian Economy, 1500-1850* (Cambridge: Cambridge University Press, 1996), 185.
[54] "Tweed Fisheries Act" 1857 (20 & 21 Vict.), c. CXLVIII; "Tweed Fisheries Amendment Act" 1859 (22 & 23 Vict.), c. LXX. The key difference was in England and Wales salmon fishing rights were exclusively riparian in nature, but in Scotland fishing rights and land ownership are in principle, if not always in practice, separable. Border rivers like the Tweed required their own regulatory Acts.

means that like the highly penal Game Laws of the eighteenth century[55], the Tweed Acts were "designed to preserve the privileges and prestige of the landed elites, they applied to an ambiguous form of 'property', they were a touchstone for opposing value systems [and] a focus of political debate."[56] In his interpretation, landed gentlemen with recreational fishing interests, led by the Duke of Roxburgh and others with powerful Westminster connections, forced through the Tweed Acts using strong-arm political tactics. Their concern was private enjoyment; concern for the salmon stock being an excuse or at most a secondary consideration. Kent's case is remarkable though, it should said: resentment against the Acts amongst local communities was such that sufficient violence arose between fishermen and those tasked with enforcing the laws that the Admiralty considered it prudent to deploy gunboats in the estuary to quell it – a state of affairs lasting for over two decades. Such a use of "naval force in the aid of civil power", says Kent, was unprecedented.[57] While unusual, the case does ably demonstrates key general themes.

Analyses like Kent's however tend towards a zero-sum game – the interests of one party, typically "elites", being seen as realised necessarily at the expense of another, namely local "communities". But as Macleod and Bartrip's analysis suggested the issue was more complex: various parties had interests in conserving salmon (I'll suggest that landed gentry were in fact not necessarily the prime social movers towards reform), and it was perceived as an issue effecting the national good. My interpetation though draws on both outlooks and does not seek to adjudicate between these positions, as will become clear. In general, it does not seek to characterise reforms in overall terms at all, but rather focuses on exploring how both sides mobilised values as rhetoric in moral economies, and how these structured representations of the situation, legitimising different actions and claims in a struggle over how to regulate conflicting social interests.

In the following sections, I explore the hidden social history of parr and parr fishing in this broader context. I connect concern with the parr to the overall

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[55] See P.R. Munsche, *Gentlemen and Poachers: The English Game Laws 1671-1831* (Cambridge: Cambridge University Press, 1981).
[56] David Kent, "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!,'" *Northern History* 42, no. 2 (2005): 294.
[57] Ibid., 293.

picture of declines in salmon stock, and specifically to changes in the value of recreational angling as a fundamental driver of change in this area, as well as the increasing popularity and social heterogeneity of the pastime. I argue that these factors caused rising concerns about poaching, and a corresponding demand to put down certain fishing methods and kinds of quarry, including parr. The practice of parr fishing, in this light, changed from being a minor and tolerated activity into a stigmatized and dishonourable one. I also show that a pattern developed in which practices seen as interfering with the young of the species in particular, and therefore its reproduction, were readily perceived as connected to a wider public interest.

3.3 A social history of parr fishing and fishermen

> The parr was at one time so wonderfully plentiful, that those farmers and cotters who resided near the rivers used not infrequently, after filling the family frying-pans, to feed their pigs with them! Countless thousands of them were annually killed by juvenile anglers, and it never occurred either to the country gentleman or their farmers that these parr were young salmon.
>
> – Alexander Russel, *The Salmon Question,* 1863

Parr fishing was a marginal enterprise, and only really emerged as a subject of earnest public debate after experimental evidence convinced enough relevant actors that the practice of parr fishing might be causally linked to the experience of a declining salmon stock. Before then, the fish was indeed insignificant – not of course to everyone, but at least too many, including regulators and salmon fisheries proprietors.

Writing a social history of parr fishing is difficult. Because of its marginality, there is little evidence available about what parr and parr fishing actually meant to many people. Nevertheless, an effort can be made to place the parr in the context of wider social dynamics in the salmon fisheries, as well as by paying especial attention to the way in which parr fishing and parr fishermen were represented. Looked at in a broader perspective, this section will show that parr fishing partook in a social-historical pattern as one of many recreational activities (often but not exclusively associated with plebeian culture) that British modernity dismantled.[58]

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[58] Kent provides a summary of the literature from the Victorian period, ibid., 294. For related studies from the Eighteenth century see also, E.P Thompson, *Whigs and Hunters: The Origin of the Black Act* (London: Penguin, 1990); E.P Thompson, *Customs in Common* (London: The Merlin Press,

3.3.1 *The growing value of salmon angling and the question of poaching*

During the first half of the century, recreational salmon angling grew increasingly popular. Developments in technology played a role in this shift, as light tackle was by now being produced that an individual could wield easily alone and yet still control the powerful runs of a hooked salmon.[59] Fly-fishing in particular became for the first time an esteemed element in the pantheon of elite field sports, and a marker of social distinction. It has been suggested that growing scarcity of salmon may have contributed to these shifts because it made the pastime appear especially rare and, therefore, valuable.[60] The trend existed throughout Britain, but was particularly remarkable in Scotland. With its prime salmon rivers (many relatively unexploited compared to those in England)[61], Scottish angling was especially prised after Prince Albert and Queen Victoria began spending their summers fishing in the highlands in the 1840s. This contributed to a fashion amongst the landed classes, and those who aspired to similar status. In this context, those who could afford it became increasingly willing to pay handsomely for the privilege of "the first *tug* of a salmon, […] the most exquisite sensation of which this mortal frame is susceptible".[62] As Bertram wrote in 1861 the "liberty to play one's rod on a salmon river is a privilege paid for at a high figure per annum."[63]

This trend was of wide significance for the salmon fisheries. In particular, it meant that even as the rents accruing from commercial salmon fishing were in general declining, increases in the monetary value of recreational fishing rights were widely reported. Importantly, these privileges obtained largely in tributaries and middle and upper stretches of rivers were commercial scale net fishing was unviable. As Russel noted "even the worst upper waters can be 'let' at a good

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1991). I do not say "exclusively" because "upper class" pastimes, like duelling, often had similar fates, and many, like cockfighting etc., were enjoyed across the socio-economic spectrum.

[59] On angling tackle, see Coates, *Salmon*, 126; and Osborne, "The Development of Salmon Angling in the Nineteenth Century," 187–97.

[60] Eg., Coates, *Salmon*, 197; Kent, "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!,'" 298.

[61] Scottish rivers are believed to have been better preserved than English because of the history of use of private legislation there previously to the general reform Acts of the 1860s, Lee, *The Directorate of Fisheries Research: Its Origins and Development*, 14.

[62] Russel, *The Salmon*, 16.

[63] [James G. Bertram], "The Salmon and Its Growth," *The Cornhill Magazine* 4, no. 19 (1861): 48; also James G Bertram, *The Harvest of the Sea: A Contribution to the Natural and Economic History of the British Food Fishes* (London: John Murray, 1865), 199.

figure", with anglers willing to "pay very high for what is of comparatively trifling value to the lower or commercial interests."[64] (This spatialisation of the salmon fisheries is also central to Chapter 4). While the overall perception of decline in salmon numbers was obviously crucial here, I suggest it was the growing importance of the "rod interest" in particular that raised the public profile of poaching as a conservation problem, and as we'll see, the parr issue was closely associated with this.

Two relevant things follow from these circumstances. On the one hand, a picture emerges of a growing resolve amongst salmon fishing proprietors to extend their grip on increasingly desirable river fishing in the face of the customary claims on the resource made by the public. It was widely recognised that, as a solicitor from the Abergaveny area put it, the "usurpation of title holders by individuals claiming 'right to fish by custom'" was of growing significance and, furthermore, a matter very difficult to "protect against".[65] Scotland had specific difficulties with regards to disputed titles, the completion of which required the demonstration of adequate prescription in addition to a written charter.[66] Depending on local circumstances and historical patterns of use, it was easy for the perception to arise that prescription had never been adequately fulfilled. In many cases proprietors may also have had little opportunity to deter interlopers in any event, and many had no doubt tolerated small-scale poaching in the past.[67] Thus in many places the public may have come to expect a continuation of fishing privileges claimed to descend from immemorial usage.[68] A result was that disputes could arise when titleholders emerged and claimed formal rights over areas

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[64] Russel, "The Salmon Question," 389; See Robertson for an analyses of these trends on the Tay, Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," esp., 284-285.
[65] PP, UK (1861) [2768] [2768-I], 52.
[66] The issue of title in Scotland was complicated and disputed. The most comprehensive account is Stewart, *A Treatise on the Law of Scotland Relating to Rights of Fishing*; For general introductions see also John Erskine, *Principles of the Law of Scotland*, 21st ed. (Edinburgh: William Green & Sons, 1911), 235; [Neish, E.W.] and D.P Blades, *Encyclopaedia of the Laws of Scotland*, ed. R.H. Viscount Dunedin, John L Wark, and A.C Black, vol. 7 (Edinburgh: W. Green & Son, 1929), 125–48; I also draw on Thomas Baker, *The Laws Relating to Salmon Fishing in Great Britain* (London: Horace Cox, "Law Times" Office, 1866) for a view of the matter in England.
[67] This may be the case on large highland estates particularly. Also, in Scotland, because salmon fishing and riparian rights are separate, proprietors often lacked the power to police the local populace. In other situations, coincidence of land and fishing meant proprietors could be more hopeful of obedience from their dependents and tenants, see eg., Young's testimony on poaching on the Shin, PP, UK 1860 [456], 103.
[68] "Time immemorial" was understood to indicate without memory to the contrary. In Scotland, proof of the exercise of prescriptive for a period of forty years had the same effect.

seldom fished before, as was increasingly likely happen as the value of previously marginal angling waters rose.[69]

On the other hand, rising prices meant the market also denied fishing options to many. By the 1850s for instance, locals in the Border's region and on the Tweed especially were being squeezed out of the market for salmon fishing by the high rents that "English gentry" were paying for them.[70] In these areas, highly accessible by train and proximate to significant population centres, Kent estimates that in 1857 the cost of angling could be calculated at between £3 and £5 per fish whose market value was only "a few shillings".[71] In these circumstances, it is possible that fishers – disenfranchised by the market and the increasing vigour with which gamekeepers were now being required to prosecute their duties – may have sought satisfaction by other means. In the Borders and Tweed region particularly, poachers most active and were said even to operate as organised gangs of roughs. As Bertram records, on the Teviot stream, where increasingly strong protections had been placed "upon the angling of late years by several landowners", the river had become correspondingly "much harassed by the Hawick mechanics".[72] The weavers of Galashiels and Selkirk had similar unsavory reputations and, it was said, that some used historical antagonism towards England as source of justification for their depredations. In some cases, it was claimed, poaching was even elevated from an amusement into "a trade or business entered into as a means of securing a weekly or annual income; it has its complex machinery".[73]

Poaching , in any event, thus became a highly contentious issue and topic. On the one hand, it was seen an affront to property and the public's interest in good regulation of the salmon stock; but on the other hand, some felt, in the words of the Lord Advocate of Scotland, that to "stretch laws for the protection of game or

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[69] Whether the rod, as opposed to the net, could be a basis for claiming prescription itself became a hotly contested issue, see [Neish, E.W.] and Blades, *Encyclopaedia of the Laws of Scotland*, 7:126; Stewart, *A Treatise on the Law of Scotland Relating to Rights of Fishing*, 76–77.
[70] Coates, *Salmon*, 127–28; Osborne, "The Development of Salmon Angling in the Nineteenth Century," 204.
[71] Kent, "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!,'" 300.
[72] Bertram, *The Border Angler*, 143, 144.
[73] Bertram, *The Harvest of the Sea*, 202. Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 282–83 notes the effects of easy access to markets and price rises after 1850 on the commercial viability of poaching.

fishing beyond the limit which custom and public opinion will justify, has tendency not beneficial to either to the preservation of the game of the general state of society."[74] The line between legitimate and illegal fishing was thus continuously debated, and the language of custom and tradition became a bastion of defence. In parliamentary debate, to jump ahead slightly (see Section 3.4), the issue often became heated. When the Scottish Salmon Fisheries Bill appeared in 1862 it originally contained a clause for local authorities to impose rod licenses, the MP for Berwickshire at the time, in opposing the clause, claimed it "was calculated to demoralize the people, who would not take out licenses to do that which had been a custom for 100 years."[75] Two years earlier, a Bill for the preservation of the trout fisheries of Scotland had been proposed, said its promoter, in "the interest of the public […] in their sports, in opposition to the number of persons who were in the habit of coming from Glasgow at night [and] exhausting the rivers". To this, the representative from Glasgow retorted that the banning of particular methods of fishing would impose "an excessive restriction on the amusements of the people, and more especially of the poorer classes." He expressed special sympathy for "the interest of the children of the rural population, who were in the habit of setting lines from time immemorial".[76]

In necessary alliance with one another, anglers and upper proprietors were at the centre of concern over salmon poaching. At the same time, however, it was also certain kinds of angler who considered that they were threatened with disenfranchisement, and who defended their fishing privileges. In his book *The Border Angler: A guide-book to the Tweed and its tributaries and other streams commanded by the North British Railway,* James Bertram defended the rights of ordinary fishers – presumably largely from the skilled working and middle classes with leisure time, people who could afford to catch the train for a day's angling and were certainly not themselves proprietors. As he had taken umbrage at poachers, he likewise declaimed the actions of supposedly covetous proprietors. For instance, he described a stretch of river between Rutherford and Kelso in the

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[74] PP, UK 1860 [456], 16. (In response to a question from Lord Polwarth, a salmon fisheries owner, about the utility of making all game and fishery offences criminal offences.)
[75] Mr David Robertson (Berwickshire, 1859 – 1873), PD, Commons, vol. 167 (17 June 1862), col. 670 – 673. The clause was voted down, as had similar ones previously.
[76] Exchange between Alexander Cochrane-Baillie (Honiton, 1859 – 1868), and Walter Buchanan (Glasgow, 1857 – 1865), PD, Commons, vol. 158 (2 May 1860), col. 536 – 539.

Borders in which not an "inch" of river was any longer available to the public, every part of it having been "seized upon" and made an "exclusive private right, in defiance of the public, asserted by force of gamekeepers". Thirty years previous, he says, the entire stretch had been open to the public.[77]

How did these wider circumstances relate to the question of parr specifically? For one, the biology and habits of salmon, especially the fact that they bred in the upland waters, meant that most parr would be caught in the angling stretches of salmon rivers, bringing lessee anglers and upper proprietors into direct proximity with those who would, or in any event did, catch them. It is therefore of no surprise that salmon anglers had been at the forefront of arguments about parr and had been since the earliest days of the controversy (as we saw in the last chapter). Moreover, as salmon fishing became increasingly rare, the value and desirability of fishing for *other* species was rising too. Importantly, the popularity of all forms of angling, not just salmon angling per se was increasing, and consequentially, new kinds of social actors were found on the riverbanks in increasingly large numbers, often (or at least supposedly) in pursuit principally of the lesser *salmonidae* (to catch a salmon might be a bonus). The (relatively) more "public" non-migratory *salmonidae*, the trouts (and parr with them), would be included in this. Parr fishing privileges, indeed, may even have been perceived as the thin end of the wedge: if they could be curtailed, what was to stop the supposed cupidity of the salmon fishery proprietors extending to trout? Bertram in fact described various instances of proprietors over-reaching in this direction, barring access to trout fishing quite "illegitimately", he claimed.[78]

With this context in mind, I turn next to looking in more detail at the practice of parr fishing itself, and the discourses that came to surround it. How did parr fishing become delegitimized, viewed as dangerous to the general interests of society? I suggest it became a symbol of the violation of norms and codes characterizing particular social worlds or groups, and a site through which marks of distinctions between social actors could be established and maintained, and in these ways connected to the "moral economy" of "society".

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[77] Bertram, *The Border Angler*, 81–82.
[78] Ibid., 81–84. This was clearly a greater problem in Scotland than elsewhere in Britain because of the overlap between riparian trout fishing rights and non-riparian salmon fishing rights – the opportunities for conflict where many (see vida supra).

3.3.2 *Parr fishing in practice and rhetoric: Social attitudes and status*

Reason suggests that parr must have been caught by a variety of folks, of different social status and class, for a variety of reasons – not only by the poorer ranks who were likely to have been most severely excluded from other kinds of angling by the market. Recreational anglers of all kinds using rod and line, including the artificial fly, certainly caught parr – deliberately or accidentally – in conjunction with angling for other species. However, the practice became firmly associated in public discourse with the "lower social orders", as well as people supposedly fishing for subsistence reasons, using lower status techniques such ground baits, set lines, nets and other tackle.

While no data was ever kept on who actually caught parr, testimonies from Wales and the Wye region heard by the Special Commission enquiry into salmon fishing in 1861 provide some insights.[79] Mr. F. Green a solicitor from Carmarthen and a former secretary of an Association for the preservation of the Cothi river, testified that in the last twenty years, baskets had been set up at "every mill on the side of the river" for the express purpose of killing what he considered salmon fry ("pinks", as they were called in the area). He admitted that he did not know whether these fish were eventually sold, but he said that they were undoubtedly "used by the individuals who take them".[80] Another witness though, a magistrate from Herefordshire and a conservator on the Wye, argued that a large part of these fish were disposed of in inns and hotels. The men of Ross in particular, he claimed, come down in their "fifties and hundreds" especially to eat fry. "The first question you hear in the coffee room is: 'Waiter, have you any salmon fry, or salmon pink?'" He says some may be sold through fishmongers, but if they are, the shop men are careful not to "expose them" in public. Skirling, (a local name for parr) were moreover deliberately targeted in the same way as pinks and were considered "quite as delicious a fish."[81] Skirling were said to sell for between 6*d* and 8*d* per pound. Moreover, because it was still a "disputed point" whether these fish were a distinct species, "we used all to go out and catch them by the hundreds".[82] Mr T.

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[79] The Report points out similar difficulties were experienced on the "Teifi, Tees, Ribble, Lune, Test, &c.", PP, UK (1861) [2768] [2768-I], *xvii.*
[80] PP, UK (1861) [2768] [2768-I], 105.
[81] Ibid., 43.
[82] Ibid., 48.

Prosser, the Mayor of Monmouth agreed: "I have seen them hawked on the streets", he said.[83] A keeper of pleasure boats near Monmouth also claimed that the "regular fishermen" pursue them "systematically", taking a "great quantity" of skirling and afterwards selling them. He thought that "there are two or three hundred" fishermen "from the Abbey to the Welsh Hay" who did so.[84]

But many who testified before the 1861 Special Commission also reflected on the fact that "gentlemen" caught parr, sometimes in notable quantities, for recreation. In fact, the Committee made a special point of questioning witnesses on this topic: "How many gentleman anglers would be upon the river during spring for the sake of this nice amusement?"[85] Mr. W. Llewellyn, an angler who rented water on the Ogmore, claimed that a gentleman (fishing, as was typically specified, with rod and fly), could kill "eight to ten dozen in a forenoon".[86] Mr J. Williams, the keeper of pleasure boats, also claimed he went "angling with gentlemen sometimes." They were a source of trade, he said, as he took them out for the express purpose of killing skirling and pinks.[87] On the other hand though, witnesses like Mr. M. Moggridge, also an angler, believed that for the most part it was not a "systematic" or deliberate habit for gentlemen to target these fish, but that in fishing for trout, it was inevitable that some other fish would be taken accidentally.[88] Similarly, Mr J. Lloyd, Harbour Commissioner at Newport and Secretary of a fishing association on the Usk, said that the numbers of pinks killed by rod are minimal, yet the subscriptions they receive for the rods wishing to angle for them were valuable. He too claimed to firmly believe that skirling are not young salmon – an attitude amongst anglers that was still clearly common in the district and more widely.[89]

Such statements reasonably suggest that parr fishing was a varied, heterogeneous activity – socially and methodologically, however as evidence they say more about how people wished to represent the situation, and justify their actions or defame those of others', than what may actually have been occurring.

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[83] Ibid., 27.
[84] Ibid., 31. See also Ibid., 32.
[85] Ibid., 65.
[86] Ibid., 102.
[87] Ibid., 31.
[88] Ibid., 33. See also pp. 106
[89] Ibid., 65.

Importantly though, these testimonies imply alertness to the forms of social distinction implied by what could be parsed as the differences between "recreational" and "subsistence", or even (semi) "commercial" fishing.[90] Apprehension of such categories implies stratifications, and the intentions and forms of tackle used in particular act as signals of the status or, to borrow Weber's phrase, the "styles of life", of those doing the fishing.[91] Social meanings of this kind inform the operative dissimilarity between "gentlemen" anglers and "systematic" fishermen, "gentleman" being practically synonymous with recreational anglers of certain status. Why might the Special Commissioners have been particularly interested in "gentlemen" targeting parr? I suggest this question was connected to the growing social heterogeneity of angling, and correspondingly the kinds of struggles for social distinction that produced many gradations in forms of fishing practice and quarry.

From the late 1850s onwards, particular ire was raised in instances where "gentlemen" caught parr and salmon fry. In 1862, a story was spread claiming that even the Mayor of Newcastle had been fined for targeting "salmon fry".[92] Why should such stories have been newsworthy within the worlds of angling? In the Borders region, Bertram claimed, English landlords exulted in the practice of netting small trout and parr (although he continued [quite dubiously] to claim that, fortunately, Scottish owners had "better notions of sport, and some lingering compunction as to the rights of the public, [which] are in Scotland sufficient to deter the class possessed of the privilege from ever proposing to use it").[93] After the Dunblane parr trial, a disapproving angling writer in the *Glasgow Herald*

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[90] The distinction between "recreational" and "subsistence" fishing though is unclear. If the Victorian era witnessed the emergence, in the area of field sports, of a process of "sportization", as Elias argued, during which a habit of rule following replaced the unruly passions or instincts of killing either capriciously or out of necessity, this was an uneven historical process, see Norbert Elias, "An Essay on Sport and Violence," in *Quest for Excitement: Sport and Leisure in the Civilizing Process*, ed. Norbert Elias and Eric Dunning (Oxford: Basil Blackwell, 1986), 150–74. On angling and "sportisation" in England specifically see Adrian Franklin, "On Fox-Hunting and Angling: Norbert Elias and the 'Sportisation' Process," *Journal of Historical Sociology* 9, no. 4 (1996): 432–56. Lowerson says that "[a]mong poorer anglers there must always have been a symbiosis between sport and food and this continued well into the nineteenth century", "Brothers of the Angle: Coarse Fishing and English Working-Class Culture, 1850-1914," 108.

[91] Weber, "The Distribution of Power within the Community: Classes, Stände, Parties," 146. On angling and social class in Victorian Britain generally, see Lowerson, *Sport and the English Middle Classes, 1870-1914*.

[92] "A Mayor Fined for Illegal Possession of Salmon Fry," *The Field*, June 14, 1862.

[93] Bertram, *The Border Angler*, 101. Kent asserts that "respectable" people were also believed to engage in poaching in the upper waters of the Tweed. "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!,'" 299.

worried that the destructive judgement had given the whole salmon question a "new character", and proved beyond doubt the parr had been "delivered over to the tender mercies of the village idlers." Moreover, the "[t]he humbler classes […] are not their only enemies": the guilty parties included "men who can teach morality, lay down the law, or fabricate the raw material of our manufactures into forms of usefulness and beauty". Thus

> [w]e cannot but think it strange that men in possession of ordinary intelligence should be so blind to their own interests as to engage in the destructive and ignoble practice of killing fry, and believe they are enjoying innocent recreation![94]

The underlying presumption appears to have been that "gentleman" should know better than to catch parr or salmon fry and that their interests coincided with general interest of society in protecting juvenile fish.

In this context, "gentlemen" being seen to fish for parr would dignify the practice; hence, those who wished to see the end of it would seek to represent it as beneath the dignity of gentleman. If high status anglers – "gentleman" – refrained the effect would be likely to cascade down the social ladder, as aspirant anglers and fishermen of all kinds, desirous of increased status, would adopt the new code. At the same time, there is likely to have been demand from both high status anglers and aspirant "middling sort" anglers to differentiate themselves from those below them. This situation closely reflects what T.H. Marshall observed in his classic account of status and the figure of the English gentleman. Moreover, Marshall argued, it was in situations of social flux, in which the "essentials of civilisation are being more equally distributed, and when the mobility of groups and individuals is increasing", that there would be distinct preoccupation with social status generally.[95] Arguably, (like various other codes including fly-fishing) parr and parr fishing found themselves at this junction, and this was useful to reformers. What mechanisms might have set these processes in motion?

Establishing a consensus on the factual identity of the parr was one aspect of this, as was the logical connection between this and the salmon stock. But, alone, these were apparently insufficient arguments: "the facts" never entirely settled the

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[94] "The Opening of the Piscatorial Season," *Glasgow Herald*, February 8, 1858.
[95] T.H Marshall, "The Nature and Determinants of Social Status," in *Sociological Perspectives*, ed. Kenneth Thompson and Jeremy Tunstall (Harmondsworth: Penguin, 1971), 297.

issue, as we will see. Killing parr and juvenile salmon however became a "moral" issue at the same time suggestive of social status. The honour of gentlemen was at stake, at least insofar as this was refracted through the local "honour worlds" of angling, to use the philosopher Appiah's term.[96] In other words parr fishing was defined as ignoble, shameful or, to use a bye-word for conduct unbecoming of gentlemen, unsporting. Tying claims about facts and consequences or ends to individuals' perceptions of how their status and character might be negatively evaluated by others in relevant social worlds, and thus to how they interpreted their own identities in this context,[97] made the empirical and utilitarian aspects of the relevant claims more effective. Given that many "systematic" parr fishers would actually have been of low status amongst anglers, and likely poorer, claims connecting the practice of parr fishing to their kind would have had an additional bite in the eyes of others.

The attitudes of angling writers offer an index of and possible stimulus for change in this area. Their opinions were usually crucial to the development, dissemination and stratification of the moral-ethical codes amongst the "brotherhood of the angle". It appears historically that many angling writers assumed parr were regularly caught, although the matter required little discussion: it was not a mainstream activity, and hardly offered occasion for censure. Parr often featured as a kind of bait used for catching larger fish, like pike and large trout. The technique, known as parr-tail, required catching a parr, cutting it in half, and using its tail portion as a lure. In 1831, Stoddart had described the use of parr-tail as an acceptable and "by far the most pleasantest method" for catching trout – apart from fly-fishing.[98] W.C. Stewart thought the parr-tail a "very inviting branch of the art", and Younger "a capital bait".[99] Writers also often represented parr as merely a nuisance, distracting attention from taking larger

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[96] Kwame Anthony Appiah, *The Honor Code: How Moral Revolutions Happen* (New York: W.W. Norton & Co., 2010).
[97] For complimentary yet diverse sociological perspectives, see Goffman, *Interaction Ritual: Essays on Face-to-Face Behaviour*, 56; Shils, *The Constitution of Society*, 162; also, Barnes, "Status Groups and Collective Action"; Thomas J Scheff, "Shame and Conformity: The Deference-Emotion System," *American Sociological Review* 53, no. 3 (1988): 395–406.
[98] Thomas T Stoddart, *The Art of Angling as Practised in Scotland*, 2nd ed. (Edinburgh: W & R Chambers, 1836), 56. See also Thomas T Stoddart, *The Angler's Companion to the Rivers and Lochs of Scotland* (Edinburgh: William Blackwood & Sons, 1847), 123–24 for similar remarks.
[99] William C. Stewart, *The Practical Angler*, 3rd ed. (Edinburgh: Adam & Charles Black, 1857), 173 [1st ed., 1857]; John Younger, *River Angling: Salmon and Trout* (Kelso: T. & J. Rutherford, 1864), 117.

fish. Stoddart advised use of large baits because these are "less apt to be assailed by parr", although he admitted that they were also delicious "if properly fried", and Stewart complained that rivers with too many parr are seldom good trouting streams because the little fellows eat up all the food.[100]

Thus a climate of relative toleration was reflected in such writings, even when the parr per se was addressed as a sporting object. In 1836, Bainbridge did not consider the parr to be a salmon, and thought it a fair sport and excellent eating – though he advised anglers not to catch young salmon out of consideration of the "injury done to the river".[101] In 1839, Hofland also thought the parr, on the basis of Yarrell's authority, to be a distinct fish, and advocated its capture either by fly or gentle (maggot); moreover, a "single pellet of salmon roe" as bait, he said, was capable of taking "ten or twelve dozen of this delicate fish in a few hours".[102] Similarly, in 1850, Bowlker wrote that parr, which he also thought distinct from salmon fry, could afford "the angler excellent diversion with the long line".[103] Even writers believing different facts, like Bertram in 1858 (who held that the recently established theory of the parr was undeniable), nevertheless claimed that he was "hardly disposed to suggest an extension of the bailiff's sympathies to it".[104] Similarly, Stoddart, who claimed to have believed in the parr-salmon theory his whole life, had nevertheless declared as early as 1831 that

> We call not for the interference of an act of legislation,
> in order to prevent the destruction of par (sic)
> – such a measure would fall too severely upon the brethren
> of the streams – would rob our countrymen of a kindly
> and quiet privilege.

The language here suggests some identification with a community of anglers and implies that parr fishing could be legitimate activity. But Stoddart had more to say on the subject, and his attitude also reflects a contrary tendency. He continued to argue that the angler should "as a principle", agree to release all parr that "come

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[100] Stoddart, *The Angler's Companion to the Rivers and Lochs of Scotland*, 153, 318; Stewart, *The Practical Angler*, 37.
[101] George Cole Bainbridge, *The Fly Fisher's Guide*, 4th ed. (London: Longman, Brown, Green, and Longmans, 1840), 72–73, 67 First ed., 1836.
[102] Thomas Christopher Hofland, *The British Anglers Manual*, 2nd ed. (London: How and Parsons, 1841), 53. [First ed., 1839].
[103] Richard Bowlker, *Art of Angling* (London: Longman, Brown, and co., 1854), 21 also, 35 for comments on the Skegger trout, another synonymous fish.
[104] Bertram, *The Border Angler*, 43.

ignorantly to his hook". The fish, he said, are "a meagre morsel, and give small proof of his skill at the gentle craft". Moreover,

> There are unprincipled poachers enough, who make it
> a glory to harass our waters with net and lath, who annually
> diminish by some millions the healthiest fry of our salmon,
> who depopulate many a river by means of their nocturnal enginery;
> but we wish not to see classed with these, the humane and virtuous,
> the true and patriotic angler[105]

A clearer description of the stakes, the role of perceptions of honour and virtue, is hardly possible.

Indeed, a growing tide of voices had began explicitly to question the qualifications of parr fishing as a "sporting" activity. In the 1834, Garnett had mentioned that it could "afford good sport" – but, he qualified, only to the angler "who is satisfied with catching small fish".[106] Since being "sporting" was becoming interchangeable with identification of gentlemanly behaviour, it was natural to associate the practice with low status, marginal social actors. Many infantilised the practice, describing it as fit only for urchins who could "with a short stick and crooked pin, [do] rapid damage".[107] The writer in the *Glasgow Herald* cited earlier accepted that the occasional child might go in for catching tiddlers, but scoffed at the idea that "bearded men" saw fit to do battle with a fish no more than "about three inches long".[108] Similarly, the practice was associated with the meaner sections of society and their baser urges: parr fishers, especially those not using rod, line and fly, were pejoratively called "Cockney anglers" and "pot-fishers", rather than sportsmen.[109] In 1861, the year that relevant English legislation passed, *All The Year Round* described the detrimental effects of parr fishing on the rivers, complaining of the "millers, navvies, labourers of all kinds" who "arm themselves with a wand, and catch all they can as bait for their own hungry maws

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[105] Stoddart, *The Art of Angling as Practised in Scotland*, 94–95.
[106] Garnett, "Facts and Considerations on the Natural History and Political Impropriation of the Salmon Fish," 204.
[107] "Salmon Breeding on the River Tay," *The Times*, January 25, 1861, 10; "The Salmon Question," 393.
[108] "The Opening of the Piscatorial Season."
[109] The phrase "Cockney angler" was common. Davy used to describe an attitude in which fishers of this kind were understood to "want skill", see Davy, *Salmonia: Or, Days of Fly Fishing*, 276; Buist and Hogg both used it to describe parr fishers specifically, see Robert Buist, "On the Salmon Fisheries," *Quarterly Journal of Agriculture* 3, no. 16 (1832): 629; and Hogg, "On the Preservation of Salmon," 443. It probably had the overtone of its old meaning of "urban dweller" too.

and to catch […] pike."[110] One of the clearest examples of this trend emerges in Stoddart's own testimony before a Special Commission appointed to enquire in the effects of recent legislation. In 1871 – a decade after the law for most of the country had been changed – Stoddart put it to the Commissioners that the law must now be changed for the Tweed as well. On this occasion, he insisted that a "declaratory clause" be inserted into legislation in order to prevent the matter becoming a "mooted point" before the courts. His language though is most revealing: in giving his evidence, he declaimed the "remnant addicted to pot-hunting" who still stuck to the opinion that parr were a small trout in order to use this as a device of extenuation, to the detriment of the stock and everyone else. Moreover, he specifically blamed trout angling competitions – a phenomenon associated with emerging fishing clubs in urban areas and amongst especially working class anglers – for encouraging the dishonourable practice of killing small fish.[111]

In sum, as the destruction of parr was being implicated amongst the causes of declining salmon stocks, so also was the social status and honour of those supposedly fishing for it attacked. These attacks may have encouraged individuals to forego the habit, because to be associated with it could mean losing social rank that came with being a "gentleman" within relevant social or "honour" worlds. This catered also to growing demand for means of signalling social distinction in the worlds of recreational angling. Of course, salmon fishing itself remained the sine qua non for the high status angler, the fish, as Stoddart wrote, alone having "a place withal amid creations of sublimity."[112] Indeed, it was high status salmon anglers specifically, including such literary, well connected and sometimes socially elevated individuals as Sir Davy, James Hogg, Sir Walter Scott and William Scrope who had been at the forefront of putting the question of parr on the agenda in earlier decades. In this context, something like a moralised panic descended upon the fish that was infused with stigmatising representations connected to ideas about the social order. Developing this argument, I now turn to the "impropriety"

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[110] "Salmon," 406.
[111] PP, UK (1871) [C. 419], 103. See also Stoddart's testimony in PP, UK (1875) [C.1117], 23. This prejudice was widespread. The elite Fly-Fishers' Club, later in the century, "strongly discourage[d] all unsportsmanlike fishing and prize competitions", "The Fly-Fishers' Club," *The Fishing Gazette*, February 11, 1888, 78.
[112] Stoddart, *The Angler's Companion to the Rivers and Lochs of Scotland*, 171.

of killing "the innocents", as *All The Year Round* put it. This discourse was also directly connected to a wider swathe of concerns about fishing practices perceived not simply to impinge upon the rights of others, but specifically to interfere with the reproduction of the species, and therefore the interests of society as a whole.

3.3.3 *Reproducing the species and the "public interest"*

Looking more broadly at the pattern amongst freshwater fishing practices that were formally and informally suppressed during this period, it is clear that special opprobrium was directed at practices that appeared to effect the reproduction of salmon. Targeting breeding fish, their eggs, and fish in their infancy was viewed as especially problematic because these aspects of the salmon's life cycle were understood to hold the key to the vitality of the resource itself. For instance, praise was showered upon a revised close season on the Tweed, which forbade fishing in certain weeks during the winter spawning season, because they saved the legal rod fisher "from the disgrace of doing what was really poachers work" – that is, destroying salmon "at the point of breeding".[113]

There are various instances of this trend in the freshwater fisheries arena by which to contextualise the fate of parr fishing. Leistering was a form of fishing in which groups gathered at night, using torches and spears to stab salmon whilst they mated on the redds. It had been celebrated as part of the national culture of Scotland, and was often considered legitimised by "immemorial usage" by angling writers, including Stoddart. Sir Walter Scott and James Hogg had apparently indulged in it in the early part of the century. But by the 1840s and '50s it was increasingly being viewed as rowdy behaviour and eventually a heinous offence against the peace. In the 1860's it became a criminal offence in Scotland, and banned also in England and Wales, and the offender could be liable for a prison sentence.[114]

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[113] Bertram, *The Border Angler*, 12.

[114] The quote from Stoddart is reported also in Coates, Coates, *Salmon*, 115; See also discussion in Osborne, "The Development of Salmon Angling in the Nineteenth Century," 207–8; for a near contemporary account of changing attitudes to leistering and the relish Scott and Hogg are supposed to have taken in it, see Younger, *River Angling: Salmon and Trout*, esp., 195; On this practice becoming a criminal offence, see Stewart, *A Treatise on the Law of Scotland Relating to Rights of Fishing*, 191.

Another example, like parr unremarked by historians, is the use of salmon roe (eggs) as bait. Many Scottish writers described this technique for trout fishing in the first half of the century. Stoddart was matter-of-fact about it in 1831, describing how effective it was, and that any who should go into business producing a paste from it for sale was likely to make a mint.[115] However, ambivalence about its use grew. In the 1850s, Stewart was keen to present it as ineffective in many situations, whilst saying "nor is the sport, if sport it be called, by any means attractive".[116] In 1858 Bertram said of roe fishing that "many sensible men regard it as no better than poaching". He also noted that roe fishing was particularly damaging as it resulted in a "strong encouragement" to kill salmon during their spawning time, in order to obtain their roe.[117] When the 1861 Special Commissioners questioned a clergyman of Monmouth as to the effectiveness of a paste made from roe, he claimed in answer to have found deploying it himself "so contemptible a way of taking fish that I did not continue to use it." Asked whether it was sold or produced by tackle makers, he replied: "I think not. I think it is a certain class of people who prepare it."[118] Once again, narratives of shame and honor in connection with evaluations of social hierarchy are prominent. Like leistering, regulations effecting the taking of roe, disturbing the redds and catching "unseasonable" fish (ie., gravid) were strengthened in the legislative reforms of the 1850s and '60s.

Various protections were also designed to apply specifically to juvenile fish. In Scotland for instance, appointed Salmon Commissioners and local officials were empowered to set and enforce the size of net meshes in order to prevent smolts and salmon fry being caught in them. In Scotland, laws regulating the trout fisheries passed in 1845 and 1860 also contributed. The use of certain tackle was outlawed, including fixed lines and especially nets, because of their effectiveness and indiscriminateness.[119]

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[115] Stoddart, *The Art of Angling as Practised in Scotland*, 54–56. The ecumenical Bowlker offered no censure either, *Art of Angling*, 148–49.
[116] Stewart, *The Practical Angler*, 214.
[117] Bertram, *The Border Angler*, 41, 42.
[118] PP, UK (1861) [2768] [2768-I], 35.
[119] See [Neish, E.W.] and Blades, *Encyclopaedia of the Laws of Scotland*, 7:147, 148. The first England and Wales Act effecting trout specifically was only passed in 1878, though efforts were made to incorporate trout fishing into salmon fisheries Bills, see below.

The protection of parr (as juvenile salmon, or indirectly by regulating trout netting) thus fitted a pattern of suppressing specific kinds of fishing. The practices considered most undesirable were seen as those that hurt the reproduction of salmon and their young. These were often stigmatised, and the integrity or honour of those participating in them impugned. This helped legitimise the case for reform by many proprietors, anglers and other members of the public who supported them. The public interest dimension of the question was elevated, because to misrecognise or act against it could be seen not only as a matter of personal shame or shame on behalf of a class of anglers, but also for national good – the "virtuous, humane and patriotic", as Stoddart had written. Insofar as these are carried through into the symbolic world mediating social relations, shaping personal and group identities, and were expressed broadly as normative evaluations, these constituted mechanisms of legitimation in the moral economy of relevant social groups and actors. In this they were functionally similar (whilst quite different in content) to the kinds of claims, based on community and tradition, typically associated with that concept.

If these social relations of parr and salmon fishing were one aspect the controversy, their counterparts were the formal, legal dimensions of the question. With the assumption that the two interacted and co-produced one another, in association also with scientific claims based on experimental evidence about salmon life cycles, I turn next to tracing this conflict through the key legal institutions involved: court actions and legislation.

3.4 The parr in courtroom and legislation

In tracing the parr's legal history, I proceed roughly chronologically, alternating between legislation and common law in order to emphasise how they related to one another and differed, especially with regards to stances taken on scientific testimony in courtrooms. It will be clear how each, due to their institutional character, biases, or relative imperviousness to the lobbying of powerful factions, provided forms of succour, points of weakness or means to rally, for the different groups. Each found in the different branches of law some kind of affinity with their outlooks and the "moral economies" they espoused or articulated.

3.4.1 *Select Committee's and Bills, 1824 – 1846*

A House of Commons Select Committee on the salmon fisheries of the United Kingdom produced a number of reports in 1824 and 1825. This body of investigations had a particularly important influence on later legislation, notably the so-called "Home Drummond" Act of 1828 in Scotland.[120] It was to the Chair of this Committee, Thomas Kennedy, that William Scrope had originally written regarding his concerns about parr (see Chapter 2). This letter was however never published in the Committee's reports. In fact, the parr question had very little play in Committee at all. Dr Fleming presented a paper on the genus *salmo* that made no mention of parr.[121] This is as predicted, given the low level of public interest in a fish that, at this stage, few people believed to be connected to the salmon. When the matter was queried, it was only to dismiss it. For instance, George Little, a proprietor with extensive interests in salmon fishing over a forty year period, admitted to have been acquainted with parr, but to "consider them merely a fresh water fish, or species of fish, by themselves, not at all connected with the salmon".[122] Likewise little mention of parr was made in a Report of 1836, although one witness cited the recently published work of Sir William Jardine and his circle of naturalist-companions (published subsequently to their trip to Sutherland, see Appendix 3) to the effect that there was "no reason for supposing them salmon" at all.[123]

By 1842 however, the tenor had changed slightly, apparently under the influence of John Shaw's work in particular, knowledge of which, as one witness put it, "is burst upon us". This particular confident, a salmon fisher from Aberdeen named Davidson, had previously testified before the 1836 Committee. Between the two occasions, his opinions on the matter had performed a complete about turn.[124] Similarly, Mr Hogarth, also of Aberdeen and with fisheries interests said to be worth over 20 000*l* a year, claimed likewise to have been convinced by Shaw's work. He said he had himself performed corroboratory observations on the Spey, and had found the facts now "beyond doubt". These witnesses now believed it was

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[120] "Preservation of Salmon Fisheries (Scotland)" 1828 (9 Geo., IV), c. 39.
[121] PP, UK (1825) [173], Appendix II, 15-16. .
[122] PP, UK (1824) [427], 105, 113.
[123] PP, UK (1836) [393], 375, 378.
[124] PP, UK (1842) [522], 11.

necessary to protect parr as the young of the salmon.[125] Such enrollment of proprietors to the cause, claiming the influence of experimental knowledge in particular, is also as expected. Why, indeed, should salmon fishing interests have cared about a fish that, previously, was believed to be of no consequence for them? Many others connected to the salmon fisheries admitted to similar changes of belief in the face of exposure to the empirical arguments.[126]

Hogarth made a further perspicuous point. He noted that parr are, or rather *should*, in fact, be protected under *existing* statutes because "it is there already *as one of the salmon kind*". However, he implied, this was not acknowledged by Magistrates. "We find so much difficulty in enforcing the law, from the justices not being willing to understand certain points in it, that possible struggle might arise with respect to whether the parr were smolts [young salmon]", he said. Hence, he considered it requisite that the word "parr" be explicitly inserted into any forthcoming Bill.[127]

This was attempted in Bills for England and Wales in 1845, and again in 1846, in which it was planned that "the words 'fry or brood of Salmon' shall extend to all Pinks, Par, Lastsprings, Fingerlings, Skerlings, Samlets, Smolts, and the fry and brood of all fish of the Salmon kind."[128] But these Bills failed for unrelated reasons. Nevertheless, legislation would eventually prove the more tractable branch of the law for reformers on this issue, the common law being rooted to a greater extent in the sympathy of Magistrates for customary claims and existing precedents, as well as being conservative about the role of science in settling legal arguments, as we will see.

3.4.2 *The judicial bench:* Perth (1844) and Dunlane (1858)

Buist v. Crawford (1844), Perth: Although Hogarth's testimony suggests that cases had come before magistrates earlier, the parr's career in court can be traced

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[125] Ibid., 13, 14.
[126] Robert Buist is a good example. Initially disagreeing publicly with James Hogg, he changed his mind after beginning work with Stormontfield, see Buist, "On the Salmon Fisheries"; Robert Buist, *The Stormontfield Piscicultural Experiments, 1853-1856* (Edinburgh: Edmonston & Douglas, 1866), 5. Also, James G Bertram, "The Secrets of Salmon Growth," *Blackwood's Magazine* 133, no. 808 (1883): 277–90.
[127] PP, UK (1842) [522], 17.
[128] "Salmon fisheries (England Wales)" 1845 (266); "Salmon fisheries (England Wales)" 1846 (60).

in important respects from a trial in 1844, although the case itself does not actually involve the parr directly. The pursuer in this case was the Association of the Proprietors of Salmon Fisheries in the River Tay, via their agent the River Superintendent Robert Buist. This was the same grouping that would later establish Stormontfield, whose evidence was important in later parr trials. The defendant was a man named Crawford.

Sherriff-Substitute Hugh Barclay heard the case at Perth. The legal issue hinged on a type of fish known commonly as whitling. The pursuers alleged that Crawford had deliberately sought to catch whitling which, they argued, were no different to young sea trout (the migratory form of river trout), a nominal "species" which was named explicitly in statute as a "fish of the salmon kind".[129] They framed their case on a passage of the "Home Drummond" Act of 1828 (see above) that emphasised trespass with intent to kill protected fish. The defence's plea was that the accused had been apprehended whilst fishing from a towpath on the River Earn, "to which the public have right, and that the path of the river where he fished is not private property, but has been fished by the public since 'time immemorial'". As Barclay recognised, this argument would have no force if it were proved that the accused was deliberately fishing for salmon, regardless of the public right of way. The Sherriff-Substitute however found it proved that Crawford's intended quarry was *whitling*, and therefore the case hinged on whether or not whitling were "fish of the salmon kind".[130] This is an exact analogue for what would follow in later parr trials.

Barclay assoilzied the accused on the basis that the pursuers did not adequately prove that whitling were "fish of the salmon kind." In his judgement he argued, firstly, that there existed no expressions of intention in the statutes to regulate "other fishings than those of the salmon", and secondly that he had been unable to "discover the name of whitling as falling under the property of salmon"

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[129] Comprehensive discussion of this legal construction is impossible here, suffice to say that it is believed to have originated as early as the 12th century, and in most cases in the 19th century it can be considered to have referred to all *migratory* fish of the same genus as salmon, and therefore included sea trout. This was disputed and misunderstood however, as we will see. As one contemporary legalist noted "natural history and common interpretation scarcely warrant the construction", see Stewart, *A Treatise on the Law of Scotland Relating to Rights of Fishing*, 74 note (d).

[130] "Buist v. Crawford, (1844)," *Law Chronicle.* 2 (1858): 134. (The case notes were reprinted, with commentary, in reference to the Dunblane parr trial of 1858.)

in any of the "old statutes" or preceding legal judgements. Crucially, Barclay felt that for further sorts of fish to be considered under the "general description appended" (i.e. as "fish of the salmon kind") it would have to be "clear and notorious" that these were members of the salmon family and, consequentially, "as little doubt in the public mind in reference to them as to the species enumerated."[131]

The Court heard evidence running in both directions from fishers of many years experience. "The complainer then produced a volume of the *Naturalist's Library*" – Dr. Robert Hamilton's work on British fishes, published only one year earlier.[132] This work reported that whitling, commonly so called, were considered by learned authorities, including John Shaw and Sir Jardine, to be identical to sea trout.[133] Barclay expressed reservation about it, but nevertheless admitted the work as evidence. He found it actually corroborated the notion that "the identity of the fish is a question of extreme difficulty"; the book in fact appeared to Barclay to "prove too much for the complainers" because it included under the *genus Salmo* "the salmon, the parr, bull trout, salmon trout, white trout, or whitling, common trout, Lochleven trout, great lake trout, and the chare." Considered thus, he argued, "there are very few fish known in our rivers [that] are not included within the protection of the statute". "In short", he said, "to give the act the full interpretation contended for, would effectually convert it [the Act] into 'an act for the *prevention* of fishing'".[134] Thus, Barclay proposed, the law was intended by Parliament to be read *popularly*, meaning "not scientifically, nor to teach natural history". This meant that for a fish to be considered under the general definition, it must be "popularly and notoriously" considered "of the salmon kind". That is, knowledge or beliefs about the nature of fish required wider currency in the minds of relevant publics, and for this knowledge to have been expressed through their habits and customs. This not being the case, he "cannot lend himself to countenance *ex post facto* law – first establish, by proof, that the fact complained of is an offence, and

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[131] Ibid.
[132] Ibid., 135; The work is Hamilton, *British Fishes* see also discussion in Chapter Two.
[133] After salmon, Shaw had turned his attention to sea trout, see Shaw, "On the Growth and Migration of the Sea-Trout of the Solway (Salmo Trutta)."
[134] "Buist v. Crawford, (1844)," 135.

punishing the party for the act done before such ascertainment." He concluded that, while it was "highly proper to preserve the valuable property in salmon",

> it is a matter for grave consideration, whether this protection is best obtained by *now* rigorously denying to the public what they have ever been accustomed to enjoy, because of recent conflicting and still doubtful opinions of naturalists.[135]

In other words, in Barclay's eyes, the common law saw a basic injustice entailed in introducing specialist scientific knowledge into legal proceedings where it overrode the common and general opinion of the people. This prejudice was reproduced exactly in later parr trials, where such acquiescence to customary and local understandings was a key factor in legal reasoning.

The immediate consequence of this case was that the proprietors went to Westminster with their cause: the word "whitling" was soon inserted into the clarifying clause.[136] According to Flowerdew's commentary in the *Law Chronicle,* they had "adroitly and quietly" attached the word whitling to the definition of salmon in a Bill whose prime purpose was instead renegotiating the boundary between estuary, sea and seashore. Flowerdew thought this modis operandi iniquitous because it left "the public not a whit the wiser until some fine sunny morning they find themselves the inmates of a jail."[137] The reality, however, was that this was in fact the norm: no Bill was ever presented for the sole purpose of redefining a type of *salmo* and the issue was seldom openly debated on the floor of either House of Parliament. Secondly, the effect of the Whitling Act, as the magistrate at a later and very similar case noted, was to have "totally changed the complexion of the matter": whereas previously "the ancient and common law of Scotland" had protected fishing for sea trout in public waters as a right belonging to "the general community", the new Act effectively "enclosed" them.[138] Thirdly, it is notable that at the Bill stage, not only whitling were included, but also, so the *Dundee Courier* reported at the time, "Herling, Finnock, and Par – in order to prevent all doubt as to these species in the future".[139] However, this wording was not, for unknown reasons, acceded to.

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[135] Ibid.
[136] See "Preservation of Salmon Act (Scotland)" 1845 (7 & 8 Vict.), c. 95.
[137] The commentary is from the note annexed to Barclay's original judgement when it was re-printed with reference to the Dunblane parr trial, see "Buist v. Crawford, (1844)."
[138] "Cooper v Spence," *Journal of Jurisprudence* 19 (1875): 613.
[139] "Salmon Fisheries Bill," *Dundee Courier*, June 18, 1844.

Galbraith v. Shaw (1858), Dunblane: Barclay's judgment provided the precedent for Sherriff-Substitute Grahame's decision at Dunblane. The substance of these proceedings has already been related in the introduction to this chapter, but it is important to revisit it with respect to the legal argument, the social composition of the debacle, and the discourses that surrounded it.

The fundamental point held to by Grahame in his verdict was that "it is not the province of a Court of Law to decide disputed theories respecting ichthyology".[140] A man is bound to know the law, he suggested, but not the facts: the "legal maxim *ignorantia juris neminen excusat*" could therefore have no force given that the underlying facts themselves were not considered settled. As such, he refused to pass judgement on the parr's identity and therefore the crime of illegally taking salmon, arguing that such questions are more fit for "the professorial chair than the judicial bench". Moreover, the witnesses called by the prosecution admitted that the facts had been finally and best established at Stormontfield, only a very short time previously, and Grahame considered that the first decided expression in favour of the theory dated only to 1839, this being the communication of John Shaw's last paper on the subject to the Royal Society of Edinburgh, which the prosecution had read before the court.[141] Other supportive articles in the *Encyclopedia Britannica* and *Quarterly Review* were also cited. Grahame deemed, rightly, that John Shaw's work had met at the time with nothing like "unanimity of sentiment", and that to presume familiarity with such literary and scientific works on the part of someone of Andrew Shaw's station in life (he was a labourer) would be to go too far. While he considered that the defendant "must naturally be presumed to be more familiar" with the contemporaneous experiments at Stormontfield than the earlier scientific publications, these were not sufficient grounds to conclude the case. He expressed hope that further experiments would in the future be conducted in which "a complete solution" in the "way of a generally recognized settlement of the parr controversy" would be found.[142]

Of the witnesses called by the prosecution, nine in total, all were associated with the management of salmon fisheries, with commercial fishing, or with

[140] "Galbraith v. Shaw," 124.
[141] Ibid., 125.
[142] Ibid., 126.

artificial fish culture.[143] One, Mr Greenhorn, a tacksman on the Forth and Allan, visited Stormontfield to learn more about its processes. Peter Marshall, the manager at Stormontfield, testified, as did Mr Walsh, a fishing tackle maker from Perth also closely associated with Stormontfield.[144] Indeed, in the light of forthcoming trials, we are forced to see the Proprietors of the Forth as in league with the neighbouring district's Proprietors of the Tay, the sponsors of Stormontfield. Examples of parr and young salmon were brought and displayed before the court. Of the twenty-one witnesses who testified for the defence, almost all confessed to being "fishers" in the district. It appears that they were mostly recreational fishermen, as many also give their primary occupations. These included a builder, a coal agent, a gardener, a joiner, a labourer, a fishmonger and a carpenter. One witness, interestingly, was a Watcher from the Water Allan. He argued, against his colleagues testifying for the prosecution, that the parr was a "different species" from the young salmon.[145] This was the defence's consistent theme: that the parr had always been considered in their district to be distinct from the salmon or other migratory fish. Two of these witnesses had also inspected Stormontfield in preparation for their court appearance. Contrary to the prosecution claims, they both insisted that there was no way that the system at Stormontfield could ensure that fish from the river, including true salmon fry, did not enter the system and therefore disturb the experiment. They also testified that the manager who had shown them around had confessed to them that he had no way of knowing what kinds of fish were actually in the ponds.[146]

The anglers' cause clearly had some professional and middle class support as well. John Maclean, who acted as representative of the accused, was identified as a "writer" of Dunblane.[147] Two physicians, including the Deputy-Inspector of Hospitals in the area, also testified in support. Dr Paterson and Dr Wingate-Johnstone's contributions were especially noteworthy, as their expertise

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[143] The only verbatim record of the evidence led in this trial discovered is reproduced in Flowerdew's (1871) book, which also reprints the verdict. Reports of the Sherriff-Substitute's verdict in places of record for Scottish law, as well as sundry press reports, confirm the reliability of the transcriptions. Flowerdew also reprints the evidence of Blair v. Miller (see below) as recorded in the *Dundee Advertiser* (11 July 1870), without error. Thus Flowerdew is unreliable as regards to his personal testimony – but we have no reason to doubt the accuracy of the legal transcripts he includes in his book.

[144] "Pursuer's Proof" in, Flowerdew, *The Parr and Salmon Controversy*, 40–56.

[145] "Defender's Proof" in, Ibid., 67.

[146] Ibid., 56–58.

[147] See "Important Fishing Case."

represented an anatomical rejoinder to the pursuers scientific evidence. They reported having performed dissections of parr and grilse (salmon) brought to them by anglers and to have found, firstly, that grilse and parr have a discrepant number of vertebrae. Moreover, they also claimed to have observed the holy grail of parr science: a female parr expressing roe (although they admitted a microscope was necessary to see it well). A parr in this state, claimed Wingate-Johnstone "is a fish capable of reproducing its species". During their testimonies, expert dissenters including Knox (who the Doctors considered the highest authority), as well as Parnell were selected and cited. Dr Paterson argued that on the basis of Shaw's proofs that it could "neither be proved nor denied" whether the "parr in our rivers" are the young of the salmon. Notably, Dr Paterson also admitted to donating five shillings to the defense's cause – not because, he insisted, he was a fisher himself and thus interested in the outcome of the case, but purely as an "act of charity". The Sherriff-Substitute admitted his evidence, despite protestations from the pursuer.[148]

Grahame's verdict occasioned much comment from those who abhorred it. The *Glasgow Herald's* angling commentator, after decrying the damage done by parr fishing and the consequences of the judgement, urged haste in remedial legislative action and recommended angling clubs be requested to expel all members caught parr fishing.[149] Adopting familiar rhetoric, a letter writer to the *Inverness Courier,* for example, worried that the outcome at Dunblane had "completely open[ed] the door for every idler to kill and destroy the salmon fry at all seasons, and that with impunity". Arguing that a large part of the problem was use of the disputed word "parr" in framing the complaint, the writer concluded: "we must not allow bastard names to open the flood-gates of poaching and destruction on our rivers".[150] *Berrow's Worcester Journal* simply found it frustrating that "the magistrates of Dunblane" had reopened "the parr question" which had finally been "set at rest" by experimental naturalists.[151]

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[148] Flowerdew, *The Parr and Salmon Controversy*, The quotes are respectively on pages 61, 64 and 63.
[149] "The Opening of the Piscatorial Season."
[150] Y, "The Parr Question at Dunblane," *Inverness Courier*, February 4, 1858.
[151] "The Salmon. 'The Parr' Question," *Berrow's Worcester Journal*, February 13, 1858.

On the other hand, of course, there were also those who supported the verdict and found the actions and intentions of the pursuers unjust. One letter writer thought it strange that the case had been taken up in the civil courts, and worried that it could be appealed in the higher Courts of Justiciary, where a "person in humble [...] position in life" would find himself once again exposed to the expenses of defending himself.[152] The case was never appealed, but the feeling of injustice accompanying it was clearly expressed here, and in the actions of the fishermen on the streets. Indeed, supporters had mobilized quite consciously, placing an advertisement in a local paper that explained "the anglers of Dunblane who defended the above action have been put to an expense of about £30 [...]. They earnestly hope that all Anglers friendly to the cause will contribute their mite to the fund for defraying expenses".[153] Similar collective actions amongst fishers (anglers or poachers, depending on perspective) were not unknown in Scotland where fishing privileges were seen as threatened by appropriation.[154]

Taken together with the whitling case, the Dunblane trial exhibits some deference in the Scotch common law to customary interpretations, reflected in this case in discovering an affinity in apparently traditional and popular conceptions of natural history.[155] The defence appealed to this, and on this basis the interests of those who claimed to belong to the fraternity or "community" of fishers was promoted. The actions of the proprietors were seen as unfair, and were judged to have failed to take into consideration the specific social condition and knowledge of the persons and groups affected. As with the whitling case, the failure of their present action was eventually reflected at the legislative level. Within the context of a parliamentary democracy increasingly inclined to rely on scientific expertise whilst framing laws related to salmon fisheries, and also beholden to the political power of fisheries proprietors and salmon angling interests to some extent (both

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[152] Salmo Herox, "The Dunblane Fishing Case," *Falkirk Herald*, January 28, 1858. For another reaction of this kind, see Eg., "Sporting Memoranda," *Glasgow Herald*, February 8, 1858.
[153] "Dunblane Parr Fishing Case," *Stirling Observer*, January 28, 1858.
[154] See eg., PP, UK (1873) [285], 22. Also, Kent, "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!,'" 299.
[155] David M Walker, *A Legal History of Scotland*, vol. 6 (Edinburgh: Butterworths LexisNexis, 2001), 3 notes that in general "[c]ustom had to be proved to the satisfaction of the Court and be reasonable, generally known, and not inconsistent with any relevant contract." Custom's influence on Scotch law though was generally less than in England, and had been established prior to the nineteenth century. On the evolution of Scotch law, especially in connection to the growing influence of legislation, during the relevant period, see Ibid., esp., 1047-1049.

of which categories were also well represented at Westminster), the legislature proved unsurprisingly proved a more pliable legal instrument.

3.4.3 *Legislative proceedings: The crucial 1860's*

The first Act to expressly include the parr in the United Kingdom was in fact Irish. In 1850 it declared: "The word 'Salmon' shall extend to and include grilse, peal, sea trout, samlets, par, &c., and the spawn and fry thereof."[156] The word "parr" was only finally included under the meaning of "salmon" and "of the salmon kind" in the Salmon Acts of 1861 (England and Wales) and 1862 (Scotland). The Scottish Act was substantially informed by the deliberations of a House of Lords Select Committee that reported in 1860. The English Act of 1861 on the other hand was framed additionally by the recommendations of a Special Commission published the same year. Notable in both cases was the reliance on expert testimony, not only the opinions of fisheries interests. For instance, the biologist Thomas Henry Huxley testified before the 1860 Select Committee because, as a professor, he held it was his "duty to be acquainted with the leading facts in the natural history of salmon."[157] He in turn acquainted the Committee with the opinions of Humphry Davy, John Shaw, and others on the natural history of the salmon. Professor Queckett of the Royal College of Surgeons also told them in no uncertain terms of the true genesis of parr, and offered to show them his collection of "well authenticated specimens" of parr and related stages in the development of salmon to the Committee.[158] These had been bred at Stormontfield. (The Prince Consort was also said to have "evinced a strong interest" in this particular collection of young salmon).[159] John Shaw himself contributed a report, compiled with ther civil engineer James Leslie (although this was only a report on the condition of the salmon fisheries and mill power of the River Doon).[160] Another important witness was an Irish salmon expert named William Ffennell. Ffennell, himself interested in artificial propagation, had been Inspector of Salmon Fisheries in Ireland, and instrumental in seeing through various salmon Acts in that country

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[156] "The Fisheries Act (Ireland)" 1850 (13 & 14 Vict.), c. 88; A Scottish Bill presented a year later never attempted anything similar, "Salmon Fisheries Bill (Scotland)" 1851, c. 471.
[157] PP, UK (1860) [456], 347.
[158] Ibid., 343.
[159] See Brown, *The Natural History of the Salmon*, 59; Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 6.
[160] PP, UK (1860) [456], Appendix B, 397 – 409. Other important commentators and scientific modernisers also testified, eg., Russel (see pp. 85 – 100); Andrew Young (see pp. 100 – 110).

in the 1840s.[161] He described the need for "very stringent" enactments to protect salmon fry in Scotland due to the "great wastage" experienced there, and clarified further the parrs' status by arguing (misleadingly) that the difference between parr and smolt was simply a question of age. He submitted to the Committee papers that included important clauses on the definition and protection of fry or parr from the relevant Irish Acts.[162] Ffennell was also central to the 1861 Special Commission on Salmon Fisheries, to which he was appointed as one of three Commissioners overseeing the process. Alongside him sat, as Chair, none other than Sir William Jardine.[163]

While the recommendations of the 1860 Select Committee Report made no specific mention of the parr or fry, the issue was clearly well known to it and had been discussed in submissions of evidence. Lord Stanley of Alderley, moreover, had acknowledged that the Report had been unanimously agreed upon by the Lords Committee, which "including several of the largest proprietors of salmon fisheries in Scotland."[164] These included, notably the Duke of Richmond who was a proprietor of netting stations on the Spey, and the Lord Polwarth, a "very successful salmon-fisher" with concerns in the Tweed area and strongly associated with the upper river or angling interest.[165]

The 1861 Special Commissioners report dealt with the issue in more detail. After hearing many depositions connecting to the subject (some of which I have referred to in section 3.3 above), they concluded that the issue was a "great source of depression" and that it was "regarded by many as a main cause of the decrease of the breed".[166] While they did not however recommend any specific changes to the wording of the law in their report, the Special Commissioners were certainly well acquainted with the difficulty of securing prosecutions in this area. A solicitor from Abergaveney, when asked whether he saw any difficulty in defining the

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[161] On Ffennell, see Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 119. also, William J Ffennell, "On the Artificial Propagation of the Ova of the Salmon and the Progress of the Experiments Now Carrying On," *Proceedings of the Dublin Natural History Society*, July 1854, 139–41.
[162] Ibid, 256, 270, Appendix E, 424 – 443.
[163] See PP, UK (1861) [2768] [2768-I].
[164] PD, Lords, vol. 167 (1 July 1862), col. 1285 – 91.
[165] PP, UK (1860) [456], 387. The quote is from Bertram *The Border Angler*, 11. Polwarth had also been actively engaged in the Duke of Roxburgh's efforts to reform the Tweed fisheries.
[166] PP, UK (1861) [2768] [2768-I], xvii.

meaning of "salmon fry" had replied: "yes; the men say that a salmon pink [fry] is not a salmon, or skirling or lastspring [parr] is not a salmon." As a consequence, the magistrates are forced to dismiss such cases saying, "we cannot decide".[167]

The words used to define "salmon" and intended to help tighten protection of young salmon occasioned but a little comment in both Houses of Parliament. In a debate on whether special protection was needed for anglers – usually defined as users of rod and line – who might take parr or salmon fry by accident, Colonel Pennant observed "there was such difficulty in distinguishing between trout and young salmon" that the Under Secretary of State had been "considerably puzzled" by specimens shown to him.[168] Pennant was developing a theme begun at the England and Wales Bill's Second Reading in the House of Commons by Mr Henley. Henley, who noted that the Bill at this stage in its career was intending to regulate both trout *and* salmon fishing, had declared it unworkable in this respect, because it would "impose upon magistrates the necessity of possessing a very minute knowledge of natural history; or when they came to carry out the Bill they would very much puzzled by the definitions in it." He noted that "[s]ome fifty different things were described as 'salmon', and that it was stated that 'trout' was to include all fish of the trout species not comprehended under the term 'salmon'."[169] The Earl of Malmesbury took up the issue in the House of Lords, with evident glee. He described the Bill as "rather extraordinary and somewhat amusing". He then proceeded to cite the relevant clause naming what was to be protected in the law as including, firstly salmon, but also

> cock or kipper, kelt, laurel, girling, grilse, botcher,
> blue cock, blue pole, fork tail, mort, peal, herring peal, May peal,
> pug peal, harvest cock, sea trout, white trout, sewin, buntling,
> guiniad, tubs, yellow fin, sprod, herling, whiting, bull trout, whitling,
> scurf, burn tail, fry, samlet, smoult, smelt, skirling or scarling, parr,
> spawn, pink, last spring, hepper, last brood, gravelling, shed, scad,
> blue fin, black tip, fingerling, brandling or brondling.

"Now, he thought [as *Hansard* records it] that most magistrates of this country would be rather puzzled when a delinquent was brought before them to know to

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[167] Ibid., 102. See also p. 30.
[168] [Edward Douglas-Pennant? (Caernarvonshire, 1841 – 1866)], PD, Commons, vol. 164 (11 July 1861), col. 771 – 72.
[169] Joseph W Henley (Oxfordshire, 1841 – 1878), PD, Commons, vol. 163 (20 June 1861), col. 1374 – 75; "Salmon and Trout Fisheries Bill (England and Wales)", 1861, c. 147.

which of these fish the offence applied." He hoped this would be simplified in Committee.[170] It wasn't. In fact, the full list of common names appeared in the legislation in extended form, all those naming "young of salmon" being also repeated, with the additional clause "or by any other local Name".[171] The Scottish legislation, appearing the following session, was more parsimonious. It stated: "'Salmon' shall mean and include Salmon, Grilse, Sea Trout, Bull Trout, Smolts, Parr, and other migratory Fish of the Salmon Kind."

Clearly however, there was quite good reason to maintain this condescension towards local understandings of species – although it seems at first extraordinary that the legislation, clearly responding to expert testimony as well as pressure from fisheries interests, would take this convoluted route. So long as the courts would insist on taking the common and general opinion on the identity of species as their basis for judging the intention, knowledge and therefore guilt of fishers, and these opinions did not coincide with the scientific consensus, it would appear to have been a reasonable response from the point of view of those drafting the law. Whether it was successful is equivocal however.

3.4.5 *Return to the judicial bench:* Radnor (1864) and Perth (1869)

In 1862, after the Scottish Act had been passed, a journalist from the *Dundee Advertiser* recorded at a meeting of proprietors on the Tay that

> Mr M. Graham remarked that the new Act [of 1862] was the first legislative enactment which recognised the parr as being the fry of the salmon. (A laugh.)

The parenthetical "laugh" suggests confidence on the part of proprietors and their agents, and no doubt many celebrated a victory. But, in fact, this was preemptory on both sides of the border.

Hopton v. Thirwall (1864), Radnor: A test case for the new laws in England and Wales emerged from the petty sessions at Radnor. In this case, a Reverend named Hopton was charged of unlawful possession of the young of salmon under the relevant section of the Act of 1861. After a days fishing on the Ithon, he had

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[170] PD, Lords, vol. 164 (23 July 1861), col. 1345 – 46.
[171] Malmesbury did however succeed in making one amendment, the definition being made to refer to "all migratory fish of the genus salmon". Lord Ravensworth pointed out that perhaps he really meant "species", but Malmesbury merely retorted his definition would include "all species of the genus salmon", PD, Lords, vol. 164 (25 July 1861), col. 1477 – 79.

been apprehended with what he admitted were "eight or ten samlets [parr] recently killed". Justice Cockburn, after hearing the defense, found that no offence had been committed under the statute. He reasoned that Hopton had been intending to catch trout and "not knowing the difference, and having no intentions of taking or having in his possession samlets or the young of salmon", he could not therefore be found guilty of willfully taking or possessing them.[172] This conclusion would seem to carry out the intentions of those who had framed the law, in that it protected anglers catching parr accidently.[173] But, of course, this was not taken well by the pursuers, who responded that whether Hopton knew what he had taken or not was beside the point – he had young salmon in his possession, and the law explicitly protects young salmon under the admitted common name for purposes of protecting property and conserving the species. In much the same move as had been made in the Scottish courts previously, the Justice retorted that "[i]gnorance of the *law is* no excuse, but it is otherwise with ignorance of the *fact."*[174] In other words, as one interpreter of the case put it, "[t]o obtain a conviction it must be shown that the offender knew the fish he was taking were the young of salmon." It appeared therefore this defence could not be maintained if the apprehended individual "be by profession a fisherman, or known to be well-skilled in the knowledge of fish."[175] Thus the justice of the matter hinged once again on expectations about how knowledge of nature figured in the awareness and understanding of different kinds of fishers, and how the knowledge and circumstances of persons on trial was accommodated with respect to this.

Blair v. Miller (1869 – 70), Perth: In Scotland, the defining case in this matter was that Robert Miller, a railway pointsman from Perth, against the Tay District Fishery Board, represented by William Blair. Heard once again by Sherriff-Substitute Barclay, the case went through two appeals before reaching a definite conclusion. The contours of the case up until that point mirror earlier precedents quite precisely, Barclay citing his own earlier verdict in Buist v. Crawford (1844),

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[172] "Hopton v. Thirwall," *The Law Times Reports*, New Series, 9 (1864): 327.
[173] See PD, Commons, vol. 164 (11 July 1861), col. 771 – 72, in which it is decided that special protection was not needed because the inclusion of the word "wilful" in the Act would be sufficient to fulfil this function.
[174] "Hopton v. Thirwall," 328.
[175] Baker, *The Laws Relating to Salmon Fishing in Great Britain*, 16 note (a).

and his colleague Grahame's in Galbraith v. Shaw (1858). How was this possible under the new legislation?

The clause libeled forbade the willful taking or possession of "smolt or salmon fry". In the relevant interpretation clause, as cited earlier, "salmon" are defined "to mean and include" smolt and parr.[176] Miller however was charged with having *parr* in his possession. Thus, put simply, and exactly in line with previous cases, Barclay based his verdict on the fact that in the "penal clause founded on, parrs are not mentioned, and he declines to inquire into and decide the scientific question whether salmon parrs are salmon fry or young of salmon".[177] In other words, he refused to interpret the question as one concerning a matter of fact, that parr are *salmon* and therefore also *salmon fry* or young salmon.

Looked at more closely, it is clear that the first key issue was whether it was proved that the accused had the fish in his possession willfully, which required proving he knew that the "fish he had in his basket" were smolts or salmon fry. But the second essential issue was whether parr, which he claimed "are confessedly not smolts" (being the younger stage of development), are (likewise) "the 'fry of salmon'." The first question required establishing that the defendant knew what he was doing, "or under the circumstances should have known".[178] The second question appeared to require establishing the truth of the facts alleged. The complainer offered to undertake this proof.

Agents involved in the local salmon fisheries presented evidence. A river watcher and the river Superintendent (a successor of Robert Buist's named Alexander Croll) testified as did Peter Marshall, the manager at nearby Stormontfield. But further scientific evidence that the prosecution attempted to have admitted was not allowed because this would, according to Barclay, encourage *ex post facto* law. On the defence's side, another local railway pointsman testified. The defence representative also urged that Miller was neither a seasoned poacher nor "habitual fisher", and had only decided, on the basis of a "leave of

[176] To be precise, Miller was charged under the "Salmon Fisheries Act (Scotland)" 1868 (31 & 32 Vict.), c. 123. However, this Act was read along with the Act of 1862, from whence the relevant interpretation clause came.
[177] "Blair v. Miller (1869)," 629.
[178] Ibid., 626, 627.

absence", to become for the day a "discipline of Izaak Walton".[179] In other words, what was allowed to be tested was the status of opinions and knowledge on the issue in the district and community that the defendant *could reasonably be expected to know*, not as the facts were considered amongst naturalists or discussed in elite literary, scientific or other professional forums.

The case was appealed in May 1870, the Tay proprietors alleging a number of reasons why Barclay's judgment was flawed, including that it was well known that "young of salmon" and "salmon fry" meant the same thing, and that the Sherriff-Substitute's judgment was awry most likely because of his own ignorance of the "finny tribe".[180] Lord Jerviswoode sustained the appeal at the Perth Spring Circuit, and remitted the case back to Barclay. The court took fresh proofs, hearing on this occasion from Mr Brown, a writer from Perth and chronicler of the Stormontfield experiments (see Chapter 4), and Mr Burn's, a farmer with experience of fish culture in Ireland. For the defense, seven local fishermen from Perth appeared (a group whose primary vocations, where given, included a dyer and two weavers).[181]

Press clippings entitled "Inquiry as to Whether Parr are Salmon Fry" from the time leave little doubt that, in the popular opinion at least, Jerviswoode had explicitly asked Barclay "to take proof as to whether parr be or be not salmon fry", as a writer from the *Fife Herald* put it.[182] However, Barclay once again refused to adjudicate on a scientific matter, and could only find therefore that it was not proved "that *in the popular and well understood sense* any of the parrs found in possession of the accused on the day libelled were 'salmon fry'".[183] In this light, Barclay wrote "He [Barclay] cannot bring himself to settle a scientific question at the expense of the unfortunate defender" because he was not "educated up to the high and nice standard of development of species." Moreover,

> It was monstrous to punish Galileo, the astronomer,
> or denouncing the popular opinion by setting up his own
> correct theory of the solar system; but it would have been

[179] Ibid., 629.
[180] Flowerdew, *The Parr and Salmon Controversy*, 97–98 reports a longer list of related objections.
[181] Ibid., 99–105. Testimonies and deponements reprinted in Flowerdew from *Dundee Advertiser,* 11 July 1870.
[182] "Inquiry as to Whether Parr Are Salmon Fry," *Fife Herald*, July 14, 1870; See also "A Novel Fishery Case," *The Dundee Courier & Argus*, July 11, 1870.
[183] "Blair v. Miller (1869)," 629 emphasis added.

> still more monstrous in those days to have punished any of the general public for adhering to the incorrect opinion of Ptolemy which they had been taught and believed from generation to generation.[184]

He argued, finally, that as the parr was not named explicitly in the libeled part of the Act (but only in the definition clause), "the framer of the statute knew of their existence, but did not intend them to be included in this highly penal clause". In this light, Barclay had some choice words for the "salmon proprietors" who, he said, could "easily remove the difficulty in the next of their long statutory series".[185]

This conclusion was widely reported on, and the Sherriff-Substitute's explanatory Notes on the judgment were reprinted in regional newspapers.[186] There appeared to be finality to the judgment. The *Leeds Mercury* concluded, despite Barclay's explicit desire to do nothing of the sort (and indeed quite incorrectly) that:

> Sheriff-Barclay, of Perth, has summarily settled a question which is an insoluble puzzle to naturalists. On Thursday, in the case of the Tay Fishery Board v. Miller, he decided that 'parr' are not salmon fry.[187]

But this closure did not last long. The proprietors appealed a second time to the Circuit Court, arguing that the entire matter could be settled by the interpretation clause of 1862, where parr were explicitly defined as salmon, and moreover that it was well known and beyond doubt that parr were salmon, making the laws qualms absurd. In this light, it was urged, "the terms of the Acts conclusively show […] that the Legislature intended that parr should enjoy the same protection as salmon did." Hearing the case put to them thus, the Lord Justice-Clerk and Lord Cowan, it seems, finally accepted the proprietors argument, and therefore the scientific consensus, and convicted Miller with a minimum possible fine of 1*s* per fish because this was the first conviction of its kind.[188] The particular circumstances of the respondent Miller, namely his reasonable and allowable ignorance, were no longer a defence in the light of the now apparently

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[184] Ibid., 630–31.
[185] Ibid., 631.
[186] See eg., "The Inquiry as to Whether Parr Are Salmon Fry," *The Aberdeen Journal*, July 20, 1870.
[187] "Sheriff Barclay, of Perth," *Leeds Mercury*, July 16, 1870.
[188] "Blair v. Miller, (1869-70]," *Scottish Jurist* 43 (1871): 18; also, "The Salmon Parr Case," *The Dundee Courier & Argus*, September 8, 1870.

implacable logic of the statute combined with the newly agreed recognition of the scientific consensus. Indeed, as the *Dundee Courier* reported, Miller was relieved of his fines by Tay District Fishery Board because, content that "they had so far gained their object in obtaining an authoritative decision", recognized that Miller's transgression of the law truly "appeared to be committed in ignorance". However, they wished it to be made clear to the populace that "any party transgressing the law in future would be prosecuted with the utmost rigour."[189] A similar case a year later, again in Dunblane, in which a ticket collector named Spalding was accused, followed the same course. Here the Sherriff-Substitute claimed the combination of statute and the solidity of the "now-established fact" made it impossible for him to repeat the kind of judgement he had handed down fourteen years before – and despite the testimony of a local angler who, "in the face of all recent authority, stoutly held to the opinion that parr were a distinct species of fish".[190]

3.5 Conclusion

The controversy did not disappear of course, especially in England. Fishers grumbled, and some found cause to doubt the facts of the parr's identity for decades to come. In 1884, a distinguished speaker and angler asked the Fly Fishers Club, whether, perhaps, despite the contributions of the fish breeders, the "question was hardly yet settled?"[191] In 1885, Willis-Bund, a lawyer and Chairman of the Severn Fisheries Board was concerned that the malaise following Hoption *v.* Thirwall had still not entirely "passed away".[192] Indeed, fishers on the Severn still justified taking these fish in certain months by calling them "skirling" into the 1890s – although some believed that they were no longer thereby made immune to prosecution.[193] In 1910, Malloch, fishing tackle shop owner and manager of the Tay Salmon Fisheries Company in Perthshire, was still worried that "the parr are slaughtered in thousands" by trout anglers.[194] In general however, attitudes had begun shifted on the issue during the 1860s. In 1867, Francis's important work *A Book of Angling* only briefly mentioned the parr-tail technique, he said, out of

[189] "The Late Parr Case," *The Dundee Courier & Argus*, November 19, 1870.
[190] "Important to Anglers - Are Parr Fish of the Salmon Kind?," *Dundee Advertiser*, June 16, 1871.
[191] "Fly Fishers' Club," *The Fishing Gazette*, March 10, 1888, 137.
[192] J.William Willis Bund, *Salmon Problems* (London: Sampson Low, Marston, Searle & Rivington, 1885), 54.
[193] See eg., Harry Perrin, "Correspondence: Skirling," *The Fishing Gazette*, February 14, 1891.
[194] PD Malloch, *Life-History and Habits of the Salmon, Sea-Trout, Trout, and Other Freshwater Fish* (London: Adam and Charles Black, 1910), 6.

obligation to record a "style which has prevailed chiefly in the north, for many years." Moreover, he said, any angler choosing to use it had better take "particular care the water-bailiff does not note your operations, or you will very probably be fined for killing salmon fry."[195] Later influential angling works took a similar position, (as one writer put it, to be "conformable to law" it was better, if possible, to use young trout in the parr-tail!).[196] If writing about use of parr as bait faded from public discussion, discussions of fishing for parr as sport per se just about disappeared. Parr fishing was now not only formerly illegal but, foremost, in the eyes of many high status salmon anglers, proprietors and legislators, and, later, it would appear, in the minds of many ordinary anglers or fishermen, also a dishonourable, unsporting activity, harmful to the interests of their own and the collective good, or, at least, best not spoken of openly.

I have tried in this chapter to show how the institutions of science and law, combined with processes of social interaction and representation, contributed to bringing about this rough settlement. As suggested, conflict is a regular feature of modern reproduction. In this instance, social rifts were exposed and exacerbated by experimental interventions into salmon breeding, and spreading, mutually reinforcing, beliefs about the salmon resource declining. New forms of social relations were established as these breaches were confronted and ameliorated. Legal changes were clearly of central importance here, though these in turn reflect a hybrid social-political settlement and social-scientific consensus. It would in any event be impossible to practically enforce a ban on parr fishing, especially so long as there was any sense in which ignorance could be used as extenuation, and given that they would inevitably be genuinely caught by accident. Dissemination of the strengthening empirical-scientific consensus was crucial, but only made really effective when connected to evaluations of the social meaning or "morality" of killing parr. A form of "internal" policing amongst anglers had to be engaged, and a sense that the laws were legitimate had to be established – at least in the minimal sense of Weber, in which some level of self-interest in upholding the law was

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[195] Francis Francis, *A Book of Angling*, 4th ed. (London: Longmans, Green, & Co., 1876), 291.
[196] H Cholmondeley-Pennell, "Spinning and Bait Fishing for Salmon and Trout," in *Fishing*, 5th ed. (London: Longmans, Green, and Co., 1889), 380; Also, H Cholmondeley-Pennell, *The Modern Practical Angler* (London: Frederick Warne and Co., 1870), 169.

recognised.[197] That there was a consensual component to this does not of course mean everyone agreed equally all the time, or benefitted from reforms to the same degree – there was a coercive element and an imbalance in power in terms of access to means of representation, recourse to legislation and repeat litigation. But this only increases the importance of struggles over establishing a framework in which mutually incompatible claims are accommodated and parties compelled to forego some benefit. Recall, both "sides" in the debacle "lost" something: proprietors their right to dispose of their salmon fishing properties as they so wished – further ins-and-outs of which will be seen in following chapter – and some fishers the privelege to catch parr without restraint.

As in all politics, it was essential that to be effective the interests of different factions had to be presented in terms of values or ideals, not simply as demands. Since their claims would ultimately require a degree of acceptance by others, they needed legitimising notions. This realisation is connected to my suggestion that the "moral economies" of both sides could be treated symmetrically as referring to uses of language involving different ideas about the common good. This also distances my approach from readings of the moral economy idea as a *Gemeinschaft* critique of modernity, or which poses *Gemeinschaft* forms of social organisation as a means of avoiding the necessity of conflicts arising from the differences in ends, goals or interests of human actors and groups.[198] However, describing at various points these competing moral economies in terms of "community" and "society" recalls typologies through which classical sociology presented transitions from traditional to modern forms of social integration, including the emergence of capitalism and modern civil society. These include, for instance, Henry Maine's theory (first published in 1861) of historical development as a transition from personal "status" based on corporate membership to impersonal "contract" based on individual abstract rights[199]; interpretations of Weber's contrast between open "associative" relations based on the "rationally motivated adjustment of interests" and closed "communal" forms of solidarity based on traditional and affective ties,

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[197] The fulfilment of an action "partly because disobedience would be disadvantageous" and "also because its violation would be abhorrent to [the] sense of duty", Max Weber, *Economy and Society: An Outline of Interpretive Sociology*, ed. Guenther Roth and Claus Wittich (Berkeley, CA: University of California Press, 1978), 31.
[198] See Holton and Turner, *Max Weber on Economy and Society*, 27.
[199] Henry Sumner Maine, *Ancient Law: Its Connections to the History of Early Society*, Everyman's Library (London: J.M. Dent & Sons, 1917).

the falling away of which comprises a history of modernity[200]; and, of course, Tönnies' famous dualism of *Gemeinschaft* and *Gesellschaft,* or community and civil society, itself.[201] My analysis resonates with these in some ways, in particular in the idea that underpinning the phenomena described by these terms lays historical struggles over political influence and authority. In line with general methodological dispositions outlined in Chapter 1, I have however not been tempted to construct my analysis with a view to inserting it into any such grand schema. In thematising my concerns in terms of "community" and "society", I have rather intended to suggest that these words are useful shorthands to describe the forms of rhetoric and outlook adopted by historical actors in struggles to achieve particular ends. In each, and in their own fuzzy and general ways, are visions of collective life that individuals could believe regulated the existence of others, and could thus contribute to shaping their conduct.[202] In so doing, I emphasise a theme also well known to these classical authors though extending further back at least as far as Hobbes: the problem of social order, or how "social orderliness" is maintained and reproduced.[203] This has taken the form of concern with the means through which crises arising from incompatible demands are assuaged or mediated. I have emphasised inequalities of power, especially in terms of access to the legislative process – and this clearly suggests a coercive as well as a persuasive element. There was also an issue of dealing with increased local social heterogeneity on the river as a greater diversity of actors, including urbanites, professionals, artisans and worker sought angling. But this would have been a relative phenomenon generated by growing tendency towards social and economic homogeneity in the sense of increased numbers of people from different social backgrounds becoming able to access and afford such leisure pursuits, and hence compete of the same or similar resources. It's in this context that we should, I think, read the struggles over marks of distinction in angling generally and to which the question of killing parr particularly was associated. Social order, in the relevant sense, in this case then refers to the consequences of managing both

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[200] Weber, *Economy and Society: An Outline of Interpretive Sociology*, 40–41.
[201] Ferdinand Tönnies, *Community and Civil Society*, trans. Margaret Hollis (Cambridge: Cambridge University Press, 2001). On the link between Maine and Tönnies, see R.A. Nisbet, *The Sociological Tradition* (London: Heinemann, 1966), 72–73. Otto von Gierke and Emile Durkheim's names might also be mentioned with respective their grand typological conceptualisations.
[202] C.f., Stone, "Max Weber and Moral Idea of Society."
[203] Frisby and Sayer, *Society*, 42; also 17-19.

overall conflict focused on the material resource, and the more specific conflict oriented around the ideal resources of status or honour amongst anglers.

4. Division amongst proprietors: Stormontfield and economic salmon culture

It is, in fact, the difficulty of *uniting*
– the old fable of the bundle of sticks over again.
– W.M. Peard, *Practical Water Farming,* 1868

4.1 The salmon manufactory on the Tay

The year 1852 saw historical lows in rental for salmon fishery proprietors on the River Tay in Perthshire. Concerned about their profits, a group of proprietors and other interested gentlemen met on the 19th of July 1853 to discuss proposals for the establishment of a salmon breeding operation. The outcome of this meeting was the founding of what quickly became known as the Stormontfield fish culture experiment, or, to the sporting periodical *The Field,* "The Salmon Manufactory on the Tay."[1] Despite their parochial motivations, the proprietors of the district were often fêted for their contribution to the development of salmon culture as an economic consideration of national importance. *All The Year Round* enthused: "[p]roprietors of other salmon rivers should take a lesson from what has been done in this instance."[2] The Earl of Mansfield, who was actively involved, was especially praised for "the liberal manner in which he has aided the carrying out the operations […] from which he can reap little advantage beyond the satisfaction to an enlightened mind of promoting the interests of science and the welfare of the community."[3] Indeed, Stormontfield became Britain's iconic contribution to a new spirit of European pisciculture, as the French called it. As one insider-historian on the continent claimed, the subject no longer belonged only to savants: rather, the "artificial multiplication of fish, […] belongs at once to the natural sciences, to

[1] "The Salmon Manufactory on the Tay," *The Field*, December 17, 1853.
[2] "Salmon Breeding," *All the Year Round*, September 7, 1861, 564.
[3] Edmund Ashworth, "Propagation of Salmon," in *Propagation of Salmon*, ed. Edmund Ashworth (Bolton: Hasler & co., 1875), 11.

agriculture, and to political economy."[4] In Britain, Russel wrote, "[o]f all the 'movements', indeed, in this age of movements, there are few more important than that which has for its object the increase of the supply of food by the propagation and better culture of fish."[5] Indeed, during the period around mid-century, salmon culture became a matter of public discourse, a promise of future prosperity, and even a symbol of progress and modernity.

Yet, as much as the Tay proprietors were praised for their "prudence, patriotism and philanthropy"[6], so they were also criticised for being narrow and self-interested. When they ostensibly refused requests for salmon eggs from other fish culturalists desirous of incubating and rearing, domestically and internationally, commentators excoriated them for failing to live up to public duty, and failing thus to partake in a wider movement of improvement, wrote Frank Buckland was "a fatal mistake." "By giving them [eggs] they would in reality lose no more than a person who gives a light to another from his burning candle." They should attempt to "assist, not endeavour to arrest, the progress of pisciculture", he said.[7] When no less a request than one from the Italian patriot Garibaldi was turned down in 1862, another commentator implored them "to get rid of the narrow-minded feelings".[8]

Discourses of praise and blame of this kind became an endemic feature of commentary on the practice and promise of fish culture. One conjunction of factors is particularly fundamental – and central to this chapter – to perceiving what motivated public criticism of salmon fishery proprietors. This concerns an entanglement of the social relations of salmon fishing as a kind of property with the geographic distribution of ownership along the courses of rivers, and the recalcitrant biological characteristics of the species itself. This heterogeneous nexus witnessed intense conflicts of interest amongst proprietors as it quickly became clear that the investments of any one actor in adopting salmon culture

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[4] Haime, "The History of Fish Culture in Europe from Its Earlier Records to 1854," 469.
[5] Russel, *The Salmon*, 214.
[6] W.M. Peard, *Practical Water Farming* (Edinburgh: Edmonston & Douglas, 1868), 115, 9.
[7] Francis Buckland, "On the Acclimatisation of Animals," *Journal of the Society of Arts* 9, no. 419 (November 30, 1860): 26, 27.
[8] A Rural D.D., "Salmon-Rearing at Stormontfield, and Fish Culture," *The Journal of Agriculture*, no. 79 (1863): 745. For more on this curious request, see Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 70, 143–44.

could hardly be guaranteed to remunerate them, but might instead benefit their competitors. Thus Sir Price would later praise "[t]he far-seeing and public-spirited proprietor", but simultaneously complain about those who failed to undertake salmon culture under the "selfish apprehension that they are benefiting other part proprietors of the same river".[9] Or, as another fish culturalist Charles Capel put it, such a man is not only

> a disgrace to his nation but a fool as well; it is as if he would cut off his nose to spoil his face. Public opinion should scourge that man until he be ashamed and reform his ways.[10]

Through a case study of Stormontfield in its formative years (roughly 1853 – 1863),[11] this chapter explores what these issues meant for the progress of pisciculture as pioneering individuals and organisations sought to turn artificial propagation technologies, in the words of *Once a Week*, from a "toy" into a "practical working fact".[12]

One aspect of this chapter therefore aims at describing the transformation in salmon culture thinking and ambition in a broad context, namely, of intensified pressure on resources, competition between fisheries agents, and perceived scarcity. In Chapter 1, it was suggested that the immediate precipitant for modern British fish culture was a problem in ichthyology. The process of qualifying this assertion began in Chapter 2, when it was shown that parr controversy itself occurred in a highly politicised context of the "salmon question". The present chapter develops this with the claim that, given the wider situation, the techniques John Shaw demonstrated took on a new significance as a potential technological solution to a social and political problem. As William Scrope had noted as early as 1843, by following Shaw's lead, "[t]he fry might be produced in any quantities by

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[9] Sir Rose Price, "Fish Culture: Salmon Rivers," *The Fishing Gazette*, January 31, 1879, 55.
[10] Charles C Capel, "Fish Culture," *The Fishing Gazette*, February 7, 1879, 66.
[11] Existing references to Stormontfield in academic commentary are minimal, but see Hill, "Sir James Maitland and the Howietoun Fishery," esp., Chapter 2 who includes some references to Stormontfield as a part of the historical context for trout farming initiatives in the 1880s in Britain; Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 478–81 includes a short appendix addressing the possible impact of artificial propagation on the Tay river fisheries; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland* mentions Stormontfield frequently but offers no detailed case study.
[12] A.W., "The Fish-Farms of the World," *Once a Week*, June 2, 1866, 614.

artificial impregnation."[13] Breeding, rearing and stocking fry to replenish wild stocks became the basic goal of Stormontfield – and a model for subsequent salmon culture in Britain and elsewhere. Thus the artificial propagation of salmon shifted in orientation: no longer a primarily experimental tool for investigating the habits and relations of *salmonidae*, it began to function as a technology of production during the 1850s. It became a means akin, in the eyes of enthusiasts, to agriculture. As Bertram asked, "[w]hy should we not cultivate our water as we have cultivated our land?"[14] Focused on the technical augmenting of natural procreative processes, it became, to borrow Marilyn Strathern's expression, a site of reproduction "enterprised-up".[15]

An important underlying factor in the development of salmon culture at Stormontfield and in the United Kingdom generally was the state's disinterest in directly supporting initiatives in artificial propagation.[16] This meant relying on salmon fishery proprietors as the only actors practically capable of undertaking the venture on any significant scale. The reasons for the state's absence are explained, on the one hand, by a reluctance to get involved in an embryonic and still uncertain industry. (Wilkin's claimed that all nineteenth century salmon culture projects were ultimately "costly failures").[17] On the other hand, the historical fact was that just about all salmon fisheries in Britain were already privately owned.[18] The state's responsibility as rule-setter for the inland fisheries, as we saw previously, was in general increasingly important; however, it never extended to investing in technological schemes for "artificially" improving fisheries. Additionally, there was in British agriculture an established precedent for private, wealthy, high status, individuals to voluntarily take up works aimed at increasing the reproductive power and bodily yields of farm animals. Arguably,

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[13] Scrope, *Days and Nights of Salmon Fishing in the Tweed*, 45. Also, Hill, "Sir James Maitland and the Howietoun Fishery," 42–43.
[14] Bertram, *The Harvest of the Sea*, 224.
[15] Strathern, *Reproducing the Future: Essays on Anthropology, Kinship, and the New Reproductive Technologies*, Chapter 2.
[16] For broader comparative accounts of state involvement (or lack thereof) in supporting innovation in economic and industrial activity, see Peter Alter, *The Reluctant Patron: Science and the State in Britain, 1850-1920*, trans. Angela Davies (Oxford: Berg, 1987); For a contrasting account from the USA in the area of fisheries science specifically, see Chandra Mukerji, *A Fragile Power: Scientists and the State* (Princeton, NJ: Princeton University Press, 1989). See also Chapter's 1 and 6.
[17] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 35.
[18] Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution," 539.

one source of attraction for participants in movements of "scientific improvement" of this kind was the social approbation and status-confirmation that came with performing works seen as contributing to the prosperity of the nation.[19] Similar incentives may have motivated some salmon, and associated discourses undoubtedly promoted this. In contrast to other innovative practices involving agricultural mammals however, there were severe constraints on *individuals* taking up salmon culture, at least on scale significant enough to be deemed more than mere "toying". Of course, all attempts to create new sources of value through harnessing the biological capacities and characteristics of animals require social technologies of some kind.[20] In the case of salmon culture in Britain however, this requirement took a specific form in which *association* and *unity* amongst proprietors became a key condition for the serious development of artificial propagation as an economic endeavour.

Thus a second central aspect of this chapter aims at understanding the problems of association and unity with respect to salmon culture in the context of a specific environment: the Tay fisheries around the middle of the century. The Tay – while exceptional in some ways – in many respects reflected the conditions of the salmon fisheries elsewhere in the UK. Other studies have shown how specific biological capacities of organisms can assist in the forming of alliances between producers in ways that augment their capacity for exercising power in markets.[21] But in the case of salmon culture, the interrelationship between biological traits and the manner in which fishing and fishery ownership was regulated meant that most British salmon fishery proprietors, and certainly those on the Tay, were throughout the century locked in internecine economic warfare and regular litigation amongst themselves. For these most powerful of economic actors in the salmon fisheries arena, calls for preserving or improving the fisheries were inseparably connected to feuds over the distribution of fishing property on the river. This manifested as intense rivalry between individuals and, more importantly, parties associated with stretches of river with different fishing

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[19] See Ritvo, *The Animal Estate*, Chapter 1, 45-82; More generally, Wilmot, *The Business of Improvement*.
[20] Eg., Ritvo, "Possessing Mother Nature: Genetic Capital in Eighteenth-Century Britain"; Derry, *Bred for Perfection: Shorthorn Cattle, Collies, and Arabian Horses since 1800*; Franklin, *Dolly Mixtures*.
[21] Eg., Katharine A Legun, "Club Apples: A Biology of Markets Built on the Social Life of Variety," *Economy and Society*, 2015, doi:10.10180/03085147.2015.1013743.

characteristics and capacities. The resulting atmosphere of distrust and competition hampered the introduction of what may, in some cases, have been mutually beneficial conservation-oriented reforms. Indeed "conservation" (or "preservation") became a secondary concern that functioned as political lever for extracting concessions. At the same time, these social conditions contributed to establishing reasons why a technological solution – artificial propagation – to the "salmon question" appeared attractive and opportune, a mechanism or balm through which to restore plenitude or engineer unity. Crucially though, it was these divided parties that would need to in co-operatie in practical salmon breeding and agree about the wider regulation of the river fisheries if the artificial production of salmon was to succeed.

Whilst promoters of salmon culture often modelled themselves rhetorically on agricultural improvers – "[to] be, in short, to rivers and waters what agriculture is to land"[22] – what was principally intended by this was the betterment of the river and the *quantity* of sizable fish it contained – not the bodies of animals or the breed itself, as scientific breeders of sheep and cattle, for example, had done. As Ritvo argued, Robert Bakewell's success with cattle lay in the redefinition what it meant to have property in an animal: this meant a shift to a logic of individuation and qualitative judgement of an animal's worth, not simple "addition". In this context, "reproductive power" means the value stored in the animals' lineage.[23] In the case of salmon under culture in the mid-nineteenth century however, reproductive power refers to a measure of the quantity of eggs and young capable of being produced from the union of the gametes of one adult pair and these achieving a harvestable size. "Property" in salmon resided in the *right to exploit* the population at particular geographic locations to the exclusion of others (the fish themselves – their individual bodies – were, as we have already seen, *fera naturae* and therefore common property). Moreover, at this time, there were no feasible technologies of individuation[24], meaning no easy means of separating individual fish's bodies from one another, and also that it was impossible to separate whole

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[22] Piscarius, *The Artificial Production of Fish*, 8.
[23] Ritvo, "Possessing Mother Nature: Genetic Capital in Eighteenth-Century Britain," 416, 419.
[24] See Henry Buller, "Individuation, the Mass, and Farm Animals," *Theory Culture & Society* 30, no. 7/8 (2013): 154–75; also, for consequences of this for human-animal relations, Jamie Lorimer, "Nonhuman Charisma," *Environment and Planning D: Society and Space* 25 (2007): 911–32, doi:10.1068/d71j.

populations of fishes, such as those "in culture" from their wild counterparts. Thus after Bakewell, "reproductive power" could become a commodity: via mediation of various social technologies – marketing techniques, quality control mechanisms, pedigree registers and effective cartelisation amongst breeders – it could be made tractable, possible to hold and to transfer when individual owners desired it. However, for individual salmon culturalists on a river like the Tay, enhancing "reproductive power" meant, in practice, augmenting a common stock that migrated according to its own habits, and whose individual components they had no guarantee of ever catching themselves. Hence for salmon culture to succeed, it depended greatly on the ability to form co-operative associations, to find compromises, and to establish and enforce legitimate fishing practices.

Since much of my analysis in this chapter deals specifically with the Tay fisheries, I am deeply indebted to previous detailed research on this area, especially that by Iain Robertson, whose PhD investigated the Tay salmon fisheries and the relations between its proprietors during the Nineteenth century. I draw extensively on his research, seeking to extend it through my focus on Stormontfield itself.[25]

I proceed firstly by contextualising Stormontfield with reference to changes in the character of fish culture as an economic proposition in the early at 1850s. Thereafter, I turn to a description of Stormontfield itself, its material practices and contemporary evaluations of it. I then show how the practice of salmon culture there was entangled with existing social tensions and politics on the Tay. The key issue here was competition between upper and lower river proprietors, which resulted in lingering historical enmities. Binding these factions into some kind of

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[25] Robertson's is the most comprehensive analysis of the fisheries of a single salmon river in Britain during during the nineteenth century that I am aware of. I work from his PhD, Robertson, "The Tay Salmon Fisheries in the Nineteenth Century"; although some of this material is also available in Robertson's book, *The Tay Salmon Fisheries since the Eighteenth Century* (Glasgow: Cruinthe Press, 1998); Two web articles by the same author, both associated with free-market economic thinking about conservation, are also notable contributions "The Scots Centuries-Old Way to Conserve Salmon Privately," *TCS Daily*, February 12, 2001, http://www.ideasinactiontv.com/tcs_daily/2001/02/the-scots-centuries-old-way-to-conserve-salmon-privately.html; "Salmon Conservation in Scotland: A History of Legislative Tradition and Private Action," *Competitive Enterprise Institute*, January 15, 2001, https://cei.org/studies-issue-analysis/salmon-conservation-scotland-history-legislative-tradition-and-private-action. Usefully, Robertson had access the Tay District Salmon Fisheries Board papers, which were not available for the present research, see Appendix 2.

co-operative arrangement was in effect a prerequisite to successful salmon culture – even as the appetite for salmon culture generally was at the same stimulated by the perception of resource scarcity that rapacious competition between these opposed interests had supposedly wrought. I discuss how these difficulties prompted additional efforts to escape the necessity of politics by developing other technologies. I conclude discussing how salmon culture, given narrow parameters on what was technically possible, was unsuccessful as a commercial-industrial and food-producing entity at the time. However, as a technology it could be redefined and remained useful in Britain according different social and cultural ideals, and with respect to the interests of certain social groups, especially recreational anglers, rather than the commercial, food producing salmon fishing industry.

4.2 Salmon culture in the 1850s: Entrepreneurs, institutions and discourses

Stormontfield became Britain's foremost example of a new spirit of fish culture, but it was in reality only one instance of a wider shift in fish culture ambitions both domestically and internationally. Bertram's opinion that the honour of rediscovering the art of artificial propagation (which was at the root of the shift) à la Jacobi "as an adjunct of science" belonged to Scotland, and "the useful part of having turned the art to commercial uses" to France has merit.[26] Certainly, the influence of French pisciculture on the global fish culture movement from the late 1840s onwards was tremendous. As the folklore of fish culturalists told it, techniques of artificial fecundation and incubation had been "discovered", independently of any scholarship, by Remy and Géhin, two supposedly "unlettered French peasants" from the Vosges region, and first revealed by them to local officials in 1843.[27] As Kinsey's study of the development of French aquaculture during this period tells, the substance of their contribution, including the possibility of artificial fecundation, was well known in scientific circles in Paris, having been long discussed by savants interested in animal reproduction.[28] Nevertheless, the government of Louis Napoleon quickly saw fit to honour the

[26] Bertram, *The Harvest of the Sea*, 75.
[27] [James G. Bertram], "The Salmon and Its Growth," 46.
[28] Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution," 533.

lowly fishermen, appearing to view the subject as an opportunity to demonstrate the democratic spirit and modernist vitality of the Second Republic. The French state thereafter sought ardently to support fish culture.[29] The crowning monument of this period was the establishment of a "piscifactoire" at Huningue in Alsace in 1852. Paid for by the state, it consisted of grounds of eighty acres and, as Kinsey describes, it

> … benefited from the most up-to-date science of aquatic biology, scientific tools, equipment with standardised interchangeable parts, rational methods of organisation, and technicians who brush the eyed-ova daily to remove harmful sediment

Huningue proved capable of fecundating and incubating over 100 million ova of French *salmonidae* (mainly trout) before the end of the decade, and distributing these to many parts of France and neighbouring countries.[30] Huningue was represented in Britain as the key instance of modern or "really scientific fish culture", as *All The Year Round* put it.[31]

Huningue directly influenced the founders of Stormontfield, and was widely admired in Britain. Bertram wrote: "if any river in France be still fishless, it is not through the fault of a paternal government."[32] *The Morning Chronicle* worried that "left to private enterprise" the matter in Britain would likely "languish under the obstruction of 'vested interests'" (they were not too far wrong, as we will see).[33] But the French "system of concentration", as one writer called it, under state support did not meet universal approval.[34] Capel, for instance, argued that there was no need for "State hatching establishments" in a country as small as Britain; here, "the useful employment of individual or private capital and energy" would be sufficient.[35] Moreover, the fact that salmon specifically were, as Dr Knox said, "the fish which the English most desire to see multiplied"[36], strongly dictated a decentralised, locally applied system based on existing patterns of river fisheries ownership and exploitation.

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[29] Ibid., 533–34.
[30] Ibid., 535, 536.
[31] "Fish Farms," *All the Year Round*, April 29, 1876, 161.
[32] Bertram, *The Harvest of the Sea*, 78.
[33] "New Mode of Salmon Propagation," *The Morning Chronicle*, February 9, 1853.
[34] A.W., "The Fish-Farms of the World," 613.
[35] Capel, "Fish Culture," 66.
[36] Robert Knox, "Fish-Culture [Part 1]," *The Illustrated London Magazine* 1 (1853): 281.

In this light, the efforts of the Messrs. Thomas and Edmund Ashworth represent a key early instance of the "commercial" spirit in British fish culture. With a background in cotton manufacture, the brothers purchased a fishery in Galway, Ireland, on the basis of the Encumbered Estates Acts[37], with the intention of developing salmon culture as a commercial speculation. They expressed the free market inclinations of the Manchester School.[38] (When commissioned to perform an assessment of the viability of the river fisheries of Portugal and Spain by the government of those countries, the brothers reported back with firm recommendations that state support of fish culture would not be beneficial.[39]) In order to "render the science […] subservient to commercial purposes"[40] in their operations, the brothers employed a man named Robert Ramsbottom, originally a fishing tackle dealer from Clitheroe, to act as engineer and chief manipulator of fish. Ramsbottom had learnt the technique of artificial fecundation from Thomas Garnett, a manager of a Lancashire mill, who had experimented with the subject in the 1830s and 1840s (see Chapter 2). Ramsbottom made his first successful attempt at artificial fecundation in Knowlmere, England, the same year (1852) that work at Galway began and Huningue commenced operation.[41] Edmund Ashworth cited Ramsbottom as the key source for "the practical development of this science" in an address on fish culture before the British Association for the Advancement of Science (BAAS) in 1855.[42] Ramsbottom and the Ashworths' were both key influences in the early years of Stormontfield.

With Huningue, Galway and Stormontfield, the early 1850s thus saw a distinctive new phase of fish culture. In Ireland, Commissioner of Salmon Fisheries William Ffennell (see Chapter 3) also occupied himself with proselytising the advantages of salmon culture and the value of those who made "practical science

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[37] These Acts, of 1848 and 1849, allowed the cheap sale of Irish land that had become mortgaged and unviable after the Great Famine.

[38] Their association with political economy was likely to have been more direct: in fact, a third brother, Henry, like Edmund a large factory owner, was a friend and associate of Richard Cobden and prominent Anti-Corn Law campaigner. See A.C. Howe, "Ashworth, Henry (1794-1880)," *Oxford Dictionary of National Biography*, 2004, http://www.oxforddnb.com/view/article/795. (Online Ed., May 2009).

[39] Edmund Ashworth and Thomas Ashworth, *Report upon the Fisheries of the Rivers of Spain and Portugal* (Manchester: Love and Barton, 1857); Also, Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 132.

[40] Ashworth, "Propagation of Salmon," 1875, 5.

[41] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 139–40.

[42] Reprinted as Ashworth, "Propagation of Salmon," 1875, 6.

their study" in this regard.[43] At the Great Industrial Exhibition in Dublin in 1853, Ffennell displayed a number of artificially hatched fry, procured from Galway. These aroused public interest – the Queen was even said to have delighted in them.[44] Following the model established at Stormontfield, the Duke of Roxburgh also began salmon breeding on the Floors stretch of the Tweed, also in 1853.[45] The same year, the Hammersmith engineer Gottlieb Boccius filed the first specialist fish cultural patent in Britain: an incubation device of a distinctly similar design to that first suggested by Jacobi in the eighteenth century.[46] Around the same time, Ramsbottom and Edmund Ashworth were involved in another design with the River Dee Fishery Association near Overton in Wales.[47] The naturalist John Hogg also reported on a number of "active gentlemen and practical ichthyologists" taking up the matter with the intention of resupplying the River Swale in 1854.[48] The allure of breeding salmon for purposes of improvement and profit was growing in prominence.

The energy of people like the Ashworths' and Ramsbottom were key to the gradual emergence of this increasingly distinctive zone of practical fish cultural activity: they were "entrepreneurs", both in the conventional sense and in the sense of what the social worlds/arenas tradition understands as those "deeply committed and active individuals" who are so often discovered as critical ingredients in catalysing new social worlds.[49] But an inseparable aspect of these developments was the appearance and utilisation of communication channels through which fish cultural activity was organised and promoted, which is to say,

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[43] Ffennell, "On the Artificial Propagation of the Ova of the Salmon and the Progress of the Experiments Now Carrying On," 139.
[44] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 54.
[45] See "Artificial Propagation of Salmon in the Tweed," *The Times*, December 23, 1853. Little is known about these experiments. Bertram believed them to have failed due to "bungling and inattention", Bertram, *The Border Angler*, 122. Also William Jardine, Dr [John] Fleming, and Edmund Ashworth, "Report of a Committee upon the Experiments Conducted at Stormontfield," in *Propagation of Salmon*, ed. Edmund Ashworth (Bolton: Hasler & co., 1875), 26–28.
[46] Gottlieb Boccius, Apparatus for the Breeding and Rearing of Fish, Office of the Commissioners of Patents 2966 (London, filed December 21, 1853, and issued June 20, 1854).
[47] See "Artificial Breeding of Salmon on the Dee," *The Field*, April 22, 1854. Another scheme was tried on the Scotch Dee at Tongueland by tacksmen there. It is reported however that the number of eggs being hatched was very small (between 25 00 and 50 000 per year). This initiative was apparently developed on the basis of earlier experiments on parr in the 1830s, see *The Harvest of the Sea*, 112–13.
[48] John Hogg, "On the Artificial Breeding of Salmon in the Swale," in *Report of the Twenty-Third Meeting of the British Association of the Advancement of Science (Hull, 1853)* (London: John Murray, 1854), 68.
[49] Clarke and Star, "The Social Worlds Framework: A Theory/Methods Package," 118.

in practice, its textual basis (see also Chapter 1 and Appendix 1). During the late 1840s and early 1850s, texts began appearing that sought to communicate the techniques and results of fish culture and artificial propagation, its relevance to the wider circumstances of the salmon fisheries, and potential social and economic benefits. These were often in book or pamphlet form, but local and national newspapers, literary magazines and popular periodicals, as well as, importantly, the sporting presses, had begun to publish stories on developments in fish culture regularly. Blatantly promotional texts, which attempted to prepare the ground by configuring participants, audiences and markets for fish culture, began to appear for the first time, for instance those by Boccius.[50] In 1850, the popular sporting writer Ephemera (Edward Fitzgibbon) published *The Salmon,* an illustrated book on angling and natural history.[51] In this venture he collaborated with Young, the salmon breeder and fisheries manager.[52] In the book, Fitzgibbon discussed the art and application of artificial propagation in detail, to which end Wilkin's has credited it as being the first book to present the subject "in a popular fashion to a general sporting public."[53] The Ashworth's, not unlikely with an eye to promoting interest in the kind of venture they were embarking on, translated and published a highly significant French treatise on the subject in 1853, written by no less than the present manager at Huningue (an embryologist named Victor Coste).[54] Ramsbottom published his own book based on his experiences as a fish cultural consultant in 1854. In it he declared: "Artificial Propagation is not now merely a question of natural philosophy. The problem is fully solved. What is now wanted, is its practical adoption."[55] While practiced hands like Ramsbottom's knew the actual difficulties that "practical adoption" entailed, this did not make the common tenor of commentary at this time any less naïve and overblown. Piscarius's pamphlet *The Artificial Production of Fish,* for instance, emphasised the public utility of artificial propagation, proclaiming that with it an "immense addition may be made to the

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[50] Gottlieb Boccius, *Fish in Rivers and Streams. A Treatise on the Production and Management of Fish in Fresh Waters* (London: John Van Voorst, 1848).
[51] Ephemera, *Book of the Salmon*.
[52] On Young see also Chapter 2. Also, Andrew Young, *The Natural History and Habits of the Salmon* (Wick: Peter Reid, 1848); *The Natural History and Habits of the Salmon* (London: Longman, Brown, Green, and Longmans, 1854).
[53] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 113.
[54] M. Jean Jacques Marie Cyprien Victor Coste, *Instructions Practiques Sur La Pisciculture* (Paris: Librairie de Victor Masson, 1853). Edmund Ashworth and Thomas Ashworth, *A Treatise on the Propagation of Salmon and Other Fishes* (London: Simpkin & Marshall, 1853).
[55] Ramsbottom, *The Salmon and Its Artificial Propagation*, 63.

peoples food with scarcely any expense" and was hence must be considered, "of practical and commercial, political and social importance."[56] Although it was not universal (Knox's articles in the *Illustrated London Magazine* in 1853 and 1854 represent, for instance, a somewhat more balanced appraisal), such rhetoric, in which material and social difficulties are downplayed in the light of apparently immanent success, became an endemic feature of fish culture discourse for at least the next decade.[57] Indeed, fish culture "propaganda", as Hill put it, reached its peak in the early-to-mid 1860s with the efforts of the well-known duo Francis Francis and Frank Buckland.[58] By 1865, Buckland had even established a permanent Museum of Economic Fish Culture at the Exhibition Grounds at Kensington, and maintained the subject's profile in forums including the Royal Institution and Society of Arts.[59] Through Buckland and Francis particularly, fish culture also became intimately connected to the acclimatization movement, not least the publicity-grabbing efforts to transport *salmonidae* to the antipodes.[60]

This was, broadly speaking, the context and mood in which Stormontfield was founded and which characterised the first decade of its operation. It was a context in which Stormontfield, as a working example and symbol of practical fish culture, played a large role in defining. In the following section, I describe some of the practical details of work at Stormontfield, examine the significance of the

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[56] Piscarius, *The Artificial Production of Fish*, 3–4, 8.

[57] A familiar theme in early phases of technology adoption cycles, see Mads Borup et al., "The Sociology of Expectations in Science and Technology," *Technology Analysis & Strategic Management* 18, no. 3/4 (2006): 285–98.

[58] Hill, "Sir James Maitland and the Howietoun Fishery," 55. See especially, Buckland, *Fish Hatching*, 1863; *Manual of Salmon and Trout Hatching* (London: Tinsley Brothers, 1864); Francis Francis, *Fish-Culture: A Practical Guide to the Modern System of Breeding and Rearing Fish*, 2nd ed. (London: Routledge, Warne Routledge, 1865) [First ed., 1865]. On Buckland's promotional activities, see Burgess, *The Curious World of Frank Buckland*, esp., 99-100; Shelton, *To Sea and Back: The Heroic Life of the Atlantic Salmon*, 122–23; On Buckland as a lecturer, see Bernard Lightman, "Frank Buckland and the Resilience of Natural Theology: A Curiosity of Natural History?," in *Evolutionary Naturalism in Victorian Britain: The "Darwinians" and Their Critics*, ed. Bernard Lightman (Surrey: Ashgate Publishing, 2007), XI. 1-27; On Francis Francis and fish culture, see John M Francis and Alan C B Urwin, *Francis Francis: 1822-1886: Angling and Fish Culture in the Twickenham, Teddington and Hampton Reaches of the River Thames*, Borough of Twickenham Local History Society, No. 65 (London: Borough of Twickenham Local History Society, 1991). On Buckland and Francis's mutual connection with *The Field* magazine, see R.N Rose, *The Field, 1853-1953* (London: Michael Joseph, 1953), Chapter 7; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 133–37.

[59] Buckland described the museum in "Museum of Economic Fish Culture," *The Times*, February 15, 1869. The Museum, bequeathed to the nation, existed in a dilapidated state into the 1880s, when it was broken up. Some artefacts from it that have survived are and are on display at the Scottish Fisheries Museum in Anstruther, which the author has visited. More details of Buckland's contribution to the fisheries are given in Chapter 5 and Appendix 3.

[60] See Lever, *They Dined on Eland: The Story of the Acclimatization Societies*; Osborne, "Acclimatizing the World: A History of the Paradigmatic Colonial Science."

model adopted, and discuss some contemporary evaluations of its successes and failures.

4.3 A model establishment

Two gentlemen in particular have been credited with initiating events at Stormontfield. The first was the powerful salmon magnate, Lord Gray, the largest proprietor on the river. The second was a local physician and mesmerist, Dr Esdaile (a one-time student of Knox), from the town of Perth. Esdaile was said to have read a French treatise on pisciculture and "[f]ired with a vision of fins", suggested the matter be taken in hand by proprietors in the district.[61] He wrote to local newspapers with suggestions for a scheme, and his proposals were read before the Town Council of Perth, the Burgh being an important owner of salmon fishing property on the river. It is possible that Lord Gray had begun thinking of breeding salmon earlier under the direct influence of John Shaw. But, in the event, having recently witnessed the work being done under the auspices of the government there, he too was inspired by the French.[62] Amongst other persons present at the decisive meeting was Thomas Ashworth, who urged the Tay proprietors to adopt a similar scheme to his Galway establishment. With the help also of Dr Queckett of the Royal of College of Surgeons, and River Superintendent Buist, Ashworth assisted in selecting an appropriate location for the works. They found this at Stormontfield Mill, near to Perth and the Palace of Scone on the banks of the Tay. The site was on the land of the Earl of Mansfield, who donated its use to the scheme with the blessing of his tenant. A local engineer was employed to do the initial work, and Buist, along with Peter Marshall who became the Keeper, took charge of overseeing the operation. Ashworth suggested that Ramsbottom be

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[61] A Rural D.D., "Artificial Breeding of Fishes Belonging to the Salmon Family," *The Journal of Agriculture*, no. 46 (1854): 82–83. Dr James Esdaile, a relative of A Rural D.D. (David Esdaile) was well known for his ideas about mesmerism, see Waltraud Ernst, "Esdaile, James (1808 - 1859)," *Oxford Dictionary of National Biography*, 2004, http://www.oxforddnb.com/view/article/8882. Esdaile's communication with Burgh of Perth is recorded in Minutes of the Town Council, (PKCA), PE 1/1/13, 548, 4 July 1853. See also "Death of Dr Esdaile," *Perthshire Courier*, January 20, 1859.
[62] "The Origins and Progress of Pisciculture," *Popular Science Monthly* 19 (May 1881): 140–41 asserts that Gray had begun experiments as early as 1838, inspired by Shaw. On Gray's debt to the French, see Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 4.

engaged to assist with the initial manipulations. By November 1853, the first salmon eggs were impregnated and laid down in prepared incubation boxes.[63]

4.3.1 *The practice of salmon culture at Stormontfield*

Stormontfield became the model establishment for salmon culture in Britain. It was easily Britain's most famous operation, visited in its early days of operation by distinguished guests including a Spanish Earl, notable naturalists like Sir Jardine and Dr Fleming, and even Victor Coste himself. Indeed, Stormontfield literally became a model. When Buckland established his Museum of Economic Fish Culture he displayed a miniature reproduction of Stormontfield as an exemplar of the system of breeding salmon.[64]

Figure 10 is an illustration of the layout of Stormontfield in its early years. The essential features are: a supply of water coming from a mill lade (at the top of the diagram); the open-air incubation boxes, the eggs' "artificial mother" as Buckland called them[65] (the square in the middle), which were capable of holding a maximum of 300,000 eggs; and a rearing pond, with its outlet to the River Tay (at the bottom). The system relied on a constant supply of clean water, which was drawn by gravity down from the lade, through the boxes, and into the pond. The eggs would typically take up to 140 days to hatch (although it was found that this time could be brought forward considerably under the influence of warmer water). The eggs yielded tiny alevins, which would at first hide in the boxes amongst the

[63] Brown, *The Natural History of the Salmon*, 23–29; Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 4–5.
[64] See PP, UK (1871) [C.419], Appendix XIX, 134.
[65] Buckland, *Manual of Salmon and Trout Hatching*, 21.

Salmon breeding on the Tay

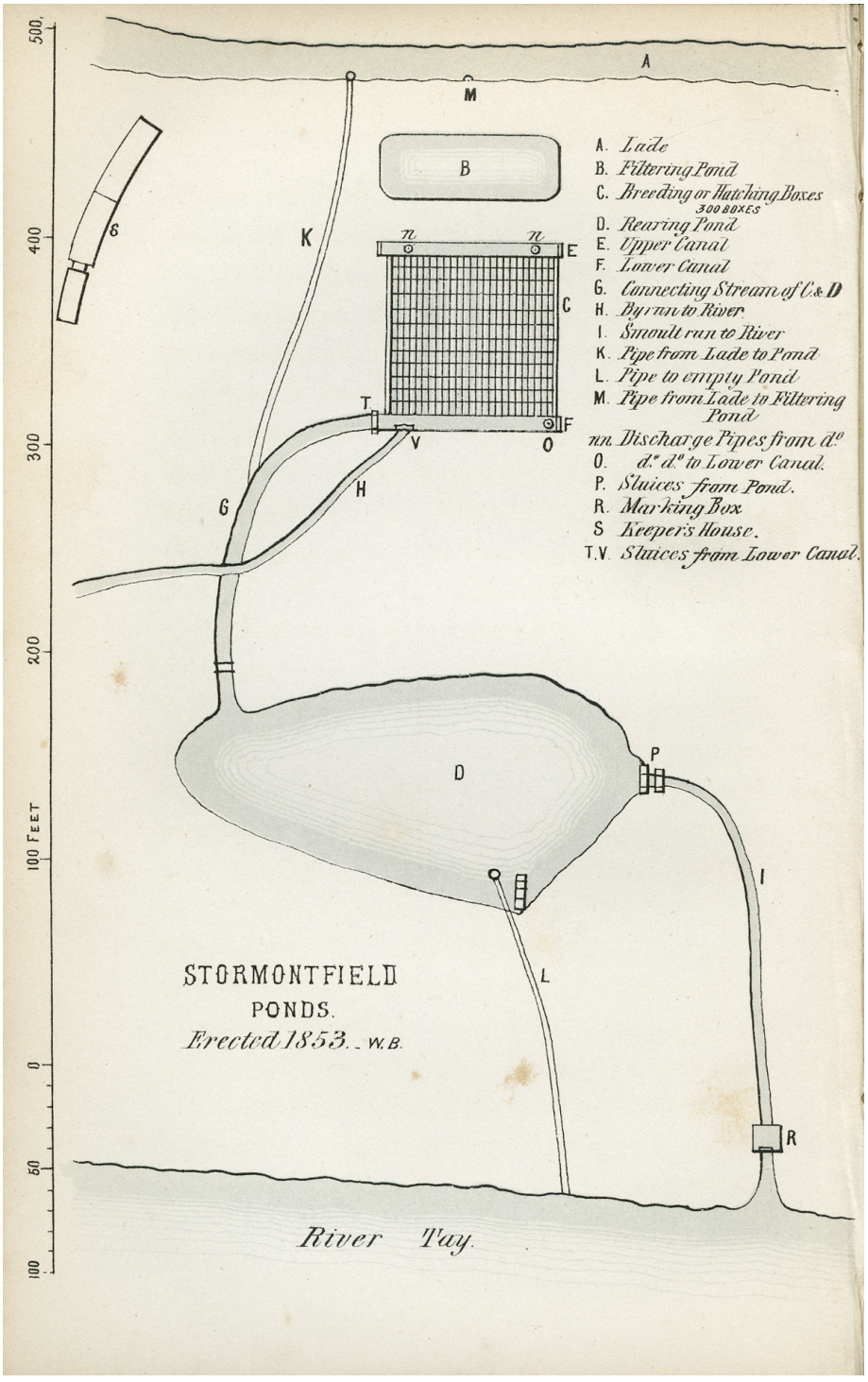

FIGURE 10: "Stormontfield Ponds". The illustration shows the layout Stormontfield prior to the construction of a second rearing pond. William Brown, 1862, *The Natural History of the Salmon,* Glasgow: Thomas and Son, facing page 28.

gravel substrate in which they had been incubated. Eventually they would move downward of their own volition, finding themselves in the larger pond. There they would be kept and fed until being released into the river.

Two features of this model are of fundamental importance. Both relate to the essential integration of the system with the wild fishery. Firstly, the reproductive materials themselves – the eggs and milt – were sourced from wild fish. Secondly, the fish were not maintained in captivity through their entire life cycle but rather merged with the wild population and migrated to the sea where they fed on abundant ocean nutrients. Only on their return to the rivers to breed in the uplands would they be harvested as returning adults. The North American term "salmon ranching" aptly captures the nature of this practice.[66] Indeed, in this system, "the ocean feeds and grows the crop we reap", as *Practical Water Farming* put it.[67] In this light, the metaphors of agriculture and domestication that adorned fish culture discourse often fall somewhat short. As Marianne Lien has noted, nineteenth century salmon culture in this mode is quite different to late 20th century intensive salmon farming in which the entire life cycle of the fish are actively managed.[68] Fish cultural discourse often emphasised as an imperative the methodical, physical management of biological reproduction leading to complete domesticatory control. For instance, the author of "Fish Farms", wrote of a desire to produce a "fish that should be no longer, like the hare and partridge, *ferae naturae*, but as completely under the owner's control as fowls in a henyard, or rabbits in a hutch."[69] But in practice this tended to take the form, in Piscarius's words, in which it was man's task to "do with fish what he has done for animals, and plants – assist and control, and improve, the operations of nature", rather than supplant them.[70] Indeed, discourse on fish culture around this time was largely characterised by a vision of nature as an ally in need of stewardship as well as a guide for successful practice. Buist argued that leaving nature to her own purposes was "a doctrine […] utterly unworthy of these days of stupendous progress in

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[66] Eg., Susan A Shaw and James F Muir, "Salmon Enhancement and Ranching," in *Salmon: Economics and Marketing* (Portland: Timber Press, 1987), 79–111.
[67] Peard, *Practical Water Farming*, 106.
[68] Lien, "Domestication 'Downunder': Atlantic Salmon Farming in Tasmania," 111. See also Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*. (See also Chapter 1).
[69] "Fish Farms," 161.
[70] Piscarius, *The Artificial Production of Fish*, 6.

science and art."[71] But Ramsbottom declared a common sentiment when he wrote "nature knows her purpose".[72] As Wilkin's summarised, fish culturalists "of that early period" tended to believe "that their best course of action in matters was to *imitate nature* as closely as possible".[73]

In fact, the fundamental task of salmon culture, and the underpinning argument of its promoters, lay in unlocking what Francis called the salmon's innate and "enormous power of reproduction", and not replacing what the Ashworth brothers called "the natural mode of propagation".[74] The idea was that the female salmon were naturally super-fecund, but that various factors (including poor fertilisation rates and predation by people or animals) conspired to destroy her spawn and her hatched brood when they were young. Following calculations made by the Ashworth's, Ramsbottom was amongst the earliest to offer an estimation of the "prolific powers" of salmon, attempting to quantify the loss experienced in the natural manner of breeding and development. He argued that a female salmon, per pound of her weight, typically produced one thousand eggs.[75] On this basis, using estimates of the number of salmon and grilse caught in the Tay, Ramsbottom calculated that, each year one hundred million eggs would be deposited onto the redds during the breeding season. However, he considered that only one hundred thousand of these hatch and survive to maturity: thus, "ninety-nine million nine hundred thousand are lost".[76] So, as Buist noted, we "see what an immanent waste takes place in the river when fish breed in the natural way, and that a very great saving might be effected were artificial propagation [to be] fully adopted."[77] Thus the mission of salmon culture was, in an economising move, to manage the earliest and most vulnerable stages of the salmon's life and so improve chances of large numbers reaching adulthood. Through Stormontfield, it was later claimed by an ardent supporter, the odds on nature were improved to the extent that over

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[71] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 7.
[72] Ramsbottom, *The Salmon and Its Artificial Propagation*, 45–46. Robert Knox, "Fish-Culture [Part II]," *The Illustrated London Magazine* 2 (1854): 43–46 offers some especially choice examples.
[73] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 51 emphasis added.
[74] Francis Francis, *The Practical Management of Fisheries: A Book for Proprietors and Keepers* (London: H. Cox, 1883), 53. Ashworth and Ashworth, *A Treatise on the Propagation of Salmon and Other Fishes*, 55.
[75] Ramsbottom, *The Salmon and Its Artificial Propagation*, 34. See the Editorial conclusion the brothers appended to their translation of Coste's treatise, Ashworth and Ashworth, *A Treatise on the Propagation of Salmon and Other Fishes*, 55. Consequently, said the Ashworth's, "it is shewn that 100 fish will produce a million of eggs".
[76] Ramsbottom, *The Salmon and Its Artificial Propagation*, 36.
[77] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 16.

seventy per cent of fecundated eggs survived to hatch, and one in one hundred of hatched eggs would result in a marketable fish.[78] Thus the model adopted clearly suggests that artificial salmon culture as a practice was inseparably connected to the river and larger fisheries system.

Breeding in the manner exemplified by Stormontfield began with the procurement of reproductive material. To do this, "ripe" salmon of each sex had to be caught from the river, during the winter months when spawning occurred. Artificial fecundation would usually have been conducted immediately on the banks of the river, the fertilised eggs being carried back to the hatchery in buckets. The standard method of fecundation, used at Stormtfield, was the so-called "wet method", as elaborated by Jacobi and described in part earlier. In this method, the milt and ova are mixed together whilst submerged in water. An alternative method though was discovered which greatly enhanced fertilisation rates. This was the "dry method", in which the gametes were mixed together in a dry bowl. A Russian fish culturalist publicised this scheme in 1856, but Coste certainly knew about it earlier, and wrote as much in his book.[79] Why British fish culturalists appear to have resisted use of the technique – for decades afterwards – is a mystery. Perhaps it had to do with it being so counter-intuitive. Francis, as late as 1883, despite being well aware of the "Russian method", as he called it, nevertheless advocated the "first plan" of using water. He claimed the reason for this was his belief that this method was "more natural" than the alternative.[80] (Capel, though, interestingly insinuated that many British fish breeders knew and used the technique from earlier on, but attempted to keep this knowledge to themselves as a kind of informal patent.)[81]

Getting hold of suitable breeders was one of the greatest challenges facing salmon culturalists. Complaints about the difficulties of procuring spawn were frequent.[82] There was, as yet, no functioning market with specialist suppliers that fish culturalists could apply to for eggs. (This would only really emerge alongside

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[78] Brown, *The Natural History of the Salmon*, 90, 102.
[79] See Nash, *The History of Aquaculture*, 59; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 27. Wilkins' says using the dry method fertilisation could be increased from as low as twenty percent to approaching 100 per cent.
[80] Francis, *The Practical Management of Fisheries: A Book for Proprietors and Keepers*, 60.
[81] Charles C Capel, *Trout Culture: A Practical Treatise on the Art of Spawning, Hatching & Rearing Trout*, 2nd ed. (London: Sampson Low & Co, 1885), 32–34.
[82] See eg., A Rural D.D., "Salmon-Rearing at Stormontfield, and Fish Culture," 745.

professional trout farming initiatives from the early 1880s.) For Stormontfield, procuring spawners was an expensive, time-consuming, unreliable business. It typically took many men with nets, perhaps boats, perhaps travelling far afield to find fish spawning on the redds, followed by the cold and uncomfortable business of bringing them to net. And then there was no guarantee the fish caught would be immediately suitable for fecundation. Early pioneers like Ramsbottom (like John Shaw before him) often advocated catching pairs of salmon together in the actual process of mating as a means of ensuring that they were both in a "perfectly mature state".[83] At Stormontfield, Buist complained that they typically hauled "about 350 fish of which only 40 could be found fit for the purpose".[84] Indeed, the operation could be unpredictable, and relatively low numbers of fertilised eggs in comparison to the holding capacity of the boxes was common. In 1853, the capacity of 300,000 was apparently attained, but in 1855 only around 183,000 eggs were laid down. In 1857, the numbers were still lower, although they improved in 1859 to 255,000. The breeding season of 1861 was a failure because the river was in spate and almost no spawners could be procured at all.[85] Bertram says that only 80,000 eggs where attained in 1863 "in consequence of the river being in an unfavourable state for capturing the gravid fish."[86] Such irregularity of supply might be of little consequence for investigations into natural history or for hobbyists, but for an attempt to seriously intervene into the productivity of the river it was frustrating and consequential.

An innovation was however added around the 1864 Stormontfield season. Bertram believed this new facility would "render the annual filling of the breeding-boxes a certainty".[87] Buist called it the "Lying-in Hospital", a simple holding pond constructed in the mill lade in which adult salmon, caught at the beginning of the season, could be kept until such time as their reproductive organs developed. The advantage of this was that it could hold about fifty salmon for a period of time nearby to operations, making it unnecessary to travel in search of spawners.[88] This modification apparently enabled a small improvement in the regularity of supply

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[83] Ramsbottom, *The Salmon and Its Artificial Propagation*, 51.
[84] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 13.
[85] Brown, *The Natural History of the Salmon*, 48–77; Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 9.
[86] Bertram, *The Harvest of the Sea*, 106.
[87] Ibid., 107.
[88] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 13.

and represents a small step in the direction of disentangling processes of reproductive control in salmon culture from reliance on the natural seasonality of the fish and their local geographies.

Incubation took place out-of-doors in twenty-five parallel rows of zinc and wooden hatching boxes, filled with gravel, and sunk partially into the earth. Gravel arranged in this manner became the standard substrate for incubation work in Britain for decades, despite, in a parallel to the dry method, alternatives existing which were potentially more hygienic and easier to use.[89] For instance, at Huningue glass grilles on which the eggs balanced were placed over ceramic dishes. Buckland reported on the disadvantages caused by the system used at Stormontfield in 1871, which included a propensity to cause rotting and spread diseases. His solution was to use finer gravel – although he was well aware of the glass grille alternative.[90] Buckland later argued that gravel was preferable purely because "parent fish do not find glass bars at the bottom of the river, but they *do* find gravel."[91]

The rearing stage, in which the hatched fry were confined to grow out, was of critical importance to salmon breeding operations. Salmon have to feed immediately after the alevins absorb their umbilical or yolk sacs. Rearing ponds were required to be large if they were to be able to house significant quantities of healthy fish. Rearing thus had potentially significant cost implications, especially in the area of providing feed. The latter was, and remains, one of the most complicated and challenging areas in the culture of all *salmonidae,* fish that are predators by nature and require the right proteins and other nutrients to grow and maintain condition.[92] Stormontfield initially favoured "boiled liver, rubbed small by hand", Ashworth told the BAAS in 1855, as food.[93] Artificial feed substitutes were at any rate a practical necessity, although many at this time – and indeed throughout the century – tended (once again) to prefer what they considered

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[89] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 51–53, 229. Commentators raised similar concerns about the readiness of British fish culturalists to innovate in the area of incubation techniques in the 1880s, see eg., Edward R Earll, "The Present Condition of Fish Culture," *Nature* 28, no. 727 (October 4, 1883): 542–44.
[90] BBP, (1871) [C.419], Appendix XIX, 134, 135.
[91] Buckland, *The Natural History of British Fishes: Their Structure, Economic Uses, and Capture by Net and Rod*, 390.
[92] See Lien, "Feeding Fish Efficiently. Mobilizing Knowledge on Tasmanian Salmon Farming."
[93] Reprinted as Ashworth, "Propagation of Salmon," 1875, 8.

"natural" feed (eg., insects), but the means to supply these on a large scale were not available.[94]

Another key issue for salmon culture at this period revolved around timing the release of young fish from the rearing ponds into the river. Many nineteenth century attempts at salmon culture settled on releasing the alevins immediately after they had depleted their natal reserves.[95] No doubt this would assist in circumventing all sorts of costs and complications at the rearing stage. However, the advantages contained in the logic of protecting salmon during their breeding *and* very earliest phases of life, as discussed above, would be almost voided in this strategy. As Wilkins notes, Ramsbottom's experience in these matters probably influenced his belief that the rate of loss of these tiny fish once turned into the river would be extremely high. Thus he argued that salmon culture could therefore not prove "remunerative" if the fish were released at this age.[96] Hence he was probably the first to advocate that the fish should only be released when they had become smolts, that is, transformed from their parr state into their silvery sea-going livery, and begun exhibiting the migratory instinct (by gathering around outlets, or even leaping onto the pond banks). The BAAS Committee, reporting on progress at Stormontfield in 1856, "felt it not impracticable" that "good and regular feeding during the winter" might "*force on*", the maturation of the fish, causing them to migrate earlier, hence speeding up the time it took before they were large enough to be harvested.[97] But given that most salmon in fact take a significant amount of time before they migrate for the first time[98], it was immediately apparent at Stormontfield that one rearing pond would be insufficient. Not only was the original pond likely to be too small to rear the number of fish that it was hoped would be hatched anyway, but, without additional facilities, breeding

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[94] This did not stop people trying, especially as trout culture expanded in later decades. See for example the patents, John Henry Johnson, Insecticulture, &c., Office of the Commissioners of Patents 3116 (London, issued July 31, 1879); Edouard Schnell, An improved method of pisciculture and apparatus therefor, Office of the Commissioners of Patents 7213 (London, issued May 17, 1887); and "Self-Reproducing Food for Young Fish," *Nature* 18, no. 911 (October 25, 1888): 631.
[95] Buckland advocated this as late as 1871, see PP, UK (1871) [C.419], XIX, 136.
[96] Ramsbottom, *The Salmon and Its Artificial Propagation*, 61; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 142.
[97] Jardine, Fleming, and Ashworth, "Report of a Committee upon the Experiments Conducted at Stormontfield," 23.
[98] See Chapter 2. Actually, it was soon discovered that some fish migrate around twelve months after hatching while others could take much longer. Despite experiments at Stormontfield, it remained a mystery as to what the cause or purpose of this differential growth rate, see Brown, *The Natural History of the Salmon*, esp., 43, 48, 66.

operations would only be possible every second year. Thus, a second pond needed to be added at Stormontfield in order to expand the works.[99]

The addition of the extra pond, recognition of the problem of releasing alevins, and innovations like Buist's "hospital", suggest minor ways in which practical fish culturalists sought technical innovations by which to separate their work from the vagaries that entanglement with the cycles of nature and the habits of salmon implied. However, at the same time, such integration was a necessary part of the system. Nature was conceived of as in need of improvement and stewardship, a guide to be admired and followed, at least as much as controlled or dominated. This model of "(re)production" and its material-cultural parameters is crucial understanding why operations like Stormontfield were irrevocably tied into the politics and factionalism of the salmon fisheries.

4.3.2 *Supporters and detractors*

How was Stormontfield viewed as an economic proposition at the time? That is to say, was it viewed as being successful in restoring the fish stocks of the river Tay at a reasonable cost? In what ways did contemporaries think about and evaluate the successes and failures of the operation? Like discussion of the practical problems facing salmon culture above, these questions are important in building up to our main theme.

There is some evidence that what credibility Stormontfield accrued on the basis of its contributions to knowledge of the natural history of the salmon was not considered an adequate return on the investment for some proprietors, who were in a position analogous to that of investors in a scheme. As the manuscript "Notes from the Minutes of the Town Council of Perth" relates, costs for establishing the works were estimated at an initial £500, with £100 annually thereafter being required. These sums were to be collected at a rate of 6.5 per cent levied on the rentals of subscribing proprietors. From the outset though there was opposition from a section of the Council, who disagreed with the amount requested for the Town's share. It is likely that other proprietors had similar qualms. In response to

[99] This only occurred in 1864 as part of general enlargement work, although the need for a second pond was discussed as early as 1854, (PKCA), PE 1/1/13, 2 January 1854, 604. Also, William Brown, "Angling in Scotland-River Tay," *Perthshire Courier*, February 12, 1857.

such opposition, the solicitors representing the subscribing proprietors, the Messrs. Mackenzie and Dickson wrote to the Council to assure them of the likelihood of Stormontfield being a success. They claimed in early 1854 that the scheme was "expected by the most distinguished Naturalists to be productive of great results, and to reflect credit on the enterprise of the Proprietors in the Tay, in being the first in Britain to undertake it on an extensive scale".[100] Apparently however, such assurances were insufficient, and problems arose when costs exceeded the original estimations, which they often did. By the end of same year, new funds were required "from the necessity of providing a cottage for the man in charge" (probably Peter Marshall) as well for tapping a new spring as an additional water source, and repairing damage caused by the "severity" of the previous winter; other costs were mentioned for the coming year too, with essential improvements being deemed necessary. While the solicitors insisted that the ongoing expenditure would be "trifling compared with the amount expended on the foundation of the works", these kinds of ongoing costs were frustrating.[101] In reassurance, the solicitors again noted that, as far as things had progressed, matters at Stormontfield were otherwise "most satisfactory"; indeed, the operation had "attracted the attention of all classes to the results. These have thrown much light on the natural history of the salmon",

> but it should never be lost sight of that the object of the experiments is mainly to ascertain whether the Artificial Propagation of Salmon can be made a commercially remunerative undertaking.

In support of this, they offered an assessment of the potential profits flowing from the works, estimating that "at least 2000 Grilse" in the Tay that year were the produce of Stormontfield, which at current prices would amount to an addition of upwards of £300 swimming up river. "We merely state these facts to show that the Proprietors are not merely prosecuting an interesting investigation in natural history but are endeavouring to increase the stock of the fish in the River, the food of the community, and last, not least, their own rentals".[102]

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[100] (PKCA), PE 1/1/13, 604, 2 January 1854, 604-605.
[101] (PKCA), PE 1/1/13, 24, December 1854, 85-86. See also Brown for objections about costs from proprietors, Brown, *The Natural History of the Salmon*, 69.
[102] (PKCA), PE 1/1/13, 1 October 1855, 184, 185.

Attempts at estimating the contribution of Stormontfield in economic terms became a feature in the commentaries on the scheme. Buist provided many of the figures subsequently used by others, and published many notes and letters on the subject in local newspapers and sporting papers like *The Field* during the 1850s. Collating his observations in his book of 1866, Buist suggested that since the commencement of breeding in 1853, total rental on the river had increased from £8000 to £16000. While he acknowledged that it was impossible to attribute this exclusively to Stormontfield, he implied it played a key role.[103] A Rural D.D., on the basis of figures supplied by Buist, calculated that in one year Stormontfield had contributed 12,000 individual fish to the river. This, he believed, represented a ten per cent increase in total river rentals.[104] In 1861, *The Times* quoted optimistically from Sir William Jardine and colleagues' British Association report which had found that Stormontfield was bound to be a "commercial success", not least because of its "really trifling cost".[105] This Report also considered that Stormontfield's key contribution was demonstrating the "practicality of rearing salmon of marketable value within twenty months from the deposition of the ova."[106] These kinds estimations were typical. Edmund Ashworth returned to Stormontfield in 1875 with the aim of producing a pamphlet that would cause public attention to shift towards "the best mode of restoring the stock of Fish hithertoe destroyed", attempted to show to this end the "economy of artificial propagation and [the] marked success at Stormontfield". His conclusions were (unsurprisingly) overwhelming positive; he claimed that, by 1873, about half of the entire river's produce came from smolts originally reared at Stormontfield![107]

It is worth noting that when twentieth century experts have attempted to assess nineteenth century claims about the successes of salmon culture in general, they have found them risible. Obviously, many such accounts are likely to be plainly biased, for obvious reasons. But an especially important concern is that estimations were based on a misconception of the salmon life cycle. While Stormontfield had purportedly proven a quick turn-around time between

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[103] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 8, also 18.
[104] A Rural D.D., *Contributions to Natural History: Chiefly in Relation to the Food of the People*, 82.
[105] "Salmon Breeding on the River Tay."
[106] Jardine, Fleming, and Ashworth, "Report of a Committee upon the Experiments Conducted at Stormontfield," 10.
[107] Edmund Ashworth, *Propagation of Salmon* (Bolton: Hasler & co., 1875), iii, 29, 32.

migration and return, the fish are now believed to spend much longer at sea than was considered at the time.[108] Moreover, enormous inferential leaps on the basis of insufficient data were necessary to concoct estimations of the numbers of Stormontfield fish returning as a proportion of total river population.[109] Another major issue was simply that of scale. The number of salmon a venture like Stormontfield was capable of contributing to the total fish population on a river the size of the Tay was, even at full production, almost negligible. Finally, on the Tay, as Buist himself acknowledged, there was more specific problem. In 1853, the same year that Stormontfield was founded, a group of proprietors on the Tay from above the junction with the River Earn (a little way downstream of Perth), worried about their falling rents, agreed to voluntarily shorten the netting season. (A Private Act replaced this voluntary agreement in 1858, which by then had fallen apart, see below).[110] The effects of this on the produce or rentals of the river cannot be distinguished from any possible contribution of Stormontfield, nor indeed from natural population fluctuations.

Despite their many grandiose claims, it is also true that supporters of fish culture might occasionally be more measured in their assessments. Many noted the problem of scale, although this hardly dampened enthusiasm about prospects.[111] Moreover there was in the 1850s recognition that in situ conservation might not only outweigh artificial propagation in effectiveness in the long run, but that, fundamentally, the "ranching" methodology used was dependent on it. Edmund Ashworth himself was clear about this in his address to the BAAS in 1855:

> So long, however, as we see the wholesale destruction
> of Salmon and grilse in the mouths of the rivers,
> permitted by law, as at present constituted, it is hopeless
> to expect any general effort for artificial propagation.[112]

Buist noted that a cause of the Ashworth's apparent relative success in Galway was, additional to their artificial breeding programme, the general improvements

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[108] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 479; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 83–84.
[109] No statistics were kept on actual total numbers of fish caught annually in the river, only of rental returns. Thus price rises needed to be controlled for. Moreover, fish culturalists had no reliable way to estimate the actual number of "their" fish returning.
[110] "Tay Fisheries Act" 1858 (22 & 21 Vict.), c. XXIV.
[111] Eg., A Rural D.D., "Salmon-Rearing at Stormontfield, and Fish Culture," 739.
[112] Ashworth, "Propagation of Salmon," 1875, 11.

they had been able to effect on the fishery itself, including instituting responsible netting practices, the deployment of salmon ladders and even blasting obstructions in order to facilitate access to breeding tributaries.[113] Buckland himself, despite his unwavering promotion of artificial propagation, argued that "opening up" the spawning fields was the true highway to success, while Marshall believed that "all the artificial breeding, and the arts of man, can never make salmon cheap and abundant, unaided by suitable and natural laws."[114]

In the following section, I turn to this social and legal context for the operations at Stormontfield. As will become clear, the events of 1853 on the Tay – the establishment of Stormontfield and the voluntary agreement on close-times between proprietors – were significant because they represent temporary periods of co-operation amongst proprietors, pressured by their economic circumstances, whose relations in the fisheries arena were otherwise typically characterised by competition, mediated by litigation and attempts to lobby parliament for changes in the law that benefitted them. How did these relations impact upon work at Stormontfield? More generally, how did failure to find compromises in the regulation of the fisheries (ex situ conservation) both stimulate demand for artificial propagation (in situ innovation) and prove to be a barrier to its progress, at least in the eyes of supporters and writers on fisheries matters?

4.4 Social conflicts and technological solutionism

> One man breeds, and another catches;
> one man pays, and another profits.
> – Alex Russel, *The Salmon*, 1864.

Jardine's British Association Committee, reviewing Stormontfield, reported: "[t]he chief difficulty to be encountered in experimenting in the artificial propagation of the salmon was the fact that the fish was common property, and those at the expense of experimenting were not secured any advantage from their labour."[115] This was the fundamental problem facing those who take up the cause of salmon culture. As noted previously, the causes of this lay in a combination of

[113] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 17.
[114] Henry Marshall, *A Few Suggestions for Restoring and Preserving the Salmon Fisheries of Great Britain* (London: Harrison, 1855), 3.
[115] Jardine, Fleming, and Ashworth, "Report of a Committee upon the Experiments Conducted at Stormontfield," 13.

three things: the arrangement of salmon fishing property, the geographical distribution of fishing opportunities on a salmon river, and the reproductive behaviour and life cycle of salmon themselves or, as Russel put it "the heavy drawback arising from its being migratory and vagabond in its instincts and habits".[116] Some proprietors, whether or not they took a share of the costs, would have equal and often greater opportunity to exploit the results of artificial breeding as they swam upstream from the ocean. This constituted a disincentive for action, with potentially harmful consequences for the stock and everyone's long term interests. As Ramsbottom asked, why should proprietors "near the heads of streams, be expected to spend their labour, their time, and their capital in hatching Salmon-fry, which will never afford them the slightest remuneration?"[117] Moreover, these were not problems effecting only artificial propagation: they were endemic to the fishery itself (as seen in Chapter 3). The result was a free-rider problem in which some stood to gain from the efforts of others, be this in artificially breeding and stocking the rivers; paying for the policing and conserving of the natural spawning grounds; voluntarily restricting their own fishing activities (or compelling their tacksmen to obey relevant fishing laws) so as to allow more fish to swim up river and reproduce their species; or other such acts of abnegation tending towards preservation. This was a crux issue that sutured the salmon culture system of production on the lines of the "ranching" model to the bio-ecological relations of the wild fisheries and the politics of the salmon fisheries. It was also a problem, resulting in conflict, which required some kind of collective social action to address.

4.4.1 *The economic geography of a salmon river*

That "[p]ersonal quarrels and conflicting interests all heap death and destruction on the salmon" was a generally held belief.[118] As Robertson has demonstrated however, the key issue on the Tay which underpinned such quarrels, and there are parallels on most large British salmon rivers, was that the distribution of fishing opportunities and profit was unevenly divided amongst proprietors and dictated by where their salmon fishing stations, or tacks, were

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[116] Russel, *The Salmon*, 223.
[117] Ramsbottom, *The Salmon and Its Artificial Propagation*, 63.
[118] "Salmon," 406.

located on the river. Rivers were thus splintered into chunks associated with interest groups. The principle relevant division was between “upper” proprietors and “lower” proprietors, the former associated with rod or recreational angling interests, and the latter net fishing for the food market (although these might well be splintered into further categories due to local circumstances, as was the case on the Tay).

The proprietors and their tenants on the lower and middle parts of rivers are structurally advantaged in salmon fishing. They have the first and best chance to waylay the fish with nets as they return from the ocean to breed in the uplands. Upstream, on the other hand, commercial scale fishing is usually unviable. On the Tay, this inequality of opportunity had been greatly exposed in the late eighteenth century as new kinds of netting stratagem or “fixed engines”, especially what were called stake nets appeared in parts of the lower river where they had apparently never before been known. These modes vastly increased the fishing power of these sections of river, to the detriment of those above them. In Scotland in 1828, in response to lobbying, the so-called Home Drummond Act had ratcheted up tensions of this kind by sanctioning a longer season for net fishing, benefitting the lower river. This status quo reflected the balance of power between the upper and the lower at the time, the latter being significantly more profitable and its proprietors more influential. Over time however, the upper found means to loosen the stranglehold of the lower; and, as we will see, as the interests of the upper changed, so the two parties began to converge and, elevating tensions, compete more directly over the resource, a resource whose benefits to some may in previous decades have been so negligibly small that it had simply not been worth fighting over. Conflict between these parties – more even than conflict between proprietors and poachers – became the central social dynamic structuring and propelling reform of the salmon fisheries.

A scene on the River Tay

FIGURE 11: "Salmon-fishing station at Woodhaven on Tay". The rustic scene belies the intensity of competition on Tayside. The boat in the middle ground appears to be fishing by the net-and-cobble method, the normal legal method of netting on the river. James Bertram, 1865, *Harvest of the Sea,* London: John Murray, p. 212.

Crucially, the upper sections of rivers are desirable for angling, and it was the rod interest that came to feel most aggrieved by the status quo. As Russel noted, the "increased value or demand for rod-fishing" specifically caused upper versus lower relations to grow proportionally more strained.[119] The upper argued that they be allowed their fair share of fishing; campaigned for restrictions on kinds of allowable net, on shortening the netting season and lengthening the rod

[119] Russel, *The Salmon*, 143. See also Ashworth, "Propagation of Salmon," 1875, 11. Note that in large commercial rivers the lower river would usually be more valuable in absolute terms. For instance, a valuation of fisheries rentals on the Tay and tributaries in 1864 finds the value of fishing on the lower river and estuary combined amounting to £10 288 at an average £62 per fishery recorded. These areas extracted rents *only* from users of the net and coble. For upper stretches, which included mixed rod and net and coble fishing as well as some sections where rentals came entirely from the rod, the total was £1051 at an average of £32 per fishery, see PP, UK (1864) [70], 15-17. Later it was claimed that only £1023 out of a total of £16852 of the river's total rental came exclusively from "the amusement of rod-fishing", PP, UK (1871) [C.419], Appendix VII, 105.

season as compensation, and pursued other strategies, such as lengthening the close times, which might increase salmon escapement from the lower river. Lower proprietors, especially those on the estuary, unsurprisingly, tended to advocate more laissez-faire approaches to regulation, and were often keen to represent their usage of particular fishing tactics as practices honoured since "time immemorial" – much as those fishers had done with respect to "community" fishing privileges in the face of conservation-orientated reforms (Chapter 3).[120]

The case, in some respects, therefore parallels the argument of the previous chapter. However, in this case it was the upper proprietors and anglers who, tending to see their interests reflected in regulations that would allow more fish to migrate upstream to their breeding grounds, were in pole position to adopt the language of conservation and to present themselves as guardians of the common weal. Because the redds are located in the upper waters, protecting these areas and what occurred in them was of great importance to the reproduction of the species. Consequently, the upper proprietors assumed, practically and symbolically, the role of custodians of the species at the point of their reproduction. The resulting conflict thus came to be widely perceived in terms well recorded in the following quote:

> There is usually a battle in progress on all salmon streams between the upper and the lower proprietors, the men who breed the fish, and the men who catch them.[121]

The upper as a consequence benefitted from a very powerful argument: that it was in everyone's interests, including all proprietors and the public at large, to allow a greater proportion of fish free passage upstream. As Buckland reported, "[t]he antagonism between upper and lower proprietors is contrary to commonsense".[122] For Bertram, preserving and improving the rivers was actually an "obligation" because they were "more of the nature of public property" than agricultural land. In this perspective, he claimed that "[n]o man at the mouth of the

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[120] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 439. Buckland provides an intriguing discussion of the phrase "time immemorial" in relation to netting contraptions, see PP, UK (1871) [C.419], xxxvi-xxxix.
[121] "Up and Down a Salmon Stream," *Sporting Gazette*, September 2, 1868, 817.
[122] PP, UK (1871) [C. 419], "Upper and Lower Proprietors", Appendix XXI, 138.

river has any moral or legal right to stop the fish from ascending to their breeding-places".[123]

Upper proprietors and their angling supporters used this situation as a political lever to extract concessions. "Justice to upper proprietors" was a regular hue and cry – though it met the retort that justice, conservation, or the interests of the public had large, had little to do with it, and what was really at stake was a scheme to reallocate property. An upper river proprietor on the Tay, Butter of Faskally, argued that concessions would "not only improve the fishing generally", but would also "give a little more justice to the upper heritors, who are looked on by the lower ones as a parcel of clocken hens, who have no right to any share of the produce."[124] But a fuller flavour of the debate can be gleaned from an exchange in the House of Lords during deliberations leading up the Scottish Act of 1862: Lord Ravenscroft, while arguing for a longer weekly close time, noted that the Bill in question had been described as "an anglers' Bill"; but he wished to remind his peers that "the interests of the angler were identical with those of the public". In response, the Duke of Richmond claimed "the only effect" of lengthening the close time was "simply to transfer fish from the lower proprietors of the rivers to the upper". The Earl of Malmsbury, moreover, said Ravencroft's proposal would no doubt be "a great boon to anglers, and he could not help thinking, therefore, that his noble friend had been saying one word for the fish and two for himself". But Lord Mansfield – who owned fishing's located in middle sections of the Tay – agreeing with Ravenscroft, ridiculed Richmond's statement whilst also remarking upon the prevelance of the belief that the fish were placed in the rivers for the "sole benefit" of the lower proprietors.[125]

Although clearly a matter of equity, the arguments of the upper could be viewed as a disincentive for conserving the species at all, and hence presented a threat. This line of contestation had, in fact, been common amongst people concerned about the fisheries for decades. In 1834 Thomas Garnett, for example, asked: "why take all the odium and trouble of preserving them, when other parties

[123] Bertram, *The Harvest of the Sea*, 488.
[124] PP, UK (1871) [C.419], Appendix VII, 105.
[125] PD, Lords, vol. 168 (10 July 1862), col. 131 – 135.

reap all the benefit?"[126] Not long before that, Sir Walter Scott had argued that the "voraciousness of poaching on the redds" could only be explained by a "desire to retaliate upon those who engrossed all the fish during the open season, by destroying all such as the close-time throws within the mercy of the high country." Upper proprietors and the "better class of farmers" even condoned this behaviour, he claimed, as a consequence of their not seeing any benefit to themselves in doing otherwise.[127] Kent, indeed, has suggested that the Duke of Roxburgh, in pushing the Tweed Acts of 1857 and 1859 through Parliament, used poaching as a kind of blackmail by implying that upper proprietors would stop policing the redds.[128] This would, supposedly, leave them open to assault, damaging the stock and the property of all. Politicking of a similar nature was common on the Tay, where upper proprietors often felt that they had no incentive to co-operate given that the value of their fishings had been severely reduced by the scale of fishing on the lower river.[129]

As with the parr controversy, authoritative representations of salmon reproductive and migratory habits were clearly key sites of contestation, with both sides keen to point out the ignorance or prejudice of the other.[130] Indeed, one might expect to receive "information", as far as the Tay was concerned, "strongly imbued with self-interest", as an official associated with the lower interest on the Tay warned the government's Special Commissioners on the Scottish salmon fisheries in 1871 – before proceeding to suggest that the upper proprietors claims to be concerned about conservation were really designs to "redistribute" property from the lower to the upper![131]

It should be stated here for clarity's sake that Robertson's detailed analysis of relations between proprietors in the Tay district found no evidence that social

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[126] Garnett, "Facts and Considerations on the Natural History and Political Impropriation of the Salmon Fish."
[127] Scott, "Salmonia, or Days of Fly-Fishing," 533; see also Coates, *Salmon*, 117.
[128] Kent, "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!,'" 298.
[129] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," esp., 285.
[130] For instance, it was often noted that estuarial interests long argued that salmon do not enter freshwater to breed at all, but only to rid themselves of sea lice, and therefore therefore that regulations intended to encourage their free passage upstream were irrelevant for conservation, see Robertson Ibid., 103.
[131] PP, UK (1871) [C.419], Appendix VI, 96.

class or status played a role in dividing upper from lower.[132] The division between "recreational" and "commercial" might tempt analysis in such terms – and in some other cases this may have been relevant – but on the Tay there is no evidence this was the case. Upper and lower proprietors might be equally wealthy, often aristocratic, landed, and both tended to have direct channels to Westminster. Moreover, there was also a large amount of intermarriage over the generations between proprietary families, and presumably other kinds of social intercourse. It is not impossible that these relations may have influenced the stance of individual proprietors associated with different factions on certain issues. However, there is, to my knowledge, no actual evidence of this, and no patterns of familial relations shed any clear light on the issues I will be discussing in the following section. Finally, it should be emphasised that the central issue here was conflict *between proprietors,* not between a rentier class and their tenants. A tacksman, as Bertram put it, sought simply "to clear his rent" and as such were "forced by competition of his rivals to do all he can in the way of slaughter."[133] Consequently, competition between tacksmen was certainly central to the perception and reality of over-fishing. Russel considered that those who leased fishing on the Tay, like the proprietors themselves, to be especially "numerous, divided and jealous".[134] Yet tacksmen tended to rent, often on a short-term basis, stations on various parts of the river – they thus had few permanent geographical alliegances, and their conflicts were consequently were not of the same kind as those between proprietors, which were veritably dynastic.[135] In general, they appear to have had little to do with Stormontfield either: as Buist alleged, with one exception, no "tacksmen evinced any interest whatever" in the experiment.[136]

4.4.2 *A mechanism for managing competing interests?*

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[132] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 438.
[133] Bertram, *The Harvest of the Sea*, 200, 201.
[134] Russel, *The Salmon*, 108.
[135] See also Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 338, 433.
[136] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 11. The exception was Alexander Speedie, a successful fisher who came from a family of tacksmen with strong commitments to the Tay. He sought long-term liability for tacks in a way that was not typical amongst tacksmen. Indeed, he became a proprietor himself, purchasing some coastal tacks in 1869, see Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," esp., 274, 347, 405. Interestingly though, Brown makes various allusions to tacksmen being "unfriendly to the experiment". Apparently, says Brown, they even threatened to withhold their rents unless the proprietors released smolts held in the ponds, Brown, *The Natural History of the Salmon*, 57–58, 47, 81, 84.

Because artificially bred fish were subject to the same dilemma as wild fish, whilst also requiring additional investment to produce, it is a truism to observe that the founding of Stormontfield was, as Russel also thought, an instance in which some "concert and co-operation" between fisheries agents had been provisionally achieved.[137] Stormontfield was the outcome of mutual action amongst some proprietors, many of whom were otherwise divided from one another. Pressured by their declining rentals, might Stormontfield have functioned additionally, even deliberately, as a mechanism for encouraging co-operation by enabling some of the costs of maintaining a healthy salmon population to be shared between upper and lower proprietors? The suggestion is not implausible. Indeed in 1883, when tensions between upper and lower were again at a critical junction, a Clerk of the Tay District Fisheries Board (on which see below) explicitly suggested that artificial propagation and feeding efforts be augmented as a remedy for the conflict.[138]

Unfortunately, there is little evidence that sheds reliable light on the attitudes of individual proprietors towards Stormontfield. In 1866 Robert Buist wrote that proprietors lower down the river were disinterested in the project and showed it little support. He praised Sir John Richardson, a large proprietor of fishing on the lower river below Perth, for having "heartily joined in", but claimed "his neighbouring proprietors refused to do so." Moreover, he insinuated, that it was "somewhat strange" that the "minority" of lower proprietors who had objected to the new closed times instituted in 1858 were also those who stood to benefit from Stormontfield the most.[139] Brown also urged lower proprietors to take up artificial propagation on an "extensive scale" because, he said, it cannot be expected that the "Upper or Highland" would, since they had no "inducement" to do so.[140] While the reliability of such testimonies might be doubted, what they do suggest is that contemporaries closely connected to Stormontfield believed that existing tensions were relevant to the progress of salmon culture on the river.

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[137] Russel, *The Salmon*, 228.
[138] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 327. The Memorandum, contained in the TDSFB Papers, cited by Robertson, was not available to the present research, see Appendix 2.
[139] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 18, 19. This "minority" would have been proprietors on the estuary.
[140] Brown, *The Natural History of the Salmon*, 101.

There is, however, some evidence available that might illuminate the social relations of Stormontfield as and when it was founded. The Minutes of the Perth Town Council contain a list of all subscribing and abstaining proprietors in 1853.[141] Taking what would later become the official dividing line between upper and lower river as the Bridge of Perth, it is apparent from these lists that, contra Buist and Brown above, support for Stormontfield was actually relatively well distributed along the river. Of a total of thirty-two proprietors recorded as contributing, of those that can be identified, twelve are associated with the upper and eighteen with the lower river. Similarly, of a total of eighteen who did not contribute at all, six are associated with the upper river and ten with the lower.[142] It is notable that all known and substantial proprietors on the section of the upper between the parishes of Scone and St Martins just upstream of Perth (where Stormontfield was based), up until beyond the junction with the tributary river Isla and into the parish of Carputh, contributed. Fishing in this area was conducted typically with a combination of net and rod, with the former tapering off in importance as the river ascended. In a sense, this section constituted a mixed "middle" river, although it was conventionally classified as "upper". Below Perth, most of the largest proprietors present in terms of rental also contributed, including the City of Perth, Lord Gray, Sir John Richardson, Robert Chrystal of Inchyra, and the Earl of Wemyss. In fact, only three out of twelve proprietors on this lower river did not contribute. Given the willingness from above and below the Bridge, this was a significant display of co-operation, and it roughly maps onto those groups of proprietors who also unified over the voluntary closed times in the same year.

A number of proprietors associated with estuary and coastal fishing contributed too. However, a notable proportion of proprietors who owned fishing in the estuary also chose not to subscribe. Estuarial interests in particular had, since the early nineteenth century, waged their own acrimonious dispute with the netting interests in the lower river (above them) as the latter had long sought to

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[141] (PKCA), PE 1/1/13, 604-606.

[142] I have not been able to identify five cited proprietors. Three of these were contributors, two were not. I have relied on two sources in making my categorizations: Firstly, that proposed by Robertson, esp., "The Tay Salmon Fisheries in the Nineteenth Century," 203–4. Secondly, PP, UK (1864) (70), 15-17, where the mode of fishing (net and coble and/or rod angling) is recorded for each fishery.

maintain its dominance by seeking to have stake nets banned from use in the estuary (they were said to have been traditional only to coastal fishings). To this end they had mostly succeeded, leaving the estuary resentful. Some of the non-contributors from the estuary were the same actors who had refused to adopt the voluntary closed times in 1853. However, it is hard to conclude anything definite about this pattern.

There is one further feature worth remarking on however. This begins with the observation that drawing the dividing line at Perth is somewhat arbitrary. As noted, net fishing above this point still constituted a significant source of revenue, and only tapered off gradually. To this extent, a portion of proprietors on this "middle" river may have shared concerns with those below them. With this in mind, what stands out is that, with one exception, true "highland" proprietors are entirely absent from the list of subscribing proprietors. This would bear out Brown's observation that little could be expected of this group. The exception is the Duke of Atholl, who owned all the angling on the tributaries Garry and Tilt, but, as if to accentuate the point, also owned fishing on the "middle" Tay, where both the net and rod were used.[143] Furthermore, fishings belonging to the Duke's late father are also explicitly recorded as not contributing.[144] In fact, a number of known proprietors in the highland areas and prominent tributaries (including the Lyon, Tummel and Isla) are simply not present on either list.[145] Of those who refused though, we find one McPherson of the tributary River Ericht at Blairgowrie, a rod-only water, as well as the Marquis of Breadalbane, who owned extensive fishings and estates on the upper Tay, and also on Loch Tay out of which the Tay itself flows. Breadalbane had his own reasons for distrusting schemes proposed by interests below him on the river. For one, he had long defended the practice of netting salmon in Loch Tay all year round on the basis that this was an

[143] These were the Burnmouth fishings in the Parishes of Stanley and Kinclaven, upstream from Stormontfield.

[144] Atholl is recorded on the list of contributing proprietors, but "The late Duke of Atholl's trs [trustees]" is recorded as a non-contributing proprietor. No explanation of the Duke's affairs in this regard is given nor has been discovered.

[145] For instance, Sir Menzies of Castle Menzies, and Butter of Faskally, who had fishing on the lower Tummel. Additionally, three proprietors on the upper Earn (a tributary which joins the Tay near its confluence with the estuary) refused to give a portion of their rentals to Stormontfield; but, although Sir Moncrieff's (Moncreiffe) fishings on the upper Earn didn't contribute anything to Stormontfield, but a portion of his rental from fishing he owned on the lower Tay were subscribed.

ancient right of his position – much to others' chagrin.[146] But, he had also for a time been a part of a scheme in which funds from the Association of Proprietors, and hence from proprietors below him, had been channelled to him as compensation for the costs of using his own men to police the spawning grounds on his estates. This arrangement had broken down by the early 1850s, distrust setting in apparently as a consequence of the intense fishing lower down destroying the value of his fishings.[147] In sum, although the available evidence is minimal, it is plausible that proprietors on the very upper parts of the river, drawing their rents from angling, felt little urgency to contribute to Stormontfield. To them, Stormontfield is likely to have appeared a project of all those below them who stood also to benefit most from it under the circumstances. Indeed, looked at from the point of view of the total funds subscribed on the basis of rental proportions, Stormontfield was effectively a scheme of the lower and especially "middle" river, with a smaller degree of support from the estuary and coast, and almost none (as far as can be ascertained and with the possible partial exception of Atholl), from the higher upper river.

On this analysis, it could be tentatively suggested that Stormontfield as an improvement scheme was, in 1853 at least, a partial instance of unity amongst divergent interests. However, it was not completely successful, and enmities probably continued to plague it. Moreover, the cracks that do suggest themselves reflect the wider consideration that serious economic salmon culture on this model was intrinsically threatened by social conflicts consequent upon differential fishing opportunities, shaped by geography, the "vagabond" habits of salmon and, crucially, the fact that private fisheries ownership applied to the right to exploit an essentially common stock. Stormontfield might symbolise a provisional spirit of co-operation – but it would be naive to think that an operation of its kind could seriously constitute a mechanism for distributing costs, responsibilities and rewards, let alone alone offset the effects of supposed over-fishing. Stormontfield could never be an alternative to legislation, and thus to political decisions, compromises, and various sorts of institutional brokerage.

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[146] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 50.
[147] Ibid., 278, 285. Atholl's highland estates had also been a part of this scheme. He too had withdrawn for the same reasons.

4.4.3 *Association, disentanglement, politics*

It should be clear now why it was unlikely that any single proprietor would be tempted to undertake salmon culture on a large scale. Association, that is to say, specific kinds of institutional form in which to organise salmon reproduction, between actors with divergent interests was a necessity; and yet as the case of Stormontfield suggests, the results of this could be an unstable arrangement and threatened by local rivalries and how these in turn were reflected in existing regulatory structures. What further forms of practical activity might have helped to promote the success of salmon culture as a (re)productive technology?

One genre of solution that occurred to pioneers and commentators depended on further technological innovation. This comprised a search for means to disentangle their activities from the *in situ* environment further, and in so doing from the complexities of the social and political context in which they were compelled to operate. By "disentangle" I mean deliberate efforts to separate salmon culture practices and produce from the wild fisheries by increasing the extent of human control over the lives of salmon.[148] This logic is implicit in Stormontfield's "hospital" scheme as well as Ramsbottom's belief that culturing salmon up to the smolt phase was critical, as previously discussed. For Wilkins, this last development represented one moment in a long historical trajectory leading from the "early aquaculturalists" attempts to "enhance and augment the wild fisheries", to "today's aquaculturalists" who have "divorced themselves almost entirely from them".[149] This issue might in turn be put in terms of changing human relationships to nature,[150] domestication,[151] the intensification of (re)productive functions in modernity,[152] or the "pacification" of living goods necessary prior to commoditization.[153] I suggest here that a source of impetus, in this case, for this trajectory can be found in responses to context-specific social divisions. That is, the

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[148] But see also discussion of markets and property in the Conclusion, Chapter 5, and Michel Callon, "Introduction: The Embeddedness of Economic Markets in Economics," in *The Laws of the Markets*, ed. Michel Callon (Oxford: Blackwell, 1998).
[149] Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 316, 317.
[150] As in Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution."
[151] Lien, *Becoming Salmon: Aquaculture and the Domestication of a Fish*.
[152] Eg., Clarke, "Reflections on the Reproductive Sciences in Agriculture in the UK and US, Ca. 1900-2000+."
[153] Koray Çalışkan and Michel Callon, "Economization, Part 2: A Research Programme for the Study of Markets," *Economy and Society* 39, no. 1 (2010): 5–8.

costs of extending the period of a salmon's life cycle spent under the direction of human artifice would be compensated for by benefits accruing from bracketing out the effects of competition and disharmony on the stock. Russel, the period's most articulate spokesman for the salmon, again expressed the point ably:

> What the system cannot accomplish is equally obvious – it cannot, as things stand, do much or anything for the fish after the age of infancy. […] If the fish bred and nursed in ponds could also be reared till near their full growth, under the care of man, and for the profit of those who had been at the cost of breeding and rearing for them, we might look with certainty for a great and rapid increase in the number of salmon-nurseries, and for proportionate results visible in the rivers and in the markets.[154]

It is in view of this that proposals emerged focusing on means of culturing salmon beyond the smolt phase in salt or freshwater, or indeed to breed a new kind of non-migratory or "landlocked" salmon altogether.

One of the earliest recognitions that the salmon culturalists ambitions might profitably be cast towards control of the saltwater phase of a salmon's life cycle was published in the *Dublin University Magazine* in 1852.[155] By 1854, William Ffennell had begun experimenting with the possibility in Ireland, building a saltwater pond in which, he hoped, by the end of the season "to produce salmon of many pounds in weight".[156] During the early years at Stormontfield, a variety of experiments were also done on whether salmon at the parr phase, or salmon eggs, could survive in salt water. (They did not and they could not).[157] Attempts to culture salmon up to the grilse stage in a combined fresh and saltwater pond system were also undertaken. These ponds were built previously at "great expense" near Stonehaven in Kincardineshire by a proprietor on the Cowie Water, a once fruitful salmon stream, which apparently had since been diminished by the use of stake and bag-nets at the river mouth.[158] An attempt was made in 1860 to rear Stormontfield-bred fish there, a project requiring moving five smolts from the ponds near Perth to Stonehaven – a feat of considerable difficulty, requiring seven

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[154] Russel, *The Salmon*, 226–27.
[155] "Artificial Breeding of Fish, with Practical Remarks," *Dublin University Magazine* 40, no. 239 (1852): 619–34; cited in Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*, 232.
[156] Ffennell, "On the Artificial Propagation of the Ova of the Salmon and the Progress of the Experiments Now Carrying On," 139.
[157] Brown, *The Natural History of the Salmon*, 61–62; John Hogg, *On the Distribution of Certain Species of Fresh-Water Fish; and on the Modes of Fecundating the Ova of the Salmonidae* (Newcastle: M. & M. W. Lambert, 1856) claimed to have already proved this.
[158] Brown, *The Natural History of the Salmon*, 116, 121.

changes of water on the course of a sixty mile train journey. Initial results seemed successful – some smolts survived and grew slowly, feeding on naturally occurring foodstuffs in the saltwater pond for over a year. But the experiment, says Brown, turned into a failure: the smolt apparently disappearing after a "notorious poacher" was seen "whipping the pond" one morning.[159] During the 1860s, *The Field* also published notes about various other desultory efforts and ill-documented proposals for saltwater rearing schemes.[160]

Another strategy, specifically useful in avoiding the pitfalls of the lower river, was to create an entirely "landlocked" salmon. During the nineteenth century, there were three means proposed for doing this. One, presented frequently in the 1880s, was to import salmon from naturally landlocked populations in other parts of the world and hope that they retained this comely characteristic.[161] Another was simply to hold salmon in captivity in freshwater under a judicious feeding regime. Buist cited experiments of rearing salmon in fresh water of this kind undertaken by friends of Stormontfield, using Stormontfield fish. Whilst the fish appeared able to survive in ponds indefinitely, they grew too slowly to be of much use, looked unhealthy, and their flesh reputedly proved "tasteless and insipid, or rather something of the taste of mud".[162] A further question was whether fish retained in fresh water in this way would become fertile themselves. Experiments relevant to this were done in connection with the parr controversy (when it was observed that some male parr are fertile), and in later decades pursued in great earnest. However, the reproductive powers of these fish were found to be weak and unviable as commercial breeding stock, and their sizes and tastes were once again not satisfactory.[163]

Since the earliest reports of the technique, many had recognised that artificial propagation offered peculiar facilities for the crossing of "breeds" and the

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[159] Ibid., 120.
[160] E.g., Thomas F Brady, "Keeping Salmon in Cages at the Bottom of the Sea," *The Field*, July 4, 1863; William J Ffennell, "Sea Ponds for Salmon," *The Field*, July 11, 1863; M Hetting, "Salt-Water Apparatus for Salmon and Sea-Trout," *The Field*, April 29, 1865.
[161] See eg., William Oldham Chambers, "Fish Breeding at the National Fish Culture Association," *The Journal of the National Fish Culture Association* 1, no. 2 (1888): 137–42; Also, "Fishing Notes," *The Country Gentleman*, September 25, 1886; A.T Morgan, "The Introduction of the Swedish Land-Locked Salmon into the Cumberland Lakes," *The Fishing Gazette*, February 12, 1887.
[162] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 27.
[163] See esp., Day, "On the Breeding of Salmon from Parents Which Have Never Descended to the Sea." Also, Hill, "Sir James Maitland and the Howietoun Fishery," 96–97.

introduction of "new blood" into the fish populations of Britain.[164] This was an exception to the rule in which salmon culturalists viewed improvement as the quantitative enhancement of rivers, not the biological quality of the organisms themselves. Although during this period almost nothing of substance was actually achieved in this line, on the basis of this ambition another strategy that attracted attention was the plan to use artificial impregnation to create a hybrid between a trout and a salmon in which it was intended the migratory instinct of the latter would be eliminated. Frank Buckland and associates in London took up the idea in the 1860s.[165] There is no suggestion that anything close to success was ever achieved – some even accused Buckland of pursuing hybridisation experiments purely as a publicity stunt to garner attention for his fish cultural activities at Kensington and his lecture tours[166] – but the idea that the Thames and other rivers could in this way be "salmonised" remained consistently attractive into the 1880s.[167] On the Thames, the idea was especially appealing to anglers who desired fishing opportunities denied to them by virtue of the river being effectively choked by pollution generated by the metropolis. But the logic held for situations in which the river was choked instead by "fixed engines" and intensive fishing practices, the pressures from which could not be lifted due to vested interests and political stalemate. In Perth, a plan of crossing trout and salmon had even been proposed as early as 1854. Hybrid or landlocked salmon would, the plan argued, remove barriers erected by the "uncertain tenure" that inhered in the species.[168] The ambition to disentangle salmon culture and its produce from the wild fisheries was, I think, motivated at least in part by a failure to reach a working compromise amongst social agents about how best to regulate fishing activity.

Adequate technological solutions never materialised largely because they were technically impossible at the time, or at least sufficient will to prosecute them

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[164] One looked with fascination towards the prospect of crossing pike with salmon, see "Artificial Fecundation of Trouts and Salmons from a Memoir in the Berlin Philosophical Transactions," *Bingley's Journal*, December 1771 Jacobi had speculated on the same possibility.
[165] Eg., "Hybrid Between the Salmon and Trout," *Sporting Gazette*, February 20, 1864; "Experiments in Fish Acclimatizing," *The Journal of Agriculture*, no. 90 (October 1865): 228–29.
[166] See Consistent, "Fish Culture at Chertsey," *The Fishing Gazette: Devoted to Angling, River, Lake & Sea Fishing and Fish Culture*, April 9, 1881.
[167] Eg., "Land-Locked Salmon and Trout for the Thames," *The Fishing Gazette*, May 2, 1885.
[168] A Rural D.D., "Artificial Breeding of Fishes Belonging to the Salmon Family," 475.

fully was lacking.[169] Were attempts to reform the way the fisheries functioned at an organisational level more successful in establishing a propitious context for artificial propagation initiatives? Certainly, success required more than simple technical know-how. Noting that the "subdivision" of the river was the major cause of the salmon culturalists woes, Peard put the issue simply: "unity is strength". But achieving unity required the ability on the part of the would-be salmon farmer "to deal with the timid and obstinate; to conciliate prejudice; smooth down self-will; to convince the intelligent and convert the ignorant. In short, he must deal successfully with men of opposite opinions, inclinations, and tempers." These "discordant elements" must thus be "welded", Peard continued "into a mass, and joined 'sweet accord' by the magic link of self-interest."[170] The work of the heterogeneous engineer, in other words, depended on essentially political skills.

One possible institutional form capable of achieving civil social relations of the necessary sort was the formation of joint-stock corporations. These were an oft-proposed idea, mooted on a number of occasions for the Tay district[171], in which the proprietors of salmon rivers were urged to form companies in which all could hold a share of the profits, allowing also the scale and therefore costs of netting to be reduced as the requirement for inefficient beggar-thy-neighbour-style competition diminished. For commentators, this was the logical solution to the problems of the salmon "scramble", as Russel characterised the existing system.[172] However no voluntary organisational arrangements of this kind were attempted during this period, for unknown reasons, though vested interests presumably opposed them. The appeal to "true" self-interest, as likely as not, appeared unconvincing to those already in the pound seats, and always liable to break contract.

Indeed, while voluntary actions amongst proprietors, such as the 1853 adjustment to close times, and the founding of Stormontfield itself, demonstrate

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[169] It is speculative, yet nevertheless interesting, to wonder whether a contributory reason for this lay in a cultural bias that made the necessary innovations appear as though they went against the grain defined by deference to nature and the natural mode of reproduction?
[170] Peard, *Practical Water Farming*, 13–14.
[171] PP, UK (1860) [456], 85-98; PP, UK (1871) [C.419], Appendix VII, 106. See also Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 292, 313–16. Macleod cites proposals for more radical "nationalization" of the fisheries in Scotland, noting that these were not taken seriously, "Government and Resource Conservation: The Salmon Acts Administration, 1860-86," 116, n14.
[172] Russel, *The Salmon*, 228; also Bertram, *The Harvest of the Sea*, 202; Peard, *Practical Water Farming*, 17.

the possibility of compromise and spontaneous organisation based on perceptions of self-interest, they also proved the fragility of such exercises so long as these commitments were not equal or binding for everyone in the system. For artificial propagation of salmon in its current material form to thrive on a significant scale, it is clear that a stable and permanent settlement, manifesting as a legitimate legal framework that satisfied both upper and lower interests, would be a precondition. The 1858 Tay Act made some progress by readjusting the close time for nets, allowing more fish to swim upwards in early autumn, and the general Scottish Act of 1862 also responded to the lobbying of the angling interest by lengthening the rod season.

The legislation of 1862 had further and quite specific positive impact from the point of view of those advocating artificial propagation. However, for one, it clarified that collecting spawn for purposes of artificial propagation or scientific experiment by qualified persons was allowed (not banned like most spawn hunting now was, see Chapter 3). But it also provided for the election of a new statutory body, a local District Board of Salmon Fisheries, with certain powers over byelaw. On Tayside, this replaced the old Association of Proprietors of the Tay. While the mandated composition of this Board continued to provoke trouble amongst factions, and allowed the lower river to maintain much of its grip on power, one consequence of its adoption was that Stormontfield fell under its direct control from 1863 onwards. Under this structure contributions to its maintenance became compulsory rather than voluntary.[173] This would have put Stormontfield on a more stable financial footing and ameliorated some anxieties surrounding uneven contributions. But such change could still not remove the basic disparities in fishing opportunity that concerned early salmon culture entrepreneurs and put off large-scale adoption of artificial propagation by proprietors. In fact, conflict between the divisions of the river remained endemic to the Tay, and many other rivers too, for the rest of the century and even beyond.

[173] In 1862 reports suggested assessments were made a voluntary one per cent, see "Meeting of Tay Salmon Fishing Proprietors," *Dundee Advertiser*, October 16, 1862. On this and the composition of the Board, see Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 317–18, 479.

4.5 Conclusion: the trouble with salmon

As a history of the social relations of a technological practice, this chapter discussed some of the many factors relevant to the emergence and shaping of mid-nineteenth century economic salmon culture in Britain, in the specific context of its application on the River Tay. These factors included the conjunction of biological, technical and geographic elements and the social tensions and forms of competition connected too and arising from them. These both stimulated demand for fish cultural innovations as a kind of technical solution to apparently intractable tensions, and rendered these to a degree unrealisable.

In general terms, I noted that for promoters of fish culture at this time, only salmon were considered worth the effort from an economic point of view. It was for a time believed that only "such a fish as this monarch of the brook that would individually pay for artificial breeding, for, having a high money value as an animal, it is clear that salmon-culture would in time become as good a way of making money as cattle-feeding or sheep-farming."[174] But enthusiasm of this sort rapidly evaporated, and realism with respect of its challenges and benefits set in. The 1870s, in fact, were the second half of the century's doldrums with respect to fish cultural innovation in Britain. There are likely to have been many contributory causes of this new apathy, including underestimation of the technical difficulties of rearing salmon at a large scale. Moreover, with the price of other food fish falling as trawler fleet capacities expanded and salmon fisheries struggling to compete, it is not unlikely that large investments into an uncertain new technology were just not attractive. I have focused however on the observation that salmon as a species were deeply troublesome from the point of view of those private interests most capable of exploiting them through artificial propagation. Indeed, in Hill's words, salmon were effectively "unmanageable".[175] This was consequent upon their migratory behaviour and, as I have emphasised, the existing geographically structured and historical relationships that defined the holding of salmon fishing property as a social institution. In fact, in light of these problems, during the '70s and '80s, fish cultural attention turned away from salmon, and came to focus almost exclusively on its lesser, more tractable cousin, the non-migratory trout.

[174] Bertram, *The Harvest of the Sea*, 116.
[175] Hill, "Sir James Maitland and the Howietoun Fishery," 69.

Recreational anglers and angling associations became the key market for a new commodity: artificially impregnated eggs and young hatched fish. These could be transported by rail and used to stock local waterways from whence they would be unlikely to swim away from their new "owners", and which could be replaced, upon death or capture, with relative ease by the placing of a new order, lodged by post, with one of a number of increasingly professional trout hatching firms. I will briefly refer to this later development again in Chapter 5.

Yet the business of artificially propagating salmon on the "ranching" model did not entirely disappear. Stormontfield itself continued artificial propagation and stocking for the remaining decades of the century. By the 1880s moreover, it was joined by the Dupplin Hatchery, another establishment supported by the Tay District Board on the River Earn, some of whose techniques were considered less antiquated than those used at Stormontfield.[176] In fact, association amongst proprietors along the lines of the Stormontfield example formed the basis for further Fisheries Boards and Associations of Conservators across Britain who wished to attempt salmon culture as a means of augmenting their wild fish populations.[177] These became a potentially workable institutional form for salmon culture to take, at least at a certain scale and for specific local purposes. A survey of Scottish fish culture in 1884 indicated that the District Boards of the rivers' Dee and Don had established a venture that had survived since 1863. It appears however that individual private enthusiasts still ran the majority of hatcheries at this time, and that these generally struggled: A hatchery at Benmore in Argyllshire, for instance, appeared to have failed on "account of it being questionable if any permanent benefit can be had in the attempt to stock small rivers on the west coast under the existing salmon laws", while another hatchery on the Moriston also appeared to be failing on account of proprietors in the area not being willing to allow the collection of spawn on their properties, and the District Boards being unsure whether it was within their powers to grant access over and above the wills of local proprietors. Somewhat exceptionally, the Marquess of Aisla's private efforts in Ayrshire though were praised, in the familiar idiom, as an example of "enlightened liberality". The maximum capacity of this establishment nearly

[176] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 479.
[177] Outside of Scotland, see for instance the annual report for the years 1885-86 of the National Fish Culture Association, who attempted to hatch salmon fry on behalf of the Severn Fisheries Board in 1880s, contained in (NRO), WLS/LX/79.430X3.

matched Dupplin or Stormontfield at around 250,000 salmon ova yearly – still hopelessly small in the greater scheme of things. Yet most existing operations were on an even smaller scale. Including the above, nine salmon hatcheries are recorded as operational in Scotland at this time, though eight were believed to have fallen into disrepair in recent years.[178]

Where the artificial propagation of salmon survived, it appears, as with trout propagation, to have done so in concert with the growing importance of angling to the salmon fishing market. This makes sense, insofar as anglers required not so much large quantities of fish and therefore large-scale fish farming, but rather the chance of catching fish.[179] Indeed, the practice of angling depends upon the fish being in the river, entangled with it so to speak, in contrast to intensive fish farming for purposes of food production. The kinds of "tenure" required by the two forms of fishing practice are really quite different. Thus salmon culture was a limited success from the point of view of certain groups, including conservation-minded anglers and angling proprietors, whose requirements for the technology were different from those connected to the sale of large quantities of salmon meat as a commodity. And, for most salmon fishing rivers in subsequent decades, angling became the major source of revenue whilst commercial netting sunk to artisanal status or disappeared entirely as fish numbers declined and competition put fishers out of business.

Salmon culture along the lines pioneered at Stormontfield and similar institutions thus continued at a small-scale in select locations and, during the twentieth century, the practice of stocking salmon fisheries by means of artificial propagation became a minor yet integrated element of British river management programmes. In recent decades, it has occasionally still been considered useful mainly to replenish degraded stocks or to re-seed rivers, often on behalf of local District Boards or similar official functionaries on behalf of proprietors of angling, but would usually not be undertaken on a repeat or large-scale basis.[180] The

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[178] See PP, UK (1884) [4431], "Note II" Appendix G, 179 – 181. This estimate excludes hatcheries whose sole business was in trout hatching.
[179] "What the upper proprietors chiefly wanted was not fish, but fishing – not gain, but sport." Russel, *The Salmon*, 151.
[180] The practice is now controversial for various reasons, see A Youngson, "Hatchery Work in Support of Salmon Fisheries" (Fisheries Research Services, 2007), available at:

overwhelming bulk of salmon culture today is, as observed, an entirely enclosed operation in which salmon mature in grow-out pens located off shore, and are supposed never to associate with their wild cousins.

The central social conflict examined in this chapter was never very effectively resolved, at least not during the nineteenth century. No entirely effective compromise was found, and so long as relative equality between factions existed, neither side could impose themselves sufficiently to end the conflict in their favour. Hence it always simmered, held in check mainly by threats of litigation and more-or-less effective legislation – at least as far as historical research has been able to ascertain. Yet the fact that initiatives like Stormontfield survived into the last decades of the century appears to reflect the gradual and relative ascendency of particular social groups, namely anglers. And as the market changed, so the power of lower proprietors waned, and upper proprietors improved their political leverage (in local and national terms).

It is worth noting in this regard, although outside of the time frame of this account, that Robertson's analysis of the Tay found that both relations amongst proprietors and the apparent health of the salmon stock were at their best when one actor managed to achieve a near monopoly over the whole fishery. In 1899, the Tay Salmon Fisheries Company, formed by a few proprietors, by paying lower river proprietors considerably above the market rate, was able to take out long leases on netting stations and deliberately under fish or disband them, as well as enforce particular fishing practices on those it continued to utilize. These efforts meant more fish could swim upstream to breed, thus pleasing upper proprietors and their angling clientele, for whom the Company acted simultaneously as agent.[181] Prior to the angling boom, the attitude of upper priorities tended towards disinterest in the conservation of salmon: since they stood to gain little by it, they affected disinterest in it. But as angling became more desirable, the potential of upper river rentals (or their value for personal use) grew, and actual rentals were dragged upwards to some extent. This tendency towards relative equalisation of stakes in salmon fishing is what had underpinned growth in tensions. And, thus, when the Company succeeded, via the market mechanism, to achieve a virtual or

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http://79.170.44.155/asfb.org.uk/wp-content/uploads/2011/06/FRS-Salmon-Hatcheries.pdf. Accessed 23/06/2015.

[181] Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 349–53.

effective monopoly, this basically reflected the growing dominance of the angling interest. Still, similar in consequence to a joint-stock style company resolution – which as a collective social action could conceivably have been achieved through some other means – the market in this case provided a system of allocation through which a significant degree of co-operation between social agents was achieved. If legislation on its own failed in mediating an acceptable compromise between interests, as did the more naive technologically solutionist visions of artificial propagation as a social binding agent, the market combined with the new political landscape, arguably picked up some of the slack, contributing to a transitory, local and by no means general solution to the problem of social order on the Tay.

5. Co-producing fish culture and society

Historians have suggested that during the nineteenth century a distinctive mode of thinking about and intervening into the biological lives of aquatic organisms emerged, an ideological shift in which these domains were re-imagined in terms of exploitable resources to be managed scientifically for the first time.[1] Fish culture was a symbol of and participant in this new modality. The literally "hands-on" aspects of reproductive control – artificial propagation – it involved were at its centrepiece. Although these were by no means the beginning and end of the movement – fish culture comprised the range of technologies to improve and conserve the fisheries – contemporary proponents tended to see it as especially significant – even epochal – and even representative of what they saw as their era's spirit of progress. Professionals and "insider-historians" of aquaculture through the twentieth century have similarly viewed the mid-nineteenth century movement as a decisive break with the past, as the "birth of scientific fish culture" and therefore an aspect of what one called, grandiosely, "the renaissance of modern civilization in Europe".[2] Of course, as an assemblage it was not entirely novel in all aspects, and it emerged out of a long series of historical precedents. But it was surely sufficiently new to be worth remarking upon, and undoubtedly distinctive in its specific combination of material and technical practices, the species to which it could be and was applied, and the new regulatory regimes and socio-political concerns with which it became practically interwoven. Its story is in many respects a story of modernisation.

The idea that fish culture symbolises a fateful junction in humankind's historical relationship to nature and, indeed, to biology as a distinct domain made thereby available for experimentation and manipulation was carried through in my initial framing of fish culture as an innovative reproductive technology that might be viewed in terms of a "pre-history" of modern reproduction. In this dissertation however, I did not attempt to pursue this via a history of ideas about

[1] Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution."
[2] Fish, "Founders of Fish Culture: European Origins," 8. Also, Chapter 1 above.

nature or conservation,[3] nor via a genealogy of "modern reproduction" as a concept, ethos or mentality. Likewise, I explored it neither in terms of the politics associated with the conceptual shift from "generation to reproduction",[4] nor even (or at least not solely) as the evolution of reproductive technologies, techniques or devices and associated modes of material and epistemic practice. Rather, led by my empirical studies of the earliest phases in the emergence of the "modern" British fish culture movement, I focused on another theme that, I think, is also relevant for the conceptualisation of modern reproduction, and more widely to sociology and the study of the social relations of technology and science. This is the centrality of social conflict, controversy and co-operation, and therefore social communication and exchange, often based on competition over of material and ideal resources, and arising out of or connected to situations involving interventions into the reproduction of organisms and populations. I explored these episodes as historically situated sites of social (re)production, viewed particularly through the means by which they were managed and ameliorated. Drawing inspiration from Sarah Franklin, I began by posing a very open question: what was fish culture as reproductive technology in fact reproducing?

Taken in the evocative sense in which it is intended, this question clearly has no definitive answer: it represents rather an opportunity to explore some of the socially consequential aspects of an emerging reproductive technology. In the empirical parts of this dissertation, I tried to show that, apart from fishes, there were a great deal of social phenomena being "reproduced" in, by or in relation to fish culture. These included various social and historical processes, relations, hierarchies and inequalities of various kinds; identities, shared practices, cultures and "worlds" – professional, recreational, economic and ethical. They also include facts and artefacts, the forms of social binding and differentiation to which these were connected, and the social regulatory institutions that these contributed to shaping – be these informal, including forms of inter-group and inter-individual approbation, or formal, including laws and the bureaucratic structures that

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[3] Eg., Donald Worster, *Nature's Economy: A History of Ecological Ideas*, 2nd ed. (Cambridge: Cambridge University Press, 1985); also, for related speculations, see Robertson, "The Tay Salmon Fisheries in the Nineteenth Century," 442–43.
[4] C.f., Jacques Roger, *Buffon: A Life in Natural History*, trans. Sarah Bonnefoi (Ithaca, NY: Cornell University Press, 1997); Lettow, "Population, Race and Gender: On the Genealogy of the Modern Politics of Reproduction."

administer them. Fish culture itself was produced and reproduced as a complex and variable yet ultimately ends-directed movement driven by a variety of human agents. The science and technology studies (STS) framework suggested by the idiom of co-production supported this broad outlook. Probing perspective again helps me now to summarise and illuminate the first series of contributions to the relevant literatures that I have attempted to make.

5.1 STS, social conflict and social order

An ambition of Sheila Jasanoff's elaboration of the "idiom of co-production" in STS was to encourage connections between outlooks in STS and more traditional perspectives in social and political science.[5] I have tried to compliment this ambition generally in the range of sociological and historical perspectives brought to bear on my materials. In particular however, I have focused on the variety of "technologies" and institutions that contributed to resolving conflicts, either by enabling social actors to "get along", to co-operate, or, by exercising forms of coercion and social power, to mitigate the effects of continuing disputes by imposing their definitions of situations on others and having them (at least provisionally) accepted. In this way, I noticed how "social order" and "civil society", in specific and local spheres of action, was maintained or established. I tried to prioritise empirical observations of diversity, rather than generalising conceptual schemes about the necessity of these processes or their mechanisms. This approach may be characteristic of STS, but it comes with significant costs and limitations.

Co-production is conveniently framed as an approach to controversy studies in STS in which it is emphasised not only that facts and artefacts are socially shaped or constructed, but that the social, including the economic and political, are simultaneously transformed and produced in the process. Controversies and conflicts in science and technology are methodological windows into these processes. Markle and Petersen long ago summarised the value of controversies: they provide means of uncovering the (often hidden) agendas and motivations of actors; provide opportunities to explore broadly the relations between science and technology and society, and scientific and technological

[5] Jasanoff, "The Idiom of Co-Production," 2.

controversies act as possible "models of disputes in society" generally, and hence are relevant to "understanding social conflict and social change".[6] These are all relevant to the investigations I have undertaken. However, I would emphasise the last of these here, a perspective echoed (over thirty years later) by Jasanoff's view of contemporary STS as needing to be concerned with "social controversies as laboratories for studying how science and technology work in society" as much as with how "laboratories" are sites for studying how "scientific controversies" are socially conditioned.[7]

There is often a great emphasis on the disruptive effects of science and new technologies, how they precipitate radical social changes and conflicts between old and emerging groups – not least in the area of artificial reproductive technologies. More widely, the view that conflict is virtually synonymous or interchangeable with change has become a sociological commonplace and basis for both ideological and methodological perspectives. But this equation is simplistic: conflict does not necessarily lead to change; change can occur in the absence of conflict, and change of some kind is often a prerequisite for the maintenance of a more widely stable order.[8] Understanding change requires understanding how conflicts are assuaged or settled in practice, not least because the means by which this occurs can have lasting effects on the nature and resilience of resulting settlements into the future. In this light, by adding a co-productive lens to the idea of local disputes involving science and technology as models of conflict, we can pursue an interest in how social order is reproduced, or simply how civil social relations are themselves co-produced.

Since Hobbes articulated it in its modern form, and Parson's re-posed it for 20th century sociology, approaches to social order or the "problem of social order"

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[6] Markle and Petersen, "Controversies in Science and Technology - A Protocol for Comparative Research," 26.
[7] Jasanoff, "Genealogies of STS," 439. Jasanoff acknowledges that a part of this shift recalls re-evaluating pioneering uses of controversy studies which were never freighted with the cognitive-epistemic baggage of other traditions, eg., Dorothy Nelkin, *Controversy: The Politics of Technical Decisions* (Beverly Hills, CA: Sage, 1979); "Controversies and the Authority of Science."
[8] See Wrong, *The Problem of Order: What Unites and Divides Society*, 205, NaN-212. It is worth noting that normative functionalism's tendency to reduce order to value consensus tended to marginalise the possibility of conflict per se. This, as a part of its vision of a highly or "over-integrated" social actor, encouraged the view that it was as a theory ideologically conservative – a view which has presumably also coloured the whole question of order in society ever since, as Wrong also suggested, Ibid., 12–13.

have tended to explore combinations of features including normative regulation (eg., values), the pursuit of "rational" self-interest (eg., markets), and forms of physical constraint or coercion (eg., police). My analyses revealed traces of all of these – combined (as far as possible) with a sometimes sceptical awareness of those perspectives understood to be more closely the preserve of STS: the idiom of co-production, and that hinted at in Latour's phrase "technology is society made durable".[9] This in its primary sense suggests that technologies are concretisations of social relations, but in a secondary sense also that technologies make society durable – they play roles in constituting and stabilising the patterns of relations between elements that comprise collective life. There are in other words "socially binding effects" or integrative functions associated with mundane practices and material or nonhuman factors.[10] In Chapter 2, investigation followed a largely familiar course in the sociology and history of science, using the parr controversy as an opportunity to peer into the regulatory functions of specific social relations in the scientific process, aspects of which I will not review here. What is relevant is that, taken as a model, it highlighted the role of linguistic and material-technical (experimental and curatorial) practices in overcoming a trust bottleneck. It was assumed that trust is key to the creation of empirical knowledge; what must be emphasised here is that establishing trust also is pivotal to aligning and co-ordinating social actions generally. If familiarity between social agents encourages trust, social difference and distance tends to discourage it. Thus analyses focused on how an "outsider" mobilised various resources, including technologies, to navigate a social context divided by status hierarchies. Behaving "correctly", that is, according to the norms and standards of honour of the relevant group and what they dictated with regards to the specific identity of an actor such as the gamekeeper John Shaw (which crucially included displaying special kinds of deference and competence), built trust and enabled cognitive and social co-ordination and agreement to ensue. Although instantiated highly locally, such processes are precisely of the kind that would, as Barnes put it, "dispose us to speak of the existence of a society" generally.[11] Chapter 3 traced the theme over a

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[9] "Technology Is Society Made Durable," in *A Sociology of Monsters: Essays on Power, Technology and Domination*, ed. John Law (London: Routledge, 1991), 103–31.
[10] Gay Hawkins, "The Performativity of Food Packaging: Market Devices, Waste Crisis and Recycling," *The Sociological Review* 60, no. Issue Supplement S2 (2013): 66–83 is a good example of what I mean.
[11] Barnes, "Catching up with Robert Merton: Scientific Collectives as Status Groups," 186.

much wider social canvass: the centrality of rhetoric framing expectations about social hierarchy, status and conduct appropriate to civil society were again viewed as important means by which conflicts over a scarce resource – this time not largely ideal or honorific as in the previous instance, but more obviously tangible and economic – were engaged in and mediated. The institutions of science and law and their interactions were also seen as key mediums and means through which interested parties imposed themselves on one another. Through the successful mobilisation of these coercive and normative resources by an increasingly powerful social faction (an alliance of comprised of proprietors and by-and-large middle class professionals interested in salmon angling), a practice (parr fishing) that had come to be a site of contestation was ultimately put down and made to appear archaic and anti-social. Thus a conflict was, for all intents and purposes, ended; and, although the hardening of the scientiric consensus that parr were salmon played a crucial role in enrolling sympathies and augmenting the justificatory languages adopted by some, this resolution was by no means guaranteed by "the facts" alone.

Chapter 4 presented a different and complicated case. Here there were no obvious or lasting social differences between competitors in terms, for instance, of social class or position in deference hierarchies. The conflict was economic in a narrow sense, and the relevant kind of stratification was differences in fishery rentals as structured by geography and the biology of salmon. Struggles here were bitter and long, and consequential because they were seen to be in the long run detrimental to all involved, because competition and conflict encouraged "overfishing" and discouraged the successful adherence to conservation measures, to the salmon stock itself. Occasionally, forms of co-operation were achieved – not least in the formation the Stormontfield fishery itself – but these were typically temporary or weak, and always threatened by free-rider problems and concomitant emnities. Successful collective action between evidently self-interested actors was seldom forthcoming, and for a long time no faction or individual could achieve an overwhelming power of monopoly – or effective kind of functional inequality – to shut out the claims of others. Little lasting sense of group solidarity or perception of common interest was apparently available to over-ride the temptation to outdo a neighbour, subvert regulations, and exploit structural advantages. In this context, I concluded by speculating (drawing on the

research of Iain Robertson), that the most successful means of co-ordination and social binding turned out, eventually, to be an arrangement effected via the market in fishery tacks. I would not say however that this occurred as a straightforward consequence of the liberal's *doux commerce*, the supposed civilising power of market trade.[12] Rather, it happened on the back of sustained political agitation and demographic pressures that saw a union of interests forming between angling interests and upper proprietors who, in time, were able to deploy their power to extract legislative concessions and, on the basis of rising rents to which this contributed, buy out their competitors. The period of relative civility on the Tay that resulted corresponded, as far as can be ascertained, with an improvement in the state of the salmon stock, too. My cases thus revealed the contextual, provisional and often local nature of resolutions to social order as problem.

Hobbes argued notoriously that the cause of conflict lay not in the existence of inequality amongst individuals, but in the essential equality of human beings. We do not need to agree with Hobbes in general to see the logic in the argument that what makes people similar is also what makes them capable of competing with one another; or, put differently, growth in equality, either belief that it is just and necessary or in material and economic terms, may be exactly what precipitates conflict over correspondingly scarce resources. We saw this dynamic in economic terms reflected in the case of the proprietors on the Tay: as the uppers' rents grew in proportion to the lowers' decline, they were emboldened to demand concessions, came to recognise their interests in a different distribution of resources, and levels of dissatisfaction and conflict increased. This in turn was connected to more general levels of relative equalisation or homogenisation – not in the sense of the disappearance of social extremities (such as the extremely wealthy and the extremely poor) – but, as J. S. Mill thought, rather in terms of the growing size and economic and political strength of the middle social strata.[13] This was the tide upon which the popularity of angling for game fish rose and which brought it as a leisure pursuit increasingly into the purview of many who

[12] See Albert O Hirschman, *The Passions and the Interests* (Princeton, NJ: Princeton University Press, 1977).
[13] See John S Mill, "Democracy in America [Review]," *The Edinburgh Review* 72, no. 145 (October 1840): 1–47.

previously would not have been able to contemplate it.[14] This, as I suggested, provoked attempts to monopolise it in its upper echelons in various ways, causing also cascading effects downwards as the social distinctions this created and reproduced were imitated (Chapter 3); and in the case of salmon angling on the Tay, the boom eventually provided the capital (economic and political) necessary to reinstate a kind of monopoly (Chapter 4).

In 1840, Mill also wrote of those material "agencies" whose effects we have already described as being of very great consequence in the fisheries arena and worlds of salmon angling and poaching especially:

> The Newspapers and the Railroads are solving the problem
> of bringing the democracy of England to vote, like that of Athens,
> simultaneously in one agora and the same agencies are rapidly
> effacing those local distinctions which rendered one part of our
> population strangers to another; and are making us more than ever
> (what is the first condition of a powerful public opinion)
> a homogenous people.[15]

Mill was of course well aware of the limited penetration of equality in Britain, and the country's continuing "love of aristocracy", yet he thought that something was changing, that "popular respect for the higher classes [was] by no means the thing it was"[16], and that this and related "moral and intellectual" developments followed from the growing dominance of middle class commercial interests. Indeed, in 1848, Thackeray's *Book of Snobs* could satirise the deferential behaviours of his countrymen precisely because, against this background, they could now appear absurd.[17] Alexis de Tocqueville, whose identification of the effects of "democracy" in America Mill was reviewing, thought the relevant characteristic of Britain was precisely the *partial* penetration of equality and the *ambiguity* as to social rank this caused. Given the rising aristocracies of talent and wealth, it was no longer necessarily obvious what kinds of deference individuals or groups should be honoured with, as may have been the case when the rank of a gentleman was consequent entirely upon birth, estate or "condition". Thus in Britain there ensued

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[14] A tendency that only increased into the early 20th century, especially with regards to trout angling in England: One writer for instance worried about the "working-man angler" bringing his maggot fishing methods to the trout fisheries, "in some instances even renting trout waters", whereas once he would have regarded these as "beyond his reach", W Carter Platts, *Trout Streams: Their Management and Improvement* (London: The Field Press, 1928), 143.
[15] Mill, "Democracy in America [Review]," 12.
[16] Ibid., 10.
[17] William Makepeace Thackeray, *The Book of Snobs* (London: Punch Office, 1848).

innumerable minor battles over rank: "a hidden war", wrote Tocqueville, in which "some try hard, by a thousand artifices, to join in reality or in appearance those who are above them; others fight constantly to repulse these men usurping their rights; or rather the same man does both things, and while he is trying to get into the upper sphere, he struggles without respite against the efforts that come from below".[18] Chapter 3, discussing the status of anglers, the differentiation of "sporting" tactics, and the honour catching parr, seems to corroborate the observation. And Chapter 2, despite the relative insulation that scientific controversies may be considered to possess with respect to ambient societal forces, again exhibits a fundamental analogy at the level of form: challenge to the monopoly of the special honour of the scientific status group provoked a sense of possible usurpation (however briefly this lasted).[19] This was centred on someone who was a partial social outsider, whose social identity and status was ambiguous, but who clearly had the wherewithal to engage in a high level of cognitive, academic dispute. Shaw was aspiring to a particularly circumscribed kind of in-group equality. We may then take the key observation, as a hypothesis, to be that while social and economic changes caused increased intercourse between socially heterogeneous actors, their differences were in fact framed and extenuated by an overall perception of the consequences of homogenisation. Social order, in the different empirical examples I have explored, can thus be read as the effect of the practical management of the different kinds of repercussion that processes of heterogeny and equalisation precipitate.

The final empirical chapter also had another dimension, which was to explore how the context of conflict amongst proprietors shaped the attempt to introduce artificial propagation as a technology of production on the Tay. I found that to the extent that this effort was successful, it is was connected to legislative successes in regulating fishing practices and existing competition between fisheries interests. But the relevant dimension to this here was my attempt to explore the further postulate that artificial propagation as-"technological"-solution may have proffered *itself* as a means to ameliorate competition and conflict; an

[18] Alexis de Tocqueville, *Democracy in America*, ed. Eduardo Nolla, trans. James T Schliefer, vol. 4 (Indianapolis: Liberty Fund, 2010), 996. See also Collins and Makowsky, *The Discovery of Society*, 51.
[19] Compare Barnes, "Status Groups and Collective Action"; "Catching up with Robert Merton: Scientific Collectives as Status Groups."

arrangement for social binding or peacemaking, so to speak. I considered that it was certainly an example of co-operation amongst some actors, and speculated that to a small extent it may have encouraged co-operation by functioning as a mechanism through which to redistribute costs. But these effects in reality, while interesting, were of trivial practical importance in resolving or sidestepping a near intractable problem.

I cannot then disagree with the view that sees social interests as constructed in heterogeneous networks[20]; nor that material-technical arrangements in principle can impose different kinds of social settlement or relations[21]; nor indeed that property and markets as social institutions do more than facilitate economic transactions but also create and sustain particular kinds of social relations.[22] I nevertheless emphasise that this can be appreciated without reducing relations of all kinds to being kinds of "politics", to a view that therefore sees politics as either as "everywhere", or as concerning "ontological" or "cosmological" commitments.[23] We can agree with Latour that there is seldom a trouble-free distinction between, for example, science and politics, but only debates about different ways of holding sway over the agora.[24] But this does not mean that we need give up the analytical purchase entailed in viewing politics (and democracy) in a more conventional way: as activities engaged in by human individuals and groups, through which are established lasting mutual agreements via acts of coercion and persuasion. I think that this has in general and rightly been the outlook to which I have given priority in this dissertation.

Interest in social order is not alien to STS. However, in this field a view has developed that marginalises the specific sense of it as a practical *problem* involving

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[20] Callon and Law, "On Interests and Their Transformation: Enrolment and Counter-Enrolment."
[21] Eg., Hawkins, "The Performativity of Food Packaging: Market Devices, Waste Crisis and Recycling."
[22] Eg., Michel Callon, "An Essay on the Growing Contribution of Economic Markets to the Proliferation of the Social," *Theory Culture & Society* 24, no. 7–8 (2007): 139–63.
[23] Eg., Asdal, "On Politics and the Little Tools of Democracy: A Down-to-Earth Approach"; Annemarie Mol, "Ontological Politics: A Word and Some Questions," in *Actor Network Theory and After*, ed. John Law and John Hassard (Oxford: Blackwell, 1999), 74–89; Isabelle Stengers, "The Cosmopolitical Proposal," in *Making Things Public: Atmospheres of Democracy*, ed. Bruno Latour and Peter Weibel (Cambridge, MA: MIT Press, 2005), 994–1003. I am drawing once again on Brown, "Politicizing Science: Conceptions of Politics in Science and Technology Studies."
[24] Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999); see discussion also in Malcolm Ashmore, Steven B Brown, and Katie Macmillan, "Lost in the Mall with Mesmer and Wundt: Demarcations and Demonstrations in the Psychologies," *Science, Technology & Human Values* 30, no. 1 (2005): 176–110.

how *social* conflicts are ameliorated and human groups and individuals in fact come typically to associate closely with one another in relative peace (when there are no *a priori* reasons for thinking this will be the case). For instance, as I discussed in the introductory chapter, in the works of sociologists and historians like Barry Barnes and Steven Shapin social order is viewed as essentially equivalent to cognitive order, and their works provide some of the most powerful sociological examples and theoretical lens's for approaching the issues I have been concerned with. And yet, it is true that their interests associate them with the theoretical and philosophical tradition that investigates how it is possible that we apprehend predictable or stable patterns in the world at all[25]; in this, they typically do no pay attention to social order as a problem confronted by actors in practices and as a subject for social analysis that is not reducible to, although is very closely linked with, the study of the basic "structures" or "patterning" of components social theories may take as characteristic of social life.[26] Other traditions in STS, despite significant differences, find themselves in a similar category. John Law for instance focused on the contributions of mundane organisational and material-technological practices of modernity with a view to understanding their role in achieving provisionally stable patterns of interaction and co-ordination, or what he calls *ordering practices.*[27] Again, this represents a valuable perspective, especially in its highlighting of the involvement of nonhuman actors. But it is unclear how it addresses the specifically *social* dimension of order as a problem. (Indeed, it may be seen as premised on a quite different notion of "the social" per se).[28] Nor does it do a great deal to alter the view that order/ing is a matter of describing how reliable or predictable patterns emerge out of relations between diverse agencies in general. Such an approach must have in principle as much to say about the miracle of regularity of supply of filtered water at the office fountain as the management of conflicting interests in a climate change negotiation. As with actor-network theory generally, the theoretical ambitions at play are in effect universal and descriptive, however much they are articulated through empirical case

[25] As Wrong put it, "the problem of knowledge or epistemology itself becomes a version of the problem of order", *The Problem of Order: What Unites and Divides Society*, 5.
[26] As I noticed previously with reference to the "cognitive-ontological" dominance in approaches to social order, see Schatzki, *The Site of the Social*.
[27] Law, *Organizing Modernity*. Although occasionally framed differently, the theme remains central to Law's more recent work on mundane practices of stabilisation as "empirical ontology", see eg., Law and Lien, "Slippery: Field Notes on Empirical Ontology."
[28] See Latour, *Reassembling the Social*.

studies.[29] I think that more theoretical work is still needed to meld these perspectives into a tool for the understanding the narrower, perhaps more conventional, problem of social order in the sense that motivates me here. An adequate way of redefining and distinguishing the problem for STS remains outstanding. Idioms of co-production may be a start, but are only just that.

It would be well to conclude this section on a note of historical irony and personal reflexivity. The great works – from Thucydides and Hobbes to Weber and even Parson's, writing whilst the Nazi's rose to power and in the aftermath of an epochal war – in the tradition of the problem of social order all emerged in the shadow of crisis. These writers experienced how shallow buried the reality of violent civil strife and social and economic collapse can be. How unlikely it then seems to discover and emphasise this vein, lodged in the bedrock of the most improbable subject matter! There is, of course, debate about whether the period since the beginning of the Napoleonic Wars until roughly the second half of the 1840s was one of genuinely "catastrophic" social change, as EP Thompson put it. Carried on under the aegis of the "Industrial Revolution" and arguments about the population explosion, and push-and-pull of constitutional reform, many have chosen, rather, to emphasise the extraordinary improvements in standards of living that the entrenchment of the industrial system and the last mass enclosures wrought, the repealing of protectionist trade laws, or of course the great changes in education, literacy and political suffrage that occurred simultaneously.[30] And these decades subsided gradually into the mid-Victorian era, a phase of such exceptional economic and political stability that it prompted the coinage of an historical epithet that has stuck: "the age of equipoise".[31] The social settlement of the time has often been characterised in terms of relative harmony between classes; and the waves of 1848 on the continent were but ripples when they reached British shores. To contemporaries like Marx it seemed by the early 1860s

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[29] For recent relevant discussion of ANT in these terms, see Lynch's adoption of Pickering's earlier characterisation of ANT as a "Theory of Everything", Lynch, "Ontography: Investigating the Production of Things, Deflating Ontology," 452–53; citing Andrew Pickering, *The Mangle of Practice: Time, Agency, and Science* (Chicago, IL: University of Chicago Press, 1995), 246ff.

[30] See for instance the discussion in the opening pages of Chapter 6, Part 2 of Thompson, *The Making of the English Working Class*. Thompson takes the view that the period was in fact catastrophic. He cites, amongst otheres, a sociologist and student of Parson's as an example of the contrary trend: Neil J Smelser, *Social Change in the Industrial Revolution* (Chicago, IL: University of Chicago Press, 1959). The ideological dimension to disagreement here is obvious.

[31] W.L. Burns, *The Age of Equipoise* (London: Allen and Unwin, 1964). The mid-Victorian era is usually seen as roughly 1852 – 1867.

that the "prolonged prosperity" of the working classes had disinclined them towards revolutionary action, adding much to the depression of the man who looked forward to economic downturns and any signs that the proletariat may be shaking off "their bourgeois infection".[32] Apparently, people were often intent on letting the infection linger, and were content with what piece-meal improvements and concessions, as social historians have (sometimes condescendingly) suggested, the era's "middle class" or "*bourgeois* social order" handed out.[33]

In respect of our topic, I can think of no more appropriate illustration of this period's apparent confidence in its achievements than that of Frank Buckland's fish culture apparatus as displayed at the Islington Dog Show in 1863, provided at Figure 12.

The scene appears as a symbol and site of both the orderly reproduction of society and the control of natural reproductive processes. In it we see a carefully curated snapshot of a portion of Victorian society, intrigued by the new science on display. In the middle lies the apparatus in question, prettified so as to appear like a perfect trout stream, with flowers and beds of moss cut from Winsor Great Park. It contained incubating eggs, and what Buckland said were now "civilised and tame" fish.[34] Both fish and dogs were being symbolically paraded as examples of mankind's ability to control biological nature – but this power also stood for society and the management of hierarchies therein. At the show (the accompanying text says), Buckland's "pains were appreciated", honoured by the "general public", "by many persons of influence in the land", as well as by the Princess and Prince of Wales – indeed the future King Edward VII received the young salmon preserved in its "bottle of physic", and was said to have given it a "careful inspection" (Buckland is depicted holding up the specimen towards the right of the image).

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[32] Letters to Engels written in 1863 and 1864, quoted in Isaiah Berlin, *Karl Marx*, 5th ed. (Princeton, NJ: Princeton University Press, 2013), 257.
[33] C.f., Eric Hobsbawm, *The Age of Capital, 1848-1875* (London: Abacus, 2011).
[34] Francis Buckland, "Fish Hatching Apparatus at the Islington Dog Show," *The Field*, July 4, 1863, 12; also Shelton, *To Sea and Back: The Heroic Life of the Atlantic Salmon*, 123; Rose, *The Field, 1853-1953*, facing page 81.

An image of fish culture and social order

FIGURE 12: "Frank Buckland's fish hatching apparatus at the Islington Dog Show". Originally published in *The Field,* 4 July 1863, Vol. 22, Issue 549, p. 12.

Moreover, special entry concessions were made for "the poor man and his family on the last days of the show", who might stand to be improved by their visiting.[35] Indeed, as the fish could be civilised, so too does the exhibit evince a faith that arrangements could be made to ensure orderliness in society.

I'm simply emphasising that the era was characterised by a strong feeling that what some may be disposed to call social order or orderliness could be, and was being, maintained, and that this may make identification of the theme of conflict in my work seem incongruous. Obviously, the point is not that there were actually no social conflicts – to hint at a mood of contemporary confidence that these could and were being managed is actually to admit that they were. And, as I

[35] Buckland, "Fish Hatching Apparatus at the Islington Dog Show," 12.

have already conjectured, it can be the very processes that give the impression of overall social stability – such as the spread of relative homogeneity consequent on the elaboration or growth of the middle strata and the aspiration, to use the language of the day, for material, intellectual and moral development – that tend simultaneously to produce new conflicts and forms of competition. But, still, if we look at our examples from the worlds of salmon culture, the closest we come to violent unrest would be in connection to the poaching wars, or "the long affray" as they have been called. The worst incidences took place outside of our period (although Kent discussed a highly unusual example from the Tweed in the 1850s).[36] Disagreement between salmon scholars obviously does not count, and nor does bickering and commercial competition between fisheries proprietors. Although the crowds at Dunblane after the parr trial marched with banner calling for "Liberty", this is little more than a conventional gesture towards to the favourite slogan of an earlier period of British radicalism and whatever rhetorical power it retained.[37] In this context it seems comically parochial.

Thus we might turn for a moment from the context of analysis towards the context of writing. What we discover of the past always says a great deal about perceptions of the present. I will not attempt to cite the litany of phenomena unfolding around us today that contribute to promoting the apprehension that the fundamental institutions and resources, upon which many of us have grown accustomed to relying on for the securing of peace and prosperity, seem threatened – from balances of geo-political forces to constitutions and, of course, the environment. Perhaps all generations come to feel they are living through a crisis of some kind. But this does not dispel the facts of the present, nor diminish the likelihood that a subjective sense of these may shape our historical vision and our selection of conceptual and narrative foci. Perhaps the real wonder is why more sociologists (or STS practitioners) writing today do not appear to be emphasising the theme of social oder and conflict in ways similar to that in which I have found myself doing?

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[36] See Harry Hopkins, *The Long Affray: The Poaching Wars, 1760-1814* (London: Secker & Warburg, 1985); Kent, "Power, Protest, Poaching, and the Tweed Fisheries Acts of 1857 and 1859: 'Send a Gunboat!'" Hopkins though does not discuss salmon poaching in detail, nor give examples from Scotland however. Other instances of poaching conflicts leading to near violence are documented in the Wye area later, in the 1870s and '80s, and even into the 20th century, see eg., Coates, *Salmon*, 119–20.

[37] C.f., Thompson, *The Making of the English Working Class*, esp., Chapter 4.

5.2 Reproduction and 19th Century British fish culture

Moving on from these airy speculations, I attend next to contributions I have made to other areas of investigation that have provided significant frames of reference for this dissertation. These include the social studies of reproduction (SSR) and the study of fish culture or aquaculture itself. These are closely linked because much of the originality of what I have said lies in attempting to bring the SSR and fish culture together. I believe an important element here lies also in acknowledging what has not been achieved: thus I will not shy away from identifying gaps in my account and interpreting them as opportunities for future investigation.

The first area to review involves a key starting assumption, derived from my reading of the SSR, and its relationship with the connecting themes of social order that arose out of the empirical sites investigated. This starting assumption, derived from literature in the SSR, argued that sites of intervention into biological reproductive processes tend to be dense and complex sites of social reproduction. It is obvious that "reproduction" does not here mean mere "replication" or "repetition": by way of analogy with biological procreation, it rather implies the novelty of recombination and of accident, of iteration, as well as continuity through time.[38] Moreover, if we believe that social phenomena have histories, there can be no mere repetition; if pure repetition occurred, it is hard to conceive what role past events, memories and traditions could play in social life. Thus the SSR have identified, on the one hand, how the development of artificial reproductive technologies in human beings may "reproduce" global stratifications in race, nation or gender, but may also reinvent social categories and "produce" novel forms of social relation, for instance understandings of the family, kinship and related institutions and norms – even ideas of the "natural", the "biological" and the "technological" per se. In this context, conflicts and differences of interests, then, whether overt or tacit, between different social agencies and groups, are features of many, if not most, accounts in the SSR. One only need hint at such crux sites, in humans, as birth and population control and abortion, or recent and ongoing controversies in the ethics and politics of artificial reproductive technologies

[38] See Franklin, *Dolly Mixtures*, 20.

(ARTs) and their techno-medical derivatives to substantiate this point.[39] It may be harder to see this in examples involving the reproduction of animals, especially where the links to human reproduction are highly attenuated. But it is nevertheless also the case, for example, in debates over the use of cloning technologies in the conservation of wildlife in which different groups of experts are mobilised in disputes over the ethics and utility of this approach and, connectedly, over the purpose and reproduction of particular social institutions – in this case zoos – as sites of conservation work and bio-technological innovation.[40]

Initially envisaging 19th century fish as an ART helped me to substantiate this outlook, providing a starting point for investigating the reproduction of various social relations and institutions. These ranged from those involving status relationships between naturalists and the changing character of natural history (Chapter 2), to stratification of relations in the worlds salmon angling and fishing – especially connected to the development of formal and informal regulatory structures and the elaboration of specific social interests, actions and norms (Chapter's 3 and 4). It would, however, I think, be a fair criticism to ask how, in this instance, were these and the conflicts they related to specifically connected intervention into the biological reproduction of fish? In other words, to what extent can we say that social reproduction in these cases was more than incidentally connected to the biological reproduction of the fish, and what mechanisms might underpin such a connection? Although I think some concession on my part is necessary here – I'm not sure that I have made a concerted theoretical contribution to understanding linkages between social and biological reproduction – I think it is nevertheless valuable to offer the range of empirical corroborations of the general idea as I have done. Moreover, in Chapters 2 and 3, a crucial dimension of the parr controversy in each case centred on the reproduction

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[39] An unrepresentative list of accounts in sociology might include: eg., Monica J Casper, *The Making of the Unborn Patient: A Social Anatomy of Fetal Surgery* (New Brunswick: Rutgers University Press, 1998); Clarke, *Disciplining Reproduction*; Nelly Oudshoorn, *The Male Pill: A Biography of a Technology in the Making* (Durham: Duke University Press, 2003); Michelle Murphy, *Seizing the Means of Reproduction: Entanglements of Feminism, Health and Technoscience* (Durham, NC: Duke University Press, 2012); Rosalind Pollack Petchesky, *Abortion and Woman's Choice: The State, Sexuality and Reproductive Freedom* (Boston: Northeastern University Press, 1984).

[40] Esp., Friese, *Cloning Wild Life*; Carrie Friese, "Genetic Value: The Moral Economies of Cloning in the Zoo," in *Value Practices in the Life Sciences and Medicine*, ed. Isabelle Dussauge, Claes-Fredrik Helgesson, and Francis Lee (Oxford: Oxford University Press, 2015), 153–67.

of parr and salmon, and I attempted to show that intervention into the breeding of these fish not only contributed to restructuring certain relationships in the field of natural history and salmon fishing, but initiated a sequence of wider social conflicts. There was, as I showed in Chapter 3, a deep concern with the moments during which salmon reproduce their species; as sites, these became interwoven with the reproduction of diverse social distinctions and preferences, be these economic and material or subjective and connected to a sense of self in relation to others. Developing this, the conflict dealt with in Chapter 4 was again irrevocably connected to the reproduction of both salmon and salmon fishing agents and, especially, those agents required to bear the cost of ensuring the fish's reproduction.

My focus on the narrow understanding of social order as a problem of ending conflict and understanding co-operative and social action, however hard this is to disentangle from the broader conception, is, I think, an original line of enquiry in this field. When authors I associate with the SSR, like Friese or Franklin, refer to social order, (and is this usually implicitly), it is typically in the more "cognitive-ontological" sense. As noted above and outlined in the introductory chapter, this refers to the reproduction of social forms and structures and how these are co-constituted in the socio-technological organisation of biological reproduction. More explicit focus on the problem of achieving consensus in the kinds of areas studied under the umbrella of SSR would be, I feel, valuable in itself to the extent that it would help to further unpack the kinds of conflicts the field discovers. Perhaps it would also assist in developing insights into the diversity of ways in which such conflicts get managed (or fail to be), and what the costs associated with whatever means are adopted in pursuing resolution to such conflicts might be, and upon whom they are likely to fall. Whereas I have identified as a hypothesis a historically rooted pattern in which struggles over social order are connected to efforts to manage conflicts that flow from a tendency towards relative social homogeneity, equality and the loss of advantage or perceived social standing (and therefore demand to re-forge distinctions), questions remain for the SSR: is this theory relevant or translatable into other historical contexts and areas of interest to the field? Or: what broad patterns underpin the achievement of social order in different cases in which conflicts connected to matters of reproduction are attempted to be ameliorated or are successfully managed?

The next area to consider concerns various more specific contributions of focusing on fish culture, especially during this period, to the social studies of animal reproduction. Studies of the social and scientific contexts of the use of species like Zebrafish and *Xenopus* frogs as model organisms and technologies in genetics research, developmental biology and reproductive science may help set the scene for fish culture.[41] But studies of the social organisation of fish reproduction outside of the laboratory (and outside of associated specialist sub-fields in the history of biology), either in farms or in situ, are more or less non-existence to my knowledge. What first attracted me to the potential of this area was the idea that the artificial propagation of fish, as a direct manipulation of reproductive capacity, helped push back our historical vision of the development and cultural understanding of artificial reproductive technologies centred on this ambition, and to extend it to new sites. The biological properties of fish, especially their ovuliparity and, in the case of the *salmonidae*, their relatively large, convenient to handle and physically inspect eggs, obviated certain technical difficulties that made similar interventions into the reproduction of mammals and often other species very difficult. You did not really need to be a savant to artificially propagate fish (although it was not as easy as was often claimed), and it was believed that this could be done relatively systematically and potentially at a commercial scale. Thus fish culture contributes to opening up the "pre-history" of modern reproduction – especially since the story of fish culture at this time was not (yet) oriented around questions of the social organisation of heredity leading to increased breeding power and bodily yields, as in agricultural breeding, a subject that has received a great deal of attention as a component in the story of the emergence of modern reproduction and the "epistemic space" that preceded modern genetics.[42]

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[41] Egs., John B Gurdon and Nick Hopwood, "The Introduction of Xenopus Laevis into Developmental Biology: Of Empire, Pregnancy Testing and Ribosomal Genes," *The International Journal of Developmental Biology* 44, no. 1 (2000): 43–50; Hopwood, "Approaches and Species in the History of Vertebrate Embyology"; Jesse Olszynko-Gryn, "The Demand for Pregnancy Testing: The Aschheim-Zondek Reaction, Diagnostic Versality, and Laboratory Services in 1930s Britain," *Studies in History and Philosophy of Biological and Biomedical Sciences* 47 (2014): 233–47; Robert Meunier, "Stages in the Development of a Model Organism as a Platform for Mechanistic Models in Developmental Biology: Zebrafish, 1970-2000," *Studies in History and Philosophy of Biological and Biomedical Sciences* 43, no. 2 (2012): 522–31.

[42] See Müller-Wille and Rheinberger, *Heredity Produced*. Reproductive physiology has been closely connected to heredity and genetics, and all of these to embryology and development. But reproduction and modern reproductive science is also a distinct and historically located field, see

In this connection though, with my attention turned to the matters of conflict, social reproduction and social order, a number of potentially fertile avenues were not explored in the detail that they may appear to merit. One area where this seems true is in the cultural genealogy of modern reproductive control, including the techniques and scientific and popular modes thinking associated with it. I've noted the centrality of "control over" biology to Clarke's understanding of the ethos of "modern" 20th century reproductive science, and her suggestion that 21st century "postmodern" reproduction would be defined by the "re/de/sign and *transformation* of reproductive bodies".[43] Franklin, similarly, discussed the "cloning" techniques that led to the birth of Dolly the Sheep in terms of the emergence of an era of "biological control" in which biology is no longer seen to be essentially conditional, but rather to be unconditional in the sense of being defined by what can be technologically done with it – its "conditions" imposed technology and culture.[44] Such developments are also characterised by what could be called "bio-hype", and they are distantly echoed in the excessive optimism that contemporaries associated with the potential of fish culture, and which made it and its apparent wielding of authority over nature, to them, a symbol of progress. But, like the arrival of Dolly, the artificial propagation of fish may also have been accompanied by cultural ambivalence. James Cossar Ewart, a Scottish zoologist, gentleman breeder and himself great influence on the founding fathers of British reproductive science, was much impressed by fish culture on a grand scale when he examined its effects on the Potomac River in North America – an example, he declared, of "[f]ish culture come to assist Nature in her unequal struggle with the destructive engines of the nineteenth century."[45] Indeed the ongoing industrial era was often perceived to have had a darker, destructive side. The Age of Mechanism as Carlyle had called it at the outset of our period, in which man warred with nature and usually won, may have been heralded – but as Carlyle felt acutely, such victories were achieved at the cost of a sense of uneasiness and of loss and nostalgia. Thus we may have enquired more deeply after the ambivalent meanings

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eg., Clarke, *Disciplining Reproduction*; Clarke, "Reflections on the Reproductive Sciences in Agriculture in the UK and US, Ca. 1900-2000+." I discussed briefly some connections between fish culture and early or proto-reproductive physiological research in the Introduction(Chapter 1).

[43] Clarke, "Modernity, Postmodernity, & Reproductive Processes, Ca. 1890-1990, or 'Mommy, Where Do Cyborgs Come From Anyway?,'" 140.

[44] Franklin, *Dolly Mixtures*, 31–32.

[45] Ewart, "Report on the Progress of Fish Culture in America," 82. Ewart was in America reporting on developments in fish culture there on behalf of the newly formed Scottish Fisheries Board.

of "artificiality"[46] at the time, and after the limits of its apparent advance. In Chapter 4 I noticed in passing how the adopting of more efficient techniques in fish culture appear often to have been retarded out of a perception that "nature knows best"; and we may be struck in this context by enigmatic statements such as this, in a review of a book dealing with artificial propagation technologies: "Nature ever erects her impossible barrier, which can never hope to cross: thus far shalt thou go, but no further, is the universal rule".[47] Or, in another instance: "Whensoever and wheresoever man has taken upon himself to interfere with Nature, Nature retaliates by giving him trouble".[48] If there was an undercurrent of scepticism, it would help explain why so many proponents of fish culture were at pains to justify their artifice, either by arguing, as Buist did, that "[t]o leave everything to the operations of nature, as some philosophers contend, is just about as reasonable as to say that we ought to leave our fields to sow themselves"[49], or attempting to explain why there was little really artificial at all about what is largely just "the application of human fingers to the belly of a parturient fish, the placing of the expressed ova under gravel in a current, the confinement of the fry till the time of migration, and feeding them on sheep's liver and occasional maggots"[50]. How did this anxiety mix with a veritable faith, in the same authors words, in "advancing intelligence and industry" that must "be unceasingly applied to the solution of the increasingly intricate problems of our social life."[51] Again, I think, we hear echoes of more recent religious, ethical and social debate around developments in reproductive cloning, ARTs and genetic science. These ostensive parallels and continuities would be worth exploring further.

Another area of interest may be conceived of as the popular and public representation of reproduction that fish culture embodied. Clarke sees the history of reproductive science as characterized by "illegitimacy" because of its links to sex[52]; and it is of course a cliché to describe the Victorian era as excessively prudish in this regard. But fish culture put fish "sex" and its mechanisms centre

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[46] C.f., Paul Rabinow, "Artificiality and Enlightenment: From Sociobiology to Biosociality," in *Essays on the Anthropology of Reason*, ed. Paul Rabinow (Princeton, NJ: Princeton University Press, 1996), 91–111.
[47] "Harvest of the Sea," *Sporting Gazette*, December 9, 1865, 906.
[48] "Salmon," 406.
[49] Buist, *The Stormontfield Piscicultural Experiments, 1853-1856*, 7.
[50] A Rural D.D., "Salmon and Pisciculture," 645.
[51] A Rural D.D., *Contributions to Natural History: Chiefly in Relation to the Food of the People*, 154.
[52] Clarke, *Disciplining Reproduction*.

stage, and in its texts openly discussed questions of the mechanisms of fertilisation and development in a popular manner. Reference to Buckland's apparatus at the Islington Dog Show again conveys this idea: He displayed the same apparatus at the window of *The Field* on the Strand in London, much to the interest of passing commuters. The story of fish culture thus points suggestively to an undercurrent of public communication and popular fascination with reproduction in potentially interesting and underexplored ways.

Such investigations may also be enriched by an explicit focus on gender and its intersection with population. At Islington, fashionable society ladies are depicted admiring the artificial reproduction of fish. We can presume it was to similar women that Buckland addressed himself when he wrote about fish culture in *The Lady's Newspaper*: "I have now under my charge (and ye ladies which make so much to do about one baby, think of it) some ten thousand water-babies".[53] When he urges them to convert their vain and unproductive aquaria into practical water farms, we are tempted to recall near contemporary anxieties about the barren womb and the falling birth rate of the middle classes, and therefore the supposed tardiness of women in fulfilling their society-reproducing duties. It is also of interest to note that at least one key pioneer in the professionalization of trout culture in the final decades of the century preferred women only to work with the delicate ova in the hatcheries because he believed them to be more tender in their habits![54]

Further areas of interest are potentially relevant to specialist histories of biological sciences. For example, the relations between fish culture and the development of evolutionary science and especially the exchange networks between lay and expert contributors that emerged here are a case in point. Charles Darwin, for example, asked John Davy to make experiments on the capacity of salmon and trout eggs to survive various kinds of climatic shocks – a matter of importance to the investigation of the distribution of and variegation amongst species – and Davy sourced his experimental material from practical fish

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[53] Francis Buckland, "Fish Hatching," *The Lady's Newspaper*, January 24, 1863.
[54] See Hill, "Sir James Maitland and the Howietoun Fishery," 99–100. Photographs from early in the 20th century confirm the prominence of women labourers at the hatchery, see USA,"The Howietoun Collection", MS 40 Box 29 also available at https://www.flickr.com/photos/unistirarchives/8641734237/in/album-72157633228556070/.

culturalists.[55] And finally, as noted in the introductory chapter, the development of fish culture was also connected in biographical and institutional terms to the emergence and specialisation of marine biology and the founding of Britain's early marine biological research stations in the final decades of the century – a subject exceeding the scope of this dissertion, not least because developments outside of the period reported on here.[56]

These observations recall how I attempted to position my work with respect to gaps in the small but growing literatures on fish culture or aquaculture in anthropology, sociology and environmental history. Here, I emphasised existing concern with transformations in ideas about wilderness, nature and human relationships to natural resources, as well as more specific theoretical focus on domestication practices as site for investigating practical "ontologies" that have emerged at the interface of anthropology and STS. My concentration on reproduction generally, and the reproduction of social relations and social order specifically, I considered original in this context. I hope to have shown the value of this approach as a means for further prising open the subject with respect to substantive issues. This of course relates largely to its historical dimension in the British context – but the direction I have taken may also be deemed relevant as a perspective on the study of contemporary aquaculture practices as these grow in diversity as well as in terms of their social and economic prominence globally. With concerns around declining wild fish stocks and changes in the fishing industry, protein scarcity problems, population growth and climate change and the potential health and environment risks of intensive aquaculture when posed as a solution to these, I think it likely that the focus on social conflict and social order

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[55] John Davy, "Some Observations on the Ova of the Salmon, in Relation to the Distribution of Species," *Philosophical Transactions of the Royal Society of London* 146 (1856): 21–29; John Davy, *The Angler and His Friend; Or, Piscatory Colloquies* (London: Longman, Brown, Green, and Longmans, 1855), esp., 259. John Davy also discusses his brother Humphry's earlier theorisations on speciation in the *salmonidae*, in connection to the likes of Erasmus Darwin's and Lamarck's ideas. Also Hogg, *On the Distribution of Certain Species of Fresh-Water Fish; and on the Modes of Fecundating the Ova of the Salmonidae*. Sir James Maitland took his own work at the Howietoun Fishery as a site for conducting practical experiments connected to evolution, as well as opening them up to his friend the ichthyologist Francis Day to study the races and hybrids of the *salmonidae*, see eg., amongst many other articles on the same subject, Francis Day, "On Races and Hybrids among the Salmonidæ.—Part I," *Proceedings of the Zoological Society of London* 52, no. 1 (1884): 17–40 (continued over three successive numbers); "Hybridization among Salmonidae," *Nature* 31, no. 809 (April 30, 1885): 599–600; and James Maitland, "Fish Culture as an Exponent of Evolution," *Transactions of the Stirling Natural History and Antiquarian Society* 10 (1887): 40–48.

[56] However, see my attempt to describe the differentiation and development of the field in an analytical Social Worlds/Arenas map at Appendix 5.

may prove relevant to the study of the political relations of the technologies, industries and social worlds of aquaculture in recent and future decades.

In terms of the historiography of nineteenth century fish culture, my contribution fills a specific gap. This involves elucidation of key dynamics in earliest period of "modern" salmon culture in Britain, a subject dealt with to any extent only by Wilkins and Hill.[57] Wilkins however focused largely on Ireland, and mentioned the parr controversy and Stormontfield only briefly. Hill, for his part, studied very specifically the history of trout culture and the Howietoun Fishery from the early 1880s onwards, as well as the biography of its founder, James Maitland. Whilst helping to fill the gap between the two, it is important to note that my contribution in no way adds up to a comprehensive history of British fish culture in the 19th century. Some further notes on areas I have neglected, and which would be worth further investigation, seem requisite.

The first area is fish culture's close association with the acclimatization movement, especially in the early 1860s, as mentioned in Chapter 4. The rhetoric's of fish culture and acclimatization were interconnected, as were many aspects of their practice. Buckland's apparatus at Islington contained, he said, "fish of the world": fish naturalised in England, but originally taken from the Rhine, the Danube, Lake Geneva or the springs of the South of France. But accommodated as such, he claimed, they were now "civilised and tame".[58] Because the acclimatization movement, including its connections to colonialism, are generally well documented however, I took this as justification for not making it a central feature of the present narrative.

One aspect however deserves special mention because it was of lasting practical significance to the development of fish culture as a domestic industry. Efforts to acclimatize British trout and salmon in temperate climates around the world – especially in the Antipodes – not only garnered great publicity for fish culture, but contributed to the development of technical innovations in the transportation of fertilised ova over long distances using a variety of methods

[57] Hill, "Sir James Maitland and the Howietoun Fishery"; Wilkins, *Ponds, Passes, and Parcs: Aquaculture in Victorian Ireland*.
[58] Buckland, "Fish Hatching Apparatus at the Islington Dog Show," 123.

involving steam, moss, charcoal and other methods, including pioneering the use of ice to slow down the metabolism and therefore maturation or growth of the eggs. Not only does this provide a curious window into the "pre-history" of embryo transfers, but it also demonstrated the possibility of making the successful conveyance of these living organisms routine. Perhaps more than any other innovation in fish culture in the latter half of the century, technologies of transportation made it possible for fish culturalists to de-localise their operations from their immediate contexts[59], and turn the produce of artificial propagation into proper commodities.[60]

Technologies of transportation "disentangled" the produce of fish culture, "pacifying" the liveliness of the goods, and enabled the next major iteration of fish culture to take place.[61] From the mid-1870s, fish culture gradually developed into a niche, professional and market-oriented activity geared towards supplying live eggs and young fish to anglers, including individual proprietors but also the growing body angling clubs who collectively rented waters and sought to improve them through constant re-stocking. While Hill's study of Howietoun provides an important starting point, investigating this "market turn" in fish culture in more depth would be a clear next destination for a project such as this. Interesting questions would involve attempts to understand the interplay of developing technologies of transportation; the primitive forms of line breeding which now emerged; efforts to manage the seasonality of fish breeding as well as use of information and communications technologies (rail, post, telegram) in the context of the development of fish culture firms and their struggles to monopolise status positions on the emergent market, at the same as continuing to cultivate the kinds paternalistic and patriotic images of the sort suggested in Chapter 4.

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[59] C.f., Lien's approach in "'King of Fish' or 'Feral Peril': Tasmanian Atlantic Salmon and The Politics of Belonging."

[60] Connections with the concerns of theorists, and especially geographers, on commodification processes involving living organisms and/or "lively" capital and commodities becomes possible, see eg., Rosemary-Claire Collard and Jessica Dempsey, "Life for Sale? The Politics of Lively Commodities," *Environment and Planning A* 45 (2013): 2682–99; Scout Calvert, "Certified Angus, Certified Patriot: Breeding, Bodies, and Pedigree Practices," *Science as Culture* 22, no. 3 (2013): 291–313; also, Haraway, *When Species Meet* whose work has been central inspiration to these lines of enquiry.

[61] The quotes refer to Michel Callon's STS-derived sociology of markets, esp., Callon, "Introduction: The Embeddedness of Economic Markets in Economics"; Koray Çalışkan and Michel Callon, "Economization, Part 1: Shifting Attention from the Economy towards Processes of Economization," *Economy and Society* 38, no. 3 (2009): 369–98.

A key dimension to this turn is the shift away from the "unmanageable" salmon and towards its more tractable cousin the trout. Being sedentary, the trout could be made de facto private property in a way salmon – at this time – could not. And it could survive – if not always breed naturally – in still waters, making it a fit denizen of the many newly created municipal reservoirs near the great "industrial centres", the fisheries potential of which angling societies often came to control.[62] Amongst other things, these developments suggest the opportunity to re-think questions of property as processes of "propertisation" from the points of view of STS and economic sociology.[63] No longer envisaging property only as "social relations between persons with respect to things"[64], abstractly as "socially recognized economic rights"[65] or even as a historical-functional institutions (codified in law)[66] promoting economic development, we would be encouraged to explore also the possibility that the materiality of property effects the way it can be appropriated and hence held in practice, and the forms it thus takes.[67]

Another neglected aspect of the historiography of British fish culture in the nineteenth century concerns the role, or rather absence, of the so-called "coarse fish", and with them the neglect of what might be called "working class fish culture" in the developing fish culture arena. They became, in the vocabulary of social worlds/arenas analysis, "implicated" actors – silenced or present largely by

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[62] William Burgess, "Angling in Reservoirs," *Morning Post*, August 23, 1889.
[63] It is often remarked that economic sociology suffers from excessive attention to markets and neglect of questions of ownership or property, see eg., Davies, "Ways of Owning: Towards an Economic Sociology of Privatisation"; Richard Swedberg, "The Case for an Economic Sociology of Law," *Theory and Society* 32 (2003): 1–37. STS's recent interest in the materiality and performativity of markets has done little to correct this imbalance.
[64] Mark Busse, "Property," in *A Handbook of Economic Anthropology*, ed. James G Carrier (Cheltenham: Edward Elgar, 2012), 111.
[65] Bruce G Carruthers and Laura Ariovich, "The Sociology of Property Rights," *Annual Review of Sociology* 30 (2004): 23.
[66] Douglass C North, "Institutions," *Journal of Economic Perspectives* 5, no. 1 (1991): 97–112; For review, see Joshua Getzler, "Theories of Property and Economic Development," *The Journal of Interdisciplinary History* 26, no. 4 (1996): 639–69.
[67] A line of enquiry already undertaken by anthropologists interests in water ownship and fishing rights, eg., Monica Minnegal, and Peter Dwyer, "Appropriating Fish, Appropriating Fishermen: Tradable Permits, Natural Resources and Uncertainty," in *Ownership and Appropriation*, ed. Veronica Strang and Mark Busse (Oxford: Berg, 2011), 197–216; Veronica Strang, "Fluid Forms: Owning Water in Australia," in *Ownership and Appropriation*, ed. Veronica Strang and Mark Busse (Oxford: Berg, 2011), 171–96; For criticism of conventional approaches the property "rights" in social history, see Rosa Congost, "Property Rights and Historical Analysis: What Rights? What History?," *Past & Present* 181 (2003): 73–106; And for an arresting, and I think in this context congenial, re-interpretation of the so-called "labour" and "possession" theories of property, see Carol M Rose, *Property and Persuasion: Essays on the History, Theory and Rhetoric of Ownership* (Boulder, CO: Westview Press, 1994).

implication alone – in way that casts the presence of the more dominant piscine actors and their human social counterparts in the fish culture arena into relief.[68] The elite salmon dominated the early phases, to be supplanted by the aspirational trout. But with few exceptions did the century witness a return to the cultivation of the traditional pond fish. Reasons for this include British distaste for eating fish like carp, as well as the fact that these fish did not usually require artificial propagation to reproduce in captivity in the same way that the *salmonidae* did (as discussed in the introductory chapter). But these observations do not exhaust interest in the question, especially when we consider the extraordinary popularity of angling amongst the more humble, urban and working classes in late Victorian Britain, and their organisation into angling fraternities.[69] It is likely that these represented a large source of demand, if not necessarily profit, and there was regular agitation to supply new public waterways and canals (where trout and salmon would not thrive) with fish. Whereas the cry for salmon culture was typically "the food of the people", for coarse fishers, it was "the sport of the people". And some entrepreneurs, either seeing in this an opportunity to promote their businesses or out of a genuine sense of public spiritedness, may even have been inclined to responded favourably.[70] The most sustained campaign for coarse fish culture I know of however, which combined with an effort to rescue it from the social ignominy contained in the low status-signifying word "coarse", came from Robert Marston, editor of the weekly *Fishing Gazette.* While always and characteristically professing to prefer high status fly-fishing himself, Marston rallied vigorously behind the idea that the country needed more coarse fish, and in this he was supported by many angling societies who pledged support to the cause.[71] In 1884, Marston sought to get the ill-fated and short-lived National Fish

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[68] Adele E Clarke and Theresa Montini, "The Many Faces of RU486: Tales of Situated Knowledges and Technological Contestations," *Science, Technology & Human Values* 13, no. 1 (1993): 42–78.
[69] See Lowerson's fascinating account in Lowerson, "Brothers of the Angle: Coarse Fishing and English Working-Class Culture, 1850-1914."
[70] See eg., William Burgess, "Stocking Public Waters," *Morning Post*, July 9, 1888. On Burgess supposed willingness to breed and distribute coarse fish for the public good, see Templar, "Waltoniana," *The Fishing Gazette*, June 30, 1888.
[71] Robert B Marston, "The Propagation of Coarse Fish," *The Fishing Gazette: Devoted to Angling, River, Lake & Sea Fishing and Fish Culture*, August 5, 1882; *Coarse Fish Culture* (London: William Clowes & Sons, 1883); "Coarse Fish Culture," *The Fishing Gazette*, December 17, 1881; "Correspondence," *The Fishing Gazette*, November 26, 1881; also, T Crumplen, "The Cultivation of Coarse Fish," *The Fishing Gazette*, November 12, 1881; William Oldham Chambers, "Coarse Fish Culture," *The Fishing Gazette*, December 3, 1881; Harrington John Keene, "Some Notes on Coarse-Fish Culture. No. II," *The Fishing Gazette*, December 31, 1881.

Culture Association to support him by appealing to the self-interest of the organisations' Board: since coarse fishers represented, according to Marston, "by far the largest portion of the angling community", the only way to get this constituency to support the activities of the organisation was through the breeding and distribution of these fish.[72] Unfortunately, little more is known about these events at the present time. But, once again, the intertwining of questions of species and technique with the politics of status, class and markets, in the context of the broader economic and demographic situation, make these developments a natural place to continue the kinds of investigation begun in this dissertation.

The final area that I believe deserves additional special attention concerns the need for a thoroughgoing comparative analysis of the development of fish culture in Britain and other countries, especially France, in the early part of the period, and the USA in the latter.[73] As I have alluded to previously, the obvious immediate divergence lies the asymmetrical role of the state, which was much more activist on both the continent and in North America than in Britain. A comparative methodology might reveal a range of insights into the different kinds of institutionalisation fish culture underwent. Comparing the American Fish-Culturalists Association (AFCA) to the National Fish Culture Association of Great Britain (NFCA) is a case in point: whereas the AFCA began as a "protective organisation" formed by professional trout culturalists intended to function as a mechanism to check the fall of prices in trout ova,[74] the NFCA explicitly sought – under suspicion, no doubt – to distance itself from commercial interests, to show it represented no competition to the professionals, but rather had only the wider interests of the public and the development of the science at heart. The AFCA went from strength to strength, and overcame its narrow origins and sought to direct its future efforts "to promotion of the public good rather than to the furtherance of

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[72] "Important Offer Made by the Fish Culture Association," *The Fishing Gazette*, September 27, 1884, 153.

[73] See Kinsey, "'Seeding the Water as the Earth': The Epicentre and Peripheries of a Western Aquacultural Revolution."

[74] Frederick Mather, "Recollections of the Early Days of the American Fish Cultural Association, with an Account of the Intentions of Its Founders," *Transactions of the American Fish Cultural Association* 8, no. 1 (1879): 56; also, Eugene G. Blackford, "Opening Remarks of the Chairman of the Fish-Cultural Section of the Fisheries Congress," in *Bulletin of the United States Fish Commission*, vol. 13 (Washington: Government Printing Office, 1894), 191.

private individuals"[75], and had transformed itself into the American Fisheries Society by the 1880s (an organisation, with a powerful lobbying function, that is still very much with us today). But its British counterpart fell almost immediately into financial hard times.[76] It was a source of comic entertainment to some[77], and was torn asunder by infighting, often between those who appear to have conceived of it as basically another angling club and those who wished it to be a genuine scientific and national body supporting all fisheries related causes.[78] Its peculiar constitution, a mixture of anglers of different persuasions, professional trout culturalists, the scientifically minded, aristocratic patrons and concerned politicians could not hold it together, and it was dead in less than a decade. The histories of these two organisations might make an interesting case study for scholars interested in the comparative analysis of the development of institutions in relation to "national cultures" and policy environments.

5.3 Final reflections

"Woe to details! Posterity neglects them all; they are a kind of vermin that undermines large works".[79] Voltaire no doubt had his reasons when he wrote these words, and it can be conceded excessive interest in details can detract from the force of historical narrative, and tend towards antiquarianism. But I nevertheless believe that some sense of the details is also crucial to the writing history, and should not be sacrificed to theoretical ambitions. I have in the previous sections laboured, perhaps overly so, various lines of empirical enquiry

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[75] Mather, "Recollections of the Early Days of the American Fish Cultural Association, with an Account of the Intentions of Its Founders," 59.
[76] It's Report for the years the 1885-86 begged for the introduction of New Members, whilst a letter from its President, the Marquis of Exeter to one its Vice Presidents, the Lord Walsingham, reveals its parlous state and reliance of donations, (NRO), WLS/LX/79.430X3. (Exeter's letter is interleaved with the Annual report and not individually catalogued).
[77] *Fun* satirised the Society, taking especial delight in supposed experiments conducted by its secretary to revivify carp with brandy: "although the poor fish was all the better for his dram, many extreme teetotallers are carping at the notion", "Fun," *Fun*, October 29, 1884, 189; also, "By All Means," *Punch*, November 22, 1884.
[78] For instance, Sir James Maitland, the professional trout culturalist, the Society's first Chairman resigned in objection to some unknown misdemeanour of conduct by Marston's, USA, MS 40 Vol. 48 (i) "The Howietoun Letter Books", letter 217, 9 January 1884, p. 442. When a new society, *The Society for Experimental Fish Culture,* arose in 1899 under the guidance of Marston and Chambers, the *Daily Mail* was quite clear that it was hoping to avoid the fate of its predecessor which had fallen apart under the weight of its contradictions: was it as a commercial adjunct, for anglers, or for the good of humanity? "Economic Fish-Culture," *Daily Mail*, December 13, 1899.
[79] Voltaire, "Letter to Abbé Baptiste Dubos [October 30, 1738]," in *The Varieties of History: From Voltaire to the Present*, ed. Fritz Stern (Cleveland: Meridian Books, 1956), 39.

that have been largely left out of my report. This of course invites scrutiny, but it should also sharpen the sense of what my major foci and possible contributions have been. Pointing out gaps and future opportunities is not only valuable by itself, but it helps to reveal what kinds of selection of material and cases have necessarily taken place in the construction of the narrative, and in this sense is methodologically useful.

Details thus matter to me here, as they have throughout this dissertation. This points more deeply towards the essential mood, stylistic and methodological, that I have attempted to cultivate throughout – as well as the tensions this creates. I have on the one hand written as a social historian, and aspired to create a work that may hope to pass muster as a piece of historical scholarship. On the other hand, I have tried to write as a sociologist indebted to science and technology studies (STS). The latter often urges itself as a theoretically modest, empirical discipline based on the accumulation of case studies, and one might expect this outlook to sit well with the historical vision. But, in my view, it also often does not: history rather gets treated as a source of material for the illustration and development of specific theories. I am aware that this mixture of ambitions may have harmed all of them, demanding inevitable compromises between the generalising tendencies in social theory, the historian's habitual concern for the specificities of location, motivations and biographies of people and events, as well as more specific if various predilections and programmatic outlooks characteristic of STS (like actor-network theory). I hope, at any event, that these tensions have proven more productive than distracting.

I emphasised sociality in a more conventional way than many in STS might have done. I also accepted the constructed provisionality of the "the social", whilst arguing that this is not necessarily contradicted, despite the risk of reification or the mistaking of models for things, when one mobilises social abstractions as hypothesis. Accounts involving conceptions of status are examples of this. Even so, I would remain disinclined to explain anything as an "effect" of very general conceptions of social historical processes or abstract forms, such as "the Industrial Revolution" or, what is of relevance to contemporary aquaculture, the "Green" and

"Blue" revolutions.[80] It is characteristic of STS, especially in its post-constructive forms, to reconfigure the explanation as the explanandum. I think my approach to social order reflected this in some ways, if not always consistently: by posing it as a problem, it precisely does not assume that human tend to get along in neatly integrated societies, but that these are rather accomplishments, require work, and are continually prone to breakdown. It is what needs to be explained. Furthermore, I would resist the reading which finds that viewing fish culture in terms of a "pre-history" of modern reproduction must inevitably view it as an instantiation of an assumed context; or to the extent that we allowed that fish culturalists saw their work as an embodiment of a certain periodical spirit, we are therefore explaining it as an effect of an "Age of Improvement", "Mechanism" or "Progress". Fish culture has thus been more of a site through which to tell the story of certain particulars and practices that contributed to what is collectively summarised in abstractions such as the "modernization in Britain". At the same time, if there is to be any movement beyond the description of emergent assemblages towards explanations for their emergence, there needs to be a time when the process of incessantly transforming explanations into that which needs to be explained is cut – however arbitrarily this point is arrived at. Some points need to be held stable for others to be adequately inspected. Thus we may find ourselves, even as co-productionists, wishing to shuttle nimbly between content and context rather than dogmatically assert an indistinction between them as a starting point, and in this way collapse an ontological assumption about the agencies that compose the world with a methodological prerogative.

[80] Eg., Barry A Costa-Pierce, ed., *Ecological Aquaculture: The Evolution of the Blue Revolution* (Oxford: Blackwell, 2002); "Fish Farming: The Promise of a Blue Revolution," *The Economist*, August 7, 2003, http://www.economist.com/node/1974103.

Appendices

Appendix 1: Electronic databases and printed sources

Full-text or keyword searchable digital databases have altered what is possible in historical research and changed the way it is done. Electronic databases, including both databases containing single titles and platforms allowing cross searching over multiple titles have been crucial to my research. They comprise an easy-to-access repository for relevant publications and other materials, and offer a means of resource discovery and exploration. Often, using them merely saves in purchase costs or visits to the library; on other occasions they represent a source of unique opportunity, but also potential danger.

Key word searches, especially across multi-publication platforms, have been of great value in identifying new sources. However, the risk of this strategy is that individual articles can become decontextualised. Effort must therefore be made in recontextualising published sources in terms of the information ecology of which they were originally a part. It can therefore be valuable therefore to return the article to its original context, using contents pages or indexes where available. Highly systematic searches, rather than exploratory forays, using variant spellings of key words, are also necessary.

It is also possible that the existence of digitised sources, because of the facility they offer, can fundamentally skew a sample. A great many potentially important sources are not digitised, and judgements need to be made about whether it is necessary to address these manually and individually (page-by-page or where possible using indexes) in order to be more representative.

Some typical operations suggesting my *modis operandi* might be as follows. I discover a reference to an article by author X in *The Gentleman's Magazine*. If included in a digital database (eg., Proquest's British Periodicals), I locate the issue or volume. I browse briefly the contents page (if there is one) looking for similar articles or familiar names. Then I download or read the relevant article online. I might at that point decide that, since *The Gentleman's Magazine* contained this article, it might contain similar articles. Then, depending on factors such the time period during which the periodical was published or its regional location, I might devise a set of key word searches appropriate to it. Another approach, applicable to large multi-title databases, is to pick broadly applicable key words and search across the entire database. This is extremely useful for resource discovery, for instance, finding out about a periodical containing that regularly published on related themes. Thereafter, those periodicals can be studied in a more in-depth fashion. In some cases, such as *The Field* magazine, there is no better way except to sit in the library archives department pouring over page after page. I have used digitised newspaper collections in much the same way as magazines, especially where collections of newspapers are held together and are jointly searchable.

The list of databases below is representative of collections and databases used.

Digitised sources for newspapers

The British Newspaper Archive: (http://www.britishnewspaperarchive.co.uk/)
- A proprietary resource housing a total of 260 local and national newspapers, from 1710 to 1959. Being searchable by location makes it a key resource for regional news. A product of brightsolid Newspaper Archive Limited and the British Library.

19th Century British Newspapers: (http://gdc.gale.com/index.php?id=116)
- Contains 48 newspapers titles selected to ensure the widest possible coverage of UK during the nineteenth century, including national and regional papers, and according to other criteria such as influence of editorials. Overlaps considerably with The British Newspaper Archive. A product of Gale Digital Collections and the British Library.

The Times Digital Archive, 1785-2006:
(http://gdc.gale.com/products/the-times-digital-archive-1785-1985/)
- A product of Gale Digital Collections.

Sunday Times Digital Archive, 1822-2000:
(http://gdc.gale.com/index.php?id=3153). A product of Gale Digital Collections

Financial Times Historical Archive, 1888 – 2007:
(http://gdc.gale.com/index.php?id=204)
- A product of Gale Digital Collections

Digitised sources for periodicals

19th Century UK Periodicals: (http://gdc.gale.com/index.php?id=160)
- An important resource for nineteenth century periodicals with over 90 unique titles. Especially important for its inclusion of a large range of sporting magazines, such as *Bell's Life, Sporting Gazette* and *Fishing Gazette* – all important titles for commentary on fish culture and fish-related themes. A product of Gale Digital Collections and the British Library.

British Periodicals and Periodicals Archive Online:
(http://www.proquest.com/products-services/british_periodicals.html ;
http://www.proquest.com/products-services/periodicals_archive.html)
Searchable together. British Periodicals houses full text articles from over 400 journals, including titles such as *Quarterly Review, Blackwood's Magazine, The Cornhill Magazine, Journal for the Society of Arts, Once a Week and The Gentleman's Magazine*, and many more titles containing articles relevant to fish culture. Both products of ProQuest LLC.

Illustrated London News Historical Archive, 1843 – 2003:
(http://gdc.gale.com/index.php?id=138) A product of Gale Digital Collections

Other full-text and image databases

The Internet Archive: (https://archive.org/) A non-profit open-access initiative archiving historical collections that exist in digital format; sourced from libraries multiple libraries, incorporating, amongst others, American Libraries, Canadian Libraries, Project Gutenberg and The Biodiversity Heritage Library. An essential resource for historical studies of science, nature and ecology amongst other subject areas, includes a large number of out-of-copyright books and pamphlets of relevance to this dissertation.

Google Books: (http://books.google.co.uk/). Contains many out of copyright full-text books, periodicals, etc. (Content overlaps considerably with *The Internet Archive.*)

19th & Early 20th Century U.S. Marine Ecology & Fisheries Research Reports: (http://www.penbay.org/history.html). Includes digitised copies of the Bulletins of the US Fish Commission (1881 – 1901) and Annual Reports of the US Fish Commission (1871 – 1903). Available courtesy of Penobscot Bay Watch and Bangor Public Library, the Library of Congress, and the libraries of the University of Maine Darling Marine Center and the Maine Department of Marine Resources Laboratory.

Freshwater and Marine Image Bank: (http://content.lib.washington.edu/fishweb/index.html). A bank of historical images relating to freshwater and marine topics, including numerous images related to fish culture. All images are in the public domain. A University of Washington Library Digital Collection.

House of Commons Parliamentary Papers: (http://parlipapers.chadwyck.co.uk/). The primary full text source for papers relating the British parliament. Includes House of Commons papers, Bills, Command papers and other Reports, as well as full Hansard text of official debates in both Houses of Parliament, from 1803 to 2005. A product of ProQuest LLC in association with the Board of British Library, the Controller HSMO, and various University libraries.

Appendix 2: Notes on archives and manuscript sources

There are few archival sources dedicated solely to nineteenth century fish culture. However, a range of relevant manuscript materials have been cited in this dissertation, and a larger amount of material, in a variety of institutional locations, has been reviewed or studied during the research, but not cited in the final manuscript. After reviewing available registers of materials and assessing them for likely relevance, a small number of sources of potential relevance were also excluded from analysis on pragmatic grounds, mainly that the likelihood of them containing relevant documents were small in comparison to the difficulties of procuring access for partially catalogued and potentially poorly preserved papers. A number of sources are also recorded here because of their relevance to future work on British fish culture.

Papers relating to Sir William Jardine and circle

Natural History Museum (NHM), London: Zoology Library: (Z 88.q.JAR) Folder of notes on fishes and fishing, proof sheets and miscellanea, including original watercolours by Jardine and Jonathan Couch; material not used in Jardine's British Salmonidae; letters from John Gould; (Z 22.o.JAR) Copy of Report of the committee upon the experiments conducted at Stormontfield and a letter from Jardine to Owen Wilson. Also, NHM General Library: (MSS JAR) Autograph correspondence from 1852; 66 letters.

Cambridge University Library Archives (CUL), Cambridge: (Alfred Newton Papers, 'Jardine Correspondence', MS Add. 9839/13) Covering dates 1824-1897, 324 letters and papers in total. Relevant letters include: one letter each from Fleming and Parnell and two letters from Yarrell, amongst correspondence from many other sources.

National Records of Scotland (NRS), Edinburgh: (GD 472) Includes miscellaneous papers and correspondence on natural history, mainly unrelated to ichthyology.

National Library of Scotland (NLS), Edinburgh: (MS.109.7 ff 131 – 137) Four letters relating to natural history topics, including one from James Wilson.

National Museums of Scotland (NMS), Edinburgh: (Harvie-Brown Collection, 'The Jardine Papers', GB 587 WJ) Large collection of letters, mainly from other naturalists, received by Jardine. These letters include 33 sheets from Richard Parnell; One sheet from Couch; five sheets from John Shaw; eight sheets from Leonard Jenyns; five sheets from Robert Hamilton; two sheets from Sarah Lee (née Wallis, other married name Bowdich); three sheets from James Wilson; fifteen sheets from William Yarrell. The papers relating to Jardine at NMS have been comprehensively catalogued by Joy Pitman (069.09411 RSM 1981 [Royal Scottish Museums call number]).

Edinburgh University Library Archives (UEA), Edinburgh: (DK 6.20-21) Includes correspondence (1828-61) from naturalists, including John Fleming and Richard

Parnell. Also containing correspondence referring to the public affairs of Dr Robert Knox in Edinburgh.

Princeton University Library Special Collections (UPSC), Princeton: ('William Yarrell Collection' CO603) Does not include any letters from key protagonists including Jardine, Wilson, Parnell and Shaw (searched with the assistance of the archivist). Mainly ornithological, relevant material includes two watercolours of trout and salmon.

University of Glasgow Special Collections (UGSC), Glasgow: (GB 2047 f66-69) 4 Letters from Prideaux John Selby to George T Fox, mainly ornithological. One letter contains a relevant mention to William Jardine and the identification of the parr.

(Archives connected to Jardine and other relevant naturalists generally are held in a large number of additional locations as well. A comprehensive catalogue of Jardine-related archives can be found in Jackson and Davis (2001), Leicester University Press. Jackson's work on Selby (1992), Spreddon Press is also essential.)

Papers relating to John Shaw and the Drumlanrig Estate

National Records of Scotland (NRS), Edinburgh: ('The Buccleuch Papers', GD224) Consists of a very large collection relating to the affairs of the Buccleuch family and their estates. The Game Books from Drumlanrig confirm John Shaw as head keeper and slayer of a very great deal of pheasants, etc., but contain little other relevant material. Unfortunately, the items which would appear to be of most relevant to Drumlanrig Castle and estate during the relevant period, and therefore potentially related to the work of John Shaw, have been recalled by the copyright owner and are hence no longer publically available.

Papers relating to fish culture at Stormontfield and fisheries proprietors on the River Tay

Perth and Kinross County Archives (PKCA), Perth: As a Proprietor of salmon fishing's on the River Tay, the Burgh of Perth subscribed to the Stormontfield fish culture scheme. The Minutes of the Town Council (esp., PE 1/1/13 and PE 1/1/14) provide a manuscript record of the activities at Stormontfield in the relevant period, (c. 1853 – 1859); some other documents relating to the legal position and financial relationship of the Burgh to the scheme.

(The archive also contains some papers connected to other Tay river proprietors, including the Glover Incorporation Papers and the Malloch and Hay of Seggieden Papers. These mostly relate periods other than those under investigation in this dissertation.)

Tay District Salmon Fisheries Board Papers (TDSFB), Perth:

Privately held papers connected to the Tay District Salmon Fisheries Board. Papers relating to 19th century, and which may be relevant to Stormontfield and the Tay salmon fisheries, are believed to exist in this collection.

(Access was not successfully negotiated to view these papers. Many are believed to be lost, damaged and uncatalogued. Personal correspondence with representatives of the Board made it clear that providing access to them would require too much

work for the staff at the present time, and was unwelcome. The unavailability of these papers during the period this dissertation was in progress constitutes a serious loss, even though it is not clear to what extent they would have been useful, especially for the period prior to 1863. Iain Robertson had extensive access to them for his Doctoral research [PhD Thesis, University of Stirling, 1989].)

National Records of Scotland (NRS), Edinburgh: ('Family Mackintosh Papers' GD176) Includes some letters relevant to Stormontfield and fish culture, including one letter from Peter Marshal (1869) at Stormontfield and another from Frank Buckland (1870) (GD176/1610); ("Campbell Family, Earls of Breadalbane" GD112) Includes writs, legal papers, rentals, accounts, estate correspondence and papers and Campbell family papers, 14th-20th century; ("Menzies Family, baronets, of Castle Menzies" GD247, GD50/130-48, 186) Includes legal and estates papers, deeds, family paper etc, 15th-19th century.

National Library of Scotland (NLS), Edinburgh: ('Murray-Stewart Family, Dukes of Atholl' Dep.301/23-82) Includes estate accounts and letterbooks, 1818 – 1868; ('Menzies Family, baronets, of Castle Menzies' MS.9941-9981, MSS 2681, Ch 8925-46, 10634-47) Includes family, household papers, and legal-financial papers, 1658 – 1927, 1690 – 1905, 1541 – 1868.

(The Estate and related papers of landed families owning fishing property during the nineteenth century in Scotland are often very large and scattered across multiple locations. In the cases of the families Menzies, Atholl and Breadelbane, I have only described some locations of potential relevance. However, it is likely only a small amount of material at these locations is related to salmon fishing, and correspondingly, there is an even smaller likelihood that these contain any material connected Stormontfield or salmon breeding [trifling concerns in the context of the affairs of such estates]. Various records related to Scottish landed proprietors of this sort are also privately held and not ordinarily available to the public, although recorded in National Register of Archives for Scotland (NRAS). For instance, the Atholl estate papers at Blair Castle (NRAS 234). The NRAS also records a small number of other private papers relating to salmon fishing on the Tay such as in the Hay of Leys Papers regarding the estates of Carpow and Mugdrum during the nineteenth century and held privately by solicitors in Perth, (NRAS 1489). These are examples of material I decided for pragmatic reasons not to pursue in depth here. Further specialist research might benefit from this however. Robertson's PhD Thesis [University of Stirling, 1989] provides the definitive account of Tay fisheries proprietors during the nineteenth century and includes a useful bibliography of other archival sources.)

Papers relating to Francis (Frank) Buckland and the Museum of Economic Fish Culture

Royal College of Surgeons (RCS), London: (MS0035 Vol 1 and 2) The Commonplace Books of Frank Buckland, including records of his life and work as recorded by himself. Includes press cuttings and lecture flyers of his work related to the fisheries and fish culture.

The National Archives (NA), Kew: Papers relating to Buckland's Museum of Economic Fish Culture at South Kensington created or inherited by the Department of Education and Science including ED 23/66, Hire of the Buckland

Collection of Fish, 1872; Ed 23/68, Professor Huxley asked to act as special referee for the collection, 1881.

Scottish Fisheries Museum (SFM), Anstruther: The SFM collection contains what remains of the material from Buckland's original Museum of Economic Fish Culture. This includes mainly casts of various kinds of fish, a bust of Buckland and some metal traps, hooks, harpoons etc., but no apparatus relating to the culture or acclimatization of salmon or trout. The Museum also owns keeps some resources relating to the Buckland Collection and Frank Buckland's work. Moreover, it is base of the Buckland Foundation, an organisation founded by Buckland in order to promote fisheries research (see http://www.scotfishmuseum.org/the-buckland-foundation). The archival material (two uncatalogued boxes) includes a small amount of printed material, some original and facsimile letters, press cuttings and other miscellanea; also, various legal and personal documents relating to Buckland's life and family. Much of this material was received from George Burgess who gathered it in the process of writing his biography of Buckland, which was originally commissioned by the Buckland Foundation. See Burgess *The Curious World of Frank Buckland* (1967), John Baker.

Zoological Society of London (ZSL), London: The Collection 19th Century letters to the secretary (B) Contains letters to the society Secretary from Frank Buckland (GB 0814 BADB); Papers of the Buckland Family (GB 0814 ZCAB) contains some letters of Frank Buckland including correspondence relating the Berlin Fisheries Exhibition of 1880; Letters from Frank Buckland to Prince Christian of Schleswig Holstein, 1869-1879 (GB 0814 ZCAA), including some reference to fish and Buckland's Museum.

Science Museum Library (SML), Swindon: (MS 1047) A letter from Buckland to K.R. Cook on how to procure the spawn of carp (1863)

Papers relating to the Howietoun Fishery and Sir James Maitland (4th Baronet of Clifton)

University of Stirling Archives (USA), Stirling: ("The Howietoun Fisheries Archive", GB 0559/MS 40) The most comprehensive extant archival resource relating a nineteenth century British fish culture institution. Maitland's original operation became the Howietoun and Northern Fisheries Company in 1914. In 1979 it was bought by the University of Stirling and still operates as a commercial fishery and site for scientific research. The Howietoun archive includes: Company minutes, 1915-47; letter books, 1880-1957; business correspondence, 1919-1958; accounts including company ledgers, company and customer account books, share ledger, cashbooks, 1874-1973. Notebooks on fish dispatch and general pisciculture, 1873-1926; essay on salmon disease, 1881; tabular accounts of spawning, 1882-1887; order books, 1903-1978; trout sales, 1916-1972; notes and reports on fish stocks, 1927-1946; notes on weather conditions, 1952-1967. Photographs, c.1870-1983. (The University Archives have made available many images of Howietoun available via Flickr, see: https://www.flickr.com/photos/40937572@N08/sets/72157633228556070/with/8642834428/).

National Records for Scotland (NRS), Edinburgh: ("Steel-Maitland Collection" GD193) Includes a Commonplace book (/1129) consisting mainly of press cuttings relating to fish and fish culture, particularly of press coverage relating the

Howietoun Fishery and the business affairs of Maitland; also includes samples of price lists from Howietoun in different years, copies of advertisements from various newspapers and magazines of Howietoun, and advertisements and price lists of competitor fish culture institutions; (/1127) Howietoun Cash Book (1879-1886); (/1128) Fragment of Howietoun Ledger (1879-1893); (/69/1) Howietoun Diploma's for prizes won at the National Fisheries Exhibition (Norwich 1882) and the International Fisheries Exhibition (London, 1883).

(Both of these locations contain sources that represent valuable evidence and information for future researchers in the history of aquaculture in Britain during the nineteenth century, although they refer largely to events outside of the period considered in this dissertation. Hill's PhD Thesis [University of Stirling 1995] already made considerable use of them.)

Papers relating to Francis Francis and the protection of fishing on the Thames

London Metropolitan Archives (LMA), London: (LMA/4601) Account book of the Thames Rights Defence Association (founded by Francis Francis), 1881 – 1883.

The British Library (BL), London: (MS 57938 f112, Vol. V. 1864-1886) One letter from Francis Francis.

Papers relating to the International Fisheries Exhibition (London 1883)

The National Archives (NA), Kew: Various papers relating to the official business of the Exhibition from a different government departs including: Treasury (T 1/13754 Arrangements); Home Office (HO 45/9613/A8580 Appointment of Commissioners; HO 45/9613/A8580B Payment for Police Services); Foreign and Commonwealth Office (FO 83/798 General correspondence respecting); Lord Chamberlain's Department and Offices of the Royal Household (LC 5/259) Programmes, memoranda and other miscellaneous papers); Royal Mint (MINT 16.25; MINT 16/24 Papers relating to the striking and awarding of Gold Medals, diplomas etc.).

(The Exhibition, one of a number of its kind, was landmark in the history of the British fisheries generally, and included input from a number of prominent fish culturalists, fisheries commentators and was connected to the National Fish Culture Association. Of general contextual importance but little direct relevance to this dissertation because falling outside of the timeframe considered.)

Papers relating to the National Fish Culture Association

Natural History Museum (NHM), London: (DF ZOO/200/25/56-60, 26/68-70, 27/49, 28/57-61, 29/55-59, 30/86-88) Letters and postcards sent by Secretary of the Association Oldham Chambers to A Günther of the British Museum. (1884 – 1886)

Norfolk Record Office (NRO), Norwich: (Walsingham (Merton) Collection, WLS/LX/79/430 x 3) Annual Report of the Association 1885-86 and enclosed letter related to marine fish culture from the Society's President to Lord Walsingham.

(The National Fish Culture Association, despite its name, was a short-lived and generally unsuccessful organisation, circa. 1883 – 1887. I studied all known archival sources connected to it. However, the most part its influence falls outside of the period considered here.)

Appendix 3: Some biographical notes and notables

In these sketches I provide some background information on a few of the most interesting and important human actors to our story. I focus on actors and their who are not extensively discussed in the chapters. To do so I have drawn on my own research, knowledge and secondary reading. Most of these characters were famous for reasons other than, or in addition too, their involvement in fish culture or other issues discussed in this dissertation, and consequently information about their lives is available. I give *Dictionary of National Biography* references where possible. Full details of additional biographical treatments, when cited her and in the main text, are available in the bibliography, as are the full details of British Parliamentary Papers (PPs, UK) here cited here.

Ashworth, Edmund (1800–1881), cotton manufacturer, free-trade activist and salmon culturalist, of Lancashire. With his better-known brother Henry, Edmund was a prominent campaigner, a founder of the Anti-Corn Law League and associate of Cobden, and member of the Manchester chamber of commerce. With his other brother Thomas, Edmund became an important source of commentary and innovation in salmon culture, employing Ramsbottom, establishing a hatchery in Galway, assisting in the foundation of Stormontfield, as well as being involved with a number other salmon-related projects and publications. The Ashworth brothers' works in fish culture are discussed in detail by Wilkins (Dublin, Glendale, 1989).

See A. J. Gritt, 'Ashworth, Edmund (1800–1881)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/42009, accessed 1 Sept 2015]

Barclay, Hugh (1799–1884), judge and commentator on Scottish jurisprudence. Barclay served as Sherriff-Substitute on a number of "parr trials" in the Perth and Dunblane districts. He wrote variously on issues of jurisprudence, including publishing a pamphlet on the *Curiosities of the Game Laws* (Glasgow, T. Murray & Son, 1864). Notably, he claimed, before a Select Committee appointed to enquire into the Game Laws, to have some sympathy for rustics in respect to these laws, see PP, UK 1873 (285). A biographical treatment described Barclay as having "little sympathy with the influence of what the politician calls political privileges, he believed that the condition of the great mass of the people, if it could be permanently elevated at all, would be by a general diffusion of knowledge" (Anon., *Sheriff Barclay: Narrative of his Public Life,* Edinburgh, J. Menzies & Co., 1884, 15.)

See T. F. Henderson, 'Barclay, Hugh (1799–1884)', rev. Eric Metcalfe, Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/1341, accessed 20 Aug 2014].

Brewster, Sir David, (1781–1868), Natural philosopher and academic administrator, Edinburgh. Editor of important publishing ventures, at different times, including the *Encyclopaedia Britannica*, *The Edinburgh Philosophical Journal* and *Edinburgh Journal of Science*, as well as founding member of the British Association for the Advancement of Science (made President in 1850), and President of the Royal Society of Edinburgh (1864–68). Such society brought him in contact with many scientific contributors to debates about ichthyology.

Brewster's only contribution to the parr controversy was being requested by Scrope make a comparative analysis of the crystalline structure of the eye of parr and salmon. Brewster was also on close terms with James Hogg.

See A. D. Morrison-Low, 'Brewster, Sir David (1781–1868)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, Jan 2014 [http://www.oxforddnb.com/view/article/3371, accessed 18 Aug 2014]

Buckland, Francis Trevelyan (1826–1880), popular naturalist and writer. Known as Frank, Buckland was the son of geologist William Buckland (1784 - 1856). He became one of Britain's most famous and charismatic popular naturalists and lecturers, well loved for his series *Curiosities of Natural History* (from 1858) particularly. Buckland was especially known for his eccentric methods and interests, including "zoophagy", and his love of exotic pets. His lasting contribution however lies in his unparalleled commitment to fish culture and British fisheries in general. Writing for *The Field* and as founding member of Acclimatisation Society, he was closely connected to Francis Francis; in 1865, he founded *Land and Water* with William Ffennell as an "independent channel for diffusing knowledge of practical natural history, and fish and oyster culture". He also wrote numerous articles and books popularising the subject, and established a Museum of Economic Fish Culture in South Kensington in the mid-1860s. Buckland became a Government Inspector of Salmon fisheries in 1867, succeeding Ffennell, and contributed to a number of additional government Enquires and Reports related to the fisheries, including on salmon in Scotland, the Norfolk fisheries, as well as herring, crab and lobster fisheries. At his death, a sum of money from his estate was bequeathed to the nation, out which was born the Buckland Foundation, an organisation supporting contemporary fisheries research. The Foundation's registered address is the Scottish Fisheries Museum, Anstruther, which also houses the remains of his Museum, most of which had become lost or dilapidated by the end of the nineteenth century. Buckland is the subject of one book length modern biography, Burgess (T. Baker, London, 1967) as well as various articles by academic historians.

M. G. Watkins, 'Buckland, Francis Trevelyan (1826–1880)', rev. Giles Hudson, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/3857, accessed 1 Sept 2015]

Couch, Jonathan, (1789–1870), physician and ichthyologist, of Cornwall. Correspondent of Yarrell and Jardine, assisting them in their investigations into salmonidae in the 1830s. His major work on fishes appeared between 1862-5, entitled *A History of the Fishes of British Islands* (4 vols). Wheeler comments that, while competent as regards fish of the Channel, "his knowledge of the fishes of the northern fauna and particularly freshwaters was less certain". He was accused by Albert Günther of the British Museum of reopening the parr controversy in 1865, when he declared it not proven that the parr did not exist as a distinct species, and that the designation of *Salmo salmulus* should therefore stand despite experiments suggesting the contrary.

See: Alwyne Wheeler, 'Couch, Jonathan (1789–1870)', Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/6435, accessed 17 Aug 2014]

Davy, Sir Humphry, (1778–1829), baronet, chemist and inventor; immanent member of the Royal Institution, and later President of the Royal Society of London

(1820 – 1829). Davy was perhaps the most influential British scientist of his day. He was also a keen angler and interested in natural history. He was on intimate terms with Scott and James Hogg, and probably knew Brewster. Although little is know of them, it is believed he conducted experiments in the artificial breeding of fish with his scientific friends in the early 1820s, making him one of the first to do so in Britain. Davy contributed evidence to the Select Committee on the salmon fisheries of the United Kingdom in 1824, citing Jacobi's experiments, see PP, UK, 1824 (427). He wrote of his knowledge of these techniques in his book *Salmonia: Or, Days of Fly-Fishing* (John Murray, London, 1828). In this work, he suggested that artificial fecundation could be used to help resolve vexing questions in the species relations of the salmonidae.

See David Knight, 'Davy, Sir Humphry, baronet (1778–1829)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, Jan 2011 [http://www.oxforddnb.com/view/article/7314, accessed 18 Aug 2014]; And Robert Hunt, 'Davy, John (1790–1868)', rev. Michael Bevan, Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/7317, accessed 18 Aug 2014]

Davy, John, (1790 –1868), physiologist and anatomist, brother of Humphry Davy. Davy published voluminously on anatomical and medical issues, including in the *Transactions of the Royal Society.* He discussed, amongst other subjects, fish physiology and issues connected to fertilization and incubation in fish and other animals. He performed experiments on the resilience of trout ova at the request of Charles Darwin, as well as commented on the parr controversy and related problems of salmon natural history. Like his brother, Davy was a passionate angler.

See Robert Hunt, 'Davy, John (1790–1868)', rev. Michael Bevan, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/7317, accessed 1 Sept 2015]

Esdaile, James, (1808–1859), East India Company surgeon, mesmerist and ex-student of Dr Knox; instrumental in encouraging the introduction of artificial fish culture to Scotland at Stormontfield. It is believed that James Esdaile was a relation of David Esdaile (pseudonym: "A Rural D.D."), a regular writer about salmon, fish culture and food supply crisis.

Waltraud Ernst, 'Esdaile, James (1808–1859)', Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/8882, accessed 20 Aug 2014]

Ffennell, William Joshua (1799–1867), fisheries inspector and administrator, Ireland and United Kingdom. Ffennell rose to prominence as a salmon conservator in Ireland, where he was assisted in the passage of a number of crucial Acts of legislation including on in 1842 under which he was appointed the country's first Inspector of Salmon Fisheries. Another Act of 1848 established key principles upon which later Salmon Acts across the UK would be based, including that their administration should be self-supporting and local, and that Inspectors would have rights to inspect fisheries that over-rode the rights of some proprietors to exclude them, as well as being the first legislation in the United Kingdom to specifically include the word "parr". Under this Act he was appointed a Commissioner. His prominence saw his expertise transferred to England and Wales and Scotland where he was a key participant in government enquires between 1860 and 1862. In 1862 he became Inspector of Fisheries in England and Wales, and thereafter a Fisheries Commissioner in Scotland. Before his death he worked closely with Francis Buckland on *Land and Water*, and had been a supporter of artificial

propagation, on which he had various times written, from early on in his administrative life.

Gill Parsons, 'Ffennell, William Joshua (1799–1867)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/9377, accessed 1 Sept 2015]

Fitzgibbon, Edward (pseudonym "Ephemera"), (1803–1857), angling writer. Originally from Dublin, Fitzgibbon settled in London where he became perhaps Victorian England's most respected angling writer and great populariser of that recreation. His illustrated work, *The Book of the Salmon* (Longmans, Green & Co., London, 1850) was compiled with the help of salmon culturalist Andrew Young, of Invershin, Sutherlandshire. It contains the first account of artificial salmon breeding for a general audience in Britain as well as Fitzgibbon and Young's arguments against John Shaw's theory that parr should be considered young salmon.

See M. G. Watkins, 'Fitzgibbon, Edward (1803–1857)', rev. Wray Vamplew, Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/9593, accessed 20 Aug 2014]

Fleming, John, (1778–1857), naturalist, geologist, and Free Church of Scotland Minister. Active participant on the Edinburgh scientific scene, including in the Wernerian Society and later the RSE, and correspondent of Jardine's His work *A History of British Animals* (1828) discussed the salmonidae and defended the *Salmo salmulus* designation. Dr Fleming submitted evidence on the migratory fish of the genus salmo to a Select Committee on the salmon fisheries of the United Kingdom, see PP, UK 1825 (173). Fleming, with Jardine and Edmund Ashworth were also on the British Association committee appointed to inquire into artificial propagation of salmon at Stormontfield (1856).

See D. T. Moore, 'Fleming, John (1785–1857)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, Oct 2009 [http://www.oxforddnb.com/view/article/9705, accessed 18 Aug 2014]

Francis, Francis (formerly Morgan) (1822–1886), angling writer. Angling editor for *The Field* newspaper and promoter of fish culture and fisheries protection. Francis' contributions to British fish culture are profound, and not only through his writing of books and articles: He attempted his own fish operations near Twickenham on the Thames; was actively involved with Buckland in the Acclimatization Society and the successful efforts to transport trout ova to New Zealand and Tasmania; he founded the Thames Rights Defence Association to conserve fish and the rights of anglers, and proposed the development of a association that would become the National Fish Culture Society. Francis' life is discussed by Francis and Unwin (London, Borough of Twickenham Local History Society, 1991). .

See M. G. Watkins, 'Francis , Francis (1822–1886)', rev. Wray Vamplew, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/10070, accessed 1 Sept 2015]

Garnett, Thomas, (1799–1878), cotton manufacturer and naturalist, of Lancashire. Garnett was one of the first to propose and experiment with the artificial fecundation of fish in Britain, and is believed to have taught the art too Ramsbottom. Possibly, his shared industrial connection to the Ashworth's was also a relevant factor in their decision to employ Ramsbottom and/or to pursue to

salmon culture as a commercial speculation. Garnett published a small number of articles touching on the subject during the 1830s.

Richard Garnett, 'Garnett, Thomas (1799–1878)', rev. Giles Hudson, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/10396, accessed 1 Sept 2015]

Hogg, James, (1770 – 1835), poet and novelist. "The Ettrick Shepherd", Hogg grew up the son of shepherd in the Ettrick district on the Scottish borders. He became however one Scotland's great romantic bards, on terms with Scott, Scrope, and the Tory literary elite gathered around *Blackwood's Magazine* (including James Wilson's brother John), a publication that he helped found. He also knew both Brewster and Humphry Davy. Like many these gentleman, he was a keen sportsman and angler, and even considered writing a book on fishing towards the end of his life. In 1815 he was settled by the 4th Duke of Buccleuch on a farm near Altrive Lake, in the Ettrick area. Here he pursued an interest in salmon – fishing, but also research into the identity of parr. On this subject he published one paper in 1832 in the *Quarterly Journal of Agriculture*, a publication of the Highland and Agricultural Society. The social, geographic and institutional links connecting Hogg to the parr and salmon controversy make it highly likely that he influenced John Shaw – but how exactly this influence may have worked is not known. It may have been indirectly via his publications and association with scientific and literary establishment of Edinburgh, or via the Duke's of Buccleuch. While not impossible (Hogg for instance had family connections in the Drumlanrig area, and went on shooting expeditions in the district), there is no evidence of Shaw and Hogg having met in person. Hogg, after a lengthy illness, also died before Shaw's work properly commenced.

See Douglas S. Mack, 'Hogg, James (bap. 1770, d. 1835)', Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/13470, accessed 18 Aug 2014]

Hogg, John, (1800–1869), classical scholar and naturalist. Active member of various scientific societies, including the Royal Society, the Linnaean Society and British Association. Hogg documented some earlier experiments in artificial fish breeding, concentrating especially on questions of the fertilisation of salmon and trout eggs, and, like John Davy, on matters relating to the use of ice in preserving the vitality of impregnated eggs.

See Gordon Goodwin, 'Hogg, John (1800–1869)', rev. Alexander Goldbloom, Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, May 2010 [http://www.oxforddnb.com/view/article/13474, accessed 18 Aug 2014]

Jenyns, Leonard (1800–1893), naturalist and clergyman. Founding member of the Ray Society and Zoological Society of London. His *Manual of British Vertebrate Animals* (1835) commented on the parr and salmon question; maintained friendships and correspondences with Jardine and Yarrell, amongst many other naturalists. He appears to have considered the parr a distinct species and to have been skeptical of Shaw's claims to the contrary.

See Thomas Seccombe, 'Blomefield [Jenyns], Leonard (1800–1893)', rev. Roger F. Vaughan,Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/2664, accessed 17 Aug 2014]

Jardine, Sir William, of Applegarth, seventh baronet (1800–1874), naturalist and

zoologist. Born at and inherited Jardine Hall in Dumfriesshire, Scotland. Jardine was an authority on many subjects in natural history, but especially botany, ornithology and ichthyology. A keen sportsman, he owned salmon fishing on the River Annan and was instrumental in seeing through the River Annan Act 1841 (4 & 5 Vict.) c. XVII). Jardine was a central authority on the salmonidae in the 1830s and 1840s and active in many scientific societies, including the Royal Society of Edinburgh, the Linnaean Society and the Zoological Society of London (amongst others) and a crucial node a network of ichthyologists. He collaborated and corresponded with Wilson, Couch, Yarrell, Parnell and Jenyns, amongst other naturalists relevant to debates about salmonidae during the 1830s. In 1838–41 he issued *British Salmonidae,* for which he etched the detailed plates. He visited and corresponded with Shaw at Drumlanrig, using some of Shaw's captive bred fish as a model for his illustrations. Jardine is also understood to have conducted his own salmon breeding experiments at Jardine Hall in the early 1840s. He was made Chair to the Royal Commission appointed to inquire into salmon fisheries in England and Wales in recognition of his expertise, and with Fleming and Ashworth was a member of a British Association committee that reported on progress of operations at Stormontfield (1856). Jardine's life and work is treated of in detail in Jackson and Davis (Leicester University Press, London, 2001), .

See: Christine E. Jackson, 'Jardine, Sir William, of Applegirth, seventh baronet (1800–1874)',Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/14663, accessed 17 Aug 2014]

Knox, Robert, (1791–1862), anatomist, lecturer and ethnologist, principally of Edinburgh. Regular contributor on zoological and anatomical topics at the Wernerian and Royal Societies of Edinburgh, Knox studied briefly with Cuvier and Geoffrey Saint-Hillaire in France. He believed that an article of his on the natural history of the salmon in 1833 was the "exciting cause" of Shaw's experiments. Knox is most famous for his role as the best customer in the Burke and Hare scandal at the end of the decade, when his efforts to procure material for his anatomic demonstrations resulted in him buying bodies murdered apparently for that purpose. This caused severe damage to his reputation and set him against some of Edinburgh society. Scott and John Wilson (James Wilson's brother), for instance, wrote scathing attacks, the latter in *Blackwood's Magazine.* Scientifically, Knox has been associated with other prominent British thinkers, in London and Edinburgh, in adopting a radical transmutationism in the 1830s. Specifically, he developed an idiosyncratic synthesis of Goethe's transcendentalist philosophical biology and Saint-Hillaire's transformationism (a post-Lamarckian proto-evolutionary theory). Contra Cuvier's notion of successive creations, and Meckel's ideas of arrested development, Knox sought to show how the young of a species represents a "generic animal", with characters corresponding to the characters of all adults within its genus, past or present. An implication of it was in effect to dismantle the centrality of the category of "species" in favour of genus, hereditary descent understood as having a primary relation to genus or "natural family". He considered the salmonidae, probably because of their extraordinary variation, a prime case study in the development of this theory that he later applied in his anthropological study of the "races of man". It is unsurprising therefore that he developed an unusual analysis of the parr (which he believes to be a hybrid of no fixed sort). Knox's relationship with academic cliques in the Royal Society of Edinburgh deteriorated in the mid-1830s – it is an open whether this contributed towards his stance on the various parr and salmon questions. He was struck from

the Rolls of the RSE in 1848. Knox also translated the French zoologist Milne Edwards, who had made important contributions to the popularising of fish culture in France. Inserted into his translation of Milne Edwards, Knox explains his transcendentalist project with respect to salmonidae in some detail, see Milne Edwards, M [Henry]. 1856. *A Manual of Zoology.* London: Henry Renshaw, pp. 358-365. Various biographical treatments of Knox are available, though his writings about fish culture specifically have remained largely obscure.

See Clare L. Taylor, 'Knox, Robert (1791–1862)', Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/15787, accessed 20 Aug 2014]

Lee, Sarah, (née Wallis, other married name Bowdich) (1791–1824), traveler, naturalist and painter of fish; correspondent of Jardine's. Lee provided illustrations and descriptions of the *Salmo salmulus* (parr) and salmon in her book *The Freshwater Fishes of Great Britain,* which appeared in parts between 1828–37. She studied with Georges Cuvier in Paris.

See Donald deB. Beaver, 'Lee , Sarah (1791–1856)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, May 2007 [http://www.oxforddnb.com/view/article/16310, accessed 20 Aug 2014]

Parnell, Richard, (1810–1882), botanist and ichthyologist, of Edinburgh. A commentator on matters relating to fish and regular correspondent of Jardine. He published on fish in Jardine's *Magazine of Zoology and Botany,* as well as comprehensive articles in the publications of the Wernerian Society and Royal Society of Edinburgh, in which he identified some new species of salmonidae and defended the *Salmo salmulus* designation staunchly. Parnell therefore rejected John Shaw's contributions during the late 1830s, and it is not known whether he later changed his mind. Jackson and Davis (Leicester University Press, London, 2001),provide some biographical details.

Scott, Sir Walter, (1771–1832), poet and novelist. Scott's iconic status as a writer needs little introduction, although his tangential connections to parr and salmon controversies is interesting. He published, in the *Quarterly Review,* a review of his friend Sir Humphry Davy's book, *Salmonia* (1828). In it he mentions Davy's discussion of the parr. He wrote that "one of the most experienced and scientific anglers of our acquaintance" believed, contrary to Davy, that parr were young salmon, and that the crystalline structure of the eyes of parr and salmon are identical. This presumably refers to his friend Scrope's collaboration with Brewster. Despite Davy's arguments to the contrary, Scott himself found it hard to reconcile the parr's abundance to their being what he called a "neutral race". Scott also discussed knowledgably the causes of the decline of salmon, particular in the borders region (where he dwelt at Abbortsford near Melrose), including the damaging moral circumstances pertaining to the different incentives given upper and lower proprietors of salmon fishing. Scott, a keen angler himself as well as prominent Edinburgh Tory, became close friends with James Hogg and was associated with the Duke's of Buccleuch. He had also served as president of the Royal Society of Edinburgh, was an active member of the Highland Agricultural Society, and was associated closely with members of the set at *Blackwood's Magazine.*

See David Hewitt, 'Scott, Sir Walter (1771–1832)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, May 2008 [http://www.oxforddnb.com/view/article/24928, accessed 20 Aug 2014]

Scott, Walter Francis Montagu-Douglas, (1806–1884), 5th Duke of Buccleuch and 7th Duke of Queensbury, politician, magnate and owner of the most extensive estates in Britain. Lord of the estate at Drumlanrig Castle and Shaw's employer. He was known as keen agricultural improver and angler, and is believed to have been extensively concerned with the preservation of salmon. He owned and rented large amounts of water in the Border districts. In the 1850s, at his other seat at Bowhill, the gamekeeper there, James Kerrs, conducted similar salmon breeding experiments to Shaw's earlier investigations. With his status, wealth and staunch conservative politics, he became President of key scientific and cultural institutions, including of Highland Agricultural Society (1831–35, 1866–69), the Society of Antiquaries (1862–73), and the British Association (1867), and was elected a member of the Royal Society of Edinburgh in 1833. He was not on intimate terms with James Hogg and Sir Walter Scott as his father the 4th Duke of Buccleuch had been, but the young Duke is likely to have been acquainted with them and their wider circle before Hogg and Scott died in the early 1830s. Whether or not the Duke played any role in the early experiments of his factors is not known, although there is reason to suspect he'd at least have been interested in them.

See K. D. Reynolds, 'Scott, Walter Francis Montagu-Douglas-, fifth duke of Buccleuch and seventh duke of Queensberry (1806–1884)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, May 2006 [http://www.oxforddnb.com/view/article/24929, accessed 18 Aug 2014]

Scrope, William, (1872–1852), artist, writer and angler. Key earlier contributor to the parr controversy, raising the issue in 1824 in a letter to Kennedy, MP. He wrote extensively about the parr controversy in his popular book, *Days and Nights of Salmon Fishing in the Tweed* (first ed., 1843), in which he declares his earlier concern for the subject and praises the scientific contribution of Shaw, whom he met. A passionate angler himself, Scrope was friends with James Hogg and on close terms with Scott, having rented a house at Melrose in the borders region. He was also an active director at the Royal Institution and fellow of the Linnaean Society.

See F. M. O'Donoghue, 'Scrope, William (1772–1852)', rev. Julian Lock, Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, Oct 2007 [http://www.oxforddnb.com/view/article/24967, accessed 18 Aug 2014]

Selby, John Prideaux, (1788–1867), naturalist, of Northumberland. Ornithologist, artist and passionate angler, close collaborator and friend of Jardine, working with him on various projects, including suggesting their trip with Wilson to Sutherlandshire to angle and investigate its natural history, especially its varieties of salmonidae. With Jardine, he founded the *Magazine of Zoology and Botany* (1836) and *Annals of Natural History* (1838).

Christine E. Jackson, 'Selby, Prideaux John (1788–1867)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/25050, accessed 2 Sept 2014]

Stoddart, Thomas Tod, (1810–1880), angler and writer, Edinburgh. Stoddart published a series of influential books about angling in Scotland. He settled the Kelso district, not least in order to fish the streams of the Scottish borders, on which he was an authority. Stoddart defended the idea that parr were salmon, however he also adopted an eccentric theory about the manner in which fertilisation in salmon occurred (believing them to be partially viviparious, with gestation taking place inside the females body during their time at sea, a theory

that had the advantage of denying the precocious parr any meaningful role in the reproduction of the species). Stoddart however visited Shaw in 1850s, decaring himself convinced of Shaw's sagacious efforts. He had some connections with the literary establishment in Edinburgh, including with *Blackwood's Magazine,* but the extent of these is not known.

See W. W. Tulloch, 'Stoddart, Thomas Tod (1810–1880)', rev. Wray Vamplew, Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/26552, accessed 20 Aug 2014]

Russel, Alexander, (1814–1876), journalist and newspaper editor. An active liberal, Russel contributed as reporter and editor to numerous Scottish papers. A keen salmon critic, and his book, *The Salmon* (1864), principally a collection of his earlier essays on the subject, is probably the most detailed and comprehensive record of the natural and economic history of the salmon at this time.

See H. C. G. Matthew, 'Russel, Alexander (1814–1876)', Oxford Dictionary of National Biography, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/24292, accessed 20 Aug 2014]

Wilson, James, (1795–1856), zoologist, member of Wernerian Society since 1812, and regular contributor to *Blackwood's Magazine*, where his brother John (pseudonym Christopher North) was a prominent critic. Wilson was later elected a Fellow of the Royal Society of Edinburgh, and was a close friend to Jardine. He traveled with Jardine and Selby to Sutherlandshire in 1834, during which time his own and his companion's early views of the parr were importantly shaped, though were later avidly recanted. Amongst many articles and books on natural history and fisheries, Wilson also authored a treatise on angling and shooting, in which he rehearses the parr controversy and describes his own change of heart on the topic (*The Rod and Gun,* T. Constable, Edinburgh, 1841).

Yolanda Foote, 'Wilson, James (1795–1856)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/29659, accessed 20 April 2016]

Appendix 4: Salmon and salmon culture glossary

Alevin: The state salmon and trout assume immediately after hatching. These fish do not begin feeding on aquatic organisms, but survive for a period of time on the egg yolk sac or "umbilical vesicle" with which they are born. During this phase they are small and translucent in appearance, sometimes described as resembling tadpoles. Their habit of hiding under the gravel of the redds in which they hatched keep them out of sight, and thus contributed to doubts surrounding the early life history of the salmon.

Fry: A generic term used variously to describe all stages of juvenile development after hatching, including the alevin, parr and smolt, and virtually synonymous in this respect with "the young of the salmon". This could lead to confusion, and judges in the "parr trials" found it necessary to try and define "fry" more precisely, for instance, as young fish in the habit of congregating in shoals in the shallows of rivers. This could barely help but to add confusion since very young salmon immediately after consuming their yolk sacs and leaving the gravel redds, as well as older smolt preparing to migrate, might do similarly. Young trout and other species are also referred to as "fry".

Grilse: Term used to refer to salmon returning from the sea to the river after their first migration. Unlike most Pacific salmon, Atlantic salmon are known to be capable of migrating and returning to freshwater to spawn more than once – ie., they do not necessarily die after spawning. Since grilse appear visually dissimilar to salmon returning for their second or subsequent attempt at spawning, there was also a "grilse controversy", and this occurred roughly contemporaneously to the "parr controversy". During this episode, some argued that grilse might, like parr, be considered a distinct species. Grilse also tend to return to the rivers slightly earlier in the season that older adult salmon.

Kelt: Term used to refer to salmon and grilse after spawning. These fish might be encountered making an outwards migration, attempting to return to the sea. These fish tend to be in poor condition, thin, diseased or injured. They were often considered unfit for eating and referred to as "black" fish or "baggits". However, an illegal trade existing in their flesh; apparently, many Scottish kelts found their way pickled in barrels to the French market, where they were not looked down upon.

Milt: The male sex cell – sperm or "seminal liquor".

Ova: The female sell cell, or egg. Fish culturalists used the term imprecisely however to refer both to fertilised (fecundated) and unfertilised eggs.

Parr: The main subject of the contention in the "parr controversy", and impossible to properly define prior to the resolution thereof. The word was known throughout the United Kingdom, but was the principle term used to designate a stage of development of both trout and salmon in Scotland. In the case of salmon, the parr can without difficulty be retrospectively defined as the stage of development intervening between alevin and smolt, during which time the fish takes on a distinctive banded appearance. All varieties of trout though take on a similar appearance soon after transforming out of the alevin state. In both cases, it

is now known that there is significant variation in the length of time the fish maintain this appearance, sometimes for years or even in the case of small burn trout, their entire adult lives. It is unproblematic today to use the term to refer to all young trout and salmon expressing these marks. The parr controversy however initially centred on the question of whether there was in fact a small but distinct species of fish that also possessed the banded appearance – ie., that was not a young salmon or a young trout, or a mixture thereof, of known species or variety. Experts who considered it a distinct species usually knew it as the *Salmo salmulus.*

Precocious parr: Sexually mature salmon parr, now known to be a phenomenon occurring in males only, although this was disputed during the nineteenth century. These parrs are typically found swarming around edges of redds, waiting for opportunities to impregnate the eggs of adult salmon whilst the much larger adult males are competing with one another for their chance to do similarly. Biologists tend now to consider the "anomaly" of precocious parr to be an efficacious adaptation of some kind, although since there are also disadvantages to the strategy, the details remain disputed. One important observation has been that the quantity of milt released by precocious parr and adult salmon around the eggs function as a protective mechanism ensuring that a smaller proportion of sperm or milt becomes waterlogged and dies before effecting fertilisation.

Salmo and salmonidae: *Salmo* are a genus of the family *salmonidae* of the order of *salmoniformes*. *Salmo* include all forms of trout and salmon native to Europe. The exact number of recognised species and subspecies within the genus is debated up until the present day, not least because they exhibit high degrees of plasticity with sometimes very local varieties occurring, and are often capable of hybridising between themselves. Trout and salmon of the Pacific basin are not considered *salmo* by present day classifications but rather *oncorhynchus*, another genus of *salmonidae.* In the nineteenth century, the Pacific coast rainbow trout (now *Oncorynchus mykiss*) was however often called *Salmo irideus*. It was brought to Britain under that name by fish culturalists. More popular however was the American brook trout of the Atlantic coast. Often referred to then as *Salmo fontinalis*, it is actually not a *salmo* at all, but rather a *salvelinus* or char, a separate genus within the family *salmonidae*.

Sea trout: A proportion of river trout migrate into saltwater. Today, these are considered to be merely a form of the ordinary European brown trout (ie., they are genetically identical), but during the nineteenth century this was disputed. Many considered them distinct species or at least distinct varieties, of which there were considered to be many different kinds. The habit of migration develops in only some trout for unknown reasons. At present, it is considered that the brown trout comes in three predominant forms: *Salmo trutta* morpha fario, *Salmo trutta* morpha *lacustris* and *Salmo trutta* morpha *trutta*, the latter being the sea trout.

Smolt: Term used to refer to the state assumed by salmon immediately prior to migrating to the sea for the first time. During this phase the fish transform from the banded appearance of parr, taking on a silver appearance as an accretion of guanine crystals overlay their existing coat. These new scales are often loose and can be easily scraped off to reveal the bands beneath them. Other anatomical and morphological changes occur simultaneously in preparation for saltwater. It is now recognised that this transformation may occur after as little as twelve months, but it often occurs many years after hatching.

Redd: Sometimes, “rid”. Term used to refer to the gravel beds in which trout and salmon lay their eggs and fecundation takes place. Usually found in upper stretches of rivers and tributary streams. Redds can by highly sensitive to disturbance and adult fish, whilst engaged in the actions of propagating their species on the redds, are vulnerable to various kinds of predation and accident. Artificial redds could be built as a form of incubation apparatus in a streamlet or by cutting a channel next to a river and preparing it with clean gravel. Like “parr”, “redd” is a Scottish word originally.

Appendix 5: Examples of Social Worlds and Situational Analysis Maps

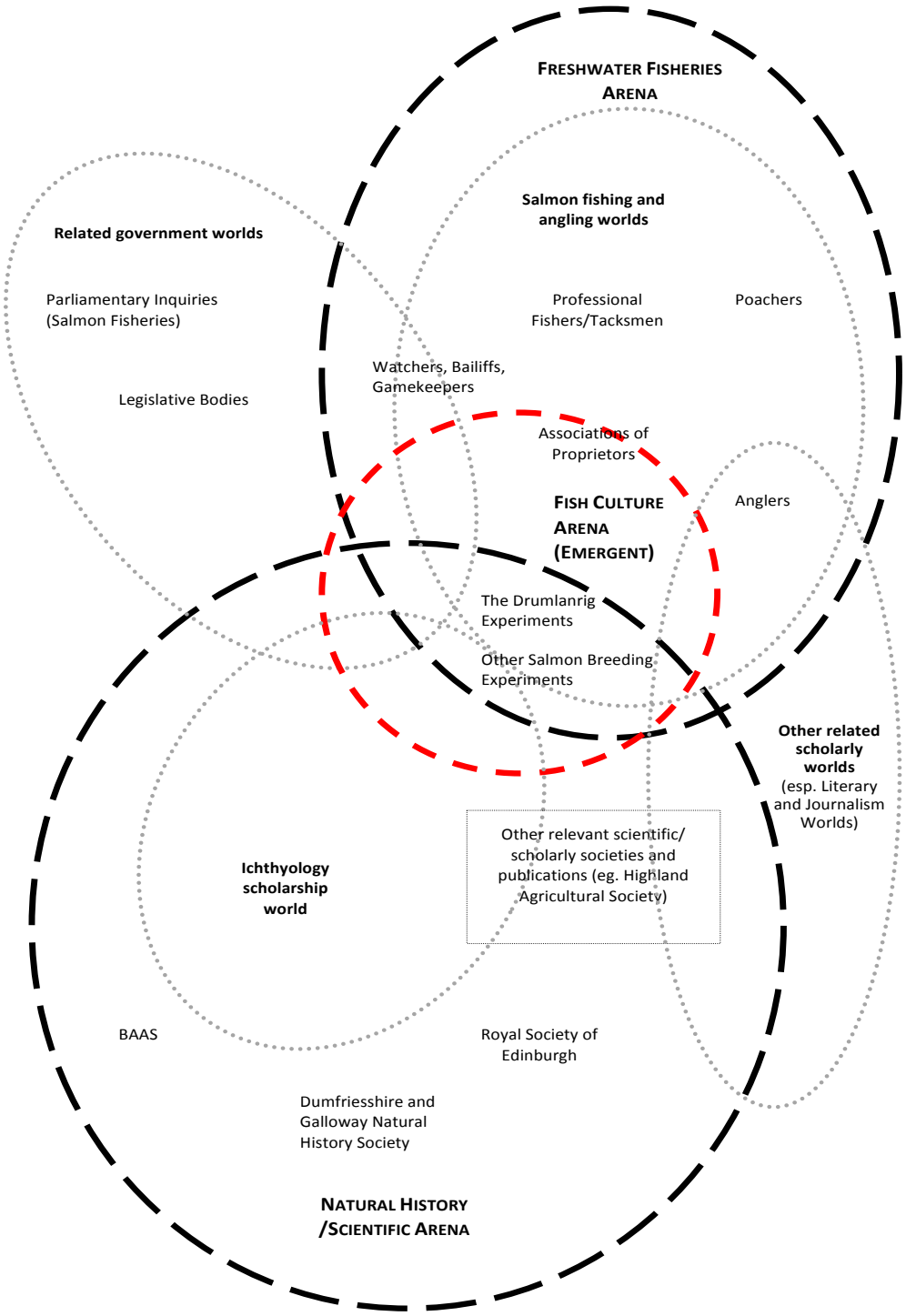
Situational analysis suggests three analytical mapping strategies: Social worlds/arenas maps, situational maps, and positional maps. I reproduce below examples of the first two of these. (Positional maps are intended to help interrogate the relations between positions taken and not taken in discourse in a given situation of enquiry).

Importantly, these maps are not in themselves research outcomes, and are typically not intended for reproduction in the final written report. They are analytical techniques only, designed as strategies for "opening up" and summarising qualitative data in a way that helps the researcher to keep and overview of relations and changes in a situation of enquiry. I used these mapping strategies regularly throughout the research process as a way asking questions and, equally importantly, and reflexively, about my changing conceptions about what I was finding and what elements I was prioritising at different stages in the process. By drawing maps of different time periods, they can be especially useful for historical scholarship and in helping track changes in elements and their relations over time. Drawn usually by hand using pencils and highlighters, my maps were constantly revised and updated – there should be no "final" or definitive map of situation, and can be done at different scales of abstraction or detail.

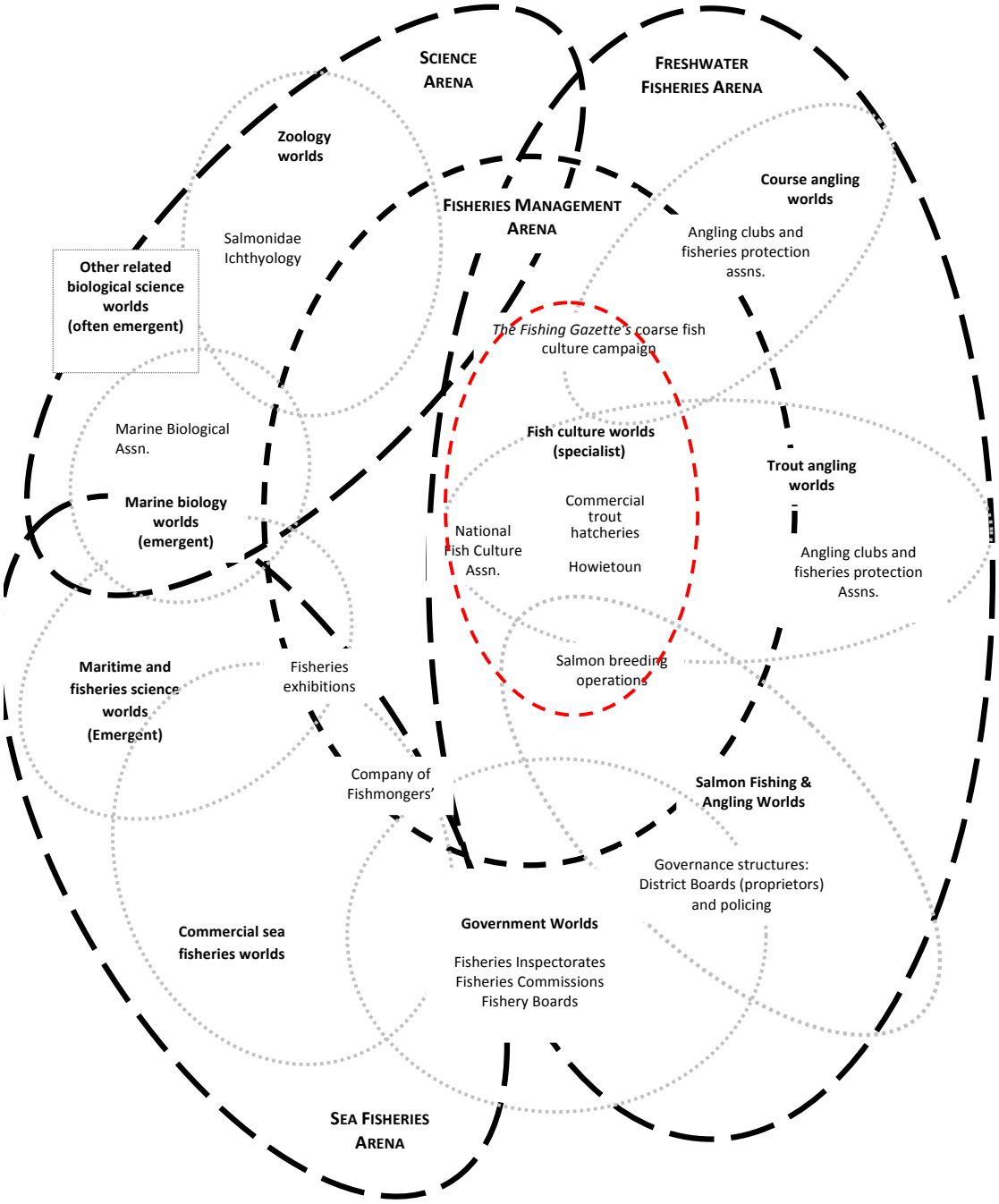
The social worlds/arenas maps lay out the major elements of collective social action associated with fish culture at different time periods. Looking at Example 1, fish culture circa 1840, helped me see, for instance, the embryonic emergence of fish culture as an arena composed of the intersection of a number of other worlds and the encompassing arenas to which they were connected. Example 2, fish culture circa 1885, by way of contrast, suggested a more differentiated situation in which fish culture had become a more specialised series of worlds, within a larger freshwater fisheries management arena, in its own right. Example 3, a "messy" situational map, represents a snap shot of all the elements that struck me as potentially relevant to the situation I was investigating at a particular point in the research and the development of fish culture. I might make photocopies of an image such as this, and use it as a template, by drawing lines connecting one element with another, systematically ask: "what is the relationship between x and y?", "Why might it be important?" etc, looking for clusters of elements connected in meaningful ways. These helped me to understand my data better, and refine my case studies and analytic foci.

Similar and additional maps based on my research are due to be published as an exemplar of using situational analysis historical social research in a forthcoming (2016) new edition of Adele Clarke's book *Situational Analysis.* More commentary insights into how these strategies have been used in my research, or could be used, will be found there.

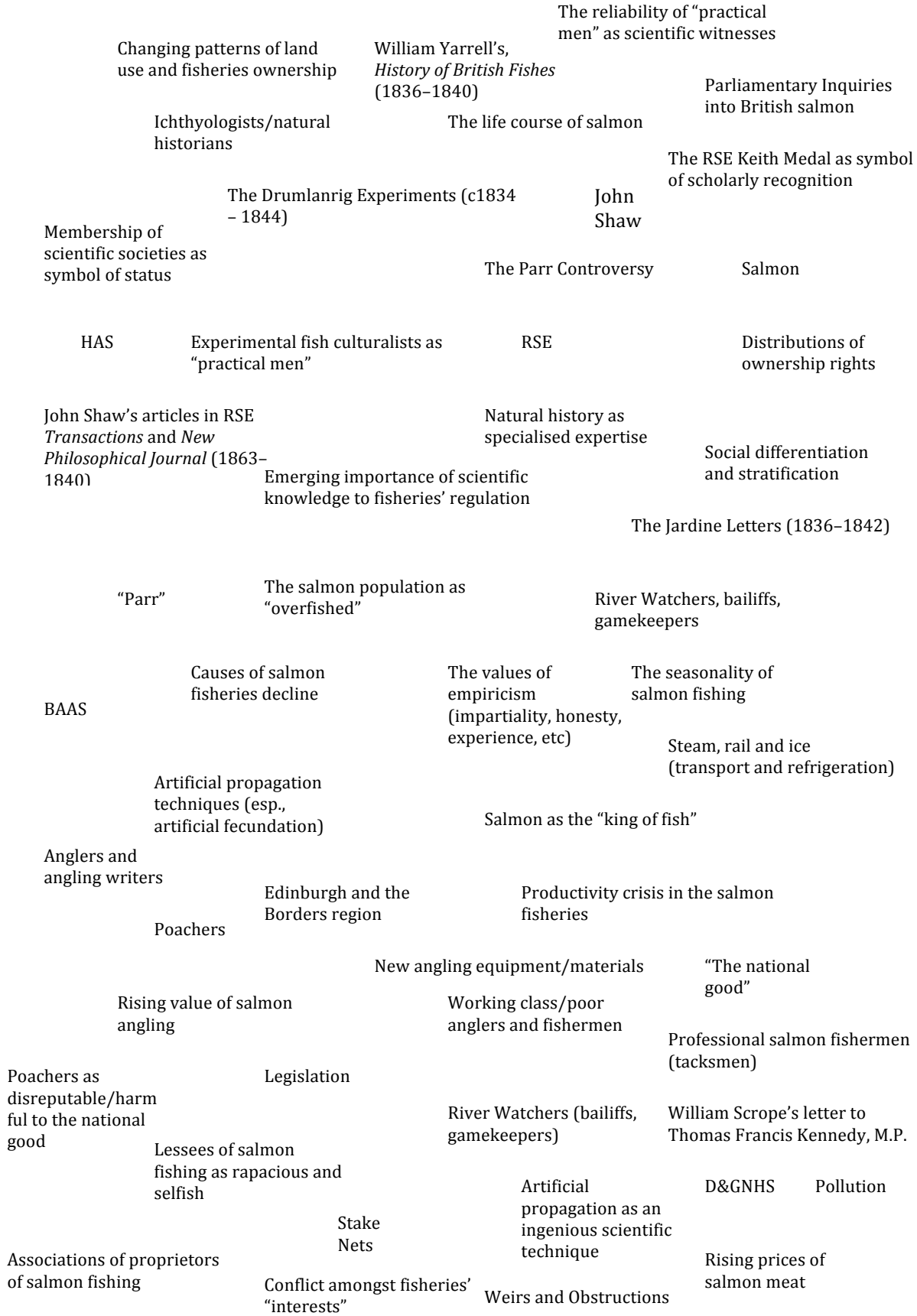
Example 1: Social worlds/arena's of fish culture, circa 1840.



Example 2: Social worlds/arena's of fish culture, circa 1885



Example 3: "Messy" situation made, fish culture circa 1840.



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