Techniques of Life: zoology, psychology and technical subjectivity (c.1820-1890).

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For E.L.

I, Tom Quick, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signed:

Abstract

This thesis associates the cultural elevation of discourse articulating physiologically-centred conceptions of self in mid-nineteenth-century Britain with a shift in power relations. I contend that the proliferation of zoologically- and neurologically-oriented texts, themselves embodying politics of natural truth, constituted a condition of possibility for the emergence of what I portray as a 'technicalization' of power. The articulation of organically determined notions of subjectivity are associated with the constitution of a technical ideal of knowledge production. Further, technical assemblages upon which physiological conceptions of self relied are shown to have helped constitute modes of resistance to discourse concerned with the organic determination of mind and life. Technical entities played an active role in the constitution of organic subjectivities, and organic subjectivities in turn participated in the constitution of technical modes of being.

The historical narrative represents the formation of two related disciplines, zoology and psychology, as contingent upon the relative status of different kinds of epistemic equipment. In a natural philosophic context pervaded by uncertainty regarding the relation of matter to spirit, claims that could be made regarding nature were circumscribed by what 'gentlemanly' equals could agree to have 'witnessed.' Gentlemen appealed to differing forms of epistemic equipment in attempts to constitute zoology and psychology as disciplines. The relative success of such appeals was determined not only by the political valency of the claims themselves, but also by the conditions constituted by the types of equipment used to make them.

The thesis then goes on to highlight ways in which the disciplined consideration of body and mind as entities determined by nature constituted conditions of possibility for the articulation of tool- and technique-centred subjectivities. The epistemic tools and representational claims appealed to as proof that the self is inherently organic (have) paradoxically participate(d) in the constitution of modes of being that extend the self into the realm of the technical. By the late nineteenth century, the capacities of cognition and replication are beginning to be attributed to the combination of technical and organic entities.

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Introduction

The problem of bio-technical subjectivity

Like many others born into our capitalist, secular world, I was encouraged from a young age to believe that our subjective experience is determined and delimited by our organic bodies. That is, through reading and discussing (in my case especially with my father) such texts as Richard Dawkins' *The Blind Watchmaker* (1986) and Daniel Dennett's *Darwin's Dangerous Idea* (1995), I, like many others, found myself convinced that the state of our living bodies determines all of out perceptions of and actions in the world. It seemed to me that humanity is, above all else, 'organic'.[1]

Despite this inculcated conviction, however, doubt has begun to encroach on my prior certainties over the past five or so years. In their stead, I have come to believe - along with a wide range of other writers, artists, engineers, scientists and performers before me - that non-biological, technical entities are key participants in our thoughts and experiences. Whether I consider the integration of our lives with the tools we use in day-to-day situations, or that our bodies are constantly re-defined in relation to the built aspects of our environments, I can't help but think that I am not only an organic being: I am also, at heart, technical.

There now exists a considerable body of literature that asserts that 'we' are (or, alternately, 'everything' is), in some sense, 'technical'. For example, it is no longer considered eccentric to assert that we are ontologically 'cybernetic' and/or subjectively 'cyborg' (on which see below).[2] The question remains, however: what

1 'Organicism' in this thesis refers to the dual contention that our bodies are constituted by a force or set of conditions defined by a force or set of conditions defined by an extra-human 'nature', and that our experiences are entirely dependent on our bodily states. See Dawkins, R. *The Extended Phenotype: the gene as the unit of selection* (Oxford, 1982); Dawkins, R. *The Blind Watchmaker* (Harlow, 1986); Dennet, D. *Darwin's Dangerous Idea: evolution and the meanings of life* (London, 1995).

2 The body of literature addressing 'the cyborg' is now extensive. See especially Haraway, D. 'A Cyborg Manifesto: science, technology, and socialist-feminism in the late twentieth century', in Haraway, D. *Simians, Cyborgs and Women: the reinvention of nature* (New York, 1991), pp. 149-181; Channell, D.F. *The Vital Machine: a study of technology and*

are we to *make* of such an ontology? And what do such notions of subjectivity imply for our approaches to organization and our strategies of survival, sustenance and replication/reproduction? What is at stake in the identification of ourselves as engineered, 'posthuman'[3] or technical beings?

This thesis is concerned with what I perceive to be an at times dangerously de-emphasised element of our technically-constituted present; that of the 'organism' element of the cyb-org. It is motivated by what I believe to be a pressing need to re-affirm and reconcile our technical selves to the 'biological' aspects of our techno-biologies. Portraying the constitution of an exclusively organic subjectivity as a key condition of possibility for the emergence of cybernetic subjectivities, it seeks (following the recent publications of Donna Haraway) to privilege an integration of bodies and machines that remains sensitive to the needs of the living.[4] There seem to be many different ways of becoming technical.[5] I here insist

organic life (New York and Oxford; Oxford University Press, 1991); Gray, C.H. (ed.) *The Cyborg Handbook* (New York and London, 1995); Hutchins, E. *Cognition in the Wild* (Cambridge, MA and London; MIT Press, 1995); Balsamo, A. *Technologies of the Gendered Body: reading cyborg women* (Durham and London; Duke University Press, 1996); Haraway, D. *Modest_Witness@Second_Millenium.FemaleMan©_Meets_OncoMouse* (New York and London, 1997); Hayles, N.K. *How We Became Posthuman: virtual bodies in cybernetics, literature, and informatics* (Chicago and London; University of Chicago Press, 1999); Clark, A. *Natural Born Cyborgs: why minds and technologies are made to merge* (New York; Oxford University Press, 2003); Hayles, N.K. *My Mother Was a Computer: digital subjects and literary texts* (Chicago and London; University of Chicago Press, 2005); Pickering, A. *The Cybernetic Brain: sketches of another future* (Chicago and London; Chicago University Press, 2010).

3 On the notion of the posthuman see Pickering, A. *The Mangle of Practice: time, agency, and science* (Chicago and London, Chicago University Press, 1995), esp. pp. 25-26 and 229-234; Hayles, *How We Became Posthuman);* Wolfe, C. *What is Posthumanism?* (London and Minneapolis; University of Minnesota Press, 2010). On relations between science and technology studies and the posthuman see also Roosth, S. and Silbey, S. 'Science and Technology Studies: from controversies to posthumanist social theory', in Turner, B.S. *The New Blackwell Companion to Social Theory* (Oxford, 2009), pp. 451-473.

4 Haraway, D. *A Companion Species Manifesto: dogs, people, and significant otherness* (Chicago, 2003). See also Haraway, D. *When Species Meet* (Minneapolis and London; University of Minneapolis Press, 2008). My concern with the conditions of possibility of becoming technical is posed in a somewhat different (though I believe complementary) manner by Adrian Mackenzie, for example. See Mackenzie, A. *Transductions: bodies and machines at speed* (New York and London, 2002), on p. 2.

5 For example, Chris Gray et. al. identify cybernetic subjectivity with literary imagination, technoscientific practice, space exploration, film, and psychology, amongst other categories. See Gray, C.H., Mentor, S. and Figuera-Sarriera, H.J. 'Cyborgology: constructing the knowledge of cybernetic organisms', in Gray, *The Cyborg Handbook*, pp. 1-14. As noted below, I address the rather protean 'nature' of 'the cybernetic' here by emphasising its embodiment in the fusing of tools and living bodies at particular times

on the necessity of attending more closely to one specific one: that of (simultaneously) becoming 'organic.' To counterpoint N. Katherine Hayles' recent title, *My Mother Was a Computer* (2005); 'my father is an organism.'

What do we understand by the cybernetic or cyborg? In their introduction to *The Cyborg Handbook* (1995), Chris Gray and his co-authors emphasise the diversity of ways in which the cybernetic can be figured and produced.[6] In contrast, I want to adopt a fairly specific (if nevertheless wide-ranging) definition of such a figure; a cybernetic entity (for the purposes of this thesis) is an integrated system whose operation is enabled by the co-participation of natural and manufactured parts. In opposition to those who represent the cyborg as an identity characterised by the organic body's 'extension' via 'technology' (see below), as well as those that consider cybernetics to be an analogical science concerned merely with the *comparison* of organism and machine,[7] I thereby adhere to a figure of the cyborg as simultaneously a material, embodied and constructed entity, characterised by its *combination* of organic and technical elements.[8]

Having highlighted the importance of the organic in the constitution of the technical, it must also be acknowledged that the technical is indispensable in consideration of the organic. 'Life' (or indeed 'existence')[9] can no longer be isolated from the tools and techniques by which it is studied, re-created and manipulated. The narrative to be deployed here indicates not only that an organic subjectivity has been critical to the constitution of the technical, but also that the technical is critical to - and thereby constitutive of - the organic. The two categories are

and in specific places.

6 Gray, et. al. 'Cyborgology'.

7 Hayles, *My Mother was a Computer* offers a critical analysis of both the tendency of technically-enthusiastic claims to efface the living body, and the anti-technicalism that underlies much recourse to analogy. For an example of the former, see Clark, *Natural Born Cyborgs*. Regarding the latter, Muri, A. *The Enlightenment Cyborg: a history of communications and control in the human machine, 1660-1830* (Toronto, Buffalo and London; University of Toronto Press, 2007) tends to conflate the analogical relation of machines and bodies with the constitution of organo-technical hybrids. See also Morus, I.R. (ed.) *Bodies/Machines* (Oxford and New York, 2002).

8 Similar definitions/declarations can be found in Haraway, 'A Cyborg Manifesto'; Channell, *The Vital Machine*, on pp. 109-110, and Cordeschi, R. *The Discovery of the Artificial: behaviour, mind and machines before and beyond cybernetics* (Dordrecht, Boston and London, 2002), on p. xi.

9 Pickering, *The Mangle of Practice*, pp. 246-252.

enfolded within broader, 'cybernetic' entities, discourses and practices.

Finally, I wish to insist, along with two other recent publications,[10] on the *historicity* (though not necessarily the originality)[11] of the notion of the self as a technical-organic hybrid. In articulating - as I do here - a specifically historical account of technical subjectivity, am not concerned with portraying an eternally valid 'reality' or 'nature' of its constitution. Rather, I am concerned with the elucidation of one particular conception of it; a conception in which the concerns of the present can begin to be thought as both temporally specific and temporally specifying; as constituted by a past, but also as constitutive of a past. I am thereby committed, along with Kay Anderson, to an inscribing of the organic within a specifically posthuman history, in which the notion of human subjectivity becomes a matter of historical concern rather than a mode of historical explanation.[12] Following Michel Foucault and others, I move toward the construction of a genealogical[13] account of the organic that does not seek to deploy 'the archive' as an authorizing technique.[14] Rather, I affirm that narratives and texts such as the one

10 Muri, *The Enlightenment Cyborg*; Ketabgian, T. *The Lives of Machines: the industrial imaginary in Victorian literature and culture* (Ann Arbor, University of Michigan Press, 2011).

11 Haraway's 'A Cyborg Manifesto' insists on the need for cyborgs to refuse 'origin stories'. This refusal should not be taken as a refusal of the cyborg's historicity, however. Though much conventional historical analysis remains committed to the recounting of origins and ends (what Haraway refers to as 'salvation history'), this does not indicate that the (re)figuration of 'the past' is irrelevant to the present (or indeed the future). See Haraway, *Modest_Witness*, pp. 8-11 and 23-39.

12 See Anderson, K. *Race and the Crisis of Humanism* (Abingdon, London and New York; UCL Press, 2006) and Anderson, K and Perrin, C. 'Thinking *with* the Head; race, craniometry, humanism', *Journal of Cultural Economy* 2 (2009), pp. 83-98.

13 Foucault, M. 'Nietzsche, Genealogy, History', in Bouchard, D.F. (ed.) *Language, Counter-Memory, Practice: selected essays and interviews* (Ithaca, Cornell University Press, 1977) pp.139-164. See esp. the comments on the body in genealogical analysis (on pp. 148, 153-154 and 155). To appropriate a passage of Judith Butler's: genealogy refuses to search for the origins of life, the inner truth of the nature of the organism, the 'true' biology of the human body that repression has kept from view; rather, genealogy investigates the political stakes in designating as *origin* and *cause* those identity categories that are in fact the *effects* of institutions, practices, discourses with multiple and diffuse points of origin. The task of this enquiry is to center on - and decenter - such defining institutions. The original quote concerns gender rather than the organic. See Butler, J. 'Preface', in Butler, J. *Gender Trouble: feminism and the subversion of identity* (London, 2006 [1990]), p. xxxi.

14 On archives as constructs see Waterton, C. 'Experimenting with the Archive: STS-ers as analysts and co-constructors of databases and other archival forms', *Science, Technology, and Human Values* 35 (2010), pp. 645-676. Bowker, G.C. *Memory*

I am presenting here are independent, bio-technical processes constituted through interactions of bodily organisms and technical bodies.[15] The implications of such an affirmation will be returned to in the conclusion of this thesis. What is important to note is that the conception of self and world as inherently 'technical' is in contention, and that I am committed to affirming that such conceptions are (and should be) historically situated.

The question of the technical

The critical role that the above terminology relating to 'the technical' plays in this thesis warrants further explication at this stage. As will become clearer as the narrative progresses, I have adopted a specific and perhaps to some rather idiosyncratic approach to terms relating to this category.

Most notably, I avoid all reference to 'technology' as referring to the built aspects of environments. The principal rationale for this has its roots in a long-standing (though not universally acknowledged) disjuncture between uses of this term in anglophone, and continental European, intellectual traditions. Nathan Schlanger highlights this difference as one between an anglophone 'instrumental' conception of the term, and the continental notion that 'technology' refers to a specific mode of being as much as it does a set of entities in the world.[16] Broadly speaking, English-language authors conceive of 'technologies' as entities that have been constructed with the performance of specific tasks, or the achievement of specific ends, in mind: hammers, as 'technologies', might be understood as a class of entities constructed for the striking of objects, for example.[17] In contrast,

Practices in the Sciences (London and Cambridge, MA; MIT Press, 2005); Derrida, J. (trans. Prenowitz, E.) *Archive Fever: a Freudian impression* (Chicago and London; Chicago University Press, 1995).

15 Hayles, *My Mother Was a Computer*. See also Foucault, M. 'What is an Author?', in Rabinow, P. (ed.) *The Foucault Reader* (New York, 1984), pp. 117-120.

16 Schlanger, N. 'Introduction', in Schlanger, N. (ed.) *Marcel Mauss: techniques, technology and civilization* (New York and Oxford, 2006), pp. 1-29. On pp. 2-4.

17 See eg. Mitcham, C. *Thinking Through Technology: the path between engineering and philosophy* (University of Chicago Press; Chicago and London, 1994).

following the work of Martin Heidegger, continental philosophers and a small minority of anglophone thinkers have begun to articulate a conception of the world which emphasises the 'logos' element of 'techno-logy':[18] 'technology' is for these authors not a set of entities on the world 'out there' (eg. a hammer), but a historically specific mode of being or becoming (the total set of entities, actions and effects associated with hammering).

The question of the definition of 'technology' constitutes a choice - between the consideration of the technical as an expanding, progressive process of 'rationalization' that we as 'subjects' that produce and deploy, and can choose either to adopt or contest, and an acknowledgement that it is precisely in the realm of the technical that cognition – and thereby the subject - is constituted and created. It is this latter, to me much richer conception of the term, that motivates its general absence in this thesis: in considering the place of 'the technical' at specific historical and geographical sites, I hope to further the notion that our historical situation is, in an important sense, also a technological one.

Rather than referring to 'technology' as a catch-all category for elements of our world that are not conventionally associated with (the equally problematic) 'nature', then, I here deploy the terms 'tool', 'technique', and 'technical' when referring to entities and activities related to non-organic elements of cognitive life. This of course begs the question of what I mean by these terms.

A number of authors have sought to address what we mean by a 'technique'. One of the earliest advocates of 'technology' as an academic discipline, Marcel Mauss,[19] articulated an instrumental notion of technique that has become particularly prevalent in the anglophone tradition: 'We call 'technique' an ensemble of movements or actions, in general and for the most part manual, which are organized and traditional, and which work together towards the achievement of a goal known be physical, chemical or organic.'[20] Techniques are the human actions

18 Thus Bernard Steigler and Adrian Mackenzie, for example, separately emphasise that technology as a notion is always-already 'technical' (ie. the technical is itself a condition of possibility for the conceptualization of something called 'technology'). See Steigler, B. *Technics and Time 1: the fault of Epimethius* (Stanford; University Press, 1998); Steigler, B. *Technics and Time 2: disorientation* (Stanford; University Press, 2009); Steigler, B. *Technics and Time 3: cinematic time and the question of malaise* (Stanford; University Press, 2011). Mackenzie, *Transductions*.

19 Schlanger, 'Introduction'.

20 Mauss, M. (trans. Redding, J.R.)'Techniques and Technology', in Schlanger, *Marcel*

requisite to achieve a certain set of technical goals. This conception of technique is accompanied in his texts by an equally instrumental schema whereby technical entities are constituted as the expression of specific social goals - as the effects of certain ideals that are not themselves influenced by the world of the technical.

In contrast to Mauss, Bruno Latour articulates a conception of technique as constituted by technical entities themselves, as much as by the bodies that appear to perform them. For Latour, 'techniques imply not [human] society... but a semisocial organization that brings together humans and non-humans from very different seasons, places, and materials... Techniques are what happen to tools and non-human actants when they are processed through an organization that extracts, recombines, and socializes them.'[21] It is this latter notion of technique that I wish to emphasise here. Techniques, this thesis highlights, are not simply actions intended for the achievement of goals that have been articulated by humans – they are actions (or, following Andrew Pickering, kinds of performance), that appear in situations that can be described as co-constituted by both tools and organic bodies.

The question of the definition of 'tools' present an equally intractable difference between instrumental and technological considerations of the nature of being. Though one of the most lauded advocates of philosophically technological considerations in the English language, in this instance, Latour offers a more instrumental definition of the term: a tool is 'the extension of social skills to nonhumans.' They 'represent the extension of a skill rehearsed in the realm of social interactions' to a non-human context.[22] The difficulty of this position for the consideration of technology as a mode of being should be clear: following the general tendency of the continental study of technique towards refusing any absolute differentiation between social (ie. human) and technical elements of existence,[23] it is equally be possible to state that tools are extensions of 'non-human' skills to societies (ie. that tools do not have an exclusively 'social' origin). Latour does not follow through with his above-noted insistence on the inseparability of the

Mauss, p. 149.

21 Latour, B. 'A Collective of Humans and Nonhumans', in Hanks, C. *Technology and Values: essential readings* (Malden, MA, Oxford, and Chichester, 2010), p. 56.

22 Latour, 'A Collective', p. 57.

23 Steigler, *Technics and Time,* Vols. 1-3.

social/psychological and the technical.[24]

Considered here, tools (following Steigler, Heidegger, et al), are understood as simultaneously instantiations and constituents of psycho-social existence. In addition, they are not considered to be differentiable from the technical endeavours that they (along with techniques) constitute, except in retrospect. As Heidegger's famous observations relating to hammering highlight, tools often only become recognisable as such when they appear as 'broken', or no longer effective.[25] They are elements of the technical that are neither significant enough to be upheld as ends in themselves, nor dispensable enough to be neglected in the constitution of those ends. Rather, they act as catalysts - participants in technical endeavour that do not undergo significant changes as a result of such participation. Tools, considered here, are (in contrast to temporally more ephemeral techniques that they are generally accompanied by) the memorial detritus left behind by technical endeavour at large. As such, they constitute the broad objects of this study – the elements around which considerations of relations between the organic and the technical have been formed over time.

These comments, whilst they defer the problem of defining the technical, do so inadequately. It should by now be evident that a consideration of 'tool' or 'technique' is part of the same endeavour that requires a definition of 'technology'. There is no room in this study for defining this collection of terms adequately, except to note that they are all both related, and open to contestation. The most definite statement that can be made regarding them is that this study - in that it aspires to the denotion 'techno-logy' - inscribes the psychological (ie. the category that denotes beliefs relating to cognition) as both constitutive of and constituted by the technical (ie. the category that denotes the bringing-forth of the world via the combination of tools and techniques). Because of this contention (that thinking, as an aspect of existing more generally, is an inherently technical endeavour), it is unable to contemplate the technical as a definite object of analysis, but rather seeks to bring it into question (in this case in relation to the history of psychology). As Steigler notes, it was during 'the nineteenth century, as stability became

24 Pickering, A. 'The Politics of Theory: producing another world, with some thoughts on Latour', *Journal of Cultural Economy* 2 (2009), pp. 197-212.

25 Mitcham, *Thinking Through Technology*, pp. 49 and 254-258.

increasingly uncertain and change the rule, [that] it began to appear to be possible that technology, emerging from the technics associated with science, might prove to be *incompatible with being*.'[26] Such a comment brings us back to the principle concern of this thesis - that of the relation between technical entities and those organic beings that are more conventionally considered constitutive of psychological existence.

Situating the organic as a matter of concern

As an object, this thesis is oriented *towards* the organic as a 'matter of concern.' In a recent article questioning why the twentieth-century project of 'critique' (which sought to escape or move *away* from the 'matters of fact' it analysed) has 'run out of steam', Latour emphasises the need for a positive engagement with the materials and themes that animate intellectual discussion.[27] He develops the concept of a 'matter of concern,' through the use of which intellectuals might begin to blur any absolute distinctions between the objects of their analysis and the standpoint they adopt to analyse (and thereby avoid positioning themselves as objective, external 'critics' of their subject matter).

As a matter of concern, the organic comes to appear not as a self-sustaining entity that follows its own intrinsic laws of development, but as a discursive-technical construct that requires the mobilization of a specific set of resources and commitments for its continued survival. The organic is thought here as an assemblage; an amalgamation of a whole range of entities ranging from tools, texts and institutions to bodies, practices and beliefs.[28] Much recent interest in scientific or 'natural philosophic' (as studies relating to nature were referred to as prior to the nineteenth century) notions of humans and human social groups has centred around the question of whether or not 'science' is something which can be reduced to its

26 Steigler, *Technics and Time 3*, p. 203.

27 Latour, B. 'Why Has Critique Run out of Steam? From matters of fact to matters of concern', *Critical Enquiry* 30 (2004), pp. 225-248.

28 On assemblages see Latour, B. *Reassembling the Social: an introduction to actor network theory* (Oxford; University Press, 2005).

social context, or whether the perception of a certain, 'objective' account of non-human nature might be attainable.[29] What is not generally addressed by such accounts is whether or not non-human (including technical) entities or actors can be said to participate in the constitution and construction of belief. Although the construal of science or natural philosophy as a pre-eminently 'human', 'subjective' activity has been helpful to historians in the past,[30] we now find ourselves in a position in which it has become possible - indeed necessary - to recognise the autonomous contributions of technical equipment and non-human organisms to such endeavour.

My preoccupation with the active participation of animals and tools in the process of apprehending 'nature' coincides with the interests of a number of studies that seek to characterise the scientific activity as above all a 'practice'-oriented activity. The study of science and technology has, over the last four decades, been marked in by a range of historical and ethnographic inquiries seeking to delineate the nature of laboratory-based investigation. Broadly, these studies have begun to turn away from questions relating to the extent to which science might be considered inherently 'social' (most famously contended in Stephen Shapin and Simon Schaffer's *Leviathan and the Air Pump* (1985)).[31] Laboratory science, according to the texts of Latour, Ian Hacking, Karin Knorr Cetina and Andrew Pickering, is marked by a specific set of relations by which human scientists and the objects of their investigation interact and intermingle in what Pickering terms a 'dance of agency.'[32] Haraway has similarly positioned her studies in relation to

29 Young, R.M. 'Science *is* Social Relations' *Radical Science Journal* 5 (1977), pp. 65-129 [available at http://human-nature.com/rmyoung/ accessed 05/04/2011]. For recent debate surrounding the objective or inherently contingent status of 'the social' in historical narrative see Zammito, J.H. *A Nice Derangement of Epistemes: post-positivism and the study of science from Quine to Latour* (Chicago and London; Chicago University Press, 2004), esp. pp. 151-182; Cooter, R. '"Framing" the end of the social history of medicine', in Huisman, F. and Warner, J.H. (eds.) *Locating Medical History: the stories and their meanings* (Baltimore; John Hopkins University Press, 2004), pp. 309-337 and Hayward, R. ''Much Exaggerated': the end of the history of medicine', *Journal of Contemporary History* 40 (2005), pp. 167-178.

30 Young, 'Science *is* Social Relations'.

31 Shapin, S and Schaffer, S. *Leviathan and the Air Pump: Hobbes, Boyle, and the experimental life* (Princeton, NJ; University Press, 1985). On alternative readings of Shapin and Schaffer see Zammito, J.H. *A Nice Derangement of Epistemes: post-positivism in the study of science from Quine to Latour* (Chicago and London: Chicago University Press, 2004), pp. 168-180.

32 Pickering, *The Mangle of Practice*, esp. pp. 21-24. Latour, B. and Woolgar, S.

laboratory hybrids in her more avowedly political accounts of contemporary technoscientific experience.[33] Taken together, these studies indicate that the highly-technical environment of the experimental laboratory constitutes a key site in which living bodies and machines become or are made into techno-organic wholes.

Though they offer powerful conceptual tools that undermine such simplistic notions as the absolute 'objectivity' of science or, conversely, its inherent 'relativism', what these studies have not interrogated quite so closely are the conditions of possibility that have enabled laboratory practices to enjoy such a prominent status in the first place. Such questions were understood as central to the history of science during the 1970s and 1980s. They have since become less fashionable.[34] Existing accounts of the institutionalization of laboratory science (an occurrence universally acknowledged to have occurred during the nineteenth century) tend to privilege one or another of two categories; that of the state, or that of individual scientists.[35] In this thesis, I re-visit the concerns of historians

Laboratory Life: the social construction of scientific facts (Beverly Hills, 1979); Hacking, I. *Representing and Intervening: introductory topics in the philosophy of natural science* (Cambridge; University Press, 1983); Latour, B. *Science in Action: how to follow scientists and engineers through society* (Cambridge, MA; Harvard University Press, 1987); Cetina, K.K. *Epistemic Cultures: how the sciences make knowledge* (Cambridge, MA and London; Harvard University Press, 1999). For an analysis of laboratory-centred 'science studies' in relation to philosophy, see Zammito, *A Nice Derangement*, esp. pp. 151-182.

33 Haraway, *Modest_Witness*.

34 Gooday, G. 'Placing or Replacing the Laboratory in the History of Science?', *Isis* 99 (2008), pp. 783-795; Kohler, R.E. 'Lab History: Reflections', *idem*, p. 761-786; Latour, B. 'The Costly Ghastly Kitchen', in Cunningham, A. and Williams, P. (eds.) *The Laboratory Revolution in Medicine* (Cambridge; University Press, 1992), pp. 295-303. Though see also Lenoir, T. *Instituting Science: The Cultural Production of Scientific Disciplines* (Stamford, CA; University Press, 1997).

35 For examples of work emphasising the former, see: Lenoir, T. 'Science for the Clinic: The Institutional Revolution in German Physics', in Coleman, W. and Holmes, F.L. *The Investigative Enterprise: experimental physiology in nineteenth-century medicine* (Berkeley, 1988), pp. 139-178; Lenoir, T. 'Laboratories, Medicine and Public Life in Germany 1830-1849: Ideological Roots of the Institutional Revolution', in Cunningham and Williams, *The Laboratory Revolution in Medicine*, pp. 14-71; Cooter, R and Sturdy, S. 'Science, Scientific Management, and the Transformation of Medicine in Britain c. 1870-1950', *History of Science* 36 (1998), pp. 421-466. Literature emphasising the latter includes: Geison, G. *Michael Foster and the Cambridge School of Physiology: The Scientific Enterprise in Late Victorian Society* (Princeton, NJ; University Press, 1978); Coleman, W. 'Prussian Pedagogy: Purkyně at Breslau, 1823-1839', in Coleman, W. and Holmes, F.L. *The Investigative Enterprise*, pp. 15-64; Kremer, R.L. 'Building Institutes For Physiology in Prussia, 1836-1846: Contexts, Interests, Rhetoric', in Cunningham and Williams, *The Laboratory Revolution in Medicine*, pp. 72-109.

concerned with the institutionalization of laboratories, but offer a somewhat different account of the conditions upon which they were able to gain cultural traction. Instead of appealing either to an unproblematized 'human' agency, or the 'technical' logic of a bureaucratizing state, I suggest, the establishment of experimental practices as critical to the institutional production of knowing subjects can be understood as concomitant with the assertion of a specific, 'organicist' conception of subjectivity. In other words, I offer here a re-interpretation of the nineteenth-century instantiation of experiment as an academically-respectable practice as dependent not only on a range of bureaucratic conditions and 'individual' efforts, but also on the specific, embodied, zoologically-informed conception of self that came to the fore at this time.

So as well as asserting that the organic, as a 'matter of concern', is in some sense inherently 'technical', this thesis makes a second, critical claim; that in establishing the organic as an authoritative mode of subjectivity, those actors or entities that help constitute such modes also establish the very conditions by which the organic begins to be re-cast as part of a broader, techno-organic whole. In other words, this thesis contends that a paradox can be said to lie at the heart of some of the more strident claims relating to the study of life: privileging the organic as a means by which questions relating to all kinds of experience might be explained has, historically, been irretrievably intertwined with the bringing-into-existence of the very technical entities that have subsequently become emblematic of 'post-organic' (and posthuman) modes of subjectivity. A comment by Judith Butler, one of the most provocative and controversial theorists of embodied conceptions of subjectivity in recent times, encapsulates this line of argument succinctly: technical subjectivity, I contend, 'has its own… temporality in which it remains enabled precisely by the contexts from which it breaks... within political discourse, the very terms of resistance and insurgency are spawned in part by the powers that they oppose.'[36] The concept of a matter of concern implies that the notion of the self as inherently 'technical' is dependent upon the very organo-centric intellectual conditions out of which it has been able to emerge since the middle decades of the nineteenth century.

The organic is thereby portrayed as a matter of concern that is not only

36 Butler, J. *Excitable Speech: a politics of the performative* (New York and London, 1997), p. 40.

assembled, but which *participates* in the assembly of subjects and objects. Hence a primary purpose of this text is to begin to re-cast the organic as a key contributor to a broader process by which bio-technical entities and representations have come to proliferate, diversify and diffuse throughout technoscientific culture. Its concern is not to evaluate or compare different notions of life with a view to privileging one above the other. Nor is it to contest the legitimacy of organicist modes of thought in any absolute sense. Rather, it follows Butler in asserting the potential for subversion that the repetition or 'citation' of modes of expression that lie outside of one's own set of beliefs can have. Butler notes that 'the resignification of norms is... a function of their *inefficacy*, and so the question of subversion, of *working the weakness in the norm*, becomes a matter of inhabiting the practices of its rearticulation.'[37] To the extent that it constitutes a rearticulation of a set of convictions and beliefs relating to 'life', this thesis highlights ways in which the organic participates in the constitution of modes of being that to it remain outside the domain of the enunciable. In announcing themselves as authoritative, organic modes of subjectivity, it claims, have participated in the construction of alternative modes of being that refuse the very possibility of apprehending a 'nature' that is not always already 'cultural' and/or 'technical'.[38] It thereby identifies the assertion that the self is inherently organic as a participant in what Butler refers to as the 'turning of power against itself to produce alternative modalities of power.'[39] To be concerned about any particular matter is to care about its fate.[40] As partly technical beings, we should not seek to disarticulate ourselves absolutely from the organic matter that concerns us.

37 Butler, J. *Bodies that Matter: on the discursive limits of "sex"* (London, 1993), p. 237.

38 On relations between these terms, see Michael, M. *Reconnecting Culture, Technology, and Nature: from society to heterogeneity* (London. 2000).

39 Butler, *Bodies that Matter*, p. 241. See also Butler, *Excitable Speech*, pp. 141-159.

40 Latour, 'Why Has Critique Run out of Steam?', p. 232; de la Bellacasa, M.P. 'Matters of Care in Technoscience: assembling neglected things', *Social Studies of Science* 41 (2011), pp. 85-106.

Locating the organic in the British nineteenth century

So far, I have referred to 'the cultural', 'the organic' and 'the technical' in a general and somewhat imprecise manner. Whilst this thesis does in some respects aspire to representing organicism as a phenomenon that embodies a certain set of power relations in general, it does not attempt to offer a universal history of ideas relating to 'life'. Instead, it presents an analysis of a specific time (the nineteenth century), a specific place (Britain) and a specific academic discipline (zoology) as a temporal, spatial and intellectual field through the analysis of which we might begin to construct a more general conception of the ways in which 'the' organic has participated in the constitution of technical modes of subjectivity through time. This thesis thereby represents the nineteenth century as a critical period for the formation of technicalization of power in the West.

Others have pointed to the emergence of new forms of self-identification during the nineteenth century.[41] To take one persuasive example, Friedrich Kittler, in his analysis of German discursive formations (*Discourse Networks 1800/1900* (1990)), has identified the period as marked by a critical shift in subjective modes. Kittler contrasts an early-nineteenth-century notion of individuality, integrity and 'authorship' with turn-of-the twentieth century conceptions of representative practice as a dissolving of unified, authorial beliefs regarding the self. He thereby positions the nineteenth century as constituting a set of conditions that enabled a fundamental re-alignment of the place of humanity in intellectual and figurative practice. In Kittler's 1800, authorship or the 'fixing' of text constitutes the human writer as 'childlike' male outside of feminine 'nature', who seeks to 'interpret' and thereby inculcate into (other male) readers a sense of a simultaneously spiritual, feminine, 'natural' source of truth. By Kittler's 1900, in contrast, a world has been constituted in which the (no-longer so markedly gendered) 'act' of authorship is characterised by the interaction of certain kinds of mechanical and living bodies (most notably gramophones, typewriters, and film equipment, along with their designers and operators) that bring the possibility of representing anything apart from immediate, subjective experience into question.[42] By 1900, for Kittler, the self

41 Eg. Foucault, M. *A History of Sexuality* [Vol.I] (Harmonsworth, 1981); Kittler, F.A. (trans. Metteer, M.) *Discourse Networks 1800/1900* (Stanford; University Press, 1990).

42 Kittler, *Discourse Networks*.

has become something that can no longer be thought as constituted in relation to an autonomous, non-human ‘nature’, because it is being recognised that human bodies are being integrated ever-more closely into a world defined by certain types of machinery.

As well as pointing to the nineteenth century as a time of radical change in subjective modes, Kittler's work presents the period via a form of narration that does not rely on a temporally linear progress from beginning to end. Drawing on tools and techniques developed by post-structuralist authors such as Jacques Derrida, Jacques Lacan and Michel Foucault, *Discourse Networks* articulates a conception of history as marked by a series of absolute epistemic breaks in modes of mediation.[43] What is enunciable at any given time, for Kittler, is constituted in relation to the technical conditions within which enunciation takes place: subjective modes centred around print and notions of self-'cultivation' in 1800 are represented as absolutely distinct from those that developed in conjunction with gramophones, films and typewriters around 1900. Whilst Kittler's linking of modes of discourse with the technical means by which such discourse took place is highly suggestive, there is little room in this account for forms of agency that are not either technical or human. The human is taken out of its animal, evolutionary context and placed in conjunction with a range of tools and devices that constitute radical differences in ways of thinking of the (always-already-human) self. Subjectivity is invariably mediated 'technically', but not necessarily done so ‘developmentally’ or 'organically'.

In that I seek to refigure nineteenth-century texts relating to animality and embodiment into a comprehensible commentary on the place of the organic in a technically-defined world, I adopt a narrative strategy that owes somewhat more to nineteenth-century commitments to evolutionary gradualism. Geoffroy Bowker's recent *Memory Practices in the Sciences* (2005) points to the nineteenth century as a critical period for the emergence of what we now understand as conventionally 'historical' modes of narration. Through a consideration of the geological science of the British natural philosopher Charles Lyell, Bowker shows how the notion of a perceptible ‘past’ that has its own, not-necessarily human agency informed much nineteenth-century scientific practice. Bowker shows that by thinking of the earth

43 Wellbery, D.E. ‘Foreword’, in Kittler, *Discourse Networks*, pp. vii-xxxiii.

as an (imperfect) archivist, Lyell helped consolidate a notion of the disciplined observer as a subject who's duties included the imposition of 'natural' order: it was the author's duty to 'interpret' or create order out of the uneven records left to the present by an abstract, impersonal 'past'.[44] In my own use of archives and textual records, I similarly draw together archival materials to form my own sense of order: one informed by the concerns regarding organic-technical interaction highlighted above.

All of which is not to say that I relate nineteenth-century texts as authoritative means of conceiving of our present selves. As already noted, this text is a bringing-together or 'refiguring' of materials relating to organic nature that were produced during the nineteenth century. It is inevitably partial, selective and informed by my own specific concerns.[45] Bowker notes that many nineteenth-century authors represented themselves as able to pronounce on the ordered nature of things because of their (self-)positioning as technically-constituted beings outside of 'nature'.[46] Here, I privilege nineteenth-century texts that, by insisting on the embodiment of mind in the nervous system, as well as the 'animality' of man, called this contention into question. I do so not because I believe that these well-studied nineteenth-century considerations of selfhood and human 'nature' are inherently interesting or especially plausible (I don't), but rather because they present a particularly vehement example of the assertion that we are first and foremost 'organic' beings.

The nineteenth century saw the coming-to-pre-eminence in Britain of notions of humanity as an inherently 'zoological' entity. Historians have long pointed to the establishment of 'evolutionary' modes of thinking at this time, especially in relation the so-called 'Darwinian Revolution'.[47] In recent years,

44 Bowker, *Memory Practices*, pp. 35-73.

45 See Haraway, D. 'Situated Knowledges: the science question in feminism and the privilege of partial perspective', *Feminist Studies* 14 (1988), pp. 575-599.

46 Bowker, *Memory Practices*, pp. 35-73.

47 I do not directly address 'Darwinism' as a movement in this thesis for two major reasons. Firstly, Darwin studies have shown that the conception of Darwinism as a 'revolutionary' event that first showed how man was inextricably connected to the rest of organic nature is largely a twentieth-century myth (see the recent special issue of *Isis*: *Isis* 100 (2009), pp. 537-614.). Secondly, those that did adhere to the 'Darwinian' label during the nineteenth century, such as Thomas Henry Huxley, frequently remained highly ambivalent regarding the embodiment of mind in the nervous system (see e.g. White, P.

narratives describing the establishment of 'life' sciences such as zoology and botany as respectable academic disciplines have been related in terms of the re-organization of knowledge as a whole during the period.[48] Differences between nineteenth-century notions of 'science' or 'natural philosophy' have been understood as disputes relating to questions of political organization, as well as the desirability (or otherwise) of certain forms of human conduct.[49] It is now well recognised that, in an important sense, the nineteenth century can be understood as one in which experience first became 'scientific' for a broad range of the British population.

The British nineteenth century has thereby constituted the focus of many histories of science concerned with examining the specific and contrasting means by which knowledge concerned with the definition of organic subjectivity has been produced and constructed over time. Such texts have characterised the period as one in which a wide variety of practices - including such diverse categories as literary narration, museological collection and display, experimentation, and natural philosophic journeying - contributed to the formation of a discourse that sought to encapsulate the nature of life.[50]

Thomas Huxley: making the "man of science" (Cambridge; University Press, 2003)). Major studies of and collections regarding Darwinism include: Beer, G. *Darwin's Plots: evolutionary narrative in Darwin, George Eliot and nineteenth-century fiction* [2nd ed.] (Cambridge and New York; Cambridge University Press, 2000 [1983]); Kohn, D. (ed.) *The Darwinian Heritage* (Princetion; University Press, 1985); Young, R.M. *Darwin's Metaphor: nature's place in Victorian culture* (Cambridge; University Press, 1985); Desmond, A. and Moore, J. *Darwin* (London, 1991); Browne, J. *Charles Darwin* [Vols. I: *voyaging* and II: *the power of place*] (London, 1995-2002).

48 Pickstone, J.V. *Ways of Knowing: a new history of science, technology and medicine* (Manchester; University Press, 2000). Bowker, *Memory Practices*, pp. 35-73; Hopwood, N., Schaffer, S. and Secord, J. 'Seriality and Scientific Objects in the Nineteenth Century', *History of Science* 48 (2010), pp. 251-285.

49 On nineteenth-century organic science in Britain as inherently 'political', see especially Young, R.M. *Darwin's Metaphor* and Desmond, A. *The Politics of Evolution: morphology, medicine and reform in radical London* (Chicago and London; Chicago University Press, 1989) . On the relevance of 'science' to ideals of human conduct more generally, see especially Poovey, M. *Making a Social Body: British cultural formation 1830-1864* (Chicago and London, Chicago University Press, 1995); Cooter, R. *The Cultural Meaning of Popular Science: phrenology and the organization of consent in nineteenth-century Britain* (Cambridge and New York; Cambridge University Press, 1984); Winter, A. *Mesmerized: powers of mind in Victorian Britain* (Chicago and London; Chicago University Press, 1998); Musselman, E.G. *Nervous Conditions: science and the body politic in early industrial Britain* (Albany; State University of New York Press, 2006).

50 Major studies and collections include: Coleman, W. *Biology in the Nineteenth Century: problems of form, function and transformation* (Cambridge and New York; Cambridge

Britain has also long been considered a context in which industrial practices proliferated relatively early. A range of histories highlight how the factories that had remained very much outside of every-day life during the eighteenth century became ever-more definitive of British identity during the nineteenth. The nineteenth century was marked by a rapid process of urbanization, industrialization and bureaucratization that fundamentally altered both the structure of the British state and the beliefs and experiences of those living within it.[51]

Yet these two trends - the elevation of conceptions of self explicitly committed to conceiving of man as an exclusively organic being, and the coming-to-pre-eminence of technical modes of production and self government – have only recently begun to be thought in relation to each other. With a small number of significant exceptions,[52] the technical emphases of 'industrialization', and the coming-to-pre-eminence of 'organicism', have been treated as categorically separate (if nevertheless complimentary) historical movements. The British nineteenth century, then, presents a rich set of possibilities for thinking through ways in which technical and organic entities have come to constitute different parts of the same systemic whole in specific, historically-contingent ways.

The organization of this thesis

Along with many texts that address the emergence of 'science' as a set of ideals that emerged during this period, my initial concern in this thesis is with the

University Press, 1977); Beer, *Darwin's Plots*; Rehbock, P.F. *The Philosophic Naturalists: themes in early-nineteenth-century British Biology* (Madison; University of Wisconsin Press, 1983); Ritvo, H. *The Animal Estate: the English and other creatures in the Victorian age* (Cambridge, MA; Harvard University Press, 1987); Desmond, *The Politics of Evolution*; Rupke, N. *Richard Owen: biology without Darwin* [revised ed.] (Chicago and London; University of Chicago Press, 2009 [1994]); Secord, J.A. *Victorian Sensation: the extraordinary publication, reception, and secret authorship of* Vestiges of the Natural History of Creation (Chicago and London; Chicago University Press, 1996)

51 Ketabgian, *The Lives of Machines*; Berg, M. *The Machinery Question and the Making of Political Economy 1815-1848* (Cambridge; University Press, 1980); MacDonagh, O. 'The Nineteenth-Century Revolution in Government: a reappraisal', *The Historical Journal* 1 (1958), pp. 52-67.

52 Ketabgian, *The Lives of Machines*; Morus, *Bodies/Machines*; Poovey, *Making a Social Body;* Desmond, *The Politics of Evolution*.

constitution of a zoological science and its close relation, 'physiological psychology', as specifically academic ‘disciplines’. However, concerned as I am above all with relations between the living and the technical, I pay particular attention to the place of what I refer to as 'epistemic' tools and techniques (ie, those tool sand techniques utilised in the constitution of belief)[53] that were brought to bear in these disciplines' formation.[54] In so doing, I follow Mary Poovey's *Making a Social Body* (1995) in refusing appeals to either technical bureaucratization or individual human agency as modes of historical explanation.[55] Poovey's text brings to the fore ways in which the constitution of disciplines during the early nineteenth century can be understood as simultaneously discursive and material.[56] But where it focuses on 'institutions' as the pre-eminent category of the 'material',[57] I emphasise techno-organic assemblages more generally: epistemic tools such as microscopes and museum specimens, as well as humans themselves,

53 The term ‘epistemic tool’ is an adaptation of Hans-Jörg Rheinberger’s concept of an ‘epistemic thing’; a laboratory hybrid of organism and machine. See Rheinberger, H-J. *Towards a History of Epistemic Things: synthesising proteins in the test tube* (Stanford; University Press, 1997). Rheinerger develops this concept as an object of his ‘archaeological’ excavation of experimental systems in scientific life. His focus is above all else on the ways in which scientific truth gets constituted in discourse through the construction of such hybrid objects. Whilst sympathetic to the overall aims of this project, I am concerned here not with how laboratories constitute 'epistemic things,' but with how such techno-organic hybrids came to be valued as entities that were worth producing in the first place. Emphasising the technical constitution of knowledge practices in science and natural philosophy, the notion of an ‘epistemic tool’ - a tool that is valued because of its’ perceived utility in the production of truth – allows an interrogation of knowledge-constituting practices without assuming a-priori (as Rheinberger tends to) that the means by which such constitution takes place is through a relation between an organically-defined, embodied observer and a technical assemblage in a dedicated scientific laboratory. Indeed, as Tamara Ketabgian has recently argued, it was a *human*-tool interaction (not an *organism*-tool interaction) that formed the pre-eminent figure of production during the nineteenth century. See Ketabgian, *The Lives of Machines*, pp. 17-44 and Ketabgian, T. 'The Human Prosthesis: workers and machines in the Victorian industrial scene,' *Critical Matrix* 11 (1997), pp. 4-32.

54 In this emphasis on a need to interrogate relations between ‘the technical’ and natural philosophy or science, I follow Forman, P. 'The Primacy of Science in Modernity, of Technology in Postmodernity, and of Ideology in the History of Technology', *History and Technology* 23 (2007), pp. 1-152; Porter, T.M. ‘How Science Became Technical’ *Isis* 100 (2009), pp. 292-309, and Forman, P. '(Re)cognizing Postmodernity: helps for historians - of science especially' *Berichte zur Wissenschaftsgeschichte* 33 (2010), pp. 157-175.

55 Poovey, *Making a Social Body*, pp. 98-114.

56 Ibid, pp. 6-7.

57 Ibid.

played at least as critical a role in the formation of disciplines as did the institutions and statistical and fictional texts that *Making a Social Body* analyses.

To this end, chapter one of this thesis relates ways in which the texts attributed to one zoological author, Robert Edmund Grant, came to be shaped by the technical conditions under which he worked during the early nineteenth century. During the 1820s, Grant's texts appealed to the microscope as a means by which the nature of relations between life and non-life (or as they put it, the organic and the chemical) might be interrogated. At stake was the politically-relevant question of whether laws developed in relation to non-living matter could be extended to the realm of life, or whether a specific, non-material force or spirit was required to explain the existence of the living. Yet during the 1830s, after Grant had been appointed as professor of zoology at University College London, this concern with microscopy came to be displaced by a seemingly more pressing concern with relations between anatomical forms visible to the naked eye. Grant's works abandon their concern with relating living and non-living matter in favour of the analysis of life itself as a unitary whole. Such a shift is explained in terms of the epistemic condition of the time, in which anatomical specimens were privileged over lens-based observations of the very small as means of witnessing nature. In a setting in which the question of observation was thought in terms of gentlemanly agreement amongst a community of observationally-privileged 'witnesses', microscopes were not considered an especially reliable means of perception. Collections of museum specimens, on the other hand, could both be witnessed by a large number of observers at one time, and were understood as embodiments of personal and national prestige. Producing and analysing museum specimens thereby came to be understood as more conducive to the formation of zoology as an academic discipline than appeals to the observational efficacy of tools such as microscopes.

The second chapter follows a similar trajectory to the first, in that it relates the differing commitments of two self-proclaimed 'physiological' analysts of the human mind in terms of the epistemic tools that their psychologies appealed to. The publications of William Benjamin Carpenter, one of the most well-known physiologists of nineteenth-century Britain, critiques prior characterizations of psychological nature on anatomical grounds. In contrast, the publications of Thomas Laycock present microscopic evidence as critical to consideration of

psyche as an embodied phenomenon. The differing emphases of these author's psychologies, as well as their respective attempts to propagate their own notions of the psyche, are analysed in relation to the changing status of microscopes and museums over the middle decades of the nineteenth century. Psychology, as the study of the nervous body, is thereby understood as predicated on to the same technical commitments as the academic discipline of zoology.

Together, these two chapters delineate ways in which tools and techniques relating to the study of zoology were brought to bear on what had hitherto been understood as nominally 'moral' questions, such as the necessity of deistic intervention in the creation of life, or the relation between reason and emotion. Technical concerns are thereby shown to have been integral to both the distinction of and negotiation of relations between studies of life and mind in nineteenth-century Britain.

However, physiological psychologists, unlike their more conventionally zoologically-concerned counterparts, found themselves without a ready set of institutional conditions upon which they could found their science as a stable 'discipline'. Chapters two and three thereby present a contrast between zoological and physiological psychological approaches to the formation of 'scientific' disciplines. Where zoologists were able to justify their status as experts and retain a sense of common purpose in relation to a museological programme of description and organization of specimens, physiological psychologists relied on their mutual commitment to a technical *epistemology* to a far greater extent. Though Carpenter and Laycock disagreed, and emphasised different conceptions of nervous physiology, both were united in their opposition to the notion that mind could be thought as a non-physiological phenomenon. Physiological psychological texts (published and unpublished) emphasise a need to agree on the specific tools and techniques that can be considered appropriate to psychological investigation. In so doing, they begin to represent science in general as an inherently 'technical' endeavour: one which both relies on the development of non-textual tools and techniques for its advancement, and concomitantly requires for its practice the mastery of an increasingly esoteric, technical set of linguistic terms.

A specifically 'physiological' psychology of learning is thereby understood as an indispensable element in the coming-to-pre-eminence of laboratory-based experimental techniques in British universities during the nineteenth century.

Examining the institutionalization of experimental practices in laboratories during the 1860s and 1870s, chapter three brings the extent to which technical commitments were made explicit by nineteenth-century organicism to the fore. Not only did physiological psychologies appeal to specific tools and techniques in their attempts to define the nature of the nervous subject: their texts were also integral to the configuration of experimental pedagogy as critical to the industrial success of the nation. The concept of power as physical energy - something that can be said to inhere in all material entities, and that constitutes a pre-requisite for animate existence - was critical to this instantiation. In representing learning as an inherently bodily, energetic activity, the texts of psychologists such as William Benjamin Carpenter and Alexander Bain privilege muscular interaction with materials and tools over the representation of truth through language. Physiological psychological texts are thereby shown to have constituted a key means by which not only the apprehension of non-human nature, but cognition of all kinds begins to be thought as an inherently technical endeavour at this time.

Chapters four and five explore ways in which late nineteenth century culture more generally came to be fashioned around tools and techniques valued as integral to the conduct of life sciences. Chapter four emphasises the importance of engaging with scientific equipment for those that wished to participate in (and contribute to) scientific ways of life. Such tools as microscopes were not only valued as a means by which human perception might be 'extended', but also as helping constitute authoritative perceptions in their own right: perception was coming to be understood not as something that occurs through the human body alone, but as interaction between an observing body and the technical equipment that it engages with. This critical shift in notions of what it means to be an observer is explored in relation to the differing ways in which middle-class women came to construct themselves (and be constructed) as competent microscopists. One of the most reputable women natural philosophers of early nineteenth-century Britain, Mary Somerville, appealed to the rational capacities of her (to her non-physiological) mind in her efforts to gain recognition as an original thinker. In contrast, women responding to the physiological conditions of mid-to-late nineteenth-century culture such as Alice Hart and Elizabeth Hoggan appealed to their technical competence and ability to develop new preparatory techniques for microscopic investigation. As the conduct of science came to be understood as a

matter of cultivating technical capacity, so acknowledgement within scientific culture came more and more to depend on one's ability to interact with and develop specific forms of equipment.

Chapter four, and especially chapter five, also point to ways in which equipment relating to the investigation of physiology has itself helped constitute subjectivities that remain committed to 'embodiment', but which do not confine themselves to individual bodily 'soma'. Examining two late-nineteenth-century figures - Edward Carpenter and Samuel Butler - who, in different ways, gained reputations for radicalism, chapter five notes the key role that vivisected animals played in their respective publications. Edward Carpenter came to be recognised as one of the founding fathers of British socialism and anarchism. The texts of many of his speeches, however, are pre-occupied with questions relating to the foundation of an anti-capitalist, technically non-invasive epistemology. Carpenter hoped that, in upholding a vision of science as a re-conciliation of humanity with an unadorned living 'nature', he might help inspire the formation of a non-competitive, mutually co-operative way of being in the world. To him, challenging capitalism meant becoming more 'animal'. In contrast, Samuel Butler's fictional and speculative conception of being complicates any attempt to consider organisms and tools as separate, unrelated entities. Drawing on physiological experimentation and physiological psychological tropes such as the creative efficacy of 'habit', Butler's works portray a situation in which the organic and the mechanical can no longer be thought as mutually independent categories. It is, for Butler, at the coming-together of life and mechanism that we become aware of our presence in the world. Insisting on an organic subjectivity that does not acknowledge 'the technical' would risk abandoning ourselves to a technically-determined future. Between Butler and Carpenter's texts, we can begin to apprehend the emergence of a new set of questions relating to humanity's place in the world. As Kittler's *Discourse Networks* observes, the question of subjectivity, by the end of the nineteenth century, was beginning to be thought in terms of a relation between organism and machine, as well as (as had been the case in early nineteenth-century zoological thought) one between matter and spirit.

As a narrative, then, this thesis moves from questions that address embodiment (the relation or lack thereof of natural law to the conception of the body, and of the nature of nerves to the understanding of mind) to those that

address relations between forms of body (whether we should privilege a conception of ourselves as amalgamations of organs and tools, or seek to resist such amalgamations through a reconciliation of ourselves with 'nature' as a whole). In its focus on the ways in which technical subjectivity has been constituted over time, it puts the possibility of conceiving of ourselves as non-technical, 'organic' bodies that operate independently of technical entities into question. Yet, at the same time, it positions the notion of the self as an organic being as critical to the conceptualization of nature as always-already technical in the first place. Finally, as the conclusion to this thesis indicates, this integration of the organic and the technical is as relevant to the conduct of historical writing as it is to that of science and engineering.

Chapter 1:

Techniques of Dispute: microscopes, museums, and the discipline of zoology in early-nineteenth-century Britain

Introduction

My concern with the place of technical entities in the constitution of belief is bound up with what I understand as their integral role in contemporary academic culture. It is generally acknowledged that the division of intellectual labour into the specialised, distinct 'disciplines' that dominated twentieth-century thinking (and still maintain a significant presence at the start of the twenty-first) had its origins in the nineteenth-century academy. It is now clear that political economic faith in the expansion of productivity through the 'division of labour' played an integral role in the organization of late-nineteenth-century academic life.[1] It would nevertheless be an exaggeration to portray political economy as an independent, determining force in academic culture during the period in question. Political economists faced similar problems of organization to those experienced by other nascent disciplines of the time such as anatomy, zoology, engineering or chemistry.[2]

What marks nineteenth-century economists out from other aspiring academicians of the time, however, is their particular concern with sites in which human practices were becoming ever more integrated with the operations of industrial tools. As an analysis of factory production, political economy characterised the division of labour and, importantly, its simultaneous reconstitution around machinery, as the inevitable consequence of national

1 Lenoir, *Instituting Science*, pp. 45-74.

2 Rothblatt, S. 'State and Market in British University History', in Collini, S. Whatmore, R. and Young, B. (eds.) *Economy, Polity, and Society: British Intellectual History 1750-1950* (Cambridge; University Press, 2000), pp. 224-242.

economic and intellectual 'progress.'[3] Although the former of these contentions - that the division of labour constituted a means of expanding production of all kinds - has been addressed by intellectual historians in some detail, its corollary - that this re-organization of labour is a pre-eminently 'technical' endeavour - is less frequently acknowledged in considerations of the industrialization of intellectual practice. Although academic disciplines are recognised as emerging in conjunction with political economic concerns regarding the specialization of production, the specific means by which they were constituted remains unclear. Addressing the constitution of two aspirant 'disciplines' - zoology and psychology - that constituted themselves as mutually relevant during the nineteenth century, the first part of this thesis thereby re-examines the place of tools in nineteenth-century academic culture.

In this chapter, I focus on the tools and techniques that one interpreter of nature – Robert Edmund Grant - brought to bear in his efforts to establish zoology as an academic field of study during the first half of the nineteenth century. Grant was one of the earliest advocates of a systematic or 'philosophic' zoology in Britain.[4] Following a relatively privileged, middle-class upbringing in Edinburgh, he had around 1811 begun to read classics at the city's university, studying Greek and geometry. He also found himself attracted to the then highly respected medical faculty of that institution. Studying medicine was not generally considered in terms of the joining of a professional body at this time (indeed, the idea of a medical 'profession' was at best embryonic in Britain during the first decades of the century). Rather, it constituted a broad-based investigation into the nature and

[3] Berg, *The Machinery Question*.

[4] Details of Grant's life can be found in Parker, S.E. *Robert Edmund Grant (1793-1874) and his Museum of Comparative Anatomy* (London, 2006), Parker, S and Desmond, A. 'The Bibliography of Robert Edmund Grant', *Archives of Natural History* 33 (2006), pp. 202-213 and 'Biographical Sketch of Robert Edmund Grant, M.D., F.R.S.L. & E, &c.', *The Lancet*, 56 (1850), pp. 686-695. Other articles that address Grant's work directly include; Desmond, A. 'Robert E. Grant: The social predicament of a pre-Darwinian transmutationist', *Journal of the History of Biology* 17 (1984), pp. 189-223; Desmond, A. 'Robert E. Grant's Later Views on Organic Development: The Swiney lectures on “palaeozoology,” 1853-1857', *Archives of Natural History* 11 (1984), pp. 395-413; Sloan, P.R. 'Darwin's Invertebrate Program, 1826-1836: Preconditions for Transformism', in Kohn, D. (ed.) *The Darwinian Heritage* (New Jersey; Princeton University Press, 1985), pp. 71-120; Desmond, *The Politics of Evolution*; Secord, J. 'Edinburgh Lamarckians: Robert Jameson and Robert E. Grant', *Journal of the History of Biology* 24 (1991), pp. 1-18.

philosophy of living bodies (though focused above all on the human body).[5] It was as an aspiring, middle-class 'natural philosopher,' then, that Grant became one of the first Britons to tour Europe following the downfall of Napoleonic France in 1815.

Grant travelled extensively on the continent, visiting established natural philosophers and savants, and coming into contact with many of the most respected intellectual figures of early nineteenth century Europe. Having returned to Scotland, and effectively become an 'apprentice' to his initial mentor in natural history Robert Jameson, he was appointed professor at the newly-founded University College London in 1827.[6] In becoming a member of this for-the-time radical intellectual establishment, founded on a commitment to the emerging ideals of a law-determined political economy, he occupied the first professorship of Zoology (full title 'Zoology and Comparative Anatomy') to be offered in England.[7] His ideals as a zoologist accorded well with those of the university's founders. His publications articulate a conception of zoological life as similarly law-determined – a commitment that went against many accounts of zoological nature in Britain at this time.[8] As such, he can be identified as an exemplary figure for the institution of zoology as an academic discipline in Britain.

Despite Grant's pivotal role in the formation of British zoology as recognisably 'disciplinary'[9] during the 1830s, few of the specific contentions that he

5 Jacyna, L.S. *Philosophic Whigs: medicine, science, and citizenship in Edinburgh, 1789-1848* (London and New York, 1994); Rosner, L. *Medical Education in the Age of Improvement* (Edinburgh; University Press, 1991); Lawrence, C. 'The Edinburgh Medical School and the end of the "Old Thing" 1790-1830' *History of Universities* 7 (1988), pp. 279-286; Lawrence, C. 'Alexander Monro Primus and the Edinburgh Manner of Anatomy', *Bulletin of the History of Medicine* 62 (1988), pp. 193-214.

6 The institution was originally simply called The University of London, but soon changed its name to University College London. To avoid confusion, I refer to it as University College London or UCL throughout.

7 On the foundation of UCL see Harte, N. and North, J. *The World of UCL, 1828-2004 (3rd ed.)* (London; University College London Press, 2004), pp. 26-27. On the medical faculty, see Mazumdar, P. 'Anatomy, Physiology and the Reform of Medical Education: London, 1825-1835', *Bulletin of the History of Medicine* 57 (1983), pp. 230-246. Mazumdar, P. 'Anatomy, Physiology, and Surgery: Physiology teaching in early nineteenth-century London', *Canadian Bulletin of Medical History* 4 (1987), pp. 119-143.

8 Elwick, J. *Styles of Reasoning in the British Life Sciences: shared assumptions, 1820-1858* (London, 2007), p. 12. Desmond, *The Politics of Evolution*, p. 84 (n. 141).

9 As in Foucault's work, I use 'discipline' here in two principal senses - firstly, to signify a

held regarding the status of natural law and the nature of life came to be adopted by his contemporaries or immediate intellectual descendants.[10] For example, as will be seen, Grant sought to promote a zoology inspired by continental natural philosophy that emphasised his belief that it was through an understanding of the nature of the non-organic that the key to knowledge of life could be found. The microscopic structure of the simplest organisms, he believed, could be explained in terms of natural laws that would describe the operation of physical and chemical nature, as well as the living. Such contentions remained at the margins of British thought throughout the period. Though much British zoology prior to the 1850's and 1860's emphasises the unity of *life*, detailed research seeking to establish the unity of *nature* - and especially natural law - is less prominent.[11] It was not the possibility of the development of life from inorganic nature that framed the most controversial mid-nineteenth-century zoological debates, but the possibility that a being as apparently complex as man had somehow grown or developed out of a simpler or 'lower' organic form. Grant's zoology can be differentiated from that of his British peers by reference to the particularly strong emphasis that he placed on the explanatory efficacy of natural law.

The formation and significance of Grant's epistemological stance has been related in terms of the social context that he inhabited. Most prominently, Adrian Desmond's *The Politics of Evolution* (1989) draws on 'interest'-determined accounts of scientific knowledge in his presentation of nineteenth-century British

process of splitting from universalist to specialist knowledge production in academic and intellectual life, and secondly, as signifying technologies and techniques that primarily function as means of inculcating specific modes of conduct in humans. See Foucault, M. *The Order of Things: An Archaeology of the Human Sciences* (London, 1974) and Foucault, M. *Discipline and Punish: The Birth of the Prison* (London, 1991 [1977]). Lenoir, *Instituting Science*, pp. 45-51 presents a useful discussion of Foucaultian discipline in relation to nineteenth-century science. Such notions are more fully developed in chapter three.

[10] Desmond, 'Robert E. Grant.'

[11] Though the popularity and controversial status of such works as Robert Chambers' *Vestiges of the Natural History of Creation* (1844) demonstrates that there was certainly interest in such issues. See Secord, *Victorian Sensation*. Later concern with 'spontaneous generation' is addressed in Strick, J.E. *Sparks of Life: Darwinism and the Victorian debates over spontaneous generation* (Cambridge,MA and London; Harvard University Press, 2000). Nineteenth-century zoological distinctions between the unity of life and the unity of nature are most clearly addressed in Lenoir, T. *The Strategy of Life: teleology and mechanics in nineteenth-century German biology* (London, 1982).

zoology as riven by a split between conservative and radical approaches to the newly-constituted study of 'life'.[12] As a self-declared 'radical', Grant is shown by Desmond to have held a set of political concerns that were diametrically opposed to the conservative interests of many of his fellow zoologists (exemplified by the figure of Richard Owen). Grant's zoology, in Desmond's account, is conceived of as an outgrowth of his social position and political beliefs.

However, 'interest'-centred accounts such as Desmond's have become the object of criticism in recent years.[13] In such accounts, an (invariably human) actor's 'interests' are understood as a set of social conditions that determine the statements that that actor makes regarding the world. Numerous articles have appeared highlighting significant weaknesses that inhere in projects that seek to explain the construction and validation of claims regarding the natural by recourse to a category – the 'social' – that is by no means itself established as a 'real' entity. Sociologists of science, it seems, are split between a desire to affirm the 'reality' of society (and thereby fall back on a foundationally 'scientific' claim regarding the the existence of a world 'out there'), and a need to affirm the 'relativity' of scientific knowledge (which undermines any confidence in the existence 'the social' as a mode of causation). By appealing to such entities in the explanation of belief regarding the natural, sociologists render science an entity able to be conceived of as the same sort of activity as the study of literature or history. For sociological authors, the constitution of the natural as a critical object of investigation has no specific historical 'force' as it were – in Foucault's terminology, it cannot be associated with a specific 'episteme'. Yet in rendering science transparent to its context, sociological accounts posit a place outside of either nature or representation – as Haraway terms it, a 'view from nowhere' - for their own claims.

Social and cultural explanations of contemporary science fail to recognise that the scientific modes of belief that have become so predominant in our

[12] Desmond, *The Politics of Evolution*.

[13] See eg. the dispute between David Bloor and Bruno Latour that occurred during the late 1990s: Bloor, D. 'Anti-Latour', *Studies In History and Philosophy of Science Part A*, 30 (1999), pp. 81-112; Latour, B. 'For David Bloor... and Beyond: a reply to David Bloor's 'Anti-Latour'', *Studies In History and Philosophy of Science Part A*, 30 (1999), pp. 113-129; Bloor, D. 'Response to Bruno Latour', *Studies In History and Philosophy of Science Part A*, 30 (1999), pp. 131-136. On Bloor and others' 'SSK' approach more generally see Zammito, A *Nice Derangement of Epistemes*, pp. 123-182.

contemporary world are indeed differentiable other forms of endeavour. They are so not because they offer epistemologically superior modes of investigation. Nor so because they invest in an ontology that is inherently more interesting or powerful than any other. Rather, they are marked out by the kinds of entity that are both appealed to and produced during scientific practice: not, as has been argued, entities geared towards *representation* (such as texts and diagrams),[14] but by tools and techniques intended for the extension of *observation* and *perception.* That is to say, the nineteenth-century coming-to-pre-eminence of 'science' is accompanied by the privileging of an epistemology in which tools and techniques of *representation* are re-evaluated in relation to those of *perception* more generally. As Pickering and others have documented as some length, the practice of science today constitutes a specific set of technical entities, the use and proliferation of which have come to be valued as indispensable to the apprehension of existence, and as at least as (if not more) significant than any verbal or written statement.[15] By examining the specific conditions under and situations in which these entities came to be valued in this way, we can begin to appreciate the specificity of the historical situation that belief in the project of science has constituted, as well as (as addressed in previous accounts) its relation to the situations in which it has arisen. It is the contention of this study that the nineteenth century saw a transition in which the study of nature changed from an inherently representational endeavour (natural philosophy) to an inherently technical one (disciplinary science), and that the construction of the self as determined by nature was critical to this shift. To affirm this is not to say that the study of nature is impervious to its 'social' or 'cultural' contexts. Scientific knowledge *is* constructed. But it is also construct*ing*. And both types of constructiveness have occurred in a rather more literal (ie. technical) sense than sociological accounts allow.

Though this chapter begins (in standard sociological mode) by situating Grant's zoology within the context of early-nineteenth-century British politics, then, it also brings into consideration the technical aspects of the conditions upon which that author was able to become recognised as an authority on the nature of life. The 'disciplinary' identity of zoology, it is emphasised, could be constructed in

[14] See eg. Latour and Woolgar, *Laboratory Life*.

[15] Pickering, *The Mangle of Practice*.

relation to certain perceptual tools and techniques more easily than others. As already mentioned, the principal contrast made here is that between microscopes and museums. Microscopes, as tools that posed problems for the constitution of mutual agreement between gentlemanly equals, were generally held in lower esteem than the apparently more trustworthy museums around which scientific societies were beginning to form. As Tony Bennett has observed, museums would come to play a critical role in the formation of the disciplinary culture over the nineteenth century. Museums operated both as institutions around and within which intellectual identities could be forged, and as means by which certain attitudes and beliefs might be inculcated into those understood as outside of the process of knowledge production.[16] Although Grant began by insisting on the centrality of microscopic evidence in the characterization of animal life, it was only through an engagement with museological specimens that he was able to constitute zoology as a discipline within the confines of University College London. The constitution of zoology as a discipline in Britain came to depend on certain forms of epistemic tool to a greater extent than others.

Force, law, and the natural philosophic context of Grant's zoology

In a general sense, Grant's speeches and research contributed to the development of a broad-based movement that sought to integrate the study of humanity with that of the natural world as a whole. By re-conceptualising humanity in relation to the insights of physics, chemistry, comparative anatomy and animal physiology, advocates of the universality of natural law sought to make the study of medicine more 'philosophic.' Rather than starting with the human and working 'down' a presumed hierarchy of natural forms, representatives of an emerging middle-class reform movement contended from the start of the nineteenth

[16] Bennett, T. *The Birth of the Museum: history, theory, politics* (London and New York, 1995), pp. 95-98. See also Hooper-Greenhill, E. 'The Museum in the Disciplinary Society', in Pearce, S.M. *Museum Studies in Material Culture* (London and New York; Leicester University Press, 1989), pp. 61-72.

century that the proper study of man must start with the simplest kinds of existence and work 'up.'[17] This contention had important political connotations, especially when it came to controversies surrounding exactly how nature as a whole was to be understood. If (as many opponents of reform contended) the natural world was created from above by the immediate action of force-like powers, it could not be invoked as justification for democracy, or self-government by a 'naturally' subordinate and dependent polity. Grant's specific contentions regarding the universal applicability of natural law have been read as embodying a set of ideals related to the emerging middle-class culture of nineteenth-century Britain.[18] The debate over the status of natural law in Britain can thereby be correlated with a politically-contentious tension that existed within natural philosophy during the early nineteenth century.

Historians have highlighted how, from the seventeenth-century onwards, a divergence of interests can be seen as emerging in European culture and politics. In this divergence, the concerns of an aristocratic elite regarding the maintenance of absolute personal authority come to be re-negotiated in terms of an appeal to mutual assent as a limiting factor in the articulation of plausible knowledge. Put another way, with the emergence of an ideal of 'civil society,' knowledge comes to be understood as something that must be agreed upon by a community of equals, as well as (as had been the case in since before the Renaissance) declared to be true by an established authority.[19] Representatives of sites and organizations such as museums, natural philosophic societies and botanical and zoological gardens seek to articulate a vision of knowledge as something that should be agreed upon by competent observers, as well as gleaned from authoritative texts or principles.[20]

[17] Pickstone, J.V. 'How Might We Map the Cultural Fields of Science? Politics and organisms in Restoration France', *History of Science* 34 (1999), pp. 1-18.

[18] Desmond, *The Politics of Evolution.*

[19] Hunter, I. *Rival Enlightenments: civil and metaphysical philosophy in early modern Germany* (Cambridge; University Press, 2001); Cohen, M. *Fashioning Masculinity: national identity and language in the eighteenth century* (London and New York, 1996); Shapin and Schaffer, *Leviathan and the Air Pump.*

[20] Bredekamp, H. (trans. Brown, A.) *The Lure of Antiquity and the Cult of the Machine: the Kunstkammer and the evolution of nature, art and technology* (Princeton, NJ, 1995); Spary, E. *Utopia's Garden: French natural history from Old Regime to Revolution* (Chicago and London; Chicago University Press, 2000).

During much of the eighteenth century, questions relating to the relative emphasis to be put on these two kinds of natural philosophic knowledge had remained unresolved. The emerging ideal of gentlemanly mutual agreement and that of an authoritative, established land-owning elite existed side by side without being seen as inherently oppositional.[21] Yet following the anti-aristocratic, self-determining sentiment that came to the fore during the French revolution, debates relating to such issues became matters of immediate political concern.[22]

The tension between the ideals of gentlemanly agreement and aristocratic authority that animated much political debate in the years following 1789 was in part played out in natural philosophic discourse as a contest between the relative power of 'force' and 'law.' On the one hand, it was believed by many that nature required constant intervention by an immaterial, active, and guiding force or 'principle.' Others stressed the self-defining, self-generating properties of nature, treating it as God's second, non-textual 'book' which possessed a concomitant moral legislative authority all of its' own.[23] Again, both tendencies had existed prior to the French revolution. Many of the most ardent proponents of 'enlightened' thought in France, for example, had insisted that nature was nothing more than the expression of mechanical principles playing themselves out in matter, and that the immediate, active presence of heavenly influence on earth could not be discerned through the study of life. Many in England and Scotland, on the other hand, were engaged in a search for 'vital' fluids that might be identified as means by which organisms could be animated by heavenly power.[24] For most of the eighteenth century, disputes between 'vitalists' and 'mechanists' were relatively easily contained within participants' broader commitments to other ideals, such as the

[21] Bredekamp, *The Lure of Antiquity*; Cohen, *Fashioning Masculinity*.

[22] Gallagher, C. *The Body Economic: life, death, and sensation in political economy and the Victorian novel* (Princeton; University Press, 2006), pp. 7-34; Reddy, W.M. *The Navigation of Feeling: a framework for the history of emotions* (Cambridge; University Press, 2001), esp. pp. 199-210; As indeed they had during the English revolution of the seventeenth century. See Shapin and Schaffer, *Leviathan and the Air Pump*.

[23] Jacyna, L.S. 'Immanence or Transcendence: theories of life and organization in Britain, 1790-1835', *Isis* 74 (1983), pp. 310-329.

[24] French, R.K. 'Ether and Physiology,' in Cantor, G.N. and Hodge, M.S.J. *Conceptions of Ether: studies in the history of ether theories 1740-1900* (Cambridge; University Press, 1981), pp. 111-134.

respectability or gentlemanliness of natural philosophic endeavour.[25] Yet by the early nineteenth century, a natural philosophic author's choice between such concepts had begun to be seen as indicative of their commitment to seemingly irreconcilable political positions.[26] In early-nineteenth-century London, the interventionist conception of creation remained pre-eminent. Advocating a law-determined notion of nature, Grant's publications are split between an evident need to establish personal authority within a culture focused on natural theological conceptions of heavenly power, and a hope that it would be possible to confirm as natural 'law'-centred democratic ideals that the French revolution was seen to embody.

Yet it is not possible, I believe, to reduce absolutely the post-revolutionary debates regarding force and law to the contestation of a purely social question regarding differing ideals of state organization. By highlighting the place of technical entities in debates relating to force and law, this chapter emphasises that the relative plausibility of claims regarding nature cannot be mapped onto the convictions of their holders in any simple way. This does not imply that knowledge is not 'political' or, for that matter, 'constructed' (indeed, the notion of construction here is particularly pertinent). Rather, it shows that, despite the thoroughly political constitution of beliefs regarding the natural, personal ideological conviction cannot be said to *determine* what is considered plausible at any given historical moment. Or rather, the plausibility of different ideological convictions regarding the natural can be said to be mediated by the technical conditions in which those concerned find themselves.[27] Attempts by Robert Grant to articulate a zoology that was law-determined, progressive and, critically, democratic had to be reconciled with a context in which the tool he relied on to construct it - microscopes - were easily dismissed as unreliable. It was only through his appeal to a technical entity that could command greater mutual assent - the museum specimen - that he was able to propagate zoology as an academic discipline. In such a context, the apparently revolutionary notion of molecular self-determination that his early publications

[25] Ibid, pp. 130-132.

[26] Gallagher, *The Body Economic*, pp. 7-34; Reddy, *The Navigation of Feeling*, pp. 199-210.

[27] This is, broadly, Andrew Pickering's thesis in *The Mangle of Practice*.

articulate came to be severely restricted. I thereby first describe Grant's molecular vision of zoological nature, and subsequently move on to discuss the museological limitations that this vision became subject to following the commencement of his teaching career in London.

Grant's zoological atomism

In his earliest publications, Grant's commitment to what John Pickstone has called a 'bottom-up,' law-defined conception of life is grounded in an appeal to atomistic chemistry as a source of analogy by which living forms might be better understood.[28] In 1808 John Dalton had controversially (see below) postulated that chemical nature could be understood in terms of fundamental atomic molecules.[29] The notion of an 'organic' atomism analogous to that which was being promoted for the non-organic world by Dalton remained a feature of Grant's work throughout his life.[30] One instance in which connections between chemical atomism and Grant's zoology became especially clear occurred in 1833, when he gave the opening lecture for the medical faculty of the new university.[31] His speech focuses on what he suggests are the ideal accomplishments of a man of medicine. Prominent in such accomplishments are (he claims) a background in ancient and modern languages, the philosophy of mind, natural philosophy and, above all, chemistry - an investigation of 'the phænomena which result from the motions of invisible atoms at insensible distances.'[32] For Grant, the 'complex living processes performed in the

[28] Pickstone, 'How Might we Map the Cultural Fields of Science?'

[29] Dalton, J. *A New System of Chemical Philosophy* (London, 1808).

[30] Sloan, P.R. 'Darwin's Invertebrate Program', pp. 77-80.

[31] Grant, R.E. *On the Study of Medicine: Being an introductory address delivered at the opening of the Medical School of the University of London, October 1st, 1833* (London, 1833), p. 7.

[32] Grant, *On the Study of Medicine*, pp. 6-9. Grant's commitment to atomism is also indicated by his promotion of the candidacy of the then-Daltonian chemist Edward Turner to the faculty of UCL in 1827. See Grant, R.E. [CHECK REF!!!: MS ADD 438-448 - 1827 Professorships (Q-W)]. Turner would return this favour in his support for Grant's later unsuccessful application for a lectureship in physiology – see Turner, E. 'To James Mill, Esq. Chairman of the Education Committee' *The Lancet*, 26 (1835), p. 844 and

laboratories of living beings' are 'as much the domain of the chemist' as are the phenomenon of non-living nature.[33]

Chemistry seemed to Grant to present a disciplinary ideal upon which the study of zoology could be modelled. As he informed the assembled faculty: 'Comparative Anatomy, like Chemistry and Botany, spurning its origin as subservient to man's œconomy or to Medicine, has assumed an independent rank among the sciences.'[34] Long-established, apprenticeship-focused modes of medical training had almost invariably taken the human body as their starting point of investigation.[35] In stark opposition to this assumption, Grant claims in his zoological lectures (which were also being published at this time) that 'everywhere the natural philosopher and the chemist are making encroachments on the province of the physiologist. Everywhere do we find the laws of natural philosophy in operation in our bodies.'[36] The study of medicine had to start with that of nature as a whole. In this context, chemical atoms constituted the critical stepping-stone between inorganic matter and human physiology.

Grant's articulation of a globular conception of life can be placed in the context of a broader contemporary movement that sought to utilize microscopy in the revealing of the universality of natural law. Literature relating to 'granules' or 'globules' of living matter had become a distinctive feature of early-nineteenth-century microscopic investigation. Marcello Malpighi and Anton van Leeuwenhoek had described seeing microscopic 'globular' structures in living

Desmond, *The Politics of Evolution*, pp. 98-99.

[33] Grant, *On the Study of Medicine*, p. 9.

[34] Ibid, p. 10

[35] Lawrence, *Charitable Knowledge*, p. 81.

[36] Grant, R.E. 'Lectures on Comparative Anatomy and Physiology, delivered during the session 1833-4' [IV], *The Lancet* (1833-4), p. 198 [henceforth referred to as Grant, 'Lectures' [no.], pp. x-x]. This re-prioritising of zoological investigation is also stated in a later address to the BMA. See Grant, R.E. *On the present state of the Medical Profession in England: being the annual oration delivered before the members of the British Medical Association, 21st October, 1841* (London, 1841), pp. 16-20. On connections between medical reform and the rhetoric of natural philosophy at this time, see Warner, J.H. 'The Idea of Science in English Medicine: The 'Decline of Science' and the Rhetoric of Reform, 1815-45', in French, R. and Wear, A. *British Medicine in an Age of Reform* (London, 1991), pp. 136-164; Warner, J.H. 'The History of Science and the Sciences of Medicine', *Osiris (2nd Series)*, 10 (1995), esp. pp. 169-170.

tissue as early as 1665.[37] But it was not until the nineteenth century that the concept that bodies were entirely made up of these globules came to play an integral role in the development of new ideas about organic nature. Most frequently, the apparent globularity of both animal and plant tissue was highlighted as pointing to the importance of 'life' (rather than the previously distinct categories of animal and vegetable) as a philosophic object of analysis. Early in the century, such German *Naturphilosophen* as Lorenz Oken and Franz von Walther had speculated that all living matter was made up of combinations of simple globular 'infusoria'. Less speculative German-language authors such as Josephus and Carolus Wenzel and Johan Frederick Meckel began to observe globules in all types of tissue over the next few decades.[38]

Apart from perhaps Leeuwenhoek, all of these figures would have been aware of the influential speculations of Gottfried von Leibniz regarding the fundamentally 'monadic' constitution of existence. Leibniz had suggested - in a contention that seemed to some dangerously close to the deistic monism of Baruch de Spinoza - that all forms of existence, including mental perceptions, could be understood in terms of a universal 'plenum' constituted by imperceptible mathematical points. These points, or monads, had no physical presence in Leibniz's metaphysics. Nevertheless, they were consistently appropriated by natural philosophers such as Charles Bonnet, and especially French materialists such as the Comte de Buffon, Pierre Louis Maupertuis and Baron d'Holbach, as referring to the presence of material 'atoms' in nature. Leibniz was held up as 'predicting' the existence of microscopic organisms ('zoophytes') that could not be perceived by the unaided eye.[39] More generally, Leibniz had argued that perception

[37] On seventeenth- and eighteenth-century microscopic science see Ratcliff, M.J. *The Quest for the Invisible: Microscopy in the Enlightenment* (Farnham and Burlington, 2009).

[38] Jacyna, L.S. 'Romantic Thought and the Origins of Cell Theory', in Cunningham, A. and Jardine, N. *Romanticism and the Sciences* (Cambridge; University Press, 1990), p. 165. Baker, J.R. 'The Cell Theory: a restatement, history and critique [Part I]', in Baker, J.R. *The Cell Theory: a restatement, history and critique* (New York and London; 1988), pp. 114-121. Coleman, *Biology in the Nineteenth* Century, Ch.2.

[39] On connections between the natural philosophy of organisms and Leibnizian metaphysics during the eighteenth century, see Rieppel, O. 'The Reception of Leibniz's Philosophy in the Writings of Charles Bonnet (1720-1793),' *Journal of the History of Biology* 21 (1988), pp. 119-145. On Leibniz's reception more generally, see Wilson, C. 'The Reception of Leibniz in the Eighteenth Century,' in Jolley, N. (ed.) *The Cambridge*

could occur without the involvement of consciousness, and that the investigation of nature presented one means of becoming aware of such 'unconscious' discernment.[40]

During the early nineteenth century, Leibniz's notion of the 'monadic' composition of existence was frequently interpreted in terms of a commitment to a law-determined, atomic materiality. Pickstone has pointed to a brief but vociferous fashion for globular or atomic theories of life amongst such French natural philosophers as Geoffroy St-Hilaire (or Geoffroy, as he was commonly known), Henri Milne-Edwards and Henri Dutrochet during the 1820s.[41] As well as emphasising that 'life' in general (rather than plant or animal life alone) constituted their principal category of analysis, Dutrochet and his contemporaries sought to constitute a 'vital physics' in which simple forms of life would be explicable in terms of laws relating to non-organic phenomena.[42] It seems most likely that it was during his tour of Europe that Grant became concerned with establishing this 'globular' claim regarding the nature of life.

Radical globulism

By 1833, Grant had developed a long-standing commitment to understanding the nature of the simplest forms of living matter. The origins of this

Companion to Leibniz (Cambridge; University Press, 1995), pp. 442-474. On Leibniz's relation to Anglophone natural philosophy, see Phemister, P and Brown, S. (eds.) *Leibniz and the English-Speaking World* (Dordrecht, 2007).

40 Ellenberger, H.F. *The Discovery of the Unconscious: the history and evolution of dynamic psychiatry* (London, 1970), p. 312.

41 Pickstone, J.V. 'Golbules and Coagula: concepts of tissue formation in the early nineteenth century', *Journal of the History of Medicine and Allied Sciences* 28 (1973), pp. 336-356. See also Sloan, P. 'Organic Molecules Revisited', in Gayon, J. et. al, *Buffon '88: Actes du Colloque international pour le bicentenaire de la mort de Buffon : (Paris, Montbard, Dijon, 14-22 juin 1988) (Science, histoire, philosophie)* (Paris, c.1992), pp. 415-438.

42 Pickstone, J.V. 'Vital Actions and Organic Physics: Henri Dutrochet and French physiology during the 1820's', *Bulletin of the History of Medicine* 50 (1976), pp. 191-211; Pickstone, J.V. 'Locating Dutrochet', *The British Journal for the History of Science* 11 (1978), pp. 49-64

interest can be traced to his extensive tour of continental Europe following the end of the Napoleonic wars. As the then-principal centre of the Western intellectual world, Paris featured prominently in his travels. Whilst there, he came under the influence of such prominent French *savants* as Geoffroy, Georges Cuvier and Jean Baptiste-Lamarck, the latter of whose research on invertebrates appears to have inspired his life-long interest in these organisms. On the same trip, he also met many of the leading zoological natural philosophers of the Germanic territories, including Johan Friedrich Meckel and Friedrich Tiedemann.[43]

On his return to Edinburgh in 1820, Grant had begun to address the physiology of a local organism that had occupied a highly ambiguous status in eighteenth-century natural philosophic classification. His local marine environment, the Firth of Forth, contained a wide variety of sponges - organisms that had been alternately classed as plants and animals, without any resolution of the matter. Grant, having conducted a series of experiments and examinations of these entities, declared them to be animals on the basis that they circulated water through themselves.[44] Such criteria as 'sensibility' to 'irritating' stimuli, an organism's ability to move of its own accord, and its ability to circulate fluid had been important to eighteenth-century schemes of zoological classification.[45] In defining sponges as 'animal,' Grant was seeking to establish a reputation as an authority on the boundaries of plant and animal life. In so doing, he also developed ideas regarding relations between organic and non-organic existence.

Grant had become convinced that the Firth sponges circulated water through extensive microscopic examination of them. Magnifying the numerous 'ventricles' which permeated the external surface of the organism, he had claimed that it was possible to observe that minute particle-like bodies in the water only ever moved outward from some of them, which he termed 'fecal orifices'. He had

[43] Desmond, 'Robert E. Grant', p. 197. Desmond, *The Politics of Evolution*, pp. 41-59. Sloan, 'Darwin's Invertebrate Program', pp. 77-80.

[44] Grant, R.E. 'Observations and Experiments on the Structure and Functions of the Sponge' [articles I-V], *The Edinburgh Philosophical Journal* 13 (1825) pp. 94-107 and 333-346, *The Edinburgh Philosophical Journal* 14 (1826), pp. 113-124 and 336-341 and *Edinburgh New Philosophical Journal* 2 (1826-27), pp. 121-141.

[45] Temkin, O. 'The Classical Roots of Glisson's Doctrine of Irritation', in Temkin, O. *The Double Face of Janus and other essays in the history of medicine* (Baltimore, John Hopkins University Press, 1977), pp. 290-316.

thereby concluded that water must be taken in through the other observable ventricles, which he had termed 'pores'.[46]

Of particular interest to Grant regarding the cause of this circulation in sponges had been a 'thin gelatinous matter' that covered their interior. The green matter that covered the inside of the organisms had presented him with what he saw as a plausible cause for the circulation of water through them. He had noted that if magnified by a microscope when in-situ around the faecal orifices, this matter appeared completely 'homogeneous'. Yet after placing it in a small amount of water and subjecting it to 'a little agitation', he had claimed that this gelatinous matter 'resolves itself almost entirely into minute, pellucid, green-coloured granules, which have a singular tendency to reunite.'[47] Significantly for Grant, these small granules, observable only at high levels of magnification, had appeared to possess the ability to move of their own accord. He had argued that it was their capacity for movement – which he had suggested could be caused by 'minute filaments' protruding from them - that produced the circulation of water through the sponges.[48]

Grant had also accorded these minute bodies a central role in the reproductive process. Regarding the observation in sponges of larger granular bodies or ova, he had observed that the microscope could detect 'nothing in their structure but transparent granular bodies, like those lining the canals'.[49] Combining this claim with the above-mentioned observation that these transparent bodies had a tendency to agglomerate had suggested to him that the ova were constructed out of the smaller filamented particles that he had attributed as the cause for the circulation of water. Even seemingly 'fundamental' parts of the species, such as its eggs, are constituted by an even more basic, globular entity.

Finally, Grant had articulated his belief that such 'elementary' microscopic

[46] Grant, 'Observations and Experiments' [I], pp. 105-107.

[47] Grant, R.E. 'On the Structure and Nature of the Spongilla friabilis,' *The Edinburgh Philosophical Journal* 14 (1825-26), p. 281.

[48] Ibid. Grant, R.E. 'Observations on the Spontaneous Motions of the Ova of the Campanularia dichotoma, Gorgonia verrucosa, Caryophyllea calycularis, Spongia panicea, Sp. papillaris, cristata, tomentosa, and Plumularia falcate,' *Edinburgh New Philosophical Journal* 1 (1826), p. 152.

[49] Grant, 'On the Structure and Nature of the Spongilla friabilis,' p. 283.

particles arose 'spontaneously' from inorganic matter, and could not therefore be subject to laws or forces different to those that applied to the non-living world.[50] In his first lecture to the students of University College, he had declared that 'the simplest organized bodies, as Monades and Globulinæ, originate spontaneously from matter in a fluid state, and that these simple bodies... are the same with the gelatinous globules which compose the soft parts of Animals and Plants.'[51] This implied that the simplest animals could be explained 'on the principles of Chemistry or Mechanics.'[52] Grant envisaged a nature that developed upwards from physical, non-organic forms of existence. The development of organisms was nothing more than the expression of laws that had been established at the start of creation. Emphasising that, at the minutest level, organic bodies appeared to be constructed out of entities similar to those that were being postulated for chemical structures appeared to constitute a confirmation of this position.

Summing up his research on the sponges in 1827, Grant had suggested that the gelatinous matter 'appears entirely composed of very minute, transparent, spherical or ovate granules, like monades', noting that 'indeed, most of the fleshy parts of organized bodies appear to be composed of similar pellucid granular or monade-like bodies in different states of aggregation.'[53] 'Granular' entities found at the limits of observation were, he had claimed, responsible for the previously mysterious circulation of water in sponges. Microscopic granules consequently appear as fundamental units of organic matter in Grant's early publications. This conclusion not only placed the zoophyte sponges firmly within the animal kingdom, but also appeared to suggest a more profound claim regarding the nature of animal life. If bodies were indeed made up of 'monade-like' granules, then they correlated analogously with the Leibniz-inspired 'atoms' of chemical nature that Dalton had begun to advocate at the turn of the century.

In Britain, organic 'atomism' was most enthusiastically received in the

[50] On the concept of spontaneity in the British life sciences of this time see Strick, *Sparks of Life*.

[51] Grant, R.E. *An Essay on the Study of the Animal Kingdom. Being an Introductory Lecture at the University of London on the 23rd of October, 1828* (2nd ed.) (London, 1829), p. 18. See also Sloan, 'Darwin's Invertebrate Program', pp. 82-86.

[52] Grant, *An Essay on the Study of the Animal Kingdom*, p. 18.

[53] Grant, R.E. 'Observations on the Structure and Functions of the Sponge' [V], p. 124.

more radical circles of the natural philosophic elite during the 1820s. A number of physiologists, most of whom known for their reformist opinions, highlighted above-described propositions of continental naturalists regarding the elementary, self-defining composition of living bodies. Unitarian medic Thomas Southwood Smith informed readers of the radical quarterly *Westminster Review* that he had demonstrated the uniform, globular structure of tissues at the private medical school in Webb Street.[54] Similarly, in an article in the *London Medical Gazette*, military surgeon Samuel Broughton proclaimed that his microscopic observations lead him 'to coincide with [the above-mentioned French physiologist] Dr. M. Edwards in all essentials.' Broughton took inspiration from the possibility that 'every thing susceptible of life may derive all its parts from one constant and primitive molecule, of an uniform character, spherical and colourless, and more or less developed as the animal may be simply formed or otherwise.'[55] For these physiologists, as for Grant, chemical and physical laws presented the most likely source by which such entities might be explained. Smith's connection with the radical *Westminster Review*'s founders Jeremy Bentham and James Mill meant that his anatomical and physiological articles (which also adopted a approach to nervous anatomy that followed the work of Geoffroy) found a wide, politically conscious audience.[56] Similarly, Grant's lectures were published in the medical journal *The Lancet* - then the mouthpiece for an emergent conception of medical organization that emphasised the self-defining, self-organizing capacities of medical practitioners over the patriarchal power of the dominant medical colleges.

More generally, 'atomism' as a whole seemed to many to confirm that the egalitarian, democratic ideals of organization then associated with the French revolution coincided with the constitution of the natural world. The prominent republican Richard Carlile's 1821 *Address to Men of Science* proclaimed chemists to be 'the greatest of all revolutionists, for they have silently and scientifically

[54] Smith, T.S. 'Life and Organization', *Westminster Review* 13 (1827), pp. 215-216.

[55] Broughton, S. 'On the Elementary Nature of Animal Structures', *London Medical Gazette* 17 (March 29, 1828), pp. 496-497. See also Bostock, J. *An Elementary System of Physiology*, [Vol. I of III], (London, 1824-7), pp. 345-350.

[56] See esp. Smith's articles on the nervous system: Smith, T.S. 'Nervous System', *Westminster Review* 17 (1828), pp. 172-197 and 18 (1828) 451-479.

undermined the dogma of the priest' by enabling us to 'consider ourselves but as atoms of organized matter'.[57] Like Unitarians such as Smith, Carlile insisted that it was only by recognising and acting according to the truths of nature as revealed by natural philosophic investigation that communities might be organized satisfactorily. It was only through the universal recognition of the chemical composition of all bodies that man would fulfil his proper place in the creation. If all children were taught that 'man, as a part of a whole, or as an atom of matter, is immortal but... that [that] atom can retain no sense of a former existence', the 'proper character' of mankind would be realised. If this plan were instigated, 'the representative system of government would be found to be the only necessary government amongst them [the people]'.[58] Carlile, along with his many followers, argued that the truths of chemistry pointed the way to the instigation of a truly democratic and egalitarian politics. Like Carlile, reform-minded zoological naturalists also saw a rationale for democratic government in their conceptions of corporeality.

Anti-globularity, species classification, and the authority of force

Although the perception of chemical-atom-like globules as self-organizing entities could be construed by proto-middle-class radicals as nature's endorsement of their calls for democratic representation, this was not the only possible interpretation. Those most closely concerned with the compatibility of conceptions of nature with the doctrines of the Anglican church, for example, tended to oppose what they believed to be the dangerous implications of conceptualising bodies as composed of countless small particles. Prior to the 1820s, natural philosophers such as Samuel Taylor Coleridge and Humphrey Davy had appealed to the explanatory power of a 'vital' force that they understood as the active manifestation

[57] Carlile, R. *An Address to Men of Science* (London, 1821), pp. 5-6. Surprisingly little has been made of the political implications of Daltonian atomism. Though see Morell, J.B. 'Thomas Thomson: professor of chemistry and university reformer', *British Journal for the History of Science* 4 (1969), pp. 245-265 and Brock, W.H. *From Protyle to Proton: William Prout and the nature of matter* (Bristol, 1985).

[58] Ibid, p. 44.

of God's immediate presence on earth.[59] Coleridge's texts articulate a Kantian, 'transcendental' philosophy of nature founded on a belief in the vital, creative powers of human spirit and divine will. Advocating a deeply historical vision of the creation of a step-like chain of being, they are particularly concerned with opposing what they characterize as the overly mechanistic tendencies of law-determined accounts of creation. Coleridge was insistent on the continual, active creation of nature by forces imposed from 'above', and was particularly suspicious of what he saw as the dangerously democratic implications of a world composed of uniform - and therefore implicitly equal - elementary parts. He aimed to propagate a 'vital chemistry,' in which the transmutation of inorganic matter was caused by divine creative powers, to rival the science of simple elements associated with Antoine Lavoisier.[60]

Coleridge was joined by such respected figures as Davy and William Whewell in this advocacy of this spiritual, idealistic, and elitist vision of creation and intellectual discovery. These conservative natural philosophers associated doctrines such as Dalton's atomic chemical theories with a subversive republicanism, and appealed to their idealistic vision of historical development in order to preserve the authority of philosophic truth - even (as was the case with Whewell's philosophy) at the expense of demarcating the activities of 'scientists' and 'philosophers'.[61] Such authoritative opposition could have far-reaching consequences. In 1828, botanist Robert Brown (later acclaimed as the discoverer of 'Brownian motion') circulated a private pamphlet 'on the general existence of active

[59] On Coleridge, see Levere, T. *Poetry Realized in Nature: Samuel Taylor Coleridge and early-nineteenth-century science* (Cambridge; University Press, 1981). On Davy, see Golinski, J. *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge and New York; Cambridge University Press, 1992), esp. pp. 204-205 and 264-265.

[60] Levere, T. *Poetry Realized in Nature*, esp. pp. 64-69, 171-179 and 216-219. On the role of such transcendent theories in organic discourse see Jacyna, 'Immanence or Transcendence,'pp. 311-329.

[61] Temkin, O. 'Basic Science, Medicine, and the Romantic Era', in Temkin, *The Double Face,* pp. 352-357. On Whewell see Schaffer, S. 'The History and Geography of the Intellectual World: Whewell's Politics of Language', in Fisch, M. and Schaffer, S. (eds.),*William Whewell: A Composite Portrait* (Oxford; Clarendon Press, 1991) esp. pp. 203-207 and 218-222, and Yeo, R. *Defining Science; William Whewell, natural knowledge, and public debate in early Victorian Britain* (Cambridge; University Press, 1993).

molecules in organic and inorganic bodies.' This paper could easily have been interpreted as confirming the observations of Milne-Edwards. However, the following year - after a number of well-respected botanists declared that they had failed to observe the molecules - Brown published a clarification that dissociated his work from other research relating to organic 'globules'.[62]

Moreover, globulism was not itself invariably cited as proof of the self-defining powers of organic molecules. One of the earliest statements of organic globulism in Britain had explicitly denied the possibility that bodies could be created by the agglomeration of individually independent particles. In 1822, Sir Everard Home - best known for his controversial appropriation of eighteenth-century comparative anatomist John Hunter's manuscripts – had suggested in his lectures at the Royal College of Surgeons that all tissues were composed of spherical particles connected by fibres of organic matter.[63] But whereas Grant would conceive of globules as agents causing the circulation of water in sponges, Home saw them as passive building-blocks for different kinds of organic matter. Globules could not move around on their own, but were organized by gasses inherent in the blood and other fluids. As he claimed, he had set out to prove that 'human blood, in the act of coagulation, evolves a gaseous matter, which, as soon as it is disengaged, pervades the coagulum in every direction; passing throughout the serum in currents which become permanent tubes'. Having established to his satisfaction that this was the case, he then went on to describe the composition of

[62] Brown, R. *A Brief Account of Microscopical Observations... on the Particles Contained in the Pollens of Plants; and on the General Existence of Active Molecules in Organic and Inorganic Bodies* (London, 1828) [not published]. Brown, R. *Additional Remarks on Active Molecules* (London, 1829). See also Sloan, 'Darwin's Invertebrate Program', pp. 92-98. Mabberley, D.J. *Jupiter Botanicus: Robert Brown of the British Museum* (Braunschweig, 1985), pp. 271-272. Another controversy relating to organic atomism occurred between William Prout and Wilson Philip. See Prout, W. 'Observations on the Applicaton of Chemistry to Physiology, Pathology, and Practice: Lecture I', *London Medical Gazette* 8 (Sat, May 28, 1831), pp. 257-265, and Philip, W. 'Some observations suggested by Dr Prout's lectures', *London Medical Gazette* 9 (Sat, Aug 20, 1831), pp. 641-652.

[63] Home, E. *Lectures on Comparative Anatomy; in which are explained the preparations in the Hunterian collection, illustrated by engravings* (London, 1823). See also Home, E. *Supplement to the foregoing Lectures on Comparative Anatomy, illustrated by engravings* (Vol. V) (London, 1828), pp. 170, 194. On Home see Clarke, E. and Jacyna, L.S. *Nineteenth-Century Origins of Neuroscientific Concepts* (Berkeley, Los angeles and London; University of California Press, 1987), pp. 58-60.

all organic tubes as globular.[64] Hence whilst his publications clearly depict both blood vessels and nervous fibres as composed of globules, the function of these globules is to provide passive material for the organization of life by vital gases. Following the dissipation of attempts to formulate a vitalist chemistry during the 1820s, Home's speculations regarding the gaseous ordering of globules largely disappeared from natural philosophic discourse. Nevertheless, it is clear that organic globulism was by no means monopolized by those concerned with the articulation of bottom-up, law-defined notions of nature during this time.

Nevertheless, for many globulism itself remained fundamentally suspicious. A notable aspect of the generally respected comparative anatomist Richard Owen's arguments in favour of the adoption of Geoffroy's conception of anatomical 'homologies' (see below) was his 1849 warning (which he had originally aired in his first Hunterian lectures in 1837) that if

> we reject the idea that these [homological] correspondences are manifestations of some archetypical exemplar on which it has pleased the Creator to frame certain of his living creatures, there remains only the alternative that the organic atoms have concurred fortuitously to produce such harmony.[65]

Even after John Goodsir had seemingly established the inherent vitality of cells during the early 1840s, Owen could still invoke organic 'atomism' as a threatening spectre when addressing his largely elite, high church audience.[66] Despite efforts aimed at re-asserting the vitalist doctrine of organic exceptionalism in the microscopic realm, it is clear that for some the globular aspects of Grant and others' science retained radical and even atheistic connotations.

[64] Home, *Lectures on Comparative Anatomy*, pp. 5-6, 20-39.

[65] Owen, R. *On the Nature of Limbs: A Discourse* (Chicago and London; University of Chicago Press, 2007 [1849]), p. 40; Owen, R. *The Hunterian Lectures in Comparative Anatomy; May-June, 1837* (London, 1992 [1837]), pp. 87-88 and 122.

[66] On the development of cell theories in Britain see Jacyna, L.S. 'John Goodsir and the Making of Cellular Reality,' *Journal of the History of Biology* 16 (1983), pp. 75-99; Jacyna, L.S. "A Host of Experienced Microscopists": the establishment of histology in nineteenth-century Edinburgh', *Bulletin of the History of Medicine* 75 (2001), pp. 225-253.

To those that considered the presence of active forces to be critical to the explanation of nature, the proposition that the universal operation of physical law was responsible for the development of organic nature seemed absurd. For most of these figures, it was not the unity, but the diversity of natural forms that constituted the principal descriptive concern appropriate to zoological endeavour. Differences between animals and plants constituted a manifestation of God's will on earth, and indicated the plenitude of creation. To explain all forms of life as entities made up of fundamentally identical types of matter seemed to belittle God's creation by reducing it to the effects of a small range of rules.[67] Even more fundamentally, it constituted a limitation of the power of God in the lived world. If there was no need for the Creator to intervene to produce new natural forms, what likelihood was there that he had performed other, seemingly less significant miraculous feats? Was the biblical account of the resurrection, for example, to be taken as a literal reporting of events, or as a seemingly vague metaphor?[68] If God was simply a law-giver who set the universe in motion, it seemed to these figures, there would be no place left for revealed religion in every-day life.

As Adrian Desmond has pointed out, though well established as a mode of zoological investigation in post-revolutionary Europe, introducing law-determined, 'philosophical' conceptions of life met with strong resistance in Britain.[69] Natural historians working within natural theological frameworks emphasised the need to address bodies as integrated wholes expressive of God's active presence in earthly creation.[70] They did this primarily through the description and analysis of human and animal anatomies. Anatomists such as Grant's university colleague Charles Bell tended to take the individual bodies of species rather than types of organic structure as their principal loci of investigation.[71] Others, such as Grant's rival Owen, sought to compromise with the notion that nature could be explained in its entirety from the 'bottom up.' Owen emphasised - following the French

[67] Temkin, ‘Basic Science’, pp. 352-357.

[68] Desmond, *The Politics of Evolution*, pp. 110-124.

[69] Desmond, *The Politics of Evolution*.

[70] Jacyna, 'Immanence or Transcendence'.

[71] Mazumdar, P. 'Anatomy, Physiology and the Reform of Medical Education’.

comparative anatomist George Cuvier - that osteological anatomical forms could be classified into four different 'types' or 'plans' that had been individually created by God.[72] To suggest - as 'philosophical' anatomists such as Grant did - that one anatomical 'element' such as the osteological or nervous system could only be properly understood through a comparison of all its forms throughout nature, starting with the single 'most simple,' seemed to many to be fundamentally opposed to the interpretation of the diversity of species as evidence of heavenly wisdom and power.[73]

To those who emphasised the notion of a vital force that worked on principles entirely unrelated to the forces that animated the inorganic world, attempts to delineate the globular nature of the very small seemed at best obscure. At worst, this notion threatened to subvert the biblical account of creation adhered to by the Anglican church. Of far greater concern for these figures was the identification of diversity in the living world. By observing differences between the anatomies of species, humanity would become more clearly aware of the plenitude of God's creation. It was not through discernment of a microscopic nature, but by that most easily comprehended by unadorned sight that these philosophers believed an as-yet ignorant public might best be informed of the constant activity by which God expressed his benevolence in the natural world.

Microscopic trust in early-nineteenth-century Europe

The French and German conceptions of globularity that began to appear at the margins of British physiology during the 1820s did not enjoy a long career. Pickstone has noted the brevity of the fashion for conceptions of organic atomism in French natural philosophy.[74] Similarly, British adherents of the globule thesis had all but disappeared by the mid-1830s. Though many factors could no doubt be

[72] Rupke, *Richard Owen*, pp. 90-140.

[73] Desmond, *The Politics of Evolution*, pp. 93-94. Mazumdar, 'Anatomy, Physiology, and the Reform of Medical Education', pp. 234-240.

[74] Pickstone, 'Locating Dutrochet.'

invoked to explain such a decline in speculation, the then-uncertain status of the microscope as a trustworthy epistemic tool constituted a critical condition for its disappearance.

Jonathan Crary has identified a fundamental tension evident in many post-renaissance conceptions of perception. He relates the emergence from the sixteenth century of a conception of observation predicated on a disembodied, rational 'mind' that centres around the figure of the camera obscura and associated technologies such as magic lanterns. According to Crary, before the re-evaluation of its cultural status during the nineteenth century, the camera obscura functions as an intellectually pervasive 'philosophical instrument' that presents contemporaries with both a means of observing, and a model for conceptualising, human observation. The human subject - removed in the operation of the camera obscura from the act of representation - accompanies and legitimates a notion of the universal existence of a (almost invariably male) rational knower acting through the human body, independently from the sense-organs by which he perceives the world.[75] Conceptions of perception that flourished in western Europe during the seventeenth and eighteenth centuries were predicated on a fundamental differentiation between sense-experience and rational insight.

Critically, this 'disembodied' mode of subjectivity posits the human body as the only medium through which experience of external realities can be effected. It thereby identifies minds as inherently individuated, mutually alienated entities, confined to the sensory experiences of their specific corporeal hosts. This brings into question the possibility of any one mind's ability to produce universally true natural knowledge. How can reliable truths be arrived at if all sensation and observation is necessarily bound up in the different experiences afforded by different bodies?

One seventeenth- and eighteenth-century response to this dilemma, noted in earlier in this chapter, called for a multiplication of rational witnesses. Natural philosophers such as Robert Boyle and Leibniz, seeking to establish the veracity of

[75] Crary, J. *Techniques of the Observer: on vision and modernity in the nineteenth century* (MIT Press; Cambridge, MA and London, 1990), pp. 25-66. Cf. Armstrong, I. 'The Microscope: mediations of a sub-visible world', in Luckhurst, R. and McDonagh, J. *Transactions and Encounters: science and culture in the nineteenth century* (Manchester University Press; Manchester and New York, 2002), pp. 30-54.

apparently rational insights into the nature of the world, had sought to make the truth-value of natural perceptions dependent on the sensory experiences of a large number of 'reputable' individuals. If a group of suitably 'disinterested' observers with very different sensory perspectives could be persuaded to agree on the existence and meaning of a given phenomena, they claimed, then its truth would no longer be contingent on the unreliable bodily experiences of any one individual.[76]

Within such an epistemic context, microscopy remained a problematic means of producing natural truth. The technical limitations presented by most microscopes of this period implied that witnesses had to perceive an event or image individually - the above-mentioned 'group' means of guaranteeing observational truthfulness is difficult to apply to minute natural objects that can be accessed only via a single lens (or set of lenses) against which only a single eye can be placed at any one time. True sensations relating to moving objects or those at the edge of a microscope's magnification power were understood as very difficult to establish, as their changing or interpretation-dependent nature could not easily be resolved via a community of witnesses - a situation that came to be accompanied by a strong emphasis on classificatory uncontroversiality as a means of judging the veracity of such knowledge.[77]

As Crary's work implies, a considerable portion of the microscopic culture of early nineteenth-century Britain was organized around attempts to overcome problems associated with the unreliability of individual experience. Much British literature concerning microscopy published during the 1830's and 1840's portrays it as an activity fully integrated into a culture of display and witnessing.[78] In 1841, Daniel Cooper, member of the recently-founded Microscopical Society of London and editor of the short-lived *The Microscopic Journal and Structural Record*,

[76] Crary, *Techniques*, pp. 51-53; Shapin, and Schaffer, *Leviathan and the Air Pump*.

[77] Ratcliff, *The Quest for the Invisible*; Schickore, J. *The Microscope and the Eye: a history of reflections, 1740-1870* (Chicago and London; Chicago University Press, 2007), esp. pp. 39-82. On visuality and eighteenth-century microscopic science see also Stafford, B.M. 'Images of Ambiguity: eighteenth-century microscopy and the neither/or', in Miller, D.P. and Reill, P.H. *Visions of Empire: voyages, botany, and representations of nature* (Cambridge; University Press, 1996), pp. 230-257 and Stafford, B.M. 'Voyeur or Observer? Enlightenment thoughts on the dilemmas of display', *Configurations* 1 (1993), pp. 95-128.

[78] Chapter four elaborates on this theme in relation to women's participation in physiological discourse.

presented its readers with his recollections of 'The Rise and Progress of Microscopic Science', which he chiefly locates in the previous decade.[79] Above all, Cooper attributes such 'progress' to the cultivation of a public interest in the instrument - a consequence, he suggests, of the development of tools and techniques that facilitate the public display of microscopic phenomena. Whilst he notes that the solar microscope (a sun-powered microscopic projector) had been used for 'the gratification of the public' for some time, it was, he suggests, only with the development of 'oxy-hydrogen' or flame-powered illumination that such displays could be made reliable. For Cooper, reliable microscopic observation is made possible by the multiplication of witnesses to demonstrations. In addition, in cultivating interest in microscopy amongst the population as a whole, these displays are understood as the principal means by which competition between instrument-makers - and with it the motive for technical innovation - have been inculcated.[80] The 'advance' of microscopic observation is in this sense intimately connected with the development of means by which invisible nature can be made visible to an audience. The status of microscopic sight is made contingent on its ability to be made public, or 'witnessed.'

Though microscopic evidence was beginning to be appealed to more and more often in nineteenth-century disputes regarding physiological nature, the efficacy of most microscopic investigation remained uncertain during the 1820s and 1830s.[81] Microscopes were not generally trusted as investigative tools, and many physiologists and natural philosophers remained sceptical regarding specific claims relating to microscopic observation.[82] Suggesting (as Grant did) that the fundamental 'elements' of bodies were to be found at the microscopic level could thereby be considered unorthodox regardless of what the claims relating to them

[79] [Cooper, D.] [attr. in text to 'The Editor'] 'A Brief Sketch of the Rise and Progress of Microscopic Science, and the Principal Means Enumerated which have tended to its General Advancement', *The Microscopic Journal and Structural Record* 1 (1841), p. 2. On eighteenth-century Europeans' extensive engagement with microscopy, see Ratcliff, *The Quest for the Invisible*.

[80] Cooper, 'A Brief Sketch', pp. 1-4.

[81] Jacyna, '"A Host of Experienced Microscopists",' p. 253; Schickore, *The Microscope and the Eye*, esp. pp. 133-157.

[82] Jacyna. '"A Host of Experienced Microscopists",' pp. 229-232.

were. At least before the articulation of more observationally sophisticated 'cell' theories from the late 1830's, reform-minded naturalists tended to accord a more central place to microscopic evidence in their conceptions of organic life than did members of the Anglican elite.

Those who remained uncertain regarding the implications of an 'atom'-like constitution of nature could thereby discredit such beliefs without attacking individual authors (and thereby calling into question the ‘disinterestedness’ of their natural philosophy) by casting doubt on the efficacy of specific forms of microscopic observation. For example, microscopists Joseph Jackson Lister and Thomas Hodgkin cited the inadequacy of their predecessors microscopic tools rather than their observational capacities in their dismissal of globular claims. They suggested that the perception of microscopic globules were caused not by the phenomena under investigation, but by the lenses of microscopes which (unlike their own) had not been corrected to account for 'chromatic’ and ‘spherical’ aberration. Hence Milne-Edwards, for Lister and Hodgkin, had been honourably misled by the inadequacies of the tools that he used: 'he described what he saw, and he only saw amiss through the imperfection of his instruments.'[83] Though Lister later asserted his belief in the individually self-defining, spontaneous actions of microscopic particles in blood and plant sap, his and Hodgkin's comments were generally interpreted as casting serious doubt on the existence of organic 'globules.'[84] The ambiguous status of microscopy in early nineteenth-century Britain played at least as significant a role in undermining attempts to establish the study of life as an extension of that of physics and chemistry as did any direct victory of 'conservative' over 'radical' politics that has been appealed to in previous accounts of the zoology of the period.[85]

[83] Hodgkin, T. and Lister, J.J. 'Notice of some Microscopic Observations of the Blood and Animal Tissues', *Philosophical Magazine* [Second Series] 2 (1827), p. 136; Lister, J.J. 'On Some Properties in Achromatic Object-Glasses Applicable to the Improvement of the Microscope', *Philosophical Transactions of the Royal Society of London* 120 (1830), pp. 187-200.

[84] Lister, J.J. 'Some Observations on the Structure and Functions of tubular and cellular Polypi, and of Ascidae', *Philosophical Transactions of the Royal Society of London* 124 (1834), p. 377.

[85] See eg. Desmond*, The Politics of Evolution*. For critiques of Desmond’s position see Secord, 'Edinburgh Lamarckians.' Corsi, P. 'Before Darwin: transformist concepts in European Natural Philosophy,' *Journal of the History of Biology* 38 (2005), esp. pp. 70-72; Hilton, B. 'The Politics of Anatomy and an Anatomy of Politics', in Collini et. al. (eds.)

The authority of museums

In comparison with the above-described concerns surrounding the reliability of microscopic vision, bodies of evidence in museums seemed to offer a particularly reliable source regarding the nature of living creation. Since the Renaissance, the collection of objects had come to be understood as an important signifier of a ruler's possession of knowledge and accumulation of power. For eighteenth-century Europe's ruling classes, cultivating a 'cabinet' indicated one's learning at the same time as embodying one's ability to procure, own, and thereby 'rule' the material productions of far-off lands.[86] Collections of specimens of minerals, plants and animals, as well as of artistic productions, mechanical 'automata' and natural philosophic tools, offered rulers a convenient means of both surveying their kingdoms and demonstrating their wealth to others.[87] Museological collections were a physical manifestation of princely power that could be referred to easily and conveniently by those visiting state capitals or a monarch's rural retreat.

By the end of the eighteenth century, however, the aristocratic impulse towards collection as a means of demonstrating one's power over art and nature had begun to be rivalled by an alternative rationale, centred on the potential of such activities to liberate and enlighten their respective nations. Museums had begun to be understood as places of 'utility,' the ordering and study of which could contribute to a wider enlightenment of man. Such conceptions became especially prominent in France following the revolution of 1789. The collections at the royal Jardin des Plantes, for example, underwent a fundamental re-alignment as a 'national' body of natural objects, as indicated by their re-naming as the Museum d'Histoire Naturelle.[88] Cuvier, Geoffroy and Lamarck were all employees of this

History, Religion and Culture: British Intellectual History 1750-1950 (Cambridge; University Press, 2000), pp. 179-197; Corsi, P. 'A Devil's Chaplain Calling?' *Journal of Victorian Culture* 3 (1998), pp. 129-137. See also Rupke, N.A. 'Richard Owen's Vertebrate Archetype,' *Isis* 84 (1993), pp. 250-251.

[86] Findlen, P. *Possessing Nature: museums, collecting, and scientific culture in early modern Italy* (University of California Press; Berkeley, LA and London, 1994).

[87] Bredekamp, *The Lure of Antiquity*.

[88] On the early history of the Paris Muséum and botanical and zoological gardens see

new institution.[89] Disputes between these figures regarding the unity and transformability of the organic world, as well as the possibility of re-constructing now-extinct organic forms, have been read as disagreements not only regarding the constitution of nature, but of the specific direction in which post-revolutionary France should be heading.[90]

In Britain, as far as life-related studies such as geology, botany and zoology were concerned, the establishment of new, 'gentlemanly' societies, gardens and museums was central to this process of 'enlightenment'. For example, between the end of the Napoleonic wars (1815) and the 1830s, the Royal Society had been joined by the Geological, Linnaean, and Zoological Societies as established features of London's intellectual landscape.[91] These institutions operated as much more than talking-shops, providing focal centres for the collection and interpretation of minerals, plants and animals from throughout the Empire and the globe.[92] The new societies of early nineteenth-century London paralleled the emergence of a respectably gentlemanly movement in natural philosophy based around utilitarian ideals and the power of natural law. Nevertheless, such sentiments never dominated these spaces - rather, they can be seen as sites in which the notion of a law-determined nature were brought into contact with the notions of elite propriety and natural fecundity outlined above in relation to Coleridge and his circle.

Of the British institutions that outwardly devoted themselves to the improvement of the nation, it was the museum and gardens of the Zoological

Spary, *Utopia's Garden*.

89 On Cuvier's museological activities see Rudwick, M. 'Georges Cuvier's Paper Museum of Fossil Bones', *Archives of Natural History* 27 (2000), pp. 51-67.

90 Appel, T.A. *The Cuvier-Geoffroy Debate: French morphology in the decades before Darwin* (New York and Oxford; Oxford University Press, 1987). Corsi, P. (trans. Mandelbaum, J.) *The Age of Lamarck: evolutionary theories in France, 1790-1830* (Berkeley; University of California Press, 1988).

91 On the politics of London's scientific societies at this time see Boas Hall, M. *All Scientists Now: The Royal Society in the Nineteenth Century* (Cambridge; University Press, 1984).

92 See eg. Knell, S.J. *The Culture of English Geology, 1815-1851: a science revealed through its collecting* (Aldershot and Burlington, 2000); Drayton, R. *Nature's Government: science, Imperial Britain, and the 'Improvement' of the World* (New Haven and London; Yale University Press, 2000).

Society that had most relevance for Grant's advocacy of zoology as a law-based science. The Society's Regents Park gardens provided polite society (and later the general public) with a novel form of 'rational recreation', simultaneously demonstrating the dominance of Empire, promoting awareness of animals as potential sources of entertainment, and providing zoologists with new objects of study.[93] Their museum was especially important for the fulfilment of this latter role, providing a repository for the specimens produced from animals that had died in the gardens, as well as those donated to the institution.[94] Grant was a highly active member of this institution during its early years (the late 1820s and early 1830s), attending meetings and providing anatomical studies for its *Proceedings* on such varied topics as the heart of the Indian tortoise, the cranium of the Grampus and the cloaca (the opening of the intestinal, reproductive and urinary tracts) of the female Condor.[95]

Museums also became the focus of political and nationalistic concerns in Britain during the 1820s and 1830s. For example, the British Museum became a focus for reform agitation. The national collection had its origins in collections made by Sir Hans Sloane during the mid-eighteenth century. By the turn of the nineteenth century it had become a place at which gentlemen naturalists and collectors conventionally deposited their unwanted or unmanageable collections (often for a price). This haphazard mode of acquisition was paralleled by an equally unsystematic approach to classification and display.[96] From the end of the Napoleonic Wars, British naturalists began to draw highly unfavourable comparisons between their own national collection and the heavily-invested-in,

[93] Ritvo, H. *The Animal Estate*.

[94] Desmond, A. 'The Making of Institutional Zoology in London 1822-1836' [Parts I and II], *History of Science* 23 (1985), pp. 153-185 and 223-250.

[95] Grant, R.E. 'On the heart and the structure of the blood vessels of he large Indian tortoise (*Testudo Indica*, Linn.)', *Proceedings of the Zoological Society of London* 1 (1833), pp. 43-44. Grant, R.E. 'On the cranium of the round-headed grampus (*Delphinus globiceps*, Cuv.)' *Proceedings of the Zoological Society of London* 1 (1833), pp. 65-66. Grant, R.E. 'On the cloaca of the female condor (*Sacorhamphus gryphus*, Dum.)' *Proceedings of the Zoological Society of London* 1 (1833), p. 78.

[96] On the early years of the British Museum see; Chambers, N. *Joseph Banks and the British Museum: the world of collecting, 1770-1830* (London, 2007); Wilson, D.M. *The British Museum: a history* (London, 2002); de Beer, G.R. *Sir Hans Sloane and the British Museum* (Oxford; University Press, 1953).

well-organized museum collections in Paris. Having recently visited the Muséum d'Histoire Naturelle at which Cuvier, Lamarck and Geoffroy worked, then-radical British anatomist William Lawrence declared his dissatisfaction with the state of affairs in his Hunterian lectures of 1816:

> I return to our own country, and am ashamed to find, that although her colonies and commercial establishments are found in every region and every climate, while every sea is covered and every coast is visited by her ships, these great facilities have been as greatly neglected. We have no national collection of living animals, no museum of natural history, no public institution for teaching natural science.[97]

Twenty years later, in a similar vein to Lawrence, Grant declared the zoological collection at the British Museum an 'opprobrium to the British Nation and these enlightened times' in his evidence to a parliamentary committee set up to investigate the possibility of reforming the institution.[98] Comparing the state of British museums with those in other countries (and especially with those in France) constituted a means by which reform politics could be expressed in terms of national interest - a tactic particularly apposite for those such as Grant, whose non-English background invited accusations of harbouring unpatriotic sympathies.[99] Collecting and organizing specimens in the name of a specifically 'British' natural philosophy helped justify the introduction and development of practices and concepts that had been first developed in 'revolutionary' settings on the continent.

As far as medical politics was concerned, one of the earliest targets for reformers campaigning for a more open, accountable and 'philosophic' medicine was the Hunterian Museum at the College of Surgeons. This large collection of

[97] Lawrence, W. *An Introduction to Comparative Anatomy and Physiology: being the two introductory lectures delivered at the Royal College of Surgeons* (London, 1816), pp. 87-88. Following his early involvement in campaigns for medical reform, Lawrence increasingly sided with the College Council in its opposition to radical medical politics. See Desmond, *The Politics of Evolution*, pp. 257-258.

[98] *Report on the Select Committee of the British Museum; together with minutes of evidence, appendix and index...* (London, 1836), p. 37. Wilson, *The British Museum*, pp. 82-91.

[99] Desmond, *The Politics of Evolution*, pp. 112-114.

zoological anatomical preparations had been built up by John Hunter during the latter half of the eighteenth century, and its care entrusted to the College by parliament following his death in 1793. Yet the College initially displayed little enthusiasm for the collection. Before 1837, members were granted access on two afternoons a week, and even then were required to present a letter from a member of the elite College of Physicians. No attempt had been made to catalogue it, or assess its value.[100] This apparent neglect provided moderate and radical reform factions with a complaint they could all agree on - the College's apparent unwillingness to allow members adequate access to the museum was indicative of a wider lack of support for the advancement of medical knowledge. This general agreement amongst reformers provided the movement with a rallying point, and contributed to the College's decision to construct a new building in which to house the collection, and appoint a new conservator (Owen) tasked with the cataloguing of it.[101] The political pressure surrounding access to and maintenance of the Hunterian collection also contributed to a more general increase in emphasis on zoological anatomy during this period.

Grant's zoology in London

The differences between Grant's focus in and around Edinburgh and his work after taking up his post as Professor of Comparative Anatomy and Zoology at UCL in 1828 are clearly shown by the research publications he produced from each location. Many of his articles published in Scottish journals relied on extended observations of living animals kept alive in a merchant friend's (a Mr. Alexander Wilson) unused property on the banks of the Firth of Forth. This private,

[100] Yanni, C. *Nature's Museums: Victorian science and the architecture of display* (Baltimore; John Hopkins University Press, 1999), pp. 46-47.

[101] Ibid. See eg. 'Royal College of Surgeons', *The Lancet* 5 (1825-6), p. 729. 'Proposed Outlay of College Money by the College in Lincoln's Inn Fields', *The Lancet* 21 (1833-4), pp. 830-832. 'Petition of the Royal College of Surgeons in London', *The Lancet* 22 (1834), pp. 158-160. On relations between museum architecture and natural history see Forgan, S. 'The Architecture of Display: Museums, universities and objects in nineteenth-century Britain', *History of Science* 32 (1994), pp. 139-162.

laboratory-like setting enabled Grant to concentrate on the study of living animals.[102] In addition to his interest in the local sponge population, he produced articles on such topics as sounds made by sea-slugs and the phosphorescence produced by certain water-borne plants.[103]

In contrast to his Edinburgh researches, Grant produced only one paper that focused on the study of living organisms following his arrival in London. Shortly after his appointment to the university in 1828, he subjected a sample of water found some nearby 'stagnant pools' to microscopic analysis. He reported that he was able to observe the motions of the *Furcocera viridis*, an infusorial 'animalcule' named by Lamarck and described by renowned German zoologist Johannes Müller. Intriguingly for Grant, whichever way he turned the vessel in which the sample was held, the organisms always collected on the side of the glass most exposed to a source of light.[104]

Though relatively short, this text is significant because it both demonstrates a continuation of Grant's interest in nature of simple organic forms, and represents a shift of intellectual focus. Whereas his previous publications exhibit a concern with establishing relations between the 'simplest' living beings and chemical nature, this article concerns itself above all else with zoological life:

> The motions of Infusoria are by many believed to be automatic, and Lamarck conceives them to result merely from the action of various imponderable fluids pervading all bodies... It is interesting, however, to observe, that an agent so extensively diffused over nature as light has an obvious and powerful influence on the motions of the *Furcocera viridis*, an animalcule which exhibits nearly the simplest known form of animal organization.[105]

[102] 'Biographical Sketch of Robert Edmund Grant', p. 693.

[103] Grant, R.E. 'Sounds produced under water by the *Tritoria arborescens*', *Edinburgh Philosophic Journal* 14 (1826), pp. 185-186. Grant, R.E. 'Notice regarding the structure and mode of generation of the *Virgularia Miribalis* and *Pennatula phosphorea*', *Edinburgh Journal of Science* 7 (1827), pp. 330-334.

[104] Grant, R.E. 'On the influence of Light on the motions of Infusoria', *The Edinburgh Journal of Science* 10 (1828-1829), pp. 346-349.

[105] Ibid, p. 349.

Critical to this shift is a concern not with demonstrating the agency or chemical origin of the most basic living particles, but with the nature of organic agency in general and its possible causes. The apparent absence of a nervous system in these animals seemed to imply that they would not be able to respond to stimuli - that their movements must be undirected or the result of vital forces internal to the organism. The portrayal of movement as 'caused' by light - a stimulus external to the body of the animal - appears to be aimed at circumventing the necessity of invoking an immaterial internal 'force' to explain organic movement. As will be shown below, this suggestion that even very simple animals could respond to an external, structurally independent force had important implications for Grant and his students' subsequent portrayals of both relations between organic structure and function, and the nature of life in general.

Following the publication of this paper, and despite the apparent significance of the claims that it made, Grant reported little further research in this experimental vein. In subsequent publications, including his Comparative Anatomy course at UCL, he concentrated almost exclusively on the description and comparison of anatomical forms, and on relating those forms to living functions. In the context of imperial London, Grant's aim of establishing zoology as a 'philosophic' science (and with it a community of zoological practitioners) was more readily achieved through the collection, production, description and utilization of anatomical specimens than by establishing normative claims relating to relations between organic and inorganic nature (as microscopic and experimental observation seemed to promise).

As Desmond demonstrates, in showing how organisms' anatomical structures formed a gradual progression from the 'simplest' to the 'most complex,' Grant was following the work of (amongst others) Geoffroy St Hilaire.[106] Geoffroy was engaged until 1832 in an extended dispute with his counterpart at the Museum d'Histoire Naturelle, the highly-respected George Cuvier, over the extent to which organic nature could be characterized as a unified whole.[107] Much of Grant's

[106] Desmond, *The Politics of Evolution.*

[107] Appel, *The Cuvier-Geoffroy Debate*. 1832 was the year of Cuvier's death.

anatomical work at the Zoological Society was aimed at breaking down Cuvier's proposed 'embranchments', by which natural forms were classified into broad, essentially dissimilar categories.[108] In this sense, we can see Grant continuing his already-discussed interest in establishing a normative position regarding natural (rather than simply organic) unity. However, establishing Geoffroy's 'unity of type' in organic structures could say very little about relations between organic and inorganic nature. By concentrating on describing relations between anatomical structures and living functions, Grant appeared to be ceding epistemological ground in his advocacy of the unity of nature and universality of natural law.

Although Grant's research in London has been characterized as calculated to support Geoffroy, and as broadly inspired by the transmutationist ideas of Jean-Baptiste Lamarck, it would be a mistake to assume that either natural philosopher's ideas provided a complete conceptual framework for Grant's lectures.[109] As indicated by the quote from the the *Furcocera viridis* article above, Lamarck's characterization of vital force did not feature prominently in Grant's work, though both shared an interest in organisms that were difficult to classify as either plant or animal, and both were interested in the possibility that life developed out of inorganic matter.[110] Similarly, Grant shared Geoffroy's belief that basic elementary forms could be traced throughout zoological nature, but placed greater emphasis on the development of life from microscopic organic structures. In this sense, Grant's lectures at UCL can be seen as an attempt to synthesise the work of the two French naturalists, similarly to the way in which Cuvier's and Geoffroy's followers in France sought a synthesis of their more antagonistic views during the 1830s and 40s.[111] The role of Germanic philosophy and zoology in this process was crucial, as it provided clear conceptual tools for an understanding of nature as a progressive, end-directed process that did not have to rely on active intervention of a disembodied or immaterial force.[112]

[108] Desmond, *The Politics of Evolution*, p. 56.

[109] For this characterization see Desmond, 'Robert E. Grant' and Desmond, *The Politics of Evolution*.

[110] Desmond 'Robert E. Grant'

[111] Appel, *The Cuvier-Geoffroy Debate*, pp. 202-237.

[112] Lenoir, *The Strategy of Life*, pp. 6-16.

As already noted, like other 'philosophic' anatomists, rather than attempting to explain organisms at the species level, Grant takes as his object of explanation the development and existence of relations between different systems of organs. For example, in his *Lancet* lectures, the skeletal, nervous and digestive systems are each described in turn, starting with characterizations of their 'simplest' manifestation and working up to their most complex (generally though not necessarily to be found in a universal 'Man'). According to Grant (following Geoffroy), each set of organs display a gradual progression of form, and the explanation for changes in form along this continuum is to be found in changes to the functional requirements of a particular organ. Thus the fact that the skull-bones of fishes are not fused together, and resemble vertebrae when compared with the skulls of mammals, demonstrates two things; firstly, it shows that fishes' skulls are lower down the skeletal developmental scale than those of mammals, and therefore closer to the 'simplest' condition in which bones can be found (in this case as countless minute 'spicula' in the sponges);[113] secondly, it shows how fish are 'perfectly adapted' to their environment - a circumstance that requires the accommodation of muscles suited to producing the lateral bodily motion necessary to move through water. This (Grant suggests) would not be possible with a fused skull.[114]

Explanations along these lines do not necessarily invoke the functional requirements of the external environment as an immediate explanation for all anatomical forms, but consider each form in relation to the whole body and its environment. This is most clear in Grant's lectures on nervous anatomy. He considers the most simple discernible form of the nervous system (though not the first manifestation of nervous function) as that of the starfish, described by Friedrich Tiedemann in 1816.[115] This system, according to Grant, consists of 'a simple circle of nervous filament around the centre of the alimentary canal... placed

[113] Grant, 'Lectures' [IV], pp. 196-200.

[114] Grant, 'Lectures' [XII], pp. 544-546. On Grant's views on perfect adaptation see eg. 'Lectures' II, p. 123.

[115] Tiedemann, F. *Anatomie der Röhren-Holothurie der pomeranzfarbigen Seesterns und Stein-Seeigels: eine im Jahre MDCCCXII vom Fransösischen Institut gekrönte Preisschrift* (Landshut, 1816).

near the mouth so as to watch over the kind of substances that are conveyed into [it]'.[116] In this 'low' state the nerves have a relatively direct relation to external environmental conditions, their primary function being to ensure the digestive system receives appropriate sustenance from without. But in organisms in which other functional systems play a greater role, the nervous system's most significant relation is with its internal environment. Hence in arachnids the relatively minor role played by the sense organs means that the 'supra-œsophageal' ganglion serving them is small. In contrast, the importance of the organs of motion for the continuance of arachnid life means that the ganglia relating to them are of greater size.[117] As the nervous system is traced upwards through the animal kingdom, its form becomes increasingly dependent on the relative importance of different anatomical structures, rather than the direct influence of external environmental conditions, for keeping the animal alive.

The principal means by which life is seen to develop in Grant's lectures is that which was being advocated by Johann Friedrich Meckel around this time: the successive arrest of embryological development along a pre-ordained plan, regulated by the operation of natural law. Though species' bodies themselves do not in this conception follow one smooth progressive path from simple to complex, all anatomical structures can be seen to progress along a gradual series as they develop into adult form. Hence anatomical structures found in adult specimens 'lower' down the scale find their parallel in still-developing human or mammalian bodies. Though Grant does not claim the human embryo exhibits the most developed examples of all anatomical forms, it nevertheless constitutes the principal example of 'higher' development deployed by him.[118] This (at this time highly speculative) practice of comparing lower organic forms to anatomies of the human embryo accorded well with the broader emphasis on museological evidence within Britain at the time.

In his museum and the lectures he produced at University College Grant could address one anatomical specimen at a time, moving up an anatomical series

[116] Grant, 'Lectures' [XXXVI], p. 483

[117] Grant, 'Lectures' XXXVII, pp. 515-516.

[118] See for example Grant,. 'Lectures' XXXIII, p. 369. Grant, 'Lectures' XXXVII, p. 513.

and relating each organ to the specific environmental and bodily circumstances that he considered to explain its structure. At the same time, continual comparison of anatomical elements of 'lower' animal adult forms with representations of 'higher' animal embryos seemed to demonstrate parallels between all organic structures.[119] Specimen-based comparative anatomy thereby presented a convincing means by which the study of human organs could be linked with that of the development of non-human nature.

Other aspects of Grant's portrayal of the 'progress' of organic structure in his UCL lectures seem more in accordance with his belief in natural unity, rather than with his later, specimen-centred zoology which he adopted during his time there. One example of this (his suggestion that tissues were made up of spontaneously-created, mutually independent globular 'atoms') has already been discussed. Another, more prominent theme of the lectures is his discussion of the gradual formation of the distinct anatomical systems evident in more complex or 'higher' animals.

In Grant's view, all the most basic functions necessary for the continuation of life are fulfilled not only by the collective operation of different anatomical structures evident in more complex organisms, but also at the most basic level by a 'gelatinous matter' similar to the one that he first encountered in his sponge research. He suggests that this basic organic substance contains within it the potential for the development of all organs that fulfil specialized functions. Hence 'all the systems that enter into the composition of animal bodies are successively developed from a primitive, simple, homogeneous, cellular tissue which at first composed the whole body.'[120] For example, following a description of the experiments relating infusoria and light described above, Grant proceeds to describe the nature of the simplest structures that can be associated with independent action; initially, 'nervous', 'muscular' and 'digestive' functions are 'diffused through every part of the homogeneous cellular tissue of the body, which

[119] On embryology and anatomical specimens see Hopwood, N. 'Producing Development: the anatomy of human embryos and the norms of Wilhelm His', *Bulletin of the History of Medicine* 74 (2000), pp. 38-39. Hopwood, N. 'Plastic Publishing in Embryology', in Hopwood, N. and de Chadarevian, S. (eds.) *Models: the third dimension of science* (Stanford; University Press, 2004), pp. 182-186.

[120] Grant, 'Lectures' II, p. 126

possesses the same properties in every part, and is infinitely divisible without destroying its vitality.'[121]

Contending that functions such as motion and volition - conventionally associated with distinct organs or entities such as muscles, the brain, or even an incorporeal 'soul' - are evident in the simplest living matter enabled Grant to emphasise his belief in the unity of organic nature (though not his belief in the unity of nature as a whole). The suggestion that muscles, brains, and other organs that were generally presumed to be functionally-specific had their origins in a single substance marks an extension of Paris-trained naturalists' contentions regarding the independence of anatomical structure and living function. Geoffroy had argued that the fins of fishes were 'the same' bones as the inner ear of mammals, and that consequentially anatomical structures could not be usefully classified according to the functions they fulfilled.[122] Grant went further, suggesting that all life developed from an original, functionally undifferentiated state. This contention can be seen as a confirmation of the characterization of nature as inherently developmental, progressing from simple to complex - a concept most prominent in what Tim Lenoir characterises as the 'teleo-mechanic' natural philosophy prevalent in Germanic territories at this time.[123] Like Germanic zoologists such as Meckel and Karl Ernst von Baer, Grant was concerned with establishing how specialized organic forms arose from an initially 'homogeneous' substance (though the more avowedly embryological focus of von Baer meant that he emphasised the development of individual organisms to a far greater extent).[124]

In addition to providing a means by which very simple organisms could be brought within the same explanatory framework as 'higher' classes such as reptiles and mammals, the invocation of differentiation as an organic 'law' naturalised an implicit hierarchy of anatomical forms. The first type of organ thought to develop (in this case the skeletal) fulfilled functions that were most fundamental to - and therefore 'lowest' in - the progress of life. Organisms further up the series had to

[121] Grant, 'Lectures' XXXVI, pp. 481-482

[122] Appel, *The Cuvier-Geoffroy Debate*, pp. 84-98.

[123] Lenoir, *The Strategy of Life*.

[124] Lenoir, *The Strategy of Life*, pp. 80-81.

respond to more challenging environmental conditions. This meant that different types of structure were needed for the species to survive. Hence skeleton, muscles, and nerves are portrayed as coming into being at successive points in the progressive unfolding of nature. The types and relative sizes of organs perceptible in any given animal become indicators of its place in the overall gradation of nature.[125] Birds might have presented the most complex forms of osteological development, and the most developed digestive systems may have been found in the Ruminata, but man remained the 'highest' being in Grant's lectures because he possessed the most complex form of nervous system - the 'highest' organ because last to appear in the differentiation of living tissues.

Describing the differentiation of tissues out of a simple homogeneous substance enabled Grant to reconcile his emphasis on absolute natural unity with the seemingly well-distinguished anatomical 'elements' he sought to explain in is lectures. Nevertheless, this view would have been difficult to convey to his students using the primarily anatomical tools at his disposal. In the absence of any established means of demonstrating the points at which different anatomical elements were differentiated out of an original homogeneous substance, he appears to have simply asserted his views as truth. Though it is possible that he presented students with microscopic evidence or illustrated these points with drawings, there is no hint of this in his published or unpublished writings. The extent to which his reliance on prepared specimens (and illustrations) determined Grant's capacity for promoting his subject indicates a limiting effect of museology on zoological discourse. Whilst a very powerful means of associating and comparing particular structures of human and animal bodies, the comparison of specimens was not well suited to illustrating the nature, origin or development of difficult-to-perceive or preserve organic phenomena. The importance accorded to museums in British natural philosophy during the early nineteenth century concentrated attention on 'higher' anatomy at the expense of the microscopic and experimental studies more popular on the continent (and that had constituted the main focus of Grant's research in Edinburgh).[126]

[125] Grant, 'Lectures' IV, pp. 193-195.

[126] Temkin, O. 'Basic Science', pp. 364-365 and 368-369.

Interpreting anatomy

The aspects of Grant's science that were most congruent with his teaching at UCL – i.e. comparisons between and explanations of specific anatomical parts - were also highly susceptible to appropriation within different and even opposing explanatory frameworks. The clearest example of this is the adaptation of his emphasis on the gradual progress of anatomical structures to natural theological discourse by his students. For example, having been commissioned to write the treatise on zoology for the natural theological *Bridgewater* series, Peter Mark Roget enrolled on Grant's course in 1832, and subsequently based a large proportion of the final text on its progressive anatomical schema. Yet this work played down Grant's emphasis on the unity of natural law, preferring instead to emphasise abrupt distinctions between whole species, and the possibility that organic change was produced by a 'subtle and pervading principle'. It also insisted that living nature was 'utterly irreducible to the known laws which govern inorganic matter.'[127]

Other attendees of Grant's classes at UCL interpreted his anatomy in a similar fashion. Edwin Lankester and Edward Meryon both published works addressing zoology that admitted the possibility of a continuum of anatomical forms. Nevertheless, both denied that man could be included in this continuum, and Lankester was particularly concerned to stress the impossibility of the spontaneous development of life out of inorganic matter.[128] Though Grant's university lectures promoted an uncompromisingly law-determined notion of zoological development, this did not prevent his students from appropriating those aspects of them that accorded with their own particular conceptions of life, nature, and divine creation.

The institutional contexts that made it possible for those without independent means to practice zoology tended to confine their activities to

[127] Roget, P.M. *Animal And Vegetable Physiology Considered with Reference to Natural Theology* (London, 1834), esp. Vol. I, pp. 9 and 21.

[128] Meryon, E. *The Physical and Intellectual Constitution of Man Considered* (London, 1836), esp. pp. 25-45. Lankester, E. 'The Natural History of Creation', in *Lectures Delivered Before the Young Men's Christian Association at Centenary Hall and Freemason's Hall, 1847-8* (London, 1848), pp. 1-32.

anatomical science. Many of Grant's students who went on to publish on zoology centred their work on the collection and interpretation of specimens. Museums were integral to the livelihoods of such of his students as the naval surgeon and naturalist Robert McCormick, and William Henry Flower, Owen's successor following the latter's retirement from the Museum of Natural History in 1884.[129] Grant himself was certainly aware of the importance of museums as sites in which zoological practitioners might gain specialist employment. He argued in his 1836 evidence to the above-mentioned committee on the reform of the British Museum that one of the chief reasons for the disordered state of its collection was the employment of curators that did not have a prior reputation in their field.[130] In a culture that emphasised the collection and production of specimens, gaining an appointment in a museum or as a collector on a naval expedition were the most obvious way in which aspiring natural philosophers could make their zoological interests pay.[131]

Though practices that would later become associated with 'laboratory' settings could and did take place in museums from the 1840s, anatomical collection and interpretation remained their principal *raison d'etre*.[132] This meant that advocates of a unified conception of nature were able to promote a zoology that emphasised law as the sole motor of organic change. However, such figures found

[129] On Flower's museology see van Keuren, D.K. 'Cabinets and Culture: Victorian anthropology and the museum context', *Journal of the History of the Behavioural Sciences* 25 (1989), pp. 26-39. Other students of Grant's who centred their subsequent zoological activities around collections and collecting include John Forbes Royal (1798-1858), Robert McCormick (1800-1890) Thomas Caverhill Jerdon (1811-1872) and Louis Hunton (1814-1838). McCormick's memoirs have recently been republished as McCormick, R.M. *Voyages of Discovery in the Arctic and Antarctic Seas and Round the World* (2 Vols.) (Boston, 2006 [1884])

[130] *Report on the Select Committee of the British Museum*, pp. 134-135.

[131] The development of Thomas Henry Huxley's career is particularly instructive in this regard. See Forgan, S and Gooday, G. 'Constructing South Kensington: the buildings and politics of T.H. Huxley's working environments', *British Journal for the History of Science* 29 (1996), pp. 435-468; White, P. *Thomas Huxley: making the "man of science"* (Cambridge; University Press, 2003).

[132] Kraft, A. and Alberti, S.J.M.M. "Equal Though Different': laboratories, museums, and the institutional development of biology in late-Victorian Northern England', *Studies in the History and Philosophy of Science, Part C: Studies in the History and Philosophy of Biological and Biomedical Sciences* 34 (2003), pp. 203-236. See also Grant's comments on locating his 'laboratory' in the university museum: Coll. Coll. Grant-Atkinson, 15 Nov. 1843.

it harder to question the initial origins of life. Statements regarding relations between life and non-life could not be articulated without the utilisation of the culturally problematic techniques of microscopy and experiment that would become associated with organic chemistry and the observation of cells later in the century.

Amongst the clearest illustration of the bias towards 'higher' anatomy that went along with the status of museums as pre-eminent sites of organic investigation is embodied by the early publications of William Benjamin Carpenter, one of Grant's students most sympathetic to his notion of nature as a unity. Significantly, although these texts (published during the mid-late 1830's) value microscopic observation, they cast doubt on the possibility of observing fundamental atom-like organic forms.[133] It was only after the establishment of cell theory by Matthias Jacob Schleiden, Theodor Schwann, Rudolf Virchow and Edinburgh microscopist John Goodsir that Carpenter's publications begin to represent bodies as made up of collections of nominally-independent microscopic parts.[134] Even then, they emphasise what they portray as the impossibility of cells developing from inorganic matter and the wide range of cell-like entities that tissues are made up of.[135] Carpenter's early publications indicate his belief that physiological studies have to be distinguished from conceptions of life as chemically-derived, and that there is little evidence for the contention that nature is built up of agglomerations of essentially similar (and therefore implicitly equal) parts.

Nevertheless, for Carpenter, the apparent existence of such fundamental

[133] Carpenter, W.B. *Principles of General and Comparative Physiology, Intended as an Introduction to The Study of Human Physiology, and as a Guide to the Philosophical Pursuit of Natural History* (London, 1839), eg. on pp. 14 (footnote), 19, 23.

[134] Schwann's work is discussed in Otis, L. *Müller's Lab* (Oxford and New York; Oxford University Press, 2007), pp. 59-66. Ackernecht, E.H. *Rudolf Virchow: doctor, statesman, anthropologist* (Madison; University of Wisconsin Press, 1953) remains the most comprehensive Anglophone study of Virchow's work. On Goodsir see Jacyna, L.S. 'John Goodsir,' pp. 75-99.

[135] Carpenter, W.B. 'Report on the Results Obtained by the Use of the Microscope in the Study of Anatomy and Physiology: Part II - On the origin and function of cells', *British and Foreign Medical Review* 15 (1843), pp. 259-281. On Carpenter's changing attitudes towards globules and cells see Jacyna, L.S. 'Scientific Naturalism in Victorian Britain' (unpublished PhD thesis, University of Edinburgh, 1980), pp. 120-125. On his hostility to spontaneous generation see Carpenter, W.B., 'Natural History of Creation', *British and Foreign Medico-Chirurgical Review* 19 (1845), esp. pp. 168-173.

differences between life and non-life did not imply that organisms could not be interrogated on the same basis as the rest of nature (as Roget and others inferred). Advocates of spontaneous generation maintained that life was reducible to natural law because it was no more than a product of the interaction of chemical or other physical forces. Carpenter's texts adopt an alternative position, suggesting that it is not the origin, but the nature of life that constitutes evidence that it is governed by discoverable laws. Specifically, they maintain that living structures exhibit phenomena that imply the existence of a physical force that can be interrogated on the same basis as forces such as light, heat, magnetism and electricity. Carpenter later suggests that the existence of this force can be understood as extending the principle of the conservation of energy to living structures.[136] This force's role in natural philosophic discourse will be addressed more fully in subsequent chapters. It is nevertheless sufficient for present purposes to note that invocation of a force related to organic nature - apparently shorn of the spiritualist connotations of Coleridge and Roget's 'subtle and pervading principle' - enabled Carpenter to sidestep the problem of establishing the veracity of microscopic observation encountered by advocates of spontaneous generation.

Conclusion

Museums, and the specimens they contained, played a critical role in the constitution of zoology as an academic discipline in Britain during the nineteenth century. As spaces that could be experienced by multiple witnesses relatively easily, they seemed particularly reliable means of constituting knowledge within a culture in which the mind was generally considered a different category of

[136] Hall, V.M. 'The Contribution of the Physiologist, William Benjamin Carpenter (1813-1885), to the development of the principles of the correlation of forces and the conservation of energy', *Medical History* 23 (1979), pp. 129-155. See also Smith, R. 'Physiological Psychology and the Philosophy of Nature in Mid-Nineteenth-Century Britain' (unpublished PhD thesis, University of Cambridge, 1970) pp. 245-255. The process of conversion of non-living into living matter became a principal concern of other students of Grant's, such as Henry Charlton Bastian and the agricultural chemist Joseph Henry Gilbert. On Bastian see Strick, *Sparks of Life*. On Gilbert's work on fertilization with John Bennet Lawes, see Brock, W.H. *Justus von Leibig: the chemical gatekeeper* (Cambridge; University Press, 1997), pp. 173-177.

investigation to that of organic nature. In addition, individual museum specimens could be utilised for the purposes of instruction more readily than individual microscopes. A specimen in a jar could be held up for a whole class to see at once, whereas a single microscope demanded that each observer witness the phenomena in question separately.[137] The production of agreement amongst observers thereby seemed far more easily obtainable via the collection and display of specimens than through their magnification.

The status of museums as pre-eminent means of researching and teaching zoology encouraged natural philosophers to ask different questions to those associated with other means of intellectual production. Microscopes were indispensable in attempts to answer such problems as 'what is the simplest unit of life?' or 'does life develop out of non-life?' The relative marginalisation of microscopic techniques in comparison with the collection and interpretation of specimen-objects meant that such questions came to be seen as less interesting than those concerning relations between anatomical structures. In particular, the issue of whether or not the understanding of humans should be informed by that of zoological nature as a whole became particularly prominent in Britain. Focus on museological specimens - along with the importance of museums as sites in which zoologists could maintain institutional positions - contributed to a concentration on the nature of human-animal relations.

Though relations between life and non-organic nature were becoming culturally important elsewhere (for example in Germany)[138] at this time, it was the relation of humans to an historically distinct 'animal' kingdom that most concerned the majority of British intellectuals addressing living nature.[139] Grant's reliance on specimens as an epistemic tool reflects both a broader focus on museums as authoritative sites of intellectual production, and the relatively marginal status of

[137] On the development of collective witnessing in microscopy, see Jacyna, L.S. 'Moral Fibre: the negotiation of microscopic facts in Victorian Britain,' *Journal of the History of Biology* 36 (2003), pp. 39-85.

[138] On this difference see Schickore, *The Microscope and the Eye*, esp. pp. 133-157. Lenoir, *The Strategy of Life*.

[139] The three figures most intensely studied in this regard have been Richard Owen, Charles Darwin, and Thomas Henry Huxley. On Owen, see Rupke, N. *Richard Owen*. On Huxley, see White, *Thomas Henry Huxley*. The most comprehensive biographical study of Darwin is Browne, *Charles Darwin*.

other means of constituting zoological knowledge in Britain at this time. His political commitment to an uncompromisingly law-determined conception of creation, in which life could be explained by 'the principles of chemistry or mechanics,' came to be articulated by him in relation to anatomical series rather than the microscopic ‘atoms’ that had at first seemed so promising.

As an epistemic tool that was critical to the instantiation of zoology as an academic discipline, museums can thereby be understood as constituting a limiting effect on British discourse regarding the nature of animality. Indeed, perhaps the most famous nineteenth-century debate regarding the nature of life, that between Thomas Henry Huxley (representing Charles Darwin) and Richard Owen (and Bishop Wilberforce), during the 1860s, centred around the interpretation of anatomical specimens of an organic 'element' that was to play a particularly prominent role in nineteenth-century natural philosophy, and which constitutes a focus for much of the rest of this thesis; the nervous system. The apparently critical status of anatomical disputes during the 1860s indicates the central role that museum specimens had come to play in the constitution of zoology as a prestigious scientific discipline. The politics of early nineteenth-century zoology was not simply a reflection of broader ideological concerns: it also depended on considerations relating to the kinds of tools which could legitimately be appealed to in its investigation.

Chapter 2:

Politicising Technique: ideology, nervous physiology, and the place of tools in 'disciplinary' psychology (c. 1830-1860)

Introduction

It is more than coincidental that University College London constituted a key site for the emergence of zoology as a recognisable academic discipline in nineteenth-century Britain. Indeed, it might be said that, as a site in which a whole range of intellectual disciplines - history, modern languages, and political economy as well as zoology and botany – first found institutional purchase, UCL offers an exemplary case study regarding changing notions of academic practice during this time. Such a study would be beyond the scope of this thesis. However, I wish to point out in this chapter the possibilities afforded by UCL and similar institutions such as the University of Edinburgh for the re-formulation of intellectual activity during the nineteenth century.

My principal concern in this chapter is the aspiration of a second science - psychology - to the status of an established, 'disciplinary' field of study in the nineteenth-century academy.[1] During the twentieth century, the emergence of psychology, as a set of ideas relating to man's 'internal' life and health, became a significant concern for historians wishing to interrogate the status of medicine in contemporary culture. As such, a wide range of studies have been published in which the constitution of psychological knowledge - and especially psychological knowledge relating to 'pathological' states of mind - is questioned, interrogated, and otherwise problematized. Of particular concern in literature relating to British medicine has been the place of asylums as institutions critical to the establishment

1 On this 'pre-disciplinarity' of nineteenth-century psychology in Britain see Rylance, R. *Victorian Psychology and British Culture, 1850-1880* (Oxford and New York; Oxford University Press, 2000), pp. 5-17.

of a psychiatric 'profession'.[2] Hence debates have raged as to what extent the emergence of psychiatry can be associated with institutionalization, the demands of industrialization, family life, and changes in the make-up of the state.[3] Somewhat paradoxically, however, histories concerned with British medical practice have until recently tended to neglect the emergence during the mid-nineteenth century of efforts to associate mind and life. The constitution of a notion of psychological existence as a specifically 'physiological' phenomenon - that is, of a 'physiological psychology' (as it came to be termed by its practitioners) - in which mind is conceived of as co-incidental to organic development, has not been subject to extensive examination by historians of medicine.[4] This may be because of its' concern with the definition of a 'nature' or a set of norms regarding human motives and desires rather than mental pathology; physiological psychology was not always applied to the treatment of pathological states. Nevertheless, as a key constituent of intellectual culture in Britain at this time, the movement as a whole deserves greater attention than it has hitherto been given.

Despite not having been addressed in great detail in histories of medicine, the drawing-together of zoological, physiological and psychological discourses

2 On medical Historians concern with professionalism more generally see Burnham, J.C. *How the Idea of Profession Changed the Writing of Medical History*, Medical History Supplement 19 (London, 1998).

3 There is now an extensive literature on the history of nineteenth-century asylums. For historiographic overviews see Bartlett, P. and Wright, D. 'Community care and its antecendents', in Bartlett, P. and Wright, D. *Outside the Walls of the Asylum* (London and New Brunswick, 1999), pp. 1-18; Melling, J. 'Accommodating Madness; New research in the social history of insanity and institutions', in Melling, J. and Forsyth, B. (eds.) *Insanity, Institutions and Society, 1800-1914: A social history of madness in comparative perspective* (London, 1999), pp. 1-23. Recent monographs and book-length collections on the British context include Suzuki, A. *Madness at Home: The psychiatrist, the patient, and the family in England, 1820-1860* (Berkeley, Los Angeles and London; University of California Press, 2006); Melling, J. and Forsyth, B. *The Politics of Madness: The state, insanity and society in England, 1845-1914* (Abingdon, 2006); Bartlett and Wright, *Outside the Walls*; Scull, A. *The Most Solitary of Afflictions: Madness and society in Britain, 1700-1900* (New Haven and London; Yale University Press, 1993).

4 Significant exceptions include James, F.E. 'Thomas Laycock and a Trophic Nervous System', *Journal of the History of the Neurosciences* 7 (1998), pp. 27-31; Jacyna, L.S. 'Somatic theories of mind and the interests of medicine in Britain', *Medical History* 26 (1982), pp. 233-258; Smith, R. *Trial By Medicine: Insanity and responsibility in Victorian trials* (Edinburgh; University press, 1981); See also Bynum, W.F. 'The nervous patient in eighteenth- and nineteenth-century Britain: the psychiatric origins of British neurology', in Bynum, W.F., Porter, R. and Shepherd, M. *The Anatomy of Madness: Essays in the History of Psychiatry* [Vol.] (London, 1985), pp. 89-102.

during the nineteenth century has not gone unnoticed in the wider literature on British history.[5] Of particular note in this regard is a substantial body of work that seeks to demonstrate that broader literary practices, generally considered to operate in isolation from the domain of academic disciplines, have in fact been intimately related to the constitution of psychological beliefs. That is, historians of a non-specialized 'literature' (generally conceived of as referring to poetry, novels, short stories, miscellaneous journal articles, and so on) have identified specific, co-constitutive links between the rhetoric and narrative techniques deployed in texts relating to both formal, disciplinary studies of mind, and informal, 'undisciplined', commercially-dependent writing.[6] The emergence of a specifically 'physiological' psychology, it has been pointed out, was to a great extent dependent on the possibilities constituted by the literary forms that prevailed during the nineteenth century.[7]

Physiological psychology as a movement has thereby been characterised as

5 Smith, R. 'The Physiology of the Will: mind, body, and psychology in the periodical literature', in Cantor, G. and Shuttleworth, S. *Science Serialized: representations of the sciences in nineteenth-century periodicals* (Cambridge, MA and London; MIT Press, 2004), pp. 81-110; Dixon, T. *From Passions to Emotions: the emergence of a secular psychological category* (Cambridge; University Press, 2003), pp. 135-179; Rylance, *Victorian Psychology and British Culture*; Leff, A. 'Thomas Laycock and the Cerebral Reflex: a function arising from and pointing to the unity of nature' *History of Psychiatry* 2 (1991), pp. 385-407; Jacyna, L.S. 'Principles of General Physiology;: the comparative dimension to British neuroscience in the 1830's and 1840's', *Studies in History of Biology* 7 (1984), pp. 47-92; Danziger, K. 'Mid-Nineteenth-Century British Psycho-Physiology: A Neglected Chapter in the History of Psychology', in Woodward, W.R. and Ash, M.G. (eds.) *The Problematic Science: Psychology in Nineteenth-Century Thought* (New York, 1982), pp. 119-146; Jacyna, L.S. 'The Physiology of Mind, the Unity of Nature, and the Moral Order in Victorian Thought', *The British Journal for the History of Science* 14 (1981), pp. 109-132; Daston, L.J. 'British Responses to Psycho-Physiology, 1860-1900', *Isis* 69 (1978), pp. 192-208; Smith, R. 'The Human Significance of Biology: Carpenter, Darwin, and the vera causa', in Knoepflmacher, U.C. and Tennyson, G.B. *Nature and the Victorian Imagination* (University of California Press; Berkeley and Los Angeles, 1977), pp. 216-230; Young, R.M. *Mind, Brain and Adaptation in the Nineteenth Century* (New York; Oxford University Press, 1990 [1970]); Smith, 'Physiological Psychology and the Philosophy of Nature'.

6 For an overview see Matus, J.L. 'Victorian Framings of the Mind: recent work on mid-nineteenth century theories of the unconscious, memory, and emotion', *Literature Compass* 4 (2007), pp. 1257-1276. See especially Dames, N. *The Physiology of the Novel: reading, neural science, and form in Victorian fiction* (Oxford and New York; Oxford University Press, 2007), esp. pp. 25-70; Stiles, A. (ed.) *Neurology and Literature* (Basingstoke, 2007); Gallagher, C. *The Body Economic: life, death, and sensation in political economy and the Victorian novel* (Princeton and Oxford; Princeton University Press, 2006), esp. pp. 35-61.

7 Smith, 'The Physiology of the Will'.

one form of representational practice amongst others. In this conception, articulations of notions of mind that depended on zoological notions of corporeality participate in a culture that is concerned, above all, with the authority of text. Implicit in such claims is that human-physiology-centred conceptions of 'the' psyche cannot be differentiated from those that concern themselves above all with other, not-necessarily-somatic categories, such as 'the soul,' or 'nature.' All claims regarding human motives or behaviours are rendered equivalent, in that they are all forms of representational practice that ebb and flow according to the literary conditions in which they find themselves.

It is my contention in this chapter that the physiological notions of psyche that emerged in conjunction with the disciplines of the nineteenth-century academy present historians with a problematic more complex than most representation-focused studies have hitherto recognised. Specifically, I show that, from its foundation, physiological psychology in Britain brought the notion of intellectual practice, as above all an activity concerning the 'representation' of nature or truth, into question. What sets physiological psychology apart from other approaches to mind, I believe, is the power it accords non-linguistic technical entities - what I have called 'epistemic tools' - in intellectual practice. As I demonstrate here, by aligning their contentions with the same forms of scientific equipment that underpinned zoological research, physiological psychologists were able to differentiate their claims from the contentions of moral philosophers, who appealed above all else to their ability to set down rational thoughts regarding mental function on paper.

Two recent literary studies that explicitly concern themselves with the coming-to-pre-eminence of physiological conceptions of psychology can help expand on this claim. Firstly, Catherine Gallagher's *The Body Economic* (2006) identifies ways in which the emergence of a discipline of political economy was intimately linked the notion of 'life' as it emerged as a category of knowledge.[8] Though principally concerned with ways in which 'economic' conceptions of life came to be instantiated in the bodies of canonical literary texts, Gallagher also points to a set of conditions that were critical to the instantiation of political economy as an academic discipline in Britain. On the one hand, political

8 Gallagher, *The Body Economic*.

economists appealed to a set of environmental conditions 'external' to human societies that, they emphasised, set limits to the abilities of man to create commodities (and especially, as in Thomas Malthus' *Essay on the Principal of Population*, food). Secondly, economists appealed to a science of the internal body - what Gallagher calls a 'physio-psychology' - in consideration of the motives and drives of human beings to consume in the first place. Political economy thereby drew on (at least) two neighbouring disciplines, one concerned with the external nature of human life, and the other with the internal. My concern here is not with political economy per se, but with how these latter two forms of knowledge came to constitute each other over the course of the nineteenth century; in other words, with how the aspiring disciplines of zoology (as one of the several disciplines concerned with the definition of non-human nature) and physiological psychology (as a science of man that claimed intellectual authority over other, competing conceptions of humanity) participated in an intellectual milieu that enabled both to be drawn on by those with different disciplinary concerns. Hence this chapter highlights ways in which the debates and concerns that prevailed in zoology more generally, as it was emerging as a discipline (described in the previous chapter), were paralleled by similar disputes that emerged in considerations of the human 'animal.'

Secondly, Nicholas Dames' monograph *The Physiology of the Novel* (2007) brings to the fore a critical feature of physiological psychological approaches to literature during the nineteenth century. Like other historians interested in relations between science and literature, Dames is concerned with establishing links between formal claims regarding nature and less formal literary tropes. Where his study stands out, however, is in its emphasis on the emergence during the nineteenth century of a physiologically-related conception of literary criticism. In this conception, texts are no longer addressed as things in and of themselves, but rather as objects that engender physiological responses within their readers. Where, within representation-centred cultures, novels are conceived of primarily in terms of their formal characteristics - their narrative structure, qualities of characterization, and so on - physiological psychological forms of literary criticism consider them as tools or techniques of affect; as means by which certain emotional and intellectual states can be produced in the body.[9] Texts thereby begin to be

9 Dames, N. *The Physiology of the Novel*, esp. pp. 25-70.

thought as technical entities that retain the potential to re-figure the bodies of their readers. In so doing, they bring into question the place of writing in culture; whether it is to be considered a commodity to be understood in terms of a political economy of consumption, or a specific, morally-privileged form of intellectual practice. Dames' study indicates that in emphasising the former of these choices, literary critics active during the middle decades of the nineteenth century who engaged with physiological psychology began to re-think texts as one kind of commodity amongst others. In other words, texts come to be thought in terms of a much broader set of tools and techniques by which specific modes of conduct might be inculcated into the individual bodies of consumers.

This chapter, then, has two aims: Firstly, it aims to demonstrate the structuring of physiological psychological discourse, in parallel with an 'external' zoology, in terms of the religious and political concerns that permeated nineteenth-century ideas of life. As detailed in the previous chapter, zoological debate came to be structured in terms of differences between bottom-up, law-determined notions of godly power, and top-down, force-centred conceptions of active heavenly creation. However, where zoology concerned itself with a nature that was almost invariably external to the human - that is, an animal creation in relation to which man could be defined - psychology placed particular emphasis on the ambiguity of that relation as an index of 'internal' life. That is, the emerging academic, disciplinary consideration of human motives and actions is marked by a tension between a faith that they constitute expressions of the natural laws of the (zoological) body, and a belief that they are something achieved despite of or as an emancipation from the 'animal' aspects of bodily existence.

Secondly, it points towards what I believe to constitute a critical difference between zoology and physiological psychology as disciplinary sciences, and the text-centred philosophies that preceded them. I have characterised the political concerns that were present within the discipline of zoology as mediated by the technical conditions in which their adherents sought to instantiate them. It was, however, those concerned with articulating physiological notions of *psychology* that most explicitly related disputes regarding the nature of life to the techniques of investigation that were used to discover them. Where, for example, Robert Grant and his rival Richard Owen were unable to reconcile their intellectual differences,

and maintained a mutually hostile relationship throughout their academic careers, the two main protagonists of this chapter - Grant's students William Benjamin Carpenter and Thomas Laycock - were able to join in common cause despite strongly divergent views regarding the physiological conditions of psychological life. They were able to do so, I suggest, because both agreed that it was through consideration and instantiation of the legitimacy of different forms of epistemic equipment - not just the representation of nature in text - that their competing claims might be resolved. In other words, what marks physiological psychology off from other forms of speculation regarding human motives and actions is its specifically technical character – the techniques and tools of zoological practice were appropriated by physiological psychologists in their attempts to constitute psychology as an academic discipline in Britain.

Before psychology: moral philosophy and phrenology

The immediate intellectual context for the emergence of physiological psychology is complex. Discourse relating to mind had conventionally been the preserve of 'moral philosophy' – an umbrella term for the combined study of what came to be known as 'human' sciences such as ethics, aesthetics, political philosophy, and conjectural history.[10] In this regard, early-nineteenth-century debate regarding the psyche was conducted to a great extent in terms of the philosophy of eighteenth-century humanism. In Britain, psychology was also conceived of in relation to one of the most characteristic features of British philosophy at this time: 'sensationalism.' Following Locke, sensationalists such as David Hume had portrayed mind as a 'tabula rasa,' passively assimilating sensations and connecting them together to form broader, more complex ideas. Within many eighteenth-century philosophies, the nervous system is portrayed as acting as a mediator between the senses and the mind - a means by which impressions are transferred from an external world to the thinking subject. The status of consciousness as either a physiological entity or an incorporeal spirit remained ambiguous, being subsumed within a concern for the ways in which

10 Gallagher, *The Body Economic*, p. 2.

simple senses and broader intellectual concepts might relate to each other.

Yet during the early decades of the nineteenth century, a conception of mind as, above all else, a corporeal entity had begun to emerge in Britain that seemed to some to undermine moral philosophers' emphasis on discrete units of sensation. Representatives of an emerging middle-class culture sought to differentiate themselves from the moral philosophic culture that they believed to have been detrimental to British commerce and national progress. From the 1820s, 'phrenology,' or the study of the brains and skulls of humans as an index of their mental capacities, came to be adopted by a wide range of middle-class adherents of political and moral 'reform' campaigns.[11] Though British natural philosophers - notably figures such as David Hartley and Thomas Willis - had previously sought to articulate conceptions of mind and brain as mutually constitutive, phrenologists claimed to have been the first to truly acknowledge the organic nature of the psyche. Working from the premise that the existence of any living function necessarily implies the existence of an associated anatomical structure, they sought to elaborate a psychology that connected the categories of sensationalist philosophy with cerebral anatomy. Despite phrenologists' claims, it would be a mistake to portray either the inherited categories of moral philosophy, or the insights of cerebral anatomy, as holding primacy in phrenological (or indeed most other psychological) doctrines of this period. Rather, phrenological texts seek to reconcile a broadly moral philosophic or 'rationalist' classification of psychological function with anatomical evidence relating to human brains (the organ assumed to be the 'seat' of consciousness).[12]

Critical to phrenological endeavour was the assignation of specific (and nominally anatomically-distinct) regions of the brain to particular psychological functions. Hence the 'sexual propensity' or 'organ of amativeness' is assigned to the cerebellum - a section of the nervous system in between the spinal column and the

11 Cooter, *The Cultural Meaning of Popular Science*, pp. 101-133. Shapin, S. 'Phrenological knowledge and the social structure of early nineteenth-century Edinburgh', *Annals of Science* 32 (1975), pp. 219-243. Though see also van Wyhe, J. 'Was Phrenology a Reform Science? Towards a new generalization for phrenology', *History of Science* 42 (2004), pp. 313-331.

12 Cooter, *The Cultural Meaning*, pp. 126-127. On relations between metaphysics and physiology more generally during the nineteenth century, see Jacyna, 'The Physiology of Mind'; Smith, 'The background to Physiological Psychology'.

brain proper, located at the back of the skull.[13] But while the 'organ of amativeness' could at that time be fairly easily differentiated from the rest of the brain through simple dissection, phrenologists tended to rely on less well-established anatomical evidence for their separation of the brain more generally into a large number of distinct functional regions. Most frequently, Franz Joseph Gall's careful (and highly contested) tracing of individual nerves of the spinal column into the brain is cited by them as proof that the nervous fibres terminate at distinct parts of the cerebrum (the large outer part that covers the other parts of the brain in many organisms).[14] Hence phrenologists split the outer regions of the brain into functionally distinct sections, each relating to distinct, already-established 'psychological' ('mental') categories.

For those concerned with the definition of psychology as a discipline separate from other moral philosophic concerns such as political economy and anthropology, phrenology, as a body of knowledge, constituted an ambiguous object. On the one hand, its popularity amongst those benefiting from the commercial and industrial developments in Britain at this time seemed to indicate its potency as an alternative approach to mind. Though eighteenth-century figures such as Hartley had proposed seemingly fully 'embodied' conceptions of intellect, it was only with the emergence of phrenology during the nineteenth century that such conceptions were widely upheld as explicitly legitimating the emergence of new forms of political endeavour. The phrenological insistence that each person could in some way 'train' different parts of the brain to work more effectively offered adherents a rationale for self-determination that seemed far more immediate than the self-generating 'molecular' conceptions of existence discussed in the previous chapter. Phrenology constituted the human as an autonomous, self-defining individual, in possession of his or her cerebral faculties. It could thereby be understood as supportive of the independence of those seeking to define themselves as psychological researchers (a tendency especially prevalent amongst

13 Shapin, S. 'The Politics of Observation: Cerebral Anatomy and Social Interests in the Edinburgh Phrenology Disputes', in Wallis, R. (ed.) *On the Margins of Science: the social construction of rejected knowledge* (Keele, 1979), pp. 161-167.

14 On Gall see van Wyhe, J. 'The Authority of Human Nature: the *Schädellehre* of Franz Joseph Gall', *British Journal for the History of Science* 35 (2002), pp. 17-42; Young, *Mind, Brain and Adaptation*, pp. 9-53.

asylum attendants at this time);[15] a means of differentiating one's activities from the moralising concerns of one's 'philosophic' superiors.

But if the self-determining aspects of phrenological thinking seemed to some to be helpful for the constitution of psychology as something that could be practised in isolation from moral philosophy more generally, others felt that simply projecting the categories of the latter intellectual movement onto the brain and skull failed to address the subtleties of nervous physiology. Specifically, from the 1830s, a number of psychological thinkers - those that would come to define themselves as 'physiological psychologists' - began to suggest that the study of the nervous system as an entity present throughout zoological nature, understood as an embodiment of the psyche, actually brings the categories of mind used in moral philosophy into question. In physiological psychology, then, we begin to see the definition of an identity for the psychologist as someone who is, unlike the general population (or even doctors and asylum attendants), able to appreciate the insights that those engaged in the systematic study of non-human life can bring to the study of mind.

William Benjamin Carpenter and Thomas Laycock

This chapter highlights the differing attitudes towards phrenology articulated by two early physiological psychologists - William Benjamin Carpenter and Thomas Laycock - as a means of interrogating the points of contention that animated physiological psychological discourse, and also of bringing to the fore some of the means by which participants in physiological psychological debate sought to resolve their differences.

As two of the first academics in Britain to identify themselves as physiological psychologists, these figures were key to the cultivation of the tenuous institutional foothold that the movement briefly gained in Britain during the second half of the nineteenth century. Laycock almost immediately set about instructing his students in his distinctive brand of physiological psychology following his appointment to the prestigious chair for the Principles and Practice of Medicine at

15 Cooter, *The Cultural Meaning*.

Edinburgh University in 1855. He was responsible for introducing such later-acclaimed psychological and cerebral investigators as David Ferrier and James Crichton Browne to the simultaneous study of mind and nervous system.[16] Carpenter, in complementary contrast, cultivated a successful administrative career at University College and its associated regulatory body the University of London. In the course of his activities at these institutions, he helped instigate a wide-ranging reform of the university curriculum, part of which entailed the incorporation of physiology and moral philosophy within a faculty devoted exclusively to the pursuit of 'physical' science.[17] As Registrar of the University of London, he became a sponsor of the careers of such physiological psychological thinkers as Alexander Bain and Henry Maudsley. Between them Carpenter and Laycock were in no small degree responsible for the instigation of the first sustained academic programme of 'physio-psychological' investigation in Britain.

Carpenter and Laycock first met in either 1834 or 1835, while they were students at University College. Both attended Grant's lectures. According to a later claim by Laycock, Carpenter 'set on the same researches with himself when both were studying comparative anatomy and physiology.'[18] Whether or not they met in one of Grant's courses, it is certainly the case that both engaged closely with his classes. On his arrival Laycock attended Grant's introductory address to the

16 See Barfoot, M. 'Introduction', in Barfoot, M. (ed.) *"To ask the Suffrages of the Patrons": Thomas Laycock and the Edinburgh Chair of Medicine, 1855* (*Medical History*; Supplement 15, 1995), pp. 1-51. And Laycock, Thomas, *DNB*. On Laycock see also Leff, 'Thomas Laycock and the Cerebral Reflex'; James, 'Thomas Laycock and a Trophic Nervous System'; James, F.E. 'Thomas Laycock: psychiatry and neurology', *History of Psychiatry* 9 (1998), pp. 491-502 and James, F.E. 'The Life and Work of Thomas Laycock', (unpublished PhD thesis, University of London, 1995); Smith, R. 'Physiological Psychology', pp. 71-100.

17 Carpenter, J.E. 'Memorial Sketch', in Carpenter, W.B. (Carpenter, J.E. ed.) *Nature and Man: essays scientific and philosophical* (London, 1888), pp. 4-152. On Carpenter see Winter, A. 'The construction of Orthodoxies and Herterodoxies in the Early Victorian Life Sciences', in Lightman, B. (ed.) *Victorian Science in Context* (Chicago and London; University of Chicago Press, 1997), pp. 24-50.

18 Laycock-Combe, 6 June 1845. Nat. Lib. Scot. MS 7276, f.14. Carpenter also noted in a later testimonial for Laycock that the two had met at University College, though he did not mention that they had attended the same class in Comparative Anatomy or Physiology. Nor do University College's Student Records record them attending Grant's classes in the same year. See Laycock, T. *Evidence of Professional Acquirements Submitted to the Honourable the Patrons of the University of Edinburgh...* (York, 1855), p. 10 and Appendix. That Grant was giving extra-mural classes in physiology at this time, however, makes it possible that they did meet during one of his courses.

medical faculty, which he declared 'splendid' in his diary.[19] He also considered himself a favourite of Grant's, describing admiringly how his mentor claimed to lecture with no papers except a note to '"speak louder", in order that he might not mumble so.'[20] Carpenter's early research into the nervous physiology of invertebrates (completed under William Pulteney Alison at the University of Edinburgh) also draws on Grant's work, and his biography recounts its subject's fond recollections of the zoology lectures at UCL.[21] Yet despite their common interest in zoology, Laycock and Carpenter relate conceptions of the connected nature of life and mind in rather different ways. Whereas Laycock's texts adhere relatively closely to Grant's hints in his research that the simplest beings are 'globular', and his suggestion that microscopic investigation presents the key to understanding 'more complex' organic forms, Carpenter's place far greater emphasis on museological evidence, and establishing anatomical relations between living beings.

Carpenter and Laycock's differing conceptions of zoological existence parallel the both their differing backgrounds and the differing sets of beliefs that each adhered to early in their careers. Carpenter hailed from a prominent Bristolian family of Unitarians. His father, Lant Carpenter, had preached Unitarian's belief in the inherent moral force of nature to the upper-middle-classes of this then-fashionable town since 1817.[22] Like his sister Mary (who became a well-known advocate of women's rights and educational and prison reform), William Carpenter enjoyed a highly privileged, education-focused upbringing, staying on at his father's school as a teacher after he had completed his own time there as a student.[23] Laycock, on the other hand, was the son of a lower-middle-class Wesleyan

19 Laycock, T. 'A journal, 1833-1857', Edin. Uni. MS Gen. 1813, f. 6.

20 Ibid, f. 92. See also f. 104 on Laycock's early commitment to applying comparative anatomy and physiology in his considerations of the human body. On his 'favourite' status see Laycock-Combe, 6 June 1845. Nat. Lib. Scot. MS 7276, f.14.

21 Carpenter, W.B. *Prize Thesis: Inaugural Dissertation on the Physiological inferences to be deduced from the Structure of the Nervous System in the Invertebrated Classes of Animals* (Edinburgh and London, 1839), pp. 8-13, 16-17. On Carpenter's fond recollections of Grants teaching see Carpenter, 'Memorial Sketch', p. 10.

22 Carpenter, ‘Memorial Sketch’, p. 4.

23 Carpenter, ‘Memorial Sketch’, pp. 4-8.

Methodist preacher.[24] Apprenticed to a local medic at the age of fifteen, he had entered University College with a hope that he might escape what he saw as the impoverished context in which he had been brought up.[25] Carpenter stayed aloof from the political controversies that were raging amongst medical practitioners and students during the 1830s and 1840s. Laycock became a convinced advocate of the formation of democratically-elected professional bodies.[26]

The first chapter of this thesis has drawn a contrast between the potentially radical but epistemologically problematic conclusions that could be drawn from microscopic vision on the one hand, and the epistemologically trusted and rather less controversial conclusions that were generally adduced from museological evidence on the other. This distinction was not of course absolute - radical claims were made in anatomical studies just as microscopic evidence was made to support conservative conceptions of nature. But to the extent that microscopes seemed to offer visions (however mistrusted) of a globule-constituted, bottom-up, democratic nature, they also presented more fundamental challenges to the general assumptions of nineteenth-century British elites than did the questions regarding anatomical relations associated with museums. Laycock's emphasis on the significance of microscopic evidence in his psychology can thereby be read as an expression of a particularly 'radical,' law-determined notion of the psyche. This can be contrasted with Carpenter's more elitist concern with the definition of anatomical difference using museological specimens. Physiological psychological and zoological debate thereby proceeded in tandem. But where zoological discourse revolved around a questioning of differences between species and the ontological status of 'life', physiological psychological questioning of humanity's 'internal' nature concerned the make-up of the nervous system above all else.

24 Barfoot, ‘Introduction’, p.4.

25 Barfoot, ‘Introduction’, p.4.

26 Ibid. pp. 7-11.

Phrenology and William Benjamin Carpenter's physiological psychology

William Benjamin Carpenter's texts appeal to the authority of comparative anatomy as a means of differentiating his conception of human psychology from that that had been adopted by the middle-class phrenologists. The first of his many textbooks intended for use by medical students (published in 1839) is a work on comparative anatomy and physiology subtitled as 'intended as an introduction to the study of human physiology'.[27] Concentrating almost exclusively on plants and non-human animals, it claims to offer an authoritative account of the latest zoological and (to a lesser extent) botanical researches. Above all, it emphasises that the study of man needs to be re-considered on a new epistemic footing - one that takes into account what it portrays as a now-established (and foundationally anatomical), comparative approach to life. As with Grant's comparative anatomy, this approach appeals to the nature of simple organisms as a means by which the more complex (such as humans) might be understood 'philosophically.'

One critical element of Carpenter's publications during the 1830s and 1840s is their reliance on Marshall Hall's experimental identification of a 'reflex function' in the nervous system between 1832 and 1837. Hall's studies consolidated a long-standing interest in 'reflexive' or uncontroversially 'bodily' characteristics of certain aspects of mental function amongst philosophers of mind. Within the Aristotelian philosophical tradition, the soul had been differentiated into three distinct categories - those relating to the vegetable, the animal, and the human. The human or 'rational' soul was marked by its dominion over the other two – the 'animal' soul which was responsible for such functions as the reception of sensation and the instigation of muscular movement, and the 'vegetative' soul which fulfilled the basic or 'nutritative' functions of life.[28] Eighteenth-century philosophers concerned with the nature of sensation had paid particular attention to the middle,

27 Carpenter, *Principles of General and Comparative Physiology*.

28 Dixon, *From Passions to Emotions*, pp. 26-61; Jacyna, L.S. 'Animal Spirits and Eighteenth-Century British Medicine', in Kawakita, Y., Sakai, S. and Otsuka, Y. *The Comparison Between Concepts of Life-Breath in East and West: proceedings of the 15th international symposium on the comparative history of medicine – East and West* (Shizuoka, 1990), pp. 139-162; Young, R.M. 'Animal Soul' in Edwards, P. (ed.) *The Encyclopedia of Philosophy* [Vol. I] (New York and London, 1967), pp. 122-27 [Available at http://human-nature.com/rmyoung , accessed 25/11/2009].

'animal' aspects of the self. Philosophers such as Thomas Reid emphasised that this element of human life remained independent of conscious experience or reason – sensation could occur instinctually or 'reflexively', without the participation of the elements of the soul associated with reason and intellect (these latter generally being conceived of as those aspects of cognitive existence least dependent on bodily function).[29] The term 'reflex' had thereby come to refer to a class of changes in the nervous system unconnected with consciousness, which only arise in response to external, non-nervous stimuli.[30] By presenting his research as revealing of a physiologically-determined aspect of mental existence, Hall seemed to be confirming the notion that nervous function could be differentiated into two distinct components - sensory, and intellectual.[31]

Carpenter's texts, influenced by those of his mentor in Edinburgh, William Pultney Alison, seek a more refined differentiation of nervous function than had been evident in Hall's texts.[32] In considering sensation and volition in relation to the brain (rather than the nervous system as a whole), many physiological texts of the late 1830s and early 1840s implicitly identified non-cerebral nerves exclusively with 'lower' animal and vegetable functions. Frequently, as in phrenology, this was expressed in terms of a binary contrast between a communicative and sensory nervous system, and a 'thinking' brain.[33] Carpenter, however, instead of adopting a simple dichotomy between automatic, or what he terms 'excito-motor' reflexes, and 'ideo-motor' intellect or agency, introduces a third set of functions, termed 'sensori-motor.'[34] Located in the cerebellum and medulla oblongata, this anatomical division

29 Dixon, *From Passions to Emotions*, pp. 83-86.

30 See Clarke, and Jacyna, *Nineteenth-Century Origins of Neroscientific Concepts*, pp. 102-114, and Canguilhem, G. 'The Concept of Reflex', in Delaporte, F. (ed.) and Goldhammer, A. (trans.) *A Vital Rationalist: Selected Writings from Georges Canguilhem* (MIT Press; Cambridge, Mass. and London, 1994), pp. 179-202.

31 Leys, R. 'Background to the Reflex Controversy: William Alison and the doctrine of sympathy before Hall', *Studies in History of Biology* 4 (1980), pp. 1-66. Leys, R. *From Sympathy to Reflex: Marshall Hall and his opponents* (New York and London, 1991), pp. 170-201 and 240-245. See also Clark and Jacyna, *Nineteenth-Century Origins*, pp. 114-122.

32 See Carpenter-Laycock, June 12 1855. RCPE MS Box 22 Folder 148. and Leys, 'Background to the Reflex Controversy'.

33 Leys, *From Sympathy to Reflex*, pp. 246-255.

34 This relation of Carpenter's anatomical nervous scheme and its critique is indebted to

of the nervous system operates as a half-way house between completely automatic, 'nervous' life, and a realm of pure rationality located in the cerebrum. As such, it constitutes the site of a set of psychological functions related to involuntary, instinctual passions or 'emotions' (which are nevertheless conceived of as intermediate between animality and humanity), and semi-conscious, 'reflex'-like muscular movements.

The specifics of Carpenter's differentiation are founded on the presumption that there exists a progression of psychological function that is accompanied by a progression of structure throughout the animal kingdom. First, recalling Grant's comments on the *Furcocerca viridis* described in the previous chapter, the simplest animals possess truly animal, not-necessarily-nervous 'excito-motor' reflexes which operate without any accompanying psychological function. Non-cerebral nerves fulfil these reflex functions in humans.[35] Second, in 'lower' animals, apparently purely 'instinctive' or emotion-like behaviour accompanies a predominance of those anatomical parts that make up the mid-brain in humans. It is therefore to these parts (by analogy) that feeling must be referable. Third, the unparalleled predominance of the cerebrum in humans is associated with what Carpenter presumes to be their unquestionable status as the most rational beings in nature. This indicates that it is in this anatomical part (the cerebrum) that consciousness inheres.[36] This categorical differentiation constitutes a basis from which Carpenter articulates an alternative to phrenologists' claims.

Carpenter's initial critique of phrenology - in the first edition of his *Principles of Human Physiology* (1842) - emphasises the importance of non-human anatomical evidence in the consideration of psychological function.[37] Specifically, it characterises phrenological anatomy as falling into epistemic error. Advancing a

Leys, *From Sympathy to Reflex*, esp. pp. 307-315.

35 Carpenter, *Principles of Human Physiology, with their Chief Applications to Pathology, Hygiene and Forensic Medicine...* [1st ed.] (1842), pp. 197-198. On Carpenter's suspicion of microscopic claims regarding spontaneous generation see Carpenter, 'Natural History of Creation', esp. pp. 168-173.

36 Carpenter, *Principles of Human Physiology* (1842), pp. 197-199.

37 Carpenter, *Principles of Human Physiology* (1842), pp. 203-211. Phrenology's ambiguous relationship with anatomical cerebral research is highlighted in a number of studies. See esp. Shapin, 'The Politics of Observation'.

critique of the above-mentioned phrenological portrayal of the cerebellum as the organ of 'amativeness' or sexual function, it highlights what it portrays as the inconsistency of phrenologists' associations of mind with brain with accounts of nervous anatomy informed by comparative anatomy. In ignoring studies relating to 'simpler' forms of life (Carpenter claims), phrenologists ignore evidence - suggested by the physiological experiments that had been conducted on simpler animals conducted by the French physiologists Marie Jean Pierre Flourens, François Magendie, and others[38] - that ablation of the cerebellum produces uncoordinated movement. In confirmation of these physiological experiments, comparative anatomy reveals that this organ tends to be larger in those animals that need to control many different moving parts.[39] Hence for Carpenter the cerebellum cannot be considered as exclusively concerned with sexual desire, as it has been shown to be important in coordinating bodily actions as well.

Carpenter's texts do not seek to challenge the association between structure and function that remained central to the identity of phrenology as a science.[40] Rather, they cast doubt on the possibility of establishing true relations between body and mind by focusing on human anatomy alone. It should be noted here that phrenologists did at times make use of comparative anatomical evidence. Carpenter nevertheless characterized phrenology as science the attended to human brains alone, and the movements defenders did not seek to contradict this characterization.

Carpenter's position concerning anatomical evidence developed into a full-blown attack on any nervous physiology that fails to take non-human anatomy into account. Phrenologists - in particular the Manchester physician Daniel Noble in *The Brain and its Physiology* (1846) - acknowledged Carpenter's initial critique, and sought in response to cast doubt on the reliability and admissibility of comparative anatomical evidence in considerations of human physiology. In direct contradiction to this, Carpenter's review of Noble's phrenological work contends

38 See Young, *Mind, Brain and Adaptation*, pp. 54-94.

39 Carpenter, *Principles of Human Physiology* (1842), pp. 203-205. For more on this association, see the discussion of Grant's interpretations of the causes of nervous structure in the previous chapter.

40 Stack, D. 'William Lovatt and the National Association for the Political and Social Improvement of the People', *The Historical Journal* 42 (1999), pp. 1027-1050.

that an exclusive concern with human anatomy does not produce an adequate account of the brain. It suggests that the cerebellum is not only responsible for the co-ordination of motion (as he had previously argued), but is also the most likely site at which sensation occurs as well.[41] Indeed, Carpenter contends that the relatively small size in man of the parts of the brain directly connected with the sensory organs had blinded anatomists to their significance in the reception of sensation. The distinction between sensory parts of the nervous system and the cerebrum is clear in simpler animals, and these parts' close connection with the organs of sense can only have been overlooked because of an over-emphasis on human anatomy in nervous physiology more generally.[42]

Carpenter's claim that systematic comparative studies should constitute the basis from which a conception of humans' nervous systems be established is more than an attempt to present physiologists or moral philosophers with a more accurate localization of psychological function. It is also a bid to limit the authority of studies by those he refers to as the 'mere human anatomist' (or, for that matter, anatomically insensitive moral philosophers).[43] Carpenter argues that comparative studies should be accorded greater epistemic weight than anatomy and physiology focused exclusively on human bodies. Any psychology that seeks to reconcile human nature with established mental categories in philosophy also has to reconcile evidence relating to animal physiology with their actions in the world.[44] Such arguments relocate intellectual authority away from moral philosophers and phrenological practitioners, and towards what was then a nascent community of specialists in zoology, organizing around expensive - and at that point relatively rare - collections of organic specimens.

That opposition to phrenological doctrines should have presented the occasion for Carpenter's departure from conventional psychological accounts might be considered significant; he chose to contest the claims of a set of doctrines that had come to be associated by many of his contemporaries with calls for political

41 Carpenter, W.B. 'The Brain and its Physiology', *British and Foreign Medical Review* 22 (1846), esp. pp. 504-511.

42 Ibid, p. 495.

43 Ibid.

44 Ibid, pp. 518-519 and 544.

change. Carpenter, as Alison Winter has highlighted, went out of his way to establish connections amongst the Anglican elite that held sway over a significant proportion of intellectual endeavour during the first half of the nineteenth century.[45] His move to align the study of psychological function with a specifically comparative-anatomical conception of nervous physiology can in this respect be understood in terms of a resistance to the interests and beliefs of the emergent middle-classes. Nevertheless, as the below examination of Thomas Laycock's relation with the leading advocates of phrenological thinking makes clear, zoologically-aligned conceptions of mind were by no means exclusively employed in opposition to calls for political reform at this time.

Laycock's psychology, phrenology, and Combe

Articulating an account of human cognition reliant on conceptions of non-human life did not necessitate the elaboration of an explicit challenge to phrenology *per se*. In 1845, as Carpenter was formulating his 1846 critique, Laycock was engaging in a rather less antagonistic correspondence with the figurehead of the phrenological movement in Britain, George Combe, and the comparative anatomist and physiologist John Reid, then Professor of Anatomy at St Andrews. The vast majority of this correspondence was published in the *Lancet*, and - along with his article 'On the Reflex Function of the Brain' of the same year and his *Treatise On the Nervous Diseases of Women* (1840) - constitutes Laycock's early attempt to articulate what he considered an entirely new approach to psychology.[46]

Where Carpenter appeals for attention to be paid to comparative anatomy, Laycock places greater emphasis on the need to begin any analysis with what he

45 Winter, 'The construction of Orthodoxies and Herterodoxies'

46 Laycock, T. *A Treatise on the Nervous Diseases of Women: comprising an inquiry into the nature, causes, and treatment of spinal and hysterical disorders* (London, 1840); Combe, G., Reid, J. and Laycock, T. 'Correspondence between Geo. Combe, Esq, Professor Reid, and Dr Laycock, on the Reflex Anatomy and Physiology of the Brain', *The Lancet* 46 (1845), pp. 231-233, 255-258, 283-284, 308-310, 347-348 and 364; Laycock, T. 'On the Reflex Function of the Brain', *British and Foreign Medical Review* 19 (1845), pp. 298-311. On Laycock's evaluation of his own work see Laycock, 'A Journal, 1833-1857', Edin. Uni. MS Gen. 1813, f. 242.

considers a proper understanding of the implications of the doctine of the unity of natural law. Above all, this implies that any account of human psychological nature must begin with a conception of the identity of all natural forms:

> If we would obtain a large and definite knowledge of the action of force upon matter and intelligence, in exciting the phenomena of life and thought as displayed in man, we must examine the laws of its action, as exhibited both in every living organism, and the molecular changes in inorganic matter. A thousand circumstances assure us, that between these last and the highest efforts of human intellect, there is a continuous chain of phenomena, although we are unable to follow it link by link.[47]

A gross anatomy of the nervous system (comparative or otherwise) cannot assist in revealing relations between psychological categories and organic bodies, without the prior adoption of a conception of all of nature as unfolding gradually from the bottom up, from simple to complex.

This approach places particular weight on microscopic evidence relating to what Laycock refers to as 'molecular' or 'bio-molecular' life.[48] Specifically, Laycock sees in the most basic organic forms the same kinds of entities that he believes constitute the minute histology of the nervous system. Microscopic evidence thereby presents a means by which both simple animals' actions can be characterised, and nervous action in general understood.[49] Above all, these forms constitute an exemplary point of reference in his conceptualization (in common with many other British physiologists of the time) of 'instinctive' action as a non-rational impulse to self-preservation.[50] His texts attribute such actions not only to

47 Laycock, *A Treatise*, p. 92. This statement originally appeared in one of Laycock's earlier articles on hysteria. See Laycock, T. On anomalous Forms of Hysteria', *Edinburgh Medical and Surgical Journal* 50 (1838), p. 50.

48 Laycock, *A Treatise*, pp. 99-100, 205. Laycock, 'On the Reflex Function', pp. 308-310. For Laycock's comments regarding microscopes themselves, see Laycock, T. 'On the Methods of Obtaining a Natural History of Diseases' *British and Foreign Medical Review* 22 (1846), esp. p. 528.

49 Laycock, *A Treatise*, p. 96. Laycock, 'On the Reflex Function', p. 308.

50 'Correspondence', p. 256. See Leys, *From Sympathy to Reflex*, pp. 35-62.

simple, organically-undifferentiated 'molecular' animals, but to the organ-systems which make up the more complex. As Laycock's first letter to Combe comments;

> *the tissues and organs* entering into the composition of organisms, and constituting the individual by their congeries, display each *in its sphere* the same law of conservation as the individuals they make up. Vascular systems, hollow muscles, and the cellules of plants and animals, so microscopically minute as they are, all display movements having an *obviously beneficial object* in reference to their *individual* existence.[51]

As detailed below, this 'law of conservation' plays an important role in Laycock's understanding of more complex manifestations of life. Here it is enough to note Laycock's understanding of all organic systems as composed of functionally similar microscopic entities.

The assumed histological identity of all nervous structures implies for Laycock that all functions associated with nerves must arise from the same cause. His texts adopt Hall's conception of a reflex nervous function that operates independently of consciousness. However (unlike other physiological texts that address the brain during this period) they extend this function to the entire nervous system. By expanding the role of reflexes in this way, they identify them with neither unconsciousness, 'instinct', or any other specific psychological function, but with a material 'substrata' to which all accounts of mind must be referable.[52] In other words, in contrast with then-prevalent conceptions of different parts of the nervous system as 'possessing' properties of unconsciousness, sensation, volition and so on (as evident in Carpenter's texts), Laycock considers all such properties as functions arising from psychologically-independent reflex actions of the nerves.

Just as Grant's lectures portray the nervous system as emergent in the unified body of all living structures, Laycock conceives of a capacity for purposive action (or at least that which originates from organic bodies)[53] as gradually

51 'Correspondence', p. 256. Original emphases.

52 Laycock, 'On the Reflex Function', pp. 308-310. 'Correspondence', p. 347.

53 On Laycock's conception of the sources of non-material agency, see Jacyna, 'The

emerging in conjunction with the self-preserving activity of an increasingly complex order of organic forms. He calls for the adoption of an approach to psychology that starts with a consideration of the simplest manifestations of psychological life. The most fundamental of these is 'automatic' action, which Laycock appears to conflate with the aforementioned instinctive impulse to self-preservation.[54] This is followed by a progressive complication of function, passing through emotional states, and ending in what he presumes to be the most complex forms of mental life such as will and volition.[55] The simplest psychological states constitute the conditions under which the more complex become possible.[56] Hence human consciousness cannot be understood without a thorough appreciation of the causative role of non-conscious elements in the formation of the psychological states of all living entities.

Laycock's views as described above might appear to have posed a far more fundamental challenge to phrenological conceptions of mind than did Carpenter's anatomical critique. It makes little sense from Laycock's perspective to talk of any particular part of the nervous system as 'for' sexual desire (for example), as the function of sexual desire is itself the product of the self-preserving physiological action of the system as a whole. Indeed, his *Treatise* makes in passing precisely the same criticism as Carpenter respecting phrenologists' 'appropriation of the cerebellum to the sexual impulse' to the exclusion of other functions.[57] Though Laycock's texts do tend to assign such phenomena as sensation, consciousness or volition to the brain, this is not their primary concern. Rather, they aim to articulate accounts of the ways in which psychological functions arise from the (more fundamental) principles of automatic action and reflex function within the nervous system as a whole. Yet in his correspondence with Combe and Reid, Laycock minimises such points of potential conflict between himself and the foremost advocate of phrenology in Britain.

Physiology of Mind'.

54 Laycock, 'On the reflex Function', p. 309.

55 Ibid, p. 311.

56 Ibid, p. 308.

57 Laycock, *A Treatise*, p. 122.

The principal point of contention in Laycock's correspondence with Combe and Reid revolves around the extent to which it is possible to distinguish between truly 'excito-motory' or reflex parts of the nervous system, and those conventionally associated with volition. As might be expected from the above, Laycock denies - in opposition to Reid - that it is possible to draw an absolute distinction between reflexive and volitional acts, referring both to 'a mechanism within the central axis' of the nervous system.[58] But as far as he addresses Combe, he is almost entirely complimentary, declaring at the outset that the latter had 'appreciated most exactly' his conception of the presence of reflex function in the brain.[59] Commenting on an article of Combe's on 'the application of phrenology to the fine arts' he declares himself to 'agree entirely with your [ie. Combe's] views, as far as they go.'[60] Such compliments appear to be aimed at gaining Combe's confidence, possibly in the hope of gaining a powerful convert to his doctrines. Where he is forced to disagree with Combe, Laycock defers stating his views in detail:

> It would require a volume to answer the three letters now before me... a complete exposition of our respective views as to the physiological nature of consciousness and will is requisite. I suspect we differ on this point, and unless we come to a clear understanding respecting it, I fear our epistolary labours will be much prolonged.[61]

In this way Laycock avoids antagonizing Combe, the figure-head in Britain for both phrenology and the desire to 'reform' society according to phrenological principles.

Despite his articulation of a seemingly fundamentally challenging position respecting phrenology, Laycock's care to subsume this perspective in favour of

58 'Correspondence', pp. 255-256.

59 Ibid, p. 255

60 Ibid, p. 258.

61 Ibid, p. 347. Laycock even advised Noble and Combe on their responses to Carpenter's critical article described above. See Laycock-Combe, 9 June 1845. Nat. Lib. Scot. MS 7276, ff. 14-15. Noble-Laycock, October 22 1845. RCPE MS B. 22 F. 149. Laycock-Combe, October 20 1846. Nat. Lib. Scot. MS 7280, ff. 117-119.

preserving the good-will of Combe indicates his adherence to a rather different set of interests to those displayed by Carpenter. Whereas Carpenter is concerned to establish in human physiological discourse a critical perspective grounded in comparative anatomy, Laycock cultivates an alliance between himself and the middle-class reformers he engages with. It seems clear that physiological psychology could express both positive and negative conceptions of self *vis a vis* the middle-class politics of reform.

That physiological psychology does not appear to have expressed middle-class reforming interests in any simple way does not however imply that it did not have any relevance to changing conceptions of politics or political practice. Rather, it highlights how connections between life and mind were coming to play an increasingly central role in the conceptualisation not only of ideal visions of state, but also of notions of human conduct and motives. Physiological psychology, like the discipline of zoology that it positioned itself as a corollary of, emerges during the nineteenth century as a site at which differing political concerns are negotiated and played out. The precise conditions of power that this development constituted is the concern of much of the rest of this thesis. However, in order both to re-iterate the contested status of attempts to correlate mind with life, and to bring out the intimate connections between the disciplinary formation of psychology and psychological interest amongst the British population as a whole at this time, I will first highlight how Carpenter and Laycock articulated their claims in relation to another popular middle-class psychological movement; mesmerism.

Anti-mesmerism and the politics of will in Carpenter and Laycock's psychologies

Carpenter's psychological texts underwent a crucial shift of emphasis during the late 1840s and early 1850s.[62] At least two aspects of his intellectual context during this time appear to have been critical to this change. Firstly, Carpenter's anatomical differentiation of the nervous system came under increasingly hostile scrutiny from other physiological researchers. Secondly,

62 Smith, R. 'Physiological Psychology', pp. 109-111.

Carpenter sought to extend his psychology to articulate a physiological account of 'spiritualist' (and especially mesmeric) phenomena.

In contrast with phrenologists' assumption that anatomical evidence supported or would be found to support their doctrines, mesmerists stressed evidence relating to the performative elements of their science. Mesmerism constituted both a claim regarding psychological truth, and the introduction to 'public' life of a phenomenon that appeared inexplicable within then-conventional rationalist discourse. As already noted, most philosophical and psychological texts available during the 1830s and 40s characterise rationality as constitutive of mental activity, which is in turn understood by them to be the most distinctive feature of being human. Yet mesmerists seemed able to suspend this rationality for a short time, an ability accompanied by the production in their subjects of almost complete obedience to the instructions of the mesmeriser. The only - or at least the most plausible - explanation for such irrational anomalies, many mesmerists claimed, was that a force of some kind acted on the mesmerised subject which disturbed the ability of a person's soul to communicate actions to its body.[63]

Such a claim seemed particularly problematic for attempts to connect mental function with physiological life.[64] If a simple act such as the swinging of an object could disrupt mental function so readily - apparently without any direct intervention in the physiology of the nervous system - how was it possible to claim that all mental functions arose from physiological processes? Conversely, if human action in the world did not rely on the purposive action of a disembodied soul or spiritual force, how else could the effectiveness of such simple techniques be explained?

Induced hypnotic, mesmeric or trance-like states came to be understood as important phenomena which any science of psychology should be capable of explaining. From around 1839, when John Elliotson - then professor of Clinical medicine at University College - was forced to resign following his public demonstrations of mesmeric phenomena at the university's hospital, respectable

63 Winter, *Mesmerised*, pp. 1-5.

64 Though some phrenologists (such as John Elliotson) sought to combine phrenology and mesmerism into a 'phreno-mesmerism'. See Ketabgian, T. 'Martineau, mesmerism, and the "night side of nature."', *Women's Writing* 9 (2002), pp. 351-368; Cooter, *The Cultural Meaning*, pp. 150, 153.

scientific authors called for the adoption of careful, rational study of trance-like states.[65] Contributors to the *British and Foreign Medical Review* were amongst the foremost advocates of such an approach, producing a number of articles setting out histories of mesmeric practices and recording cases relating to them.[66] Elliotson was singled out for particular attention, being cited as a source of embarrassment for the reputation of physiology and the medical profession more generally.[67]

Yet although medical journals called for physiological explanations, conceptions of nervous function prevalent in the late 1840s offered little guidance for the articulation of a rationalist interpretation of trance-like phenomena. The foremost interpreter of mesmeric states who did not describe himself as a mesmerist - James Braid - had restricted his analysis to the description of cases, and recommending the continuing accumulation of 'facts' from which he was confident inferences regarding the true explanation for the phenomena would eventually be made.[68] Nor had other physiologists sought to explain hypnosis in terms of nervous physiology.[69] The sense that physiology should be able to account for mesmeric phenomena, combined with the continuing absence of such an account, presented physiological psychologists with an opportunity to legitimate their doctrines as able to contribute to the broader contestation of 'superstition' and uncritical belief that was becoming characteristic of an emerging ideal of disciplined, 'scientific' endeavour. Carpenter came to be recognised as a leading figure in the articulation of such explanations. This recognition was due at least in part to the close engagement with the concept of the physiological reflex in his

65 On Elliotson see Winter, *Mesmerised*.

66 'History of Animal Magnetism in France, Germany and England', *British and Foreign Medical Review* 7 (1839), pp. 301-352; 'On Mesmerism', *British and Foreign Medical Review* 19 (1845), pp. 428-485; 'Dr Esdaile on the Application of Mesmerism in Surgery and Medicine', *British and Foreign Medical Review* 22 (1846), pp. 475-487. See also eg. 'Mesmerism', *Blackwoods Magazine* 57 (1845), pp. 219-241; 'Madamoiselle Julie; or, witchcraft for the aristocracy', *The Athenaeum* 957 (28th Feb 1846), pp. 221-223.

67 See eg. 'History of Animal Magnetism...', p. 304. 'On Mesmerism', p. 484

68 Braid, J. *Neurypnology; or, the Rationale of Nervous Sleep, considered in relation with Animal Magnetism* (London, 1843), pp. 153-157.

69 Laycock had however made a number of what he later considered to be highly suggestive remarks on the subject - see Laycock-Combe, 14th August 1851. Nat. Lib. Scot. MS 7317, ff. 42-43. Carpenter-Laycock, 23rd January 1855. RCPE MS B. 22 F. 148.

texts, and his connection of it with conceptions of autonomous action and voluntary will, as related below.

Towards the end of the 1840s, Carpenter's tripartite differentiation of the anatomy of the nervous system described above began to attract critical scrutiny from researchers interested in the minute study of nerves. Microscopists argued that the specific connections that would be appropriate to an anatomical differentiation of nervous function could not be found in the minute histology of nerves. Most tellingly, there seemed to be no way of differentiating three independent systems of nervous fibre that emerged from anatomically distinct parts of the brain to the non-cerebral nervous system. Without such a differentiation (they argued), specific functions could not reliably be associated with specific regions of nerves.[70]

In an 1850 article that indicates the increasingly reputable status of microscopic research during the mid nineteenth century, Carpenter acknowledges the legitimacy of this critique.[71] Coincident with his acknowledgement is a seemingly sudden move to extend the reflex function to explain the operation of the whole of the nervous system.[72] But rather than retract his claims regarding the relations of physiology and psychology, he uses it as an opportunity to restate his doctrines. His adoption of the reflex function as constitutive of all nervous functions operates as more a rhetorical device in his texts than it substantively changes his views on the constitution of mind.

In effect, Carpenter maintains his initial system in his post-1850 texts. Though he now contends with Laycock that the entire nervous system is subject to the operation of automatic reflexive nerves, he does not (as Laycock does) conceive of simpler, reflex states as more fundamental than consciousness in the consideration of mental life. Rather than inhere in the cerebellum and medulla oblongata, the intermediate 'sensori-volitional' actions are now considered to arise from the interaction of consciousness, automatic nervous reflexes, and the actions

70 Todd, R.B. 'The Physiology of the Nervous System', in Todd, R.B. and Bowman, W. (eds.) *The Cyclopedia Anatomy and Physiology* [Vol. 3] (London, 1835-59), pp. 720G-723G. Leys, *From Sympathy to Reflex*, pp. 312-313.

71 Carpenter, W.B. 'On the Physiology and Diseases of the Nervous System', *British and Foreign Medico-Chirurgical Review* 5 (1850), pp. 1-50.

72 Smith, 'Physiological Psychology', pp. 109-111.

of sensory organs.[73] The cerebrum itself constitutes the site in which ideas occur 'reflexively', but these reflexes are now subject to the controlling force of an independently-operating (but apparently still cerebral) 'will.'[74] In such a conception, the automatic action of nerves is not only considered productive of conscious states, but also as threatening to their integrity.

The constitutive presence in physiology of an autonomous volition or will thereby becomes critical to Carpenter's conception of psychological existence. His texts from this period emphasise to a far greater extent than previously the need for such a presence. Self-determination of purpose, as the means by which rational action can be differentiated from animal instinct, appears in his work as a bulwark against the dangers of materialism and impiety. Hence:

> All educational efforts, as it seems to us, must be based on the assumption, that until the self-directing power has been acquired, the character is the resultant of original constitution, and of the circumstances in which the individual is placed... The real *self-formation* commences with his consciousness of the power of *self-control*; a power which is exercised by the Will, in virtue of its dominion over what may be designated the automatic operation of the *mind*.[75]

The relation of such comments to physiological psychologists' more general conceptions of learning and pedagogy will be addressed later in this thesis. What is important to note here is that this conception of psychology is one in which the cultivation of self-control actually constitutes autonomous self-hood - that it is by controlling the 'automatic' effects of one's 'original constitution' that will gains ascendancy over reflexively-determined instincts and ideas.

73 Carpenter, *Principles of Human Physiology...* [4th ed.] (London, 1853), pp. 667-672.

74 Carpenter, W.B. 'On the Influence of Suggestion in Modifying and Directing Muscular Movement, Independently of Volition', *Notices of Proceedings of Meetings of Members of the Royal Institution* 1 (1851-1854), pp. 151-152. This characterization and that below largely follows Smith, 'Physiological Psychology', pp. 110-114.

75 Carpenter, W.B. 'On the Relations of Mind and Matter', *British and Foreign Medico-Chirurgical Review* 10 (1852), p. 510. Original emphases.

The powerful presence of a potentially volatile, 'automatic' nervous system nevertheless places limits on the ability of the will to determine mental action. The fourth edition of Carpenter's *Principles of Human Physiology* (1853) relates how sensorial 'impressions' travel in an 'upward' direction through the nervous system towards the cerebrum. If these impressions are interrupted, they form 'purely' reflex acts, unmediated by consciousness. But if they pass straight to the cerebrum they can take one of two forms. Either they constitute unmediated sensation, from which 'simple ideas' are formed. Or they are accompanied with a feeling of pleasure or pain, and take on the character of 'emotional ideas'.[76] Sensation thereby constitutes the means by which physiological nervous action is communicated to consciousness:

> either as a simple or as an emotional idea, it [sensation] becomes the subject of *intellectual operations*, whose final issue is in a *volitional determination*, or act of the Will, which may be exerted in producing or checking a muscular movement, or in controlling or directing a current of thought.[77]

The will retains a more fundamental status than in its reflex-dependent portrayal in Laycock's psychology. Yet whilst according will an important role in the determination of rational 'intellectual operations,' Carpenter also accords it a comparatively minor place in psychological action. It is not for a volitional will or soul to *produce* intellect, as assumed in many of the then-available texts addressing nervous action. Rather, the will operates as 'controlling or directing' an already-present current of thought, caused by the operation and interaction of nerves.[78] It is this physiologically-restricted status of will that presents Carpenter with a means of explaining the apparent ease with which trances are produced in mesmeric performance.

76 Carpenter, *Principles of Human Physiology* (4th Ed.), pp. 671-672 See Winter, *Mesmerised*, p. 290 for Carpenter's diagramatic representation of this arrangement.

77 *Principles of Human Physiology* (4th ed.) , pp. 671-672.

78 Ibid. pp. 800-801. See also Carpenter, 'Electro-Biology and Mesmerism', *The Quarterly Review* 93 (1853), pp. 507-508.

Accompanying Carpenter's re-formulation of his psychology is a vocal portrayal of the induction of trance-like behaviour as indicating a subversion of the proper working of will-power in mental life. During normal psychological existence, the will is constantly exercising its judgement over physiologically-produced ideas. However, this judgement (Carpenter claims) 'can only take place while the Will has the power of selecting those which are appropriate, and of bringing them into collocation with each other.'[79] Mesmerists, by concentrating the attention of their subjects on one single point to the exclusion of all others, are able to suspend the will's ability to discriminate between 'real' and the 'illusory' ideas, and thus to direct thought. This places it in a state of 'abeyance', in which it is possible to direct the actions of the subject directly, via the automatic and 'sensor-volitional' operation of the nervous system.[80] It is not only by focusing on the attention of their subjects on one object, but also through the exclusion of all other sources of distraction, that mesmeric practitioners are able to produce their effects. Given the apparent physiological basis for such an explanation, it now appears to Carpenter incumbent on those who assert the mystical significance of mesmeric states to produce evidence in favour of their contentions.[81]

Mesmerism thereby appears in Carpenter's texts as the artificial induction of an exclusively emotional, 'instinctive' state in humans that is entirely natural in 'lower' beings. Mesmeric, or 'hypnotic' practices enable the flow of physiologically-constituted 'dominant ideas' to override the normal directing action of the will. As a subversion of the ability of the will to determine mental direction, mesmerism is an 'epidemic disorder' that is potentially dangerous to its participants.[82] Carpenter's texts extend the application of this conception of the potential subversion of a normal, will-directed psychology to account for a wide range of mental pathologies. Excessive consumption of alcohol or a lack of rational education tend to leave the will weak, and thereby open to subversion from emotional or even automatic states.[83] Indeed, even the origin of erroneous religious belief

79 Carpenter, 'Electro-Biology', p. 508.

80 Ibid, pp. 510-511.

81 Ibid, pp. 550-555.

82 Ibid, p. 556.

83 Ibid, p. 557.

> has uniformly lain in the preference given to the feelings over the judgement, on the inordinate indulgence of emotional excitement without adequate control on the part of the rational will... What kind of spirits they are, which thus take possession of credulous and excitable minds, we hope that we have made sufficiently plain. They are *Dominant Ideas*.[84]

Carpenter's critique of mesmerism is part of a wider articulation of a physiological psychological conception of relations between reflexes, instincts and will-power or rationality. The swift adoption of his analysis of the phenomena in question in subsequent attacks on mesmerists' claims - most immediately and famously by Michael Faraday[85] - accompanied an intensification of interest in Carpenter's and others' advocacy of the need to link conceptions of mind with claims about nature, and assisted in the legitimation of physiological psychology within a rationalist, 'scientific' academic discourse.

Physiological psychological critiques of spiritualist mesmeric claims can be understood as an early instance of what Rhodri Hayward characterises as a general effort within psychological discourse to rationalise instances of apparent mental discontinuity.[86] Whilst agreeing with this evaluation, I wish here to highlight that such efforts did not necessarily entail the adoption of a uniform response by psychologists committed to the articulation of embodied explanations of psychological existence. For example, Laycock reached rather different conclusions to Carpenter regarding the appropriate response to mesmerism, despite similarly expressing skepticism regarding mesmerists' claims.

In accordance with his emphasis on what he considers to be the primitive nature of non-conscious states, Laycock understands 'empirical' beliefs (as

84 Ibid. Original emphasis.

85 'Professor Faraday on Table-Moving', *The Athenaeum Journal of Literature, Science, and the Fine Arts* 1340 (July 1853), pp. 801-803.

86 Hayward, R. *Resisting History: religious transcendence and the invention of the unconscious* (Manchester; University Press, 2007). On Carpenter and Laycock's joint commitment to explaining mesmeric practices, see Laycock-Combe and Carpenter-Laycock, 28th April [1851]. RCPE MS Box 22 Folder 148.

contrasted with truly scientific, 'inductive' beliefs)[87] such as mesmerism or homoeopathy as relying on the presence of potentially useful but as-yet not understood aspects of medical practice. When they are not making disingenuous claims, 'empiricists' succeed because they adopt practices that (at least occasionally) produce tangible effects.[88] Their principal mistake is to attribute the effectiveness of their practices to causes that explain only that practice - and that are likely to be inconsistent with more general beliefs.[89] The appropriate response to such 'primitive' practitioners is therefore a laissez-faire one - to allow the continuation of unexplained practices whilst at the same time seeking to bring the effects of them within the wider explanatory framework offered by a 'scientific' or 'inductive' perspective.[90]

In contrast, Carpenter understands the practice of mesmerism to be a danger that demands more immediate refutation through rational argument and empirical demonstration.[91] Though Carpenter's (like Laycock's) conception of mind accords non-conscious states an important role in conscious life, it is only by avoiding their influence that true thought or rationality can be maintained. Connected with this belief is a deep-seated concern with the active and constitutive role of volition in mental life, and a commitment to willful direction as a guarantor of rational belief. In a later article, Laycock criticises Carpenter and Faraday's response to mesmerism as inconsistent with their advocacy of 'scientific' beliefs.[92]

87 Both Carpenter and Laycock advocate the adoption of an 'inductive' approach to medical practice similar to that that had been proposed by William Whewell. See Whewell, W. *On Induction: with especial reference to Mr J. Stuart Mill's system of logic* (London, 1849).

88 Laycock, T. 'The Relation of True Medicine to Empirical Systems', *British and Foreign Medico-Chirurgical Review* 5 (1850), p. 287.

89 Ibid. p. 293.

90 Ibid, pp. 302-305. Laycock, T. 'Odyle, Mesmerism, Electro-Biology, &c.' *British and Foreign Medico-Chirurgical Review* 8 (1851), p. 431.

91 Laycock's articles on mesmerism do nevertheless contain many similarities with those of Carpenter cited above. See Laycock, T. 'Modern Demonology and Divination', *The Journal of Psychological Medicine and Mental Pathology* 7 (1854), pp. 1-23; Laycock, T. 'The Psychology of Monomaniacal Societies and Literature', *The Journal of Psychological Medicine and Mental Pathology* 7 (1854), pp. 301-326. Faraday devised a number of experiments intended to test mesmeric claims. See Winter, *Mesmerised*, pp. 290-294.

92 Laycock, 'The Psychology of Monomaniacal Societies', p. 326.

Though both Carpenter and Laycock deny the legitimacy of mesmeric interpretations of hypnotic practices, each stresses subtly different aspects in their articulation of re-interpretations of the nature of trance-like states. For Carpenter (unlike Laycock), it is not primarily through manipulation of the non-conscious influences on conscious life, but the cultivation of will, that goals are best achieved.

It is tempting to portray Carpenter's doctrines as a half-hearted engagement with Laycock's more systematic articulation of the necessary primacy of reflex function in any thoroughly 'physiological' psychology.[93] Yet for all their apparent inconsistencies, they attracted far more attention at the time of their publication than did Laycock's more complex and at times esoteric works. Given the academic contexts in which each figure operated, Carpenter's simultaneously anatomically based and will-constituted physiology and psychology, I suggest, accompanied the adoption of what was at that time a more easily accepted and culturally resonant approach to political action.[94]

The intellectual culture of nineteenth-century Britain was beginning to be re-oriented around a specific conception of academic practice. Physiological psychologists, to a greater extent than phrenologists or their predecessors the moral philosophers, prided themselves on their ability to comprehend, assimilate, and incorporate into their texts the publications of those considered authorities on areas that were not their immediate concern. These academics, aspiring to the constitution of a disciplinary psychology, sought to articulate a conception of psyche that would enable them to collaborate as equals with figures from other recognisable 'disciplines' such as zoology and political economy. The culture of universities such as UCL, founded on a presumption that competition between individuals and the division of academic labour constituted the most appropriate means of organizing the production of knowledge, seemed to offer particularly fertile ground for the establishment of such a discipline. Indeed, as will be made clearer later in this thesis, physiological psychological notions would become critical to the entrenchment of conceptions of the economically active liberal

93 Carpenter-Laycock, 26th October 1849. RCPE MS Box 22 Folder 148.

94 The relation of Carpenter's work to the politics of pedagogy is addressed more fully in chapter three.

individual as a masculine ideal later in the century. Before the means by which physiological psychological discourse contributed to this entrenchment can be made clear, however, it is first necessary to move on to the second stated aim of this chapter - the examination of ways in which physiological psychologists placed particular emphasis on the persuasive power of both textual and non-textual objects in their attempts to establish themselves as authorities on the 'nature' of human minds.

Physiology and Psychology

Through their above-mentioned attainment of prestigious positions in academic life, Carpenter and Laycock helped establish psychology as a matter of physiological and zoological as well as of moral philosophic concern. Yet their psychologies claimed little that had not already been articulated without substantial reference to physiological evidence. Laycock cited the philosophy of William Hamilton in support of his claims.[95] Drawing on the Scottish ‘common sense’ tradition (and especially the work of Thomas Reid), as well as the German philosopher Immanuel Kant, Hamilton had articulated an 'intuitionist' conception of mind in which non-conscious elements played a fundamental role.[96] Elsewhere, Coleridge and his followers drew heavily on Germanic philosophy to make similar claims.[97] By the middle decades of the nineteenth century, the understanding of mind as a purely rational entity had come under criticism from a number of different quarters, of which zoologically-informed physiology was only one.

What marks physiological psychology out from other means of conceptualising mind is not the substantive claims that it makes regarding the psyche, but the ways in which its adherents sought to put their doctrines into practice, and the means by which they addressed differences amongst themselves. Physiological psychologists' common commitment to articulating embodied

95 Laycock, *Mind and Brain*, pp. 72, 117-118.

96 Hamilton, W. 'Philosophy of the Unconditioned', in Hamilton, W. et. al. *Kant's Thought in Britain: The Early Impact* (London, 1993 [1829]), 38 pp.

97 Levere, *Poetry Realized in Nature*.

conceptions of mind meant that their texts privilege very different sorts of evidence than do those of their contemporaries engaged in moral philosophy. For example, Hamilton privileges non-conscious or 'unconditioned' elements of psychological existence on textual, rational grounds - a commitment held in common by the vast majority of philosophers.[98] In contrast, within physiological psychology, non-textual entities are given far greater political and epistemic weight.

In this final section, I briefly highlight the for-the-time unusual conceptualization by physiological psychologists of both textual and non-textual objects as tools of persuasion. Firstly, drawing on Dames' insights regarding the physiologically-determining potential of literature, and its consideration as a technique by which affect can be inculcated into individuals' bodies, I examine Laycock's use of text as a mechanism of persuasion during his campaign for his post at the University of Edinburgh. Secondly, in an extention of Dames' analysis to non-textual objects, I point to one means by which physiological psychologists sought to reconcile disputes amongst themselves. In appealing to the persuasive power of specific epistemic tools, I suggest, Carpenter and Laycock's psychological commitments placed particular weight on the persuasive power of non-linguistic objects in intellectual endeavour. Psychology in Britain thereby emerges as a movement constituted not only around textual and institutional formations (such as landmark publications, or bodies such as UCL), but also in relation to a specific set of tools and techniques: those appealed to by zoologists concerned with the definition of a nature that exists 'outside' of the human body.

Laycock and the conceptualization of texts as persuasive objects

Phrenological sympathisers played an important role in Laycock's surprise appointment to the much-sought-after chair of the Principles and Practice of Medicine at Edinburgh in 1855. A phrenologist even influenced his initial decision regarding the post. Since their initial exchange, Combe had introduced Laycock to the target of Carpenter's critique, Daniel Noble.[99] The latter, along with the

98 Hamilton, 'Philosophy of the Unconditioned', esp. pp. 11-19.

99 Laycock, T. 'Account of the Election of Dr Thomas Laycock to the Chair of the Practice of Medicine Edin University 1855 Autobiographical', in Barfoot (ed.), *"To ask the*

Mancunian zoologist William Williamson, were the first men Laycock consulted about his chances, the two having stayed at his house in York the evening after he received notice of the vacancy. His wife Anne (whom he had conferred with initially) believed it would be better to stay in York. The two friends (who had been invited by Laycock as honoured guests at a meeting of the Provincial Medical and Surgical Association) recommended he should stand. In a move completely in accordance with his published opinions on what he characterises as women's inferior capacity for rational contemplation, he left that morning for Edinburgh.[100]

The details of Laycock's campaign have been related at some length by Michael Barfoot, in an introduction to the 1860 apologia of the former recounting the circumstances of his appointment.[101] However, although Barfoot's history offers a wealth of detail regarding both the social context of Edinburgh and the personal interests of members of the university medical faculty, it does not attempt to link these to Laycock's efforts to articulate a physiological psychology. In order to highlight the ways in which Laycock's psychology related to his conduct of his campaign, I will concentrate on his personal approach to it rather than on the broader contexts foregrounded by Barfoot.

Laycock's positioning of his work as complementary to phrenology gained him a sympathetic audience in Edinburgh. The Scottish city had been at the centre of the initial formulation of the movement in Britain, and though phrenology's influence as a viable science of man was beginning to wane, it still held great attractions for many intellectually-engaged townspeople. In his campaign, Laycock's inner circle included the evolutionary author Robert Chambers (the foremost phrenological sympathiser in Scotland at that time, as Combe was abroad), Chambers' future son-in-law William Overend Priestley, and David Ramsay Hay, who had drawn on phrenology in his articulation of a 'scientific' theory of aesthetics.[102] The combined efforts of these figures - along with the crucial but more ambiguous support of James Young Simpson, who appears to

Suffrages...", pp. 55-56.

100 Ibid, p. 55. Laycock, *A Treatise*, esp. pp. 72-76. Physiological psychological conceptions of the mind as gendered are discussed in Chapter 4.

101 Barfoot, 'Introduction', pp. 1-51.

102 Barfoot, 'Introduction', pp. 36-37.

have simultaneously supported the efforts of a rival candidate, John Hughes Bennett - presented Laycock with a campaign team and support group.

Although an interest in phrenology might have constituted a common ground for Laycock's close supporters, it was of little advantage as far as the university medical faculty was concerned. Edinburgh University had by 1855 built up a reputation as a particularly hostile place for phrenologists. Combe had applied for the Chair of Logic there nineteen years before, in defiance of the first serious attempt in Britain (led by William Hamilton) to discredit its supporters' claims to advocate a science of mind and brain.[103] His narrow defeat had set the tone for an oppositional relationship between town and gown on the issue.[104]

Despite the historical hostility of its members to embodied notions of mind, the faculty of Edinburgh University did not have the power to appoint professors to its body - a right invested in Edinburgh's Town Council.[105] This had profound implications for candidates to Edinburgh chairs. Rather than address a small community of academics, they had to convince the representatives of an entire town of their suitability for any post.

Laycock's extensive apologia (mentioned above) is the principal body of evidence relating to the election. As evidence of Laycock's and his rivals' campaigns, it is a problematic document. It was written in 1860, following a bitter dispute with a number of his new academic colleagues, including Bennett, his principal rival during the election.[106] In addition, as a historical account it is highly unusual - it remains less than clear what motivated Laycock to write such a long narrative of the campaign. He did not seek to publish it, and appears to have used it as a means of justifying his own success to himself.[107] This places severe limits on the sorts of claims that it can be made to support.

103 Cantor, G.N. 'The Edinburgh Phrenology Debate: 1803-1828', *Annals of Science* 32 (1975), pp. 195-219; Shapin, 'Phrenological Knowledge', pp. 219-243. See also van Wyhe, J. *Phrenology and the Origins of Victorian Scientific Naturalism* (Aldershot and Burlington, 2004), pp. 85-92.

104 Shapin, ‘Phrenological Knowledge’, pp. 234-240. On Laycock’s anxieties over being ‘called a materialist’ see Laycock, ‘Account’, pp. 41-42.

105 Barfoot, 'Introduction', pp. 24-32.

106 Ibid, pp. 47-50.

107 Ibid, pp. 1-2.

I here offer a reading of it that takes into account its problematic nature. Instead of interpreting the text as testimony to the campaign itself, I use it as evidence of the ways in which Laycock himself conceived of effective political action. Written at a distance of five years from the events themselves, it is best understood as a reflection of Laycock's own conception of what made the campaign successful, rather than as evidence regarding the campaign as it happened. Specifically, its privileging of the potential for texts to inculcate specific emotional states in their readers accords well with Dames' account of the status of literary entities as tools and techniques of affect in physiological culture.

As far as his campaigning is concerned, Laycock characterises the collecting of testimonials as central to his efforts. He casts himself a relative unknown in Edinburgh, seeking the Town Council's approval in the face of anti-English prejudice and established local power networks.[108] The public system of academic appointment required candidates to place successive rounds of attestations of their suitability for a position before the Town Council, each seeking to outdo the others in both the volume and gravitas of their support.[109] On the face of it, such a system would appear to entail a simple popularity contest, with the intellectual community constituting the field to which candidates must appeal. Yet Laycock recalled what he characterised as the 'art' of requesting testimonials to involve much more than this:

> It is of great importance that the testifier should express himself so as to carry his readers with him, in the expression of his opinion. To this end an earnest style, free from conventionalism is the most important characteristic; but earnestness in expression is only attained through feeling in the writer. This need not necessarily be one of friendship; vanity, hatred to a rival, the mere love of encouraging the weaker side, the desire to patronise a rising man and similar feelings would equally serve to give earnestness and vigour to the language.[110]

108 Laycock, 'Account', p. 59.

109 Barfoot, 'Introduction', pp. 23-32.

110 Laycock, 'Account', p. 61.

This passage hints that Laycock adopted an unconventional approach to campaigning. He does not consider himself to have taken the task of collecting testimonials as simply a matter of appealing to an already-existent support network, but as of manipulating the emotions of his acquaintances in a way that would maximise his support. Implicit in the above quotation is that written appeals to more 'instinctive', uncontroversially 'bodily' states are more likely to be effective than those addressing the rational faculties of their readers. In other words, that the most powerful testimonials are those composed for the inculcation of affective response. This, I suggest, parallels the primacy accorded the more 'simple' mental states in Laycock's early psychological texts. If (as Laycock argued) rational states are dependent for their existence on a pre-existing field of feelings, appeals to the latter would constitute a more effective means of persuasion than appeals to the former.

Along with the testimonials themselves, the apologia portrays the packaging of a catalogue of Laycock's own publications along with them as having the most powerful influence in favour of his candidature. Simpson had recommended that such a list be sent along with the testimonial request letters and appeals to Council members, as a means of convincing prospective supporters.[111] The publication of the catalogue constituted an opportunity for Laycock to claim authorship of a wide range of texts that would not otherwise have been attributed to him. Though he had by 1855 produced a number of signed articles for such journals as the *Dublin Medical Press*, the *Lancet* and the *London Medical Gazette*, the vast majority of his literary output remained unsigned. The then-recent re-orientation of literary culture around a collection of increasingly specialised journals was accompanied by the general maintenance of anonymity in reviews.[112] This policy remained in place even when (as often happened in Laycock's case) authors advanced what they considered new or unusual claims. Hence amongst Laycock's numerous anonymous articles published in the *British and Foreign Medical Review* (the editorship of which Carpenter was to take over in 1847)[113]

111 Laycock, 'Account', p. 66.

112 On connections between physiological psychology and journal culture, see Smith, 'The Physiology of the Will'. For an overview of the historiography of nineteenth-century journal culture and science see Dawson, G. and Topham, J.R. 'Science in the Nineteenth-Century Periodical', *Literature Compass* 1 (2004), 11 pp.

113 Carpenter, 'Memorial Sketch', p. 41 - see below.

were claims relating to such diverse topics as the origin of epidemics, medical ethics and relations between anatomy and art.[114] By producing a catalogue of them, he could highlight the extent of his hitherto unacknowledged literary labours.

The account emphasises the importance of the catalogue as a document in the campaign:

> The effect of this catalogue was instantaneous. Dr Laycock had not formed any adequate conception of the extent of his labours, much less those to whom the greater part was unknown. Its influence was that of an astonishing surprise, both in and out of the profession. Testimonials were more easily attained from every quarter, and breathed a more hearty and earnest spirit.[115]

As well as appealing directly to what he considered the affect-constituted psychological states of those who he hoped would influence his appointment, Laycock portrays his campaign as bringing to his electors' (and their advisers') consciousnesses a whole range of textual materials that they would have otherwise remained unaware of (and may have otherwise considered irrelevant).

Laycock portrays himself as adopting a more general, text-centred approach to political action that parallels his conception of psychology as inherently embodied. The early pages of his apologia characterise him as:

> not ambitious of cash so much as desirous of power over the minds of men. This he had exercised largely through the press, although to a great extent secretly... He had thus abundant opportunities for influencing the mind of the profession upon all great questions of the day, whether medico-scientific, ethical, scientific or practical, and he felt a pride in exercising this influence behind the scenes of periodical anonymousness [sic].[116]

114 Laycock, T. *Evidence of Professional Acquirements*, pp. 14-24.

115 Laycock, 'Account', p. 66.

116 Ibid, pp. 53-54.

This comment makes clear two important points regarding Laycock's view of the catalogue; that it relied on his participation in secretive and indirect means by which he hoped to influence intellectual life; and that he saw this indirect mode of influence as a source of power.

In addition to the above-described textual means of persuasion, Laycock portrays his personal conduct during the campaign as consistent with a more general 'psychological' approach to the contest. He portrays himself as highly aware of what he considers the state of ignorance as to academic matters of the town councillors, commenting that 'they found themselves in a difficult position, because their previous education and habits of life had certainly not qualified them to be judges of the merits of professors.'[117] Understanding his electorate as unable to differentiate between the candidates on academic grounds, Laycock sought to influence the opinions of those to which they might turn for advice. Hence the construction and distribution of the catalogue and testimonials was heavily oriented towards the persuasion of local medical men.[118] This tactic could also operate at a more personal level - Laycock relates how he sought to persuade a particularly inscrutable councillor - one 'Ex-Baille Tullis' - by convincing the latter's wife of his suitability. Other candidates targeted the councillor directly.[119] In Laycock's view, the most effective aspects of the campaign had not been those in which he had addressed the Town Council - indeed the councillors themselves receive very little attention - but his attempts to influence the emotional and intellectual environment in which they sought to make their decisions.

For the Laycock of 1860, then, it appears that textual entities are critical to the conduct of political action or the persuasion of a population. It was not only the literary critics that Dames highlights such as Eneas Sweetland Dallas and Alexander Bain that portrayed texts as having physiological impacts on their readers. For physiological psychologists, texts designed for the inculcation of specific bodily states could help constitute an environment in which one's own broader aims might be achieved more readily. As noted later in this thesis,

117 Ibid, p. 60.

118 Ibid. p. 61

119 Ibid, p. 93.

Carpenter appears to have adopted a similar attitude with regard to his engagement with 'amateur' microscopic practitioners during the 1850s. Physiological notions of effective political action tended to highlight books and pamphlets as means to an end (rather than entities valuable in and of themselves).

It should however also be noted that as far as physiological psychologists' disagreements amongst themselves are concerned, a far broader range of objects are brought to bear in matters of dispute. Though texts were considered entirely effective means of inculcating consent amongst populations unschooled in the physiological aspects of psychology, it was the tools and techniques of zoology that cwere brought into question when discussing the physiological nature of mind. The 'internal' disciplinary dynamic of physiological psychology privileged the persuasive capacities of non-representative techniques, rather than those of literary objects. In order to expand on this point, I conclude this chapter by examining the means by which Carpenter and Laycock sought to resolve some of the differences between their respective claims regarding the nervous psyche.

The place of tools in physiological psychology

During the late 1840s and early 1850s, Carpenter and Laycock became involved in a dispute regarding the application of the reflex function to the entire nervous system. The conflict between the two had its origins in the question of exactly how this application should be achieved. Though only one side of their correspondence appears to have survived, it nevertheless enables an interrogation one significant way in which psychological psychologists sought to resolve disagreements amongst themselves. As already mentioned, Carpenter sought to connect psychological categories and anatomically-distinct parts of the nervous system. Laycock was consistently critical of such an approach.[120] Such criticism was not only a matter of establishing a claim relating to physiological truth. As stressed above, in a discourse seeking to identify nervous and psychological life, claims regarding the nature of the nervous system become psychologically (and politically), as well as physiologically, relevant.

120 See eg. Laycock-Combe, 27th Feb 1845, Nat. Lib. Scot. MS 7276, ff. 3-4; Laycock-Combe, Oct 1846. Nat. Lib. Scot. MS 7240 ff. 117-119.

At some point in 1849, Laycock appears to have submitted a text to Carpenter as editor of the *British and Foreign Medico-Chirurgical Review* critical of the latter's anatomical stance (and supportive of the already-mentioned, more general microscopic criticisms of his work at this time). Specifically, he appears to have claimed the presence of nerves directly connecting organs of sense with the cerebrum, rather than the cerebellum or medulla oblongata. As Carpenter had claimed all sensory nerves passed through these latter parts, this drew a hostile response from him. His position as editor constituted a unique position with regard to the expression of his opinion on the matter. As he indicated to Laycock:

> I found myself obliged to omit parts of your article, as inconsistent with doctrines already expressed in the former review of Todd, and as only embarrassing (in my apprehension) the discussion of the question of which you treat... What you call a nerve is a commissure, connecting the olfactory ganglia to the spinal axis (see Fisher). The corp[us]. striata and thal optici [optic thalamus], moreover, are quite independent of the cerebrum as both Comp[arative]. Anat[omy]. and develop[men]t show... You must forgive me doctoring this Art[icle]. a little, as it so closely trenches on my own subject.[121]

As editor, Carpenter was able to censor those portions of Laycock's article that did not agree with his own views on the subject. Equally significant, however, is the way that Carpenter appeals to museological evidence in his justification of his position. Regardless of his position as editor, it is on comparative anatomical grounds that Laycock's claims cannot be admitted.

Following this initial exchange, the correspondence becomes more mundane, and peters out entirely in 1852. To Carpenter it must have seemed that his appeal to comparative anatomy was successful, as the 1853 edition of his *Principles of Human Physiology* contains a note on Laycock's work seeking to differentiate it from his own. Though he had been the first author to apply the reflex function to the entire nervous system, Laycock, Carpenter claims, had not

121 Carpenter-Laycock 5th Dec [1850 (attached to Carpenter-Laycock 15th Jan 1851)] RCPE MS B. 22 F. 148. See also Carpenter-Laycock, 26th Oct and 6th Nov 1849 at the same location.

recognised 'the essential distinction, both in their anatomical and physiological relations, between the Sensory Ganglia and the Cerebrum.'[122] In addition, he had failed, in Carpenter's estimation, to 'mark-out the distinction between the '*sensori*-motor' or 'consensual' actions, which are the manifestation of the reflex power of the former [sensory ganglia], and the '*ideo*-motor' actions which depend on the reflex action of the latter [cerebrum].'[123] Carpenter's text clearly marks out what he considers to be his original contribution to nervous psychology.[124] In his subsequent 1855 edition, he drops reference to Laycock's work entirely.[125] By claiming the originality of his doctrines in this way, Carpenter also claims the right to define what constitutes reflex or 'automatic' cerebral action - a phenomenon that in his (but not Laycock's) view is distinct from the operation of the will in nervous life.

In 1855, Laycock responded to Carpenter's claim. In a long letter, which he sent to both Noble and another (presumably the geologist David) 'Forbes',[126] he sets out his objections to Carpenter's position. His chief concern is to portray Carpenter's term 'unconscious cerebration' as (as it describes nothing more than Laycock's own previously-worked-out doctrine of reflex action of the cerebrum) entirely unnecessary. As such, this term operates in Laycock's view as a means for Carpenter to avoid engagement with Laycock's own publications on the relations of physiological to psychological states:

> As to that which he claims in the 4th [1853] Ed[ition]. namely the [sic] having marked the distinction between sensori-motor and ideo-motor - my answer is that the distinction has been enumbrated [ie. articulated] by me (in the true sense of the term) from the very first. The sensori-motor actions are as much reflex as the ideo-motor in my system, and are often equally independent of the will or

122 Carpenter, *Principles of Human Physiology* (4th ed.), note on pp. 799-800.

123 Ibid. Original emphasis.

124 Ibid, pp. xi-xii.

125 Carpenter, *Principles of Human Physiology* (5th ed).

126 Carpenter's mentor Edward Forbes had died in 1854.

> consciousness. C[arpenter] has an anatomical scheme... the truth of which I very much doubt and which is I think in our present state of knowledge incapable of proof.[127]

Again, it is the status of anatomical evidence that is at issue here. As set out at the beginning of this chapter, Laycock's psychology relied to a far greater extent than did Carpenter's on establishing the nature of microscopic organisms. By 1855, microscopy enjoyed a rather more respectable status within intellectual culture than it had during the early decades of the nineteenth century.[128] Laycock's rejection of Carpenter's 'anatomical scheme' reflects a sense of confidence in the epistemic status of his own conception of nervous action. Critically, however, the dispute as a whole did not result in an irrevocable split between the two academics.

As the first chapter of this thesis highlights, appeals to the unreliability of microscopic vision presented early-nineteenth-century researchers with a means by which controversial claims could be managed within a gentlemanly tradition of natural philosophic debate. Similarly, deferring disagreements relating to the psyche to disagreements relating to the epistemic status of various forms of scientific equipment helped maintain a sense of common purpose amongst physiological psychologists. Though Carpenter seeks to establish the originality of his physiological psychology, and Laycock denies the legitimacy of his claims, when it comes a direct confrontation between the two, psychology itself is no longer at issue. Instead, the commitment of both to establishing a science of mind and brain means that their disagreement revolves to a significant extent around the appropriate means of conducting nervous research.

In an immediate sense, these psychologists' agreement that nerves and mind are co-terminous contributed to their ability to maintain a collaborative if at times strained working relationship.[129] Appealing to the means of researching nervous life rather than specific claims regarding the nature of mind meant that disagreements regarding the politically-contentious issue of the psyche could

127 Laycock-Forbes, 6th June 1855. RCPE MS B. 22 F. 148. Original emphases.

128 Jacyna, '"A Host of Experienced Microscopists"'.

129 See eg. Carpenter-Laycock 23rd Jan 1855 and Carpenter-Laycock 12th Dec 1873. Both RCPE MS B. 22 F. 148.

(ideally) be resolved in the academic arena of zoological investigation, through the evauation of the legitimacy of differing forms of epistemic equipment. The resolution of this particular debate is of less concern here than the ways in which psychological concerns were incorporated into those relating to tools established in more established academic disciplines such as zoology. To the extent that they defer psychological differences amongst themselves to questions relating to techniques of nervous investigation, physiological psychologists invested physiological (and more generally scientific) equipment with the power to define psychological life.

Conclusion

As an academic discipline, British psychology enjoyed considerably less prominence than did zoology during the nineteenth century.[130] The foundation of two journals devoted to psychological 'science' - *Mind* in 1876, and *Brain* three years later - indicates that by the latter third of the century, psychology was coming to be recognised as a discipline in which one might specialise. Yet British zoology had by this point come to be lauded to the extent that a national museum (the Natural History Museum in South Kensington) had been dedicated to its' dissemination throughout the population, and zoology professorships had been established in all of the major universities. In contrast, those recognised a authorities on the psyche in Britain were split into different camps; those relating to a specific interpretation of an academic 'moral philosophy' (as with Alexander Bain's examinership at UCL), those that concerned themselves above all with the treatment of mental pathologies in asylums such as Henry Maudsley, and independent scholars earning a living from writing such as Herbert Spencer. Laycock, for example, based his course on the physiology of mind in an asylum local to Edinburgh University. Maudsley (one of the most prominent late-Victorian alienists), after a brief academic career, focused exclusively on treatment within private institutions for the psychologically unwell. Carpenter, in contrast, remained

130 See Danziger, K. *Naming the Mind: how psychology found its language* (London, 1997), pp. 51-52.

firmly within the academy, as did experimental physiological psychologists such as David Ferrier. Physiological psychology as a discipline remained fragile, split as it was between a variety of approaches and institutional loyalties.

Yet the diverse range of psychological investigators committed to the linking of mind and nerve did, it seems, feel themselves to hold something in common. Carpenter's texts, and especially those of Spencer, the one physiological psychologist with no institutional ties whatever, were used as touchstones in a movement that sought to construct psychology as a science that could assimilate the latest research from other disciplines. To a certain extent, this feeling of commonality of purpose was achieved via a rhetorical rejection of 'metaphysical' philosophy - ie. that which speculated on the causes of mental phenomena without recourse to a tangible forms of evidence. Indeed, it almost seems to go without saying that it was precisely physiological psychology's articulation of a notion of mind that was above all *tangible* that constituted its disciplinary identity. Nevertheless, the final sections of this chapter suggest that these figures' conceptualisation of the *tools* of psychological research and practice as the ultimate arbiters of scientific truth was at least as critical to the constitution of physiological psychology as an academic field. This insight will be expanded upon in the next chapter.

Physiological psychology, as an aspirant (even if in Britain ultimately unsuccessful) disciplinary science, played a critical role in the constitution of a specifically 'technical' conception of disciplinarity. Texts, microscopes, museological specimens, and other epistemic tools are employed by physiological psychologists as means by which their discipline can be both constituted and policed. On the one hand, conceiving of texts as means of inculcating affective responses in the bodies of their readers, physiological psychologists sought to deploy them as objects of persuasion; means by which academic and other institutional positions might be obtained. On the other, when disputes amongst physiological psychologists did arise, an appeal to the relative legitimacy of differing techniques of nervous investigation became the principal means by which such disputes (it was believed) could be resolved. Non-textual tools relating to nervous investigation thereby helped constitute an exclusively 'internal' discourse, in which dispute could (in principle) be resolved amongst gentlemanly equals. This contrasts with efforts to inculcate specific emotional states in a ‘non-specialist’

'public' via the publication of texts. In this latter sense, physiological psychology exemplifies a more general tendency within nineteeenth-century disciplinarity; the policing of boundaries via the articulation of technical languages, the meaning which remaining exclusive to recognised specialists.

The establishment of physiological psychology as an intellectual movement constituted a means by which knowledge of non-human life became a means of articulating specific approaches to interpersonal relations. The second half of this thesis will examine in more detail ways in which differing techniques of studying life were made, via psychological discourse, into objects of explicit political concern in mid-to-late-nineteenth-century Britain.

Chapter 3:

Cultivating Technique: Energy, physiological psychology, and experimentation as discipline (c. 1860-1880)

Introduction

By 1870, a rhetorical connection between industrial success and experimental discipline had become firmly embedded within a discourse that sought to prioritise 'science' and - as importantly - 'the scientist' in the then-emerging economy of liberal democracy. As University College's professor of chemistry Alexander William Williamson proclaimed, in a speech that year at the opening of the institution's newly-constituted Faculty of Science:

> Efficient and improving men of business get more and more the command of markets, whilst those who cannot advance with their time gradually get pushed out, and are known by their complaint that "business is not as good as it used to be."
>
> Now the mental qualifications which enable a man of business to contribute to progress in the particular industrial operations which he conducts, may be described by one word: - they are the qualifications of an experimentalist.
>
> The introduction of any change in an industrial system is an experiment; and whoever manages it ought to know that it is one, and to conduct it in such a manner as to make it a true and good experiment.[1]

1 Williamson, A.W. *A Plea for Pure Science: Being the Inaugural Lecture at the Opening of the Faculty of Science, in University College London, October 4th, 1870* (London, 1870), p. 21.

Williamson (as the title of this lecture, 'A Plea for Pure Science', indicates) is careful to reserve a space for 'pure' science in his discourse. However, it is the pragmatic necessity of experimentation for the evolution of industry that constitutes the principal justification for establishing it as the most appropriate mode of training a new generation.

My concern in this chapter is to link the previous two chapters' interrogation of the role that tools and techniques played in the constitution of zoological and physiological notions of self and nature to broader shifts in intellectual and pedagogic practice that occurred during the 1860s and 1870s. Historians have long acknowledged that these decades saw profound changes to the way natural philosophical investigation was conducted in Britain. Specifically, they have pointed to the emergence of a strong emphasis on the emergence of the 'scientist' or 'man of science' as an identity marked by his mastery of experimental techniques and practices.[2] What remains in question, however, are the exact conditions under which such identities and the spaces within which they were constituted came to be instantiated as critical elements of economic and intellectual activity.

The academic experimental laboratory begins to be held up in Britain as an exemplary space in which science is to be conducted from around 1860. Whereas French and German governments had previously supported physiology and physics laboratories as places of research, laboratories in British educational institutions had invariably been established as a result of individual initiative (or at least patronage). During the 1870s, laboratories were established in all of the higher educational institutions in Britain, with support (and sometimes direction) from government. A whole host of legislation, largely piecemeal, presented universities with far more substantial funds for experimental research and teaching than had existed previously.[3] Laboratories were established or expanded for chemistry,

2 Barton, R. "Men of Science': language, identity and professionalization in the mid-Victorian scientific community', *History of Science* 41 (2003), pp. 73-119; White, *Thomas Huxley*); Mussel, J. 'Private Practices and Public Knowledge: science, professionalization and gender in the late nineteenth century' *Nineteenth-Century Gender Studies* 5 (2009), pp. 1-36 [accessible at http://www.ncgsjpournal.com/issue52/mussell.htm (retrieved 23/08/2010)]; White, P. 'Darwin's Emotions: the scientific self and the sentiment of objectivity,' *Isis* 100 (2009), pp. 811-826. The association of science with masculinity is addressed in chapters four and five of this thesis.

3 Anderson, R.D. *European Universities from the Enlightenment to 1914* (Oxford and New York; Oxford University Press, 2004), pp. 191-193; Sanderson, M. *Education and*

physics and physiology at Oxford and Cambridge, these subjects and engineering and biology at University College and Kings College, and new, purpose-built buildings erected in South Kensington for the School of Mines.[4] At the same time, the founding of self-consciously 'scientific' institutions such as Owen's College in Manchester, University College Liverpool, and the Birmingham Science College extended the number and diversity of sites committed to teaching through experimental practice.[5]

Such institutional developments were in large part the consequence of the implementation of the report of an 1867-1868 government select committee tasked with investigating 'Provisions for Giving Instruction in Theoretical and Applied Science to the Industrial Classes.'[6] Despite its title, much of the report concerns itself with what it characterises as a need for the inculcation of a new, experimental ethos into the managers of British industries. The report as a whole makes a

Economic Decline in Britain, 1870 to the 1990s (Cambridge; University Press, 1999), pp. 48-49; Cardwell, D.S.L. *The Organization of Science in England* (London, 1972 [1957]), pp. 125-126, 130-131. Key literature relating specifically to nineteenth-century laboratories is cited in note [24] of the introduction to this thesis.

4 On government intervention and laboratory science at Cambridge see Geison, *Michael Foster*, pp. 81-115; Schaffer, S. 'Late Victorian Metrology and its Instrumentation: A Manufactory of Ohms', in Budd, R. and Cozzens, S.E. (eds.) *Invisible Connections: Instruments, Institutions, and Science* (Washington, 1992), pp. 23-54; Blackman, H.J. 'The Natural Sciences and the Development of Animal Morphology in Late-Victorian Cambridge', *Journal of the History of Biology* 40 (2007), pp. 82-91; Weatherall, M.W. *Gentlemen, Scientists and Doctors: Medicine at Cambridge, 1800-1940* (Woodbridge, 2000), pp. 121-132. On experimentation at Oxford see Fox, R. and Gooday, G. (eds.) *Physics in Oxford, 1839-1939: laboratories, learning and college life* (Oxford and New York: Oxford University Press, 2005) and Romano, T.M. *Making Medicine Scientific: John Burdon Sanderson and the Culture of Victorian Science* (Baltimore and London; John Hopkins University Press, 2002), pp. 139-160. On laboratories at UCL see Harte, N. and North, J. *The World of UCL, 1828-1990* [3rd ed.] (London; UCL Press, 2004), pp. 80-95. On laboratories at King's College London see Hearnshaw, F.J.C. *The Centenary History of King's College London, 1828-1928* (London, Bombay and Sydney, 1978 [1929]), pp. 288-292. On the School of Mines see Forgan and Gooday, 'Constructing South Kensington'; Forgan, S. and Gooday, G. '"A Fungoid Assemblage of Buildings": Diversity and Adversity in the Development of College Architecture and Scientific Education in Nineteenth-Century South Kensington', *History of Universities* 13 (1994), pp. 153-192.

5 Cardwell, *The Organization of Science*, pp. 139-140.

6 'Report of the Select Committee on the Provisions for Giving Instruction in Theoretical and Applied Science to the Industrial Classes with Minutes of Evidence Appendix and Index 1867-68', *Irish University Press Series of British Parliamentary Papers: Education, Scientific and Technical* [Vol. I] (Shannon, 1970). On the report, see Cardwell, *The Organization of Science*, pp. 111-119.

number of recommendations regarding the teaching of such technical subjects as drawing, physical geography, and 'the phenomena of nature' in elementary schools, and characterises the introduction of scientific instruction in secondary schools as 'urgently required'.[7] On a more general level, it associates a desire that government increase industrial production in order that it might better compete with other nations with a need to provide the 'proprietors and managers' of industry with 'scientific training' in a laboratory.[8] It marks a threshold after which it was increasingly assumed that experimental discipline constituted a (if not the) critical means by which educational institutions might train a population of scientific men suited to the demands of international industrial competition.

As already highlighted, one key plank upon which considerations of life, as well as of industry and national competition, had come to enjoy such political urgency in Britain at this time was the emergence of a discipline of political economy. Gallagher's already-highlighted study shows how notions of life and mind did not develop in isolation from the emphasis that political economists placed on competition. In a similar vein, Robert M. Young has highlighted the coming-to-pre-eminence of an evolutionary rationale for freedom of competition during this period.[9] But as the Williamson quote above indicates, it was not only zoologists and physiologists that sought to orient their activities towards a pragmatic rationale of industrial efficacy at this time. Gallagher and Young's analyses need to be coupled with a complementary understanding of how experimental investigators in general were able to construct their activities as constituting an appropriate response to the vagaries of international competition. Not only are liberal economies 'naturalised' by evolutionary conceptions of man during this period, but 'scientists' more generally come to construct themselves as key contributors to the economic well-being of nations.

Though the significance of the committee on ‘Instruction in Theoretical and Applied Science' for future British educational practice has been acknowledged in a number of texts, what is less clear is exactly why its authors chose to emphasise the need for experimental instruction in schools and

7 'Report of the Select Committee,' pp. viii-ix.

8 Ibid, pp. vii-viii.

9 Young, *Darwin's Metaphor*, esp. pp. 23-55.

universities quite so vehemently.[10] How was it that competence in experimentation - rather than mathematical skill, or mastery of language, for example - came to be understood as the most important element in the cultivation of British industrial prowess?

The central claim of this chapter is that the emergence of a zoologically-informed notion of psyche as an inherently 'embodied' phenomenon constituted a critical condition of possibility for a rhetorical connection of experimentation in laboratories with industrial advancement of the nation. The thinking-together of mind and body that occurred during the nineteenth century positioned experimental equipment as a 'motor' of national economic success. It should be noted that this discourse was one amongst many - it was accompanied by various appeals to the need for an unregulated labour force, free trade, protectionism and so on as critical to their own activities.[11] Nevertheless, by the end of the nineteenth century, the laboratory had attained a privileged status in discourse regarding industrial development.

Accompanying the physiological psychological assertion that mind and body are congruous, I here emphasise, is a presumption that learning is inherently 'bodily,' and therefore dependent on muscular movement. For many physiological psychologists, the centrality of movement in the production of knowledge implied a necessary re-constitution of learning around tools that required active, skilful manipulation for their effective operation.[12] Physiological psychology thereby

10 Gooday, G. 'Precision Measurement and the Genesis of Physics Teaching Laboratories in Victorian Britain', *British Journal for the History of Science* 23 (1990), pp. 25-26. On teaching practices in laboratory settings see Jacyna, '"A Host of Experienced Microscopists"'. The literature on laboratories is vast. On the recent historiographic shift away from concerns regarding laboratories as institutions, see Gooday, 'Placing or Replacing the Laboratory'; Kholer, 'Lab History: Reflections', p. 767; Latour, 'The Costly Ghastly Kitchen'. Though see also Lenoir, *Instituting Science*.

11 See eg. Berg, *The Machinery Question*.

12 On scientific pedagogic practice see also Rudolph, J.L. 'Epistemology for the Masses: The Origins of "The Scientific Method" in American Schools', *History of Education Quarterly*, 45 (2005), pp. 341-376; Josefowicz, D.G. 'Experience, Pedagogy and the Study of Terrestrial Magnetism', *Perspectives on Science* 13 (2005), pp. 452-494. On the historiography of education and subjectivity see Warwick, A and Kaiser, D. 'Conclusion: Kuhn, Foucault, and the power of pedagogy', in Kaiser, D. (ed.) *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives* (Cambridge, Mass.; MIT Press, 2003), pp. 393-410; Olesko, K.M. 'Science Pedagogy as a Category of Historical Analysis: Past, Present, and Future', *Science & Education* 15 (2006), pp. 863-880; Rudolph, J.L. 'Historical Writing on Science Education: A View of the Landscape', *Studies in Science Education* 44 (2008), pp. 63-82.

emerges as critical to the instantiation of a skill-centred, technical ideal of truth-production.

This claim touches on a number of issues raised by recent work on the history of ideals of 'objectivity.' Lorraine Daston and Peter Galison have identified the mid nineteenth century with the emergence of what they term a 'mechanical' ideal of scientific practice.[13] Focusing above all on changing forms of natural philosophic representation in relation to changing conceptions of subjectivity, they argue that a wide range of practitioners subscribed to a notion of self that privileged automatic, mechanism-determined forms of observation. Scientific practitioners, they suggest, 'willfully' sought to inhibit their individual sensory perceptions (which they presumed to be observationally unreliable) in favour of techniques that they believed would constitute a reliable, objective conception of nature.[14] 'Mechanical objectivity,' as a form of representative practice, is contrasted with a prior, already-established ideal of truth in which natural philosophers had sought to arrive at stable, 'true-to-nature' representations of natural forms via an extensive process of collection and comparison. More notably given this chapter's concern with the institutionalization or 'disciplining' of experimental practice, mechanical objectivity also preceded (Daston and Galison claim) the emergence of separate ideal that privileges the agency of the experienced observer in the evaluation of scientific images.[15] This latter ideal, which they term 'trained judgement,' is characterised as emerging from within the context of the disciplined, laboratory sciences, principally during the twentieth century.

This chapter indicates that both of Daston and Galison's categories of mechanical objectivity and trained judgement are inextricably bound up with an underlying conception of scientific practice as a skilful, bodily encounter with an ever-changing set of epistemic tools. Further, emphasising that physiological

13 Daston, L. and Galison, P. *Objectivity* (New York, 2007).

14 Daston and Galison, *Objectivity*, pp. 115-190. See also Lightman, B. 'The Visual Theology of Victorian Popularizers of Science: from reverent eye to chemical retina', *Isis* 91 (2000), pp. 651-680; Noakes, R. "Instruments to Lay Hold of Spirits': technologizing the bodies of Victorian spiritualism', in Morus, B*odies/Machines*, pp. 125-163; Gooday, G. 'Spot-Watching, Bodily Postures and the 'Practiced Eye': the material practice of instrument reading in late Victorian electrical life', in *idem*, pp. 165-195.

15 Daston and Galison, *Objectivity*, pp. 309-362.

psychological modes of subjectivity call the status of representation into question, it shows how physiological psychologists' conceptions of learning privileged bodily interaction with technical entities over the representation of scientific truth in text or image. The privileging of both mechanically-constituted representations, and the notion that accurate perception can only be achieved via an extended process of training with the tools of the laboratory, emerged in conjunction with the articulation of a notion of mind as an embodied phenomenon. Physiological psychologists, in insisting on the necessity of active bodily movement in intellectual endeavour, helped constitute a culture in which technical objects and the organic self emerge as mutually dependent entities that develop together, and even begin to be understood as different aspects of the same perceiving whole.[16]

In advocating conceptions of learning that emphasised the work of the perceiving body, physiological psychological texts presented experimental scientists with a rhetoric that effectively naturalised their own techniques of investigation as activities best suited to the cultivation of individuals as economically effective units. Critical to the emergence of this non-representational conception of subjectivity is the configuration of psychological life around a notion of an all-pervasive natural 'power' or 'energy.' The science of nineteenth-century Britain was deeply concerned with relations between nature and the industrial processes that (it was generally presumed) would harness nature's potential to human ends. The possibility of converting natural power into industrial production - or organic 'energy' into human 'work' - became a key pre-occupation of mid-to-late nineteenth-century science.[17] The rhetoric of power and energy was thereby

16 On the constitution of this culture see Ketabgian, *The Lives of Machines*; Ketabgian, 'The Human Prosthesis'; O'Connor, E. *Raw Material: producing pathology in Victorian culture* (Durham and London; Duke University Press, 2000), pp. 102-147; Morus, I.R. ''The Nervous System of Britain': space, time and the electric telegraph', *British Journal for the History of Science* 33 (2000), pp. 455-475; Ketabgian, 'Martineau, Mesmerism'; Schaffer, S. 'Babbage's Intelligence: calculating engines and the factory system', *Critical Inquiry* 21 (1994), pp. 203-227. This tool-centred conception of perceptive activity contrasts with the merely 'rhetorical' association of science with technical improvement earlier in the century. See Berg, *The Machinery Question*, pp. 145-178.

17 Rabinbach, A. *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley, CA; University of California Press, 1990), esp. pp. 45-68 and 120-145; Coleman, *Biology in the Nineteenth* Century, pp. 118-159. See also Kremer, R.L. 'The Thermodynamics of Life and Experimental Physiology, 1770-1880' (unpublished PhD thesis, Harvard University, 1984). On the specifics of energy physics and physiology in Britain see Hall, 'The Contribution of the Physiologist'. Recent English-language examples of the much larger literature on physiology and energy physics in Germany includes Cahan, D. (ed.) *Herman von Helmhotz and the Foundations of Nineteenth-*

inextricably linked with the bodily practices and technical bodies that constituted the factory as a critical site of industrial culture.

This chapter starts, then, by emphasising ways in which the articulation of a dynamic, 'energy'-centred conception of life came to be linked with the investigation of the human body in a broad range of work-focused settings during the middle decades of the nineteenth century. The conception of life as a particular kind of energy that could be converted into other forms (such as electricity, or chemical heat) through bodily labour paralleled an expansion in the range of sites in which physiologists undertook their investigations. Inhabitants of prisons, military barracks, and other places associated with intense muscular labour became key objects of interest for those concerned with the energetic 'correlation of forces.' It then goes on to delineate the connection of this discourse with physiological psychological speculation regarding mind as an inherently embodied phenomenon. Focusing on the work of the Scottish psychologist and language-theorist Alexander Bain, it highlights ways in which learning began to be conceived of as a kind of bodily work. Through Bain, Carpenter, and others, a notion of learning-as-practice took hold in British culture. The final part of this essay thereby relates ways in which the committee on ‘Instruction in Theoretical and Applied Science,' along with experimental practitioners themselves, adopted this physiological psychological rhetoric. In so doing, they helped constitute a broad-based commitment to technique- and skill-centred learning in British academic life. Such a conclusion calls into question the received stereotype of British academic life as dominated by text-based disciplines and as disdainful of technical practices.[18]

Century Science (Berkeley; University of California Press, 1993); Lenoir, *Instituting Science*, esp. pp. 75-95; Rabinbach, *idem.*

18 Barnes, B. and Shapin, S. 'Head and Hand: Rhetorical Resources in British Pedagogical Writing, 177-1850', *Oxford Review of Education* 2 (1976), pp. 231-254. See also Secord, A. 'Botany on a Plate: Pleasure and the Power of Pictures in Promoting Early Scientific Knowledge' *Isis* 93 (2002), pp. 28-57; Kehler, G. 'Gothic Pedagogy and Victorian Reform Treatises', *Victorian Studies* 50 (2008), pp. 437-456. On the tensions highlighted by Barnes and Shapin in relation to later laboratory practices in physics see Schaffer, 'Late Victorian Metrology'.

Correlating life-force

In 1865, fifteen years after the initial publication of his only article to be included in the Royal Society's *Philosophical Transactions*, William Benjamin Carpenter suggested in an article for the *Quarterly Journal of Science* that its general neglect amongst physiologists might be accountable by reference to its overly 'speculative' nature.[19] This latter article portrays his initial publication - entitled 'On the Mutual Relations of the Vital and Physical Forces' - as an attempt to undermine the notion of a generative 'germ force' or 'Bildungstrieb' as productive of organic forms. In order to support what he claims were his initial conclusions, he concentrates on recounting ways in which the simplest elements of life (presumed to be cells) maintain their 'vitality' by converting chemical into organic matter. In so doing, he claims, cells produce 'animal heat' in the process.[20]

In articulating this conception of life as a kind of 'force' which distinguishes it from other kinds of physical body, Carpenter might have been read as declaring his allegiance to the vitalist doctrines that had emerged in Europe during the eighteenth century. At that time, various 'subtle fluids' such as electricity, fire and 'ether' had been held up as immaterial 'principles' which might be appealed to as causes of the movement of passive, inert matter.[21] For the vitalists, it was a principle or force that inhered in the material of organisms - not a universal spirit external to living matter - that was responsible for their animation. 'Force,' which had until the eighteenth century been conceived as a term that denoted the effects of moving matter on other bodies, comes in vitalist texts to be

19 Carpenter, W.B. 'On the Correlation of the Physical and Vital forces', in Youmans, E.L. (ed.) *The Correlation and Conservation of Forces: a series of expositions* (New York, 1865), p. 406. Carpenter, W.B. 'On the Mutual Relations of the Vital and Physical Forces', *Philosophical Transactions of the Royal Society of London*, 140 (1850), pp. 727-757. The 1850 article does not, however, appear to have escaped the attention of Harriet Martineau and Henry G. Atkinson in their *Letters on the Law's of Man's Nature and Development* (1851). See Ketabgian, 'Martineau, Mesmerism' pp. 351-355.

20 Carpenter, 'On the Correlation', esp. pp. 411-412. It should be noted that the originality or otherwise of Carpenter's work is not at issue here. German physiologists articulated far more sophisticated conceptions of the actions of cells and their relations with non-organic matter, for example, than any British investigator of this period. See eg. Parnes, O. 'The Envisioning of Cells', *Science in Context* 13 (2000), pp. 71-92.

21 French, 'Ether and Physiology'

elevated to the status of an originator of bodily movement.[22] In addressing the nature of a 'vital force' then, Carpenter's title might have been read as implying something about the nature of life; that it could only be conceived of as an entity in and of itself, unrelated to other kinds of physical activity or law. Life for the vitalists constituted a phenomenon entirely independent from the laws that underlay non-organic nature.

Despite Carpenter's adoption of the terminology of vitalism, his *Philosophical Transactions* article could also be read as marking a series of subtle shifts in the way in which force, matter and life was being considered. This text articulates a cellular explanation of the origin of bodily heat, indicating that the notion of a force specific to life, although valid, can only be understood as enjoying a status equivalent to that of gravity in Newtonian mechanics or chemical attraction in Lavoisier's chemistry - not as a means of explaining the origins or development of life per se, but as a phenomena characteristic of life that renders it amenable to sustained investigation.[23] Though it does not use the word 'energy', that was beginning to be talked of at this time as a unifying category for the investigation of physical science (preferring to talk of force and power), it is clear that Carpenter's text is working towards a notion of life that will constitute it as the equal of other, more established scientific disciplines.

By 1865, despite Carpenter's disquiet over the neglect of his paper, the broader thrust of it - that all worldly phenomena could be conceived of as mutually convertible manifestations of different kinds of power - had become a prominent theme in European natural philosophic discourse. Nineteenth-century conceptions of different forces as interrelated aspects of an more fundamental and ultimately indestructible energy have become the object of sustained historical investigation since Thomas Kuhn drew attention to them during the 1950's.[24] Historical accounts highlight how the diverse interests of such figures as the speculative naturalist Julius Robert Mayer, physiological chemist Justus von Liebig, brewer and physicist James Prescott Joule, physical philosopher and physiologist Hermann von

22 French, 'Ether and Physiology', pp. 130-134.

23 Carpenter, 'On the Mutual Relations', esp. pp. 728-733.

24 Kuhn, T.S. 'Energy Conservation as an Example of Simultaneous Discovery,' in Clagett, M. (ed.) *Critical Problems in the History of Science* (London; University of Wisconsin Press, 1969), pp. 321-356.

Helmholtz, and the electrical physicist William Robert Grove could be made mutually relevant via the concepts of correlation and convertibility.[25] Notions regarding correlation constituted an important means by which scientific investigation was differentiated from philosophical speculation more generally during the middle decades of the century.[26]

Yet although correlation became a means by which apparently disparate research in physical science could be brought together, I wish to point here to the particular emphasis that British authors placed on what they perceived to be its implications regarding the cultural status of technical entities in industrial production.[27] As Iwan Morus highlights, for experimentalists such as Grove, this correlation of forces was as important as a means of re-conceptualising industrial machinery as a productive entity in its own right as it was in legitimating his extensive use of demonstrative experiments in lectures. The displacement of human labour, potentially a threat to the authority of industrial managers, came to be assimilated via the concept of correlation into an ideology of harmonious worker-machine relations.[28] Yet conceptualisations of physiological (and especially 'nervous') force remain an under-acknowledged element in analyses of this industry-centred discourse.[29] Physiological claims relating to the nature of learning

25 Morus, I.R. *When Physics Became King* (Chicago and London: University of Chicago Press, 2005), pp. 71-85, 123-155; Smith, C. *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain* (London, 1998), pp. 1-14.

26 This is particularly clear in the philosophy of science advocated by William Whewell. On Whewell see Yeo, *Defining Science*.

27 On the aestheticization of machines outside of industrial settings within bourgeois German culture, and relations between this circumstance and German interpretations of correlation during the middle decades of the nineteenth century, see Norton Wise, M. 'Architectures for Steam', in Galison, P. and Thomson, E. *The Architecture of Science* (Mass; MIT Press, 1999), pp. 107-140. On aesthetics in relation to German energy research more generally, see Lenoir, *Instituting Science*, pp. 131-178.

28 Morus, I.R. 'Correlation and Control: William Robert Grove and the Construction of a New Philosophy of Scientific Reform', *Studies in the History and Philosophy of Science* 22 (1991), pp. 610-616. See also Ketabgian, 'Martineau, Mesmerism'; Smith and Norton Wise, *Energy and Empire*; Smith, *The Science of Energy*.

29 Of the numerous studies addressing British physiology during the middle decades of the nineteenth century, I have only been able to find detailed analysis of relations between nervous physiology and energy in Smith, 'Physiological Psychology', on pp. 131-193. Though see also Danziger, *Naming the Mind*, pp. 62-65; Musselman, *Nervous Conditions*. On the articulation of pathologies of nervous energy during the late nineteenth century see Gosling, F.G. *Before Freud: Neurasthesia and the American medical community* (Urbana; University of Illinois Press, 1987); Gijswijt, M. and Porter,

played an indispensable role in institutionalising the technical (ie. experimental) means by which the doctrine of correlation was coming to be established in physics and chemistry. This was primarily due to physiological psychologists' positioning of concepts relating to nervous and muscular action as critical to the effective conduct of pedagogy in universities and schools.

Before moving on to expand on and clarify these points, however, it is first necessary to examine the means by which notions of bodies as 'energetic' entities came to be established in British natural philosophic discourse in the first place. Physiological notions of the body as a site in which different kinds of 'power' were converted into each other relied for their construction on a linking of the chemical laboratory with sites of especially strenuous muscular endeavour.

Muscular labour and the physiological body

Perhaps the most immediate and obvious impetus to the 1867-8 committee on science instruction is presented by a report on the 1867 Paris 'Universal Exhibition' by the chemist, politician and agitator for educational reform Lyon Playfair. In May of that year, the then-chancellor of the University of London, Lord Granville, forwarded a letter to *The Times*, in which Playfair (who had both acted as an assistant in Thomas Graham's UCL laboratory and studied with the German bio-chemical pioneer Justus von Liebig during the 1830's)[30] sets out his main concerns. Principally, he is dissatisfied with what he portrays as the lack of innovation demonstrated by British representatives of industry in Paris, in comparison with other nations: 'I am sorry to say that, with very few exceptions, a singular accordance of opinion prevailed that our country had shown little inventiveness and made but little progress in the peaceful arts of industry since [the last major international exhibition, in] 1862.' He is also clear about his opinions as to the reasons for the comparatively rapid 'progress' made by other nations; 'the one

R. (eds.) *Cultures of Neuasthenia from Beard to the First World War* (Amsterdam and New York, 2001).

30 On Playfair see Hardy, A. 'Lyon Playfair and the Idea of Progress: Science and Medicine in Victorian Parliamentary Politics', *Clio Medica* 23 (1993), pp. 81-106.

cause upon which there was most unanimity of conviction is that France, Prussia, Austria, Belgium, and Switzerland possess good systems of industrial education for the masters and managers of factories and workshops, and that England possess none.'[31] Playfair calls for attention to be paid to the cultivation of technical innovation amongst British industrialists on the grounds of national necessity. That he frames this in terms of a need for 'industrial' education of managers might seem uncontroversial, until it is remembered that in Britain at this time education had been understood in terms of a specifically moral (rather than economic) discourse, consciously differentiated from question of economy or production.

'Scientific training' had not always enjoyed a privileged place in debates surrounding the perceived need for industrial expansion. As Barry Barnes and Steven Shapin have pointed out, during the first half of the nineteenth century, many British commentators were particularly anxious that natural philosophic investigation should not be associated with processes of production. The possibility that a practical, hand-centred knowledge embodied by artisanal skill might supplant a culturally 'higher' type of learning focused on linguistic dexterity (and presumed to be centred on the head) constituted a source of much concern for many early nineteenth-century pedagogues.[32] Daston and Galison also note this denigration of hand-centred learning as non-intellectual, and associate this trope with the emergence during the century of their 'mechanical' conception of observation.[33] Yet as will be elaborated below, Playfair, along with the physiological psychologists, challenged the assumption that thinking was something that occurred exclusively in the head, as well as the characterization of work as an inherently 'unthinking' activity undertaken by hands or machines. The context in which they did so was one in which places of experimentation were beginning to be though of as places of physical work, and vice versa.

As already noted, educational reform was not Playfair's only concern. As well as enjoying considerable eminence as a chemist, he was also an important focus for debates surrounding the government of health and (later) animal

31 All of the above quotes are from Granville, 'Industrial Education' *The Times*, Wed. May 29th, 1867, p. 5.

32 Barnes and Shapin, 'Head and Hand'

33 Daston and Galison, *Objectivity*, pp. 137-138.

experimentation.[34] Especially relevant to this chapter however is Playfair's interest in the correlation of forces - in particular, with the investigation of relations between the chemistry of food and muscular effort - and the ways in which this interest intersected with his efforts to associate industrial stagnation with what he considered to be the inappropriate priorities of British educational institutions.

Both German and British researchers became particularly concerned with calculating the transfer of energy from foodstuffs into bodies during the 1860s. Much controversy evident in these texts centres around questions regarding which of the substances present in and around muscle tissues are expended during bodily movement. Following Antoine Lavoisier, Liebig had suggested in 1842 that the power necessary for physical exertion was retained in the tissues of muscles, and released by tissues being broken down during the exertion of muscular effort. This led him to speculate that due to its preponderance in muscular fibres, protein must be the primary source of the body's motive power.[35]

During the 1860s, a number of studies challenged Liebig's muscular proposition. Utilising an analogy that had become widespread within energy research, chemical physiologists such as the Zurich-based physiologist Adolf Fick and chemist Johannes Wislicenus, and UCL's professor of chemistry Edward Frankland (who had studied with Playfair at the latter's laboratory in Westminster during the 1840s), argued that muscles were no more than machines for converting the heat energy latent in fat and starch into motion.[36] In Frankland's words: 'Like the piston and cylinder of the steam engine, the muscle itself is only a transformation of heat into motion; both are subject to wear and tear, and require renewal; but neither contributes in any important degree, by its own oxidization, to the actual production of the mechanical power.'[37] Almost identical analogical

34 On Playfair and the government of health see Hardy, 'Lyon Playfair and the Idea of Progress'. The politics of vivisection is discussed in more detail in the final chapter of this study.

35 Brock, *Justus von Liebig*, pp. 190-203.

36 Fick, A. and Wislicenus, J. 'On the Origin of Muscular Power', *Philosophical Magazine* [Fourth Series], Suppl. to 31 (1866), pp. 485-503. Frankland, E. 'On the Origin of Muscular Power', *Philosophical Magazine* [Fourth Series], 32 (1866), pp. 182-199. On Frankland see Russel, C.A. *Edward Frankland: Chemistry, Controversy, and Conspiracy in Victorian England* (New York; Cambridge University Press, 1996). See Brock, *Jutus von Liebig*, esp. pp. 183-214.

37 Frankland, 'On the Origin', p. 194.

language had been used by natural philosophers such as Grove in theoretical works on conservation and correlation.[38] However, whereas Grove derived a large part of his authority from 'performing' his experiments in reputable public arenas, physiological research along these lines relied to a lesser extent on theatrical means of persuasion. Physiologists expanded the category of 'laboratory' to include spaces associated with muscular labour, thereby re-categorizing physical work from something done by unthinking, labouring bodies (and that was thereby irrelevant to the life of the mind), to a source of knowledge in its own right.

Though reliant on chemical analysis for calculations of the energy content and convertibility of different foodstuffs, British studies of muscular energy place at least as much authorial emphasis on sites in which heavy muscular effort is carried out as they do on experimental apparatus.[39] One typical study - conducted by assistant physician at London's Brompton Hospital for Consumption, Edward Smith - proposes estimates of the amount of power required to maintain the body during the gruelling disciplinary exercises then required in almost all British prisons.[40] Calculating the minimum amount of food that would supply power for sessions on the treadmill and 'crank-labour' (the manual powering of heavy industrial equipment by turning a crank), Smith's publications call for the rationalisation of diets according to the nutritional value of foodstuffs, as defined by chemical analysis.[41] Others conducted similar studies. The Irish geologist and physiologist the Reverend Samuel Haughton produced calculations of the amount of energy expended during the 'shot-drill', in which prisoners had to lift and carry cannon-balls from location to location.[42] In 1865 Playfair, interpreting such

38 Morus, *When Physics Became King*, pp. 123-155.

39 On the background to this mode of investigation see Ashworth, W.J. 'England and the Machinery of Reason', in Morus, *Bodies/Machines*, pp. 39-65.

40 Smith, E. and Milner, W.R. *Report of the Action of Prison Diet and Discipline on the Bodily Functions of Prisoners.* [Part I.] (London, 1862), pp. 43-81.

41 Ibid. Smith, E. *Practical Dietary for Families, Schools, and the Labouring Classes* (London, 1864). See also Smith, E. 'On the Elimination of the Urea and Urinary Water, in Relation to the Period of the Day, Season, Exertion, Food, Prison Discipline, Weight of the Body, and other Influences Acting in the Cycle of the Year', *Philosophical Transaction of the Royal Society of London* 151 (1861), pp. 747-834.

42 Haughton, S. *Address on the Relation of Food to Work, and its Bearing on Medical Practice* (Dublin; University Press, 1868). See also LeConte, J. 'The Correlation of

research in terms of Liebig's protein-based conception of muscular action, added extensive calculations of the amount of power expended during military exercises to such prison-based studies.[43]

A corollary of these texts' concern with the transfer of power from one state to another is an underlying assumption that all kinds of manual work are equivalent, and therefore that studies of one kind of work can be applied to all others. Smith, for example, sought to extend his studies to encompass common occupations amongst the labouring poor.[44] Though Fick, Wislicenus and Frankland's study was conducted during a hike up the Faulhorn mountain in Switzerland, they claim to be investigating muscular work of all kinds.[45] Measuring work becomes a matter of calculating the inputs and outputs of chemical force into a system - calculations that could be (and were) understood as means of ensuring the efficient (or 'healthy') operation of bodies in relation to sites of any kind of labour.

As related to non-nervous physiology, the doctrine of correlation constituted the theoretical component of a discourse that sought to calculate the minimum foodstuffs necessary for different kinds of labour by measuring flows of substances into and out of the body. Reliant on overtly 'disciplinary' spaces such as barracks and prisons, it linked the study of ‘muscular’, ‘economic’ activity to the practices of the chemical laboratory. Yet such links alone did not establish that experimentation in laboratories was necessarily 'useful' or advantageous to the cultivation of industry (let alone of individuals likely to contribute to industrial progress). It was only with the development, via physiological psychology, of notions of learning as a work-like activity that experimentation and the spaces devoted to it came to be seen as critical to national economic success.

Physical, Chemical, and Vital Force, and the Conservation of Force in Vital Phenomena', *Philosophical Magazine* [Fourth Series] 19 (1860), pp. 133-148.

43 Playfair, L. *On the food of Man in Relation to His Useful Work* (Edinburgh, 1865).

44 Smith, *Practical Dietary for Families*.

45 Fick and Wislicensus, 'On the Origin of Muscular Power'. On the historical place of mountains in scientific culture see *Science in Context* 22 (3) (2009). On the Faulhorn in the nineteenth century see Aubin, D. 'The Hotel that became an Observatory: Mount Faulhorn as Singularity, Microcosm and Macro-Tool', *idem*, pp. 365-386.

Nervous power and intellectual labour

Carpenter's 1850 publication in the *Philosophical Transactions* places at least as much emphasis on a rather different set of relations between bodily processes and non-somatic nature than had those texts concerned with the transfer of energy from foodstuffs into work. The paper is indeed partly concerned with analysing what it refers to as 'vital power' in terms of the ways in which cells convert chemical power into organic matter and heat,[46] but it also articulates a conception of another, separate force, associated with nerves alone:

> in animals we find an additional power, termed Nervous Agency, nothing analogous to which exists in plants; this power, related on the one hand to the conscious mind, to which it communicates impressions derived from the external world, is also related, in a very remarkable manner, to the vital endowments of the organism in general, as will be presently seen, and particularly to the contractile tissues; the most perfect form of which (the striated muscular fibre) is usually called into action through its instrumentality, in obedience to mental impulses.[47]

It then goes on to assert the agency of nervous action in the process of cell production and growth, and the mutual convertibility between nervous and electrical force.[48] Citing the work of Humphrey Davy, Michael Faraday, and especially the Italian nervous physiologist Carlo Matteucci on the production of shocks by 'electric fishes', it draws a strong contrast between the mode of nervous action and that of other bodily or physical processes. This notion of the presence within the body of two distinct forces became a key means by which mind would begin to be conceived of as a 'labouring' entity.

Playfair had been campaigning for what he termed 'industrial instruction'

46 Carpenter, 'On the Correlation,' pp. 733, 737, 741 and 751-2.

47 Ibid. p. 736

48 Ibid. pp. 740-744.

long before his report of 1867. Granville's aforementioned letter printed in *The Times* of 1867 refers its readers to a tract of Playfair's (entitled *Industrial Instruction on the Continent*), published fourteen years previously. This tract compares Continental with British exhibits at the Great Exhibition of 1851.[49] Like the *Times* letter, it articulates Playfair's perception of a need for greater investment in education as a means of competing with other industrialising nations. Significantly, it elaborates on this theme by distinguishing between different types of bodily labour:

> Labour... is of two kinds - corporeal and mental, or, as Mill calls it - muscular and nervous... The fact is every day more apparent, that mere muscular labour, in the present state of the world, is little better than raw material, and that both are sinking in value as elements of production, while nervous or intellectual labour is constantly rising. The whole of industrial competition is now resolved into a struggle to obtain a maximum effect by a minimum expenditure of power. But this power is derived from natural forces, and not from brute strength: mental labour has engrafted itself upon muscular effort, and, by a healthy growth, has reduced the size and relative force of the latter.[50]

From enjoying a status as an ideal means of producing and maintaining

49 Granville, 'Industruial Education'; Playfair, L. *Industrial Instruction on the Continent: being the introductory lecture of the session 1852-1853* [Royal School of Mines] (London, 1852).

50 Playfair, *Industrial Instruction on the Continent*, p. 5. See also Playfair, L. S*cience in its Relations to Labour: Being a Speech Delivered at the anniversary of the People's College, Sheffield, on the 25th October, 1853* (London, 1853). By 1853, Playfair had already sought to articulate a need for investment in 'scientific' instruction as a means of encouraging competition, but did not do so in terms of a 'force'-based naturalism. See Playfair, L. 'The Study of Abstract Science Essential to the Progress of Industry, Being the Introductory Lecture at the Government School of Mines, in 1851', in anon, (ed.) *Literary Addresses, Delivered at Various Popular Institutions* [Second Series] (London and Glasgow, 1855), pp. 47-86, and Playfair, L. 'The Chemical Principles Involved in the Manufactures of the Exhibition as Indicating the Necessity of Industrial Instruction', in *Lectures on the Results of the Great Exhibition of 1851, Delivered Before the Society of Arts, Manufactures and Commerce* [Vol. I] (London, 1852), pp. 159-208. In so doing, he was echoing an earlier statement by James Martineau. See Berg, *The Machinery Question*, pp. 155-158.

gentlemanly conduct (as described by Barnes and Shapin),[51] knowledge, embodied in mental labour (ie. the nervous system), becomes in Playfair and Carpenter's texts a pragmatic means of ensuring national competitive advantage.

But it was only by the late 1860s that such a re-evaluation appears to have begun to have any discernible effect on government legislation. The invigoration between 1850 and 1870 of physiological conceptions of the nature of learning appeared to substantiate Playfair's contentions, enabling him to cite his earlier work as a prescient diagnosis of the perceived failure at the Paris Exhibition in 1867. The articulation of physiological psychologies thereby constituted a critical aspect of a broader re-evaluation of the cultural status of practical investigation as an intellectually significant (and hence desirable) form of educative practice during the period.

During the 1850's and 1860's, psychologies seeking to connect conceptions of mind and body invariably incorporated some notion of force or power. As well as Carpenter, such physiological psychologists as Thomas Laycock, Alexander Bain, Herbert Spencer, Henry Maudsley and John Daniel Morell all published statements addressing relations between mind and force during this period.[52] Differences regarding the nature of force constitute an important point of departure for analysing the differing theological and philosophical emphases of physiological psychologists' claims.[53] Of particular interest for the purposes of this chapter, however, are points of common ground between them regarding a practice-oriented, inherently developmental conception of the nature of learning. Mid-to-late nineteenth-century physiological texts' discussion of notions of force or power generally signify their adoption of a distinctly dynamic conception of bodily activity.[54] Physiological psychologists express this dynamism in terms of a relation between nervous and non-nervous elements of individual bodies as they develop

51 Barnes and Shapin, 'Head and Hand', pp. 231-240.

52 Laycock, T. *Mind and Brain: or, the correlations of consciousness and organization* [Vol. II] (Edinburgh, 1860), pp. 250-269; Spencer, H. *First Principles* [2nd ed.] (London, 1867), pp. 185-221; Maudsley, H. *The Physiology and Pathology of the Mind* (London, 1867), esp. pp. 38-42, 60, 169-179; Morell, J.D. *An Introduction to Mental Philosophy on the Inductive Method* (London, 1862), pp. 36-63. Bain's statements on force are examined in detail below.

53 Smith, 'Physiological Psychology', esp. pp. 131-135.

54 Rabinbach, *The Human Motor*, pp. 1-4.

over time.

Nearly all physiological psychological conceptions of the nature of nervous activity characterise it as intimately connected to the operation of bodies as individual wholes. The concern of Laycock's texts with the representation of simple organic molecules as the principal condition of possibility for the emergence of purposive behaviour is addressed in chapter two of this thesis. Other authors placed similar emphasis on the importance of non-nervous life in the analysis of mind. Perhaps the most widely read physiological psychological text during the nineteenth century, Spencer's *Principles of Psychology* (1855), interprets the psyche as emergent from a natural resistance between organic and non-organic entities. All forms of life must struggle against the deleterious effects of non-organic forces, a circumstance which favours the evolution of nerves as means of responding to and interpreting the rest of nature.[55] Indeed, in Spencer, the perception of force in nature is portrayed as originating in precisely this experience of resistance.[56] Similarly, Alexander Bain's then-influential associationist physiological psychology portrays what it terms the manifestation of bodily 'energy' as constituting a critical condition for the emergence of human perception.[57] Because many of Bain's texts place particular emphasis on what they portray as the implications of physiological conceptions of psyche for pedagogical practice, it is necessary to examine them in some detail.

Alexander Bain and the work of perception

As in Spencer's evolutionary philosophy, Bain's texts articulate a more avowedly developmental conception of physiology and psychology than do

55 Spencer, H. *The Principles of Psychology* (London, 1855), pp. 339-490. See Young, *Mind, Brain and Adaptation*, pp. 150-196.

56 Spencer, *First Principles*, pp. 158-171. This and the following paragraphs are especially indebted to Smith, 'Physiological Psychology', pp. 131-193.

57 Bain, *The Senses and Intellect*, p. vii. On Bain see Young, *Mind, Brain and Adaptation*, pp. 101-133; Smith, 'Physiological Psychology', pp. 160-193; Flesher, M.M. 'Human Nature Surpassing Itself: An Intellectual Biography of the Early Life and Work of Alexander Bain (1818-1903)' (unpublished PhD thesis, Lehigh University, 1986).

Laycock's. Rather than emphasise an analogy between the nature and development of cells and that of larger bodies, Bain's statements regarding physiology foreground an emergence of psychological categories during post-natal human bodily growth and interaction with the wider world.[58]

In addition, and despite their emphasis on the role of non-nervous elements of bodies in the production of nervous states (on which see below), Bain's texts follow much contemporary British physiology in treating nervous activity as an object of study apart from bodily physiology more generally. The principal authors Bain draws from for his physiology include Lorenz Oken, the principal advocate of 'Okenian' natural philosophy in Britain, Richard Owen, and, in particular, the Berlin physiologist Johannes Müller.[59] Expressing both anatomical and experimental strands of physiology, publications attributed to these authors had tended to address bodily systems as distinct, largely independent entities. As such, they had isolated elemental systems such as (for example) the 'skeletal', 'digestive' and 'nervous' parts of the zoological body, and characterised each as operationally independent from the others.

The notion of a correlation of nervous, organic and other physical forces presents Bain with the linguistic means of obviating these distinctions between nerves and other parts of the body. Bain's first book-length publication on psychology, *The Senses and the Intellect* (1853), adopts Carpenter's distinction of nervous from physiological force more generally:

> The nerve force that is derived from the waste of a given amount of food, is capable of being transmuted into any other form of animal life. Poured into muscles during violent conscious effort, it increases their activity; passing to the alimentary canal, it aids in the force of digestion; at other points it is converted into sensible heat; while the same power is found capable of yielding true electrical currents. The evidence that establishes the common basis of mechanical and

58 Flesher, 'Human Nature Surpassing Itself', pp. 215-244.

59 Young, *Mind, Brain and Adaptation*, pp. 114-121. Flesher, 'Human Nature Surpassing Itself', pp. 184-196. On Owen see Rupke, *Richard* Owen. On Müller's research on nervous physiology see Lohff, B. 'Facts and Philosophy in Neurophysiology. The 200th Anniversary of Johannes Müller (1801-1858)', *Journal of the History of the Neurosciences* 10 (2001), pp. 277-292.

> chemical force, heat, and electricity, namely, their mutual convertibility and common origin, establishes the nerve force as a member of the same group.[60]

Indeed, recognition of the transfer of force within the body

> leads to a considerable departure from the ancient mode of viewing the brain as the organ of mind... The organ of mind is not the brain itself: it is the brain, nerves, muscles, organs of sense and viscera. When the brain is in action there is some transmission of nerve power, and the organ that receives, or that originated, the power, is an essential part of the circle of the mechanism.[61]

The presence of two nominally distinct organs - the brain and the muscles - between which force is transmitted, implies that neither can be understood as able to determine the actions of the other.

The combination of muscular with cerebral force thereby becomes a fundamental category of psychological existence in Bain's texts. For example, it constitutes the grounds upon which Bain challenges a then-predominant conception amongst sensationalist philosophers of perception as a 'passive' assimilation of extra-bodily reality by the mind. Writers living during the 1850s could potentially access a wide variety of texts challenging the sensationalist assumption that perception of a world external to the individual body relies on the passive reception of sense impressions. For example, philosophers such as George Berkeley (1685-1753) and Thomas Brown (1778-1820) had emphasised the importance of mental activity in the production of sensation.[62] Their philosophies claim that in order to operate, sense organs need to be manipulated by muscles directed by an individuals' mind. In so doing, they claim, the activity of mind is implicated in all

60 Bain, *The Senses and the Intellect* (London, 1864 [1855]), pp. 65-66.

61 Ibid. See also Bain, A. 'On the Correlation of Force in its Bearing on Mind', *Macmillan's Magazine* 16 (1867), pp. 372-383.

62 For a brief survey of this 'muscle sense' in eighteenth- and nineteenth-century philosophy see Smith, 'Physiological Psychology', pp. 135-160.

sensations - perception is an inherently ideal or 'mindful' phenomenon.[63] Bain's texts naturalise such idealistic conclusions by locating the origins of perceptive activity not in an incorporeal 'mind,' but rather in the energetic interaction of muscles and nerves.

For Bain, the movement of muscles does not simply involve the brain acting on the body; the action of movement is itself productive of nervous activity. Hence force is transmitted into as well as out of the brain during bodily movement. In its (re)active effects on the brain, muscular activity is accompanied by a category of sensation entirely distinct from sight, smell, hearing, taste or touch, which Bain terms 'muscle sense'.

As muscles are involved in the operation all of the conventional five senses for Bain, 'muscle sense' constitutes a more fundamental condition for perception than any other. The constant interaction between nervous and other forces is manifest as initially undirected or 'spontaneous' action in the bodies of infants. As *The Senses and the Intellect* claims:

> I have thought proper to assign to Movement and the feelings of Movement a position preceding the Sensations of the senses; and I have endeavoured to prove that the exercise of active energy, originating in purely internal impulses, independent of the stimulus produced by outward impressions, is a primary fact of our constitution.[64]

Such a claim is repeated in relation to a presumed need for muscles to expend energy in the subsequent *The Emotions and the Will* (1859):

> experience proves that the active tone and tension of the moving members is never entirely at a stand while life remains; not in rest, nor in sleep, nor in the most profound sensibility that ever overtakes us. We must recognise central energy or activity as a fundamental and

63 For a recent interpretation of Berkeley's philosophy see Arsiç, B. *The Passive Eye: Gaze and Subjectivity in Berkeley (via Beckett)* (Sanford, CA. Stanford University Press, 2003). On Grove's use of Brown see Morus, 'Correlation and Control', pp. 598-606.

64 Bain, *The Senses and Intellect*, p. vii.

> permanent property of the system; and this being once shown to exist, we are at liberty to suppose that it may show itself in a variety of ways.[65]

As infants develop, they begin to control the spontaneous actions engendered by the release of energy by associating some of those actions with specific sensations (see below). Will (and with it moral sense) emerges out of a natural interaction between individual bodies' tendency to expend energy, and the environments in which they act.[66] Bain's texts thereby claim that the manifestation of force in the physiology of individual bodies constitutes a fundamental basis for and origin of human culture and understanding.

Bain's neuro-muscular epistemology

It is notable that Bain did not practice experimental physiology personally, preferring instead to concentrate on writing, fulfilling his duties as professor of Logic at the University of Aberdeen (from 1860), and teaching English. Bain's pedagogic articles articulate a critical stance on what they portray as debatable assumptions regarding the place of linguistic instruction in English culture. Specifically, they attack the then-prevalent notion that the learning of grammatical rules should be valued as means of instilling disciplined reason in students.[67] For Bain, the educational utility of grammar can only be considered in relation to its function in assisting in composition. His texts portray the production of compositional - not rational - ability as the appropriate end of linguistic

65 Bain, A. *The Emotions and the Will* (London, 1859), p. 329.

66 Ibid. pp. 327-567. Flesher, 'Human Nature Surpassing Itself', pp. 245-273.

67 Bain, A. 'English University Education', *Westminster Review* 49 (1848), pp. 441-463; Bain, A. 'The Retentive Power of the Mind in its Bearing on Education' *Fortnightly Review* [New Series] 21 (1868) pp. 237-249; Bain, A. 'On Teaching English', *Fortnightly Review* [New Series] 26 (1869), pp. 200-214. On Bain's continuing commitment to the production of a science of education, see Bain, A. *Society for the Development of the Science of Education: Second Presidential Address of the Society* (London, 1879). On grammar in science pedagogy see Barnes and Shapin, ‘Head and Hand’. On Bain's relation to literary studies, see Dames, *The Physiology of the Novel*, esp. pp. 47-70.

instruction.[68] Potential motivations for such assertions seem obvious from Bain's complaint that the 'dead languages have yet such a hold of the [academic] ground that only a mere corner can be got for our living tongue.'[69] Yet the assertion that classical grammar is not particularly useful in the cultivation of reason also contained broader implications - not least that instruction in classical languages might be supplanted by instruction in practice- rather than language-oriented activities (such as those utilized in experimental science). Bodily, or 'hand'-centred learning, for Bain, could occur without constituting a threat to the cultivation of rationality amongst the population as a whole. Indeed, to neglect the centrality of muscular effort in intellectual activity would itself constitute an abandonment of the scientific project of national economic and cultural progress.

Historians have highlighted the above-described ways in which Bain's texts constituted a conception of psychology as inherently physiological.[70] Less attention has however been paid to what these texts portray as the implications that such commitments to the embodiment of psyche had for the conduct of pedagogy.[71] For Bain, adequate recognition of the physiological nature of mind had to include a re-assessment of the nature of learning. In its elevation of the release of muscular energy to the status of a condition of possibility for the emergence of perception, Bain's psychology constituted a fundamental re-assessment of the cultural importance of hand-centred learning.

Bain's psychology classifies consciousness into three primary groups; 'discrimination', or the awareness of difference; 'similarity', or the awareness of identity; and (most importantly for its conception of human learning) 'retentiveness.' This latter category 'sums up all that we should understand by memory, acquisition, education, habit, [and] learning by experience'.[72] Indeed, 'retentiveness' is assigned a fundamental place *vis a vis* the other two categories, as

68 Bain, 'On Teaching English', esp. pp. 201-204 and 206-207.

69 Ibid. p. 214.

70 Rylance, *Victorian Psychology*, pp. 150-202 and Young, *Mind, Brain and Adaptation*, pp. 101-133.

71 Though see Flesher, 'Human Nature Surpassing Itself', pp. 274-291 for an account of the place of 'habit' in Bain's psychology of learning.

72 Bain, *The Senses and the Intellect*, p. 5.

'we could not discriminate two successive impressions, if the first did not persist mentally to be contrasted with the second; and we could not identify a present feeling with one that had left no trace in our framework.'[73] In accordance with their general emphasis on dynamic modes of causality, Bain's texts portray conceptions of similarity and difference as arising in the physiology of the nervous system in conjunction with the emergence of an individual's sense of temporal change.

Physiological conceptions of memory had been articulated before the publication of Bain's *Senses and the Intellect*. For example, the fourth edition of Carpenter's *Human Physiology* (1853) suggests that the repetition of mental and physical exercises have physiological effects. According to this text, by going over the same thoughts or actions again and again, specific nerve-paths are built up in the brain. In this way actions or thoughts are eventually conducted via 'unconscious cerebration' (ie. without a feeling of conscious effort).[74] Learners thereby subsume abilities into the non-conscious parts of their nervous system. Actions such as walking might thereby become 'automatic', enabling the conscious elements of mind to attend to other things whilst they are being carried out.[75]

Nevertheless, Bain's texts constitute the first detailed articulation of the explanatory power of such a conception of nervous training.[76] Specifically, they draw a close correlation between the repetition of specific bodily movements and nervous growth. As already noted, the spontaneous release of energy within the body constitutes the principal precondition for cognition in Bain's psychology. This state of undirected action presents Bain with the problem of how to explain the progression from such an initial state to one in which bodily actions become organised into apparently intentional acts. Such a question is resolved through recourse to iteration as a means of elevating certain bodily movements over others:

> spontaneous movements are without doubt confirmed by repetition, and thereby made to recur more readily in the future. Any movement

73 Ibid.

74 Carpenter, *Principles of Human Physiology,* [4th Ed.] (London, 1853), pp. 741-743, 783-784.

75 Ibid.

76 Flesher, 'Human Nature Surpassing Itself', pp. 274-291.

> struck out by central energy leaves as it were a track behind, and a less amount of nervous impulse will be required to set it on a second time... The iteration of all these various movements does not make them voluntary movements in the proper sense of the expression; but it prepares them for becoming such by a future and distinct acquisition.[77]

The iteration of movements, through its production of 'tracks' in the brain, constitutes one crucial condition of possibility for the emergence of consciousness. Though this text is concerned to differentiate 'repetitive' from 'voluntary' actions, it seems clear that such a schema called distinctions between the two into question.[78] For present purposes, it is enough to note the emphasis on the repetition of specific muscular actions that accompanies this conception of learning.

Memory is made contingent on the development of the corporeal frame: 'Actions, Sensations, and States of Feeling tend to grow together, or cohere in such a way that when any one of them is afterwards presented to the mind, the others are apt to be brought up in idea.'[79] The recollection of groups of sensations and feelings had been a (if not the) prominent trope in association psychology more generally.[80] In their re-consideration of sensation and feeling as bodily states, Bain's texts emphasise a third element - corporeal movement - by which the processes that associationists assume to constitute 'elements' of mind become co-joined. Bodily movements thereby gain a new status in discourse surrounding the nature of learning. If, prior to Bain, much anglophone psychology had been especially concerned with the means by which ideas became associated, the question of the role of bodily movement in such a process does not appear to have been emphasised previously.

As Bain's articles demonstrate, the implications of his claims were profound

77 Bain, *The Senses and the Intellect*, p. 334.

78 See Smith, R. *Inhibition: History and Meaning in the Sciences of Mind and Brain* (London, 1992). Leys, R. 'Mead's Voices: Imitation as Foundation, or, the Struggle Against Mimesis' *Critical Enquiry* 19 (1993), pp. 277-307.

79 Bain, *The Senses and the Intellect*, p. 332.

80 See eg. Hume, D. *A Treatise of Human Nature* (London, 1985 [1739-1740]), pp. 56-73.

as far as educational practice was concerned. An 1848 piece by him in the *Westminster Review* criticising 'English University Education', presents a fairly typical example. Comparing the pedagogic efficacy of mathematics and chemistry, it portrays the practical bent of the latter in a favourable light:

> in chemistry... there is a discipline more than merely mathematical. The laboratory operations of testing and analysis, in which every blunder recoil upon the operator, and where his knowledge, ingenuity and watchfulness are incessantly on the stretch, may be strongly recommended as a disciplining of the reasoning and judging faculties; and in many instances it would probably be the best training that could be chosen [for cultivating the reason].[81]

This elevation of the place of practice in learning is expanded in a later article in the *Fortnightly Review*. As in the above quote, the effectiveness of practice-oriented, 'concrete branches' of natural science for the conduct of learning are emphasised over more abstract studies.[82] In addition, linguistic instruction is conceived of as most effectively conducted through the vocal cords and ear-drum as much as in the brain (or 'head'):

> Language, like mechanical skill, is distributed between active organs and senses, there being, in the first instance, the voice and the ear; written language introducing the hand and the eye. Great aptitude for vocal utterance, or speech proper, is founded partly on the activity, flexibility, and graduated exertion of the muscles of the voice and of the mouth, and, for the largest part, on the delicacy of the ear.[83]

As already stressed, Bain's psychology seemed to imply a necessity for a broad re-

81 Bain, A. 'English University Education', p. 455. The conduct of mathematical education at Cambridge was also undergoing significant changes at this time. See Warwick, A. *Masters of Theory: Cambridge and the rise of mathematical physics* (University of Chicago Press, 2003).

82 Bain, A. 'The Retentive Power of the Mind', pp. 243-247.

83 Ibid. p. 245.

orientation of pedagogic practice around a conception of bodily action as the principal means of mental cultivation.

The final point that is important to note regarding Bain's conception of pedagogy is the extent to which he employs the notion of the transference of power as a limiting factor in the conduct of learning. Given that (Bain supposes) mind is a physiological phenomenon, then the correlation of forces must apply to mental acts. Hence the ability to learn becomes contingent on the amount of energy possessed by the organic system. Learning capacity is limited not by the 'willingness' of pupils conceived in the abstract, but by their bodily functionality. The most direct implications of this for pedagogic practice (as characterised by Bain) relate to the need to alternate learning activities:

> If a pupil has sat four or five hours intently studying mathematics, he can have little power left for any subject. But after a limited time devoted to one thing, the mind can turn with a certain freshness to another thing, so far different as to strike into new avenues of the brain. This is a pleasure, and not a burden. From mathematics one can pass to language, then to music, and thence to bodily manual discipline.[84]

Bain's re-casting of mental processes as manifestations of bodily activity presents cognitive activity as a process that can and should be maximized according to the potential energy present in the corporeal system. He thereby articulates a work-based, practice-oriented conception of mental cultivation, in which manual labour, mathematical calculation and experimental skill become different, equivalent expressions of bodies' conversion of latent energy into work.

Neuro-muscular learning

Though Bain's texts articulate the most intellectually thorough link between physiological conception of mind and pedagogy of this period, others emphasised

84 Bain, 'The Retentive Power of the Mind', p. 242.

similarly 'physiological' conceptions of ideal pedagogic conduct. The Swiss pedagogue Johann Heinrich Pestalozzi (1746-1827) had advocated a 'natural' mode of teaching closely informed by his understanding of physiological development some time before the physiological psychologists emerged in Britain. Early advocates of experimental discipline in Prussia had appropriated his concept of learning as a combination of personal observation and mental activity, or *Anschauung*.[85] In British interpretations of the so-called 'Pestalozzian system', lessons were conducted around 'natural' objects rather than texts. This mode of teaching was understood as a means of allowing children (in formal pedagogic contexts, boys) to develop 'according to their nature', and became particularly prevalent in homes and elementary schools during the 1830's and 1840's.[86]

Spencer's widely-read *Education: Intellectual, Moral and Physical* (1861) presents a critique of the Pestalozzian system on the grounds that its naturalism, whilst welcome, does not go far enough. Instead of teachers acting as mediators of the significance of objects, Spencer claims, students should be encouraged to investigate such objects for themselves, without supervision.[87] Such independently conducted object-lessons should also be extended beyond early childhood:

> They should not be limited to the contents of the house; but should include those of the fields and the hedges, the quarry and the sea-shore. They should not cease with early child-hood; but should be so kept up during youth, as insensibly to merge into the investigations of the naturalist and the man of science.[88]

85 Coleman 'Prussian Pedagogy', and Kremer, 'Building Institutes for Physiology', pp. 94-100. Significantly, Kremer emphasises that Pestalozzian justifications for experimental discipline did not accompany attempts to link laboratory practices with the cultivation of industry. Kremer, *Idem*, pp. 100-109.

86 Keene, M. 'Object Lessons: Sensory Science Education 1830-1870' (unpublished PhD thesis, University of Cambridge, 2008); Layton, D. *Science for the People: The Origins of the School Science Curriculum in England* (London, 1973),esp. pp. 23-34. See also Barnes and Shapin, 'Head and Hand', pp. 240-245.

87 Spencer, H. *Education: Intellectual, Moral, and Physical* (London and Edinburgh, 1888 [1861]), pp. 69-70.

88 Ibid. p. 76.

Learning would thereby be made consonant with Spencer's conception of the nature of man's historic evolution, in which development from simple to complex physiology is paralleled by an analogous progression from empirical to theoretical knowledge.[89] Similar sentiments are expressed in an article by the principal advocate of Spencer's philosophy in North America, Edward Youmans, in a London-published collection of writing on 'scientific education'.[90] For these figures, the superiority of practice-based approaches to intellectual discipline implies that the learning of knowledge related to a primarily 'external' nature will become the principal (and in time even the only significant) mode of learning.

Nor is such discourse confined to avowedly physiological writing of this time. The grammar school Master and advocate of teacher training Robert Hebert Quick's *Essays on Educational Reformers* (1868) presents a critique of what it portrays as school-teachers' over-reliance on book-centred instruction:

> Not recognising the truth that the function of books is supplementary... teachers are eager to give second-hand facts in place of first-hand facts. Not perceiving the enormous value of that spontaneous education which goes on in early years, not perceiving that a child's restless observation, instead of being ignored or checked, should be diligently ministered to and made as accurate and complete as possible, they insist on occupying its eyes and thoughts with things that are, for the time being, incomprehensible and repugnant.[91]

Quick's comparatively conservative work remains sceptical about Spencer's elevation of 'science' as a discipline to be valued above all others, insisting on the independence of the teaching of business and the arts. Hence the above quote is intended to apply to all modes of pedagogy.[92] Such passages indicate the broad

89 Ibid. Eg. pp. 89-90.

90 Youmans, E.L. 'Observations on the Scientific Study of Human Nature: a lecture delivered before the London College of Preceptors', in Youmans, E.L. (ed.) *Modern Culture. Its True Aims and Requirements: A Series of Addresses and Arguments on the Claims of Scientific Education* (London, 1867), pp. 320-361.

91 Quick, R.H. *Essays on Educational Reformers* (London, 1868), pp. 249-250. On Quick see DNB

92 Ibid. pp. 229-245.

rhetorical reach that physiological conceptions of childrens' 'natural' spontaneity enjoyed during the 1860s.

By the late 1860s, a considerable body of writing on relations between the conduct of pedagogy and the physiological mind had appeared. Such writing presents learning as an inherently practical, movement-centred activity, to be conducted via individual students' interaction with 'nature', rather than passed down from teacher to pupil. Of course, as the first two chapters of this thesis make clear, such interaction was never (and could never have been) entirely unmediated. In insisting that individuals discover nature 'for themselves', physiological psychologists implicitly invested those objects or tools presumed to grant investigators access to natural truth with the power to discipline and instruct.

Work, intellect and the privileging of experiment

It is no coincidence that physiological psychologists played an active role in promotion of experimental science in British universities and schools. Their conception of mind was predicated on a notion of bodily activity as critical to the assimilation of knowledge. Experiment, as a hand-centred, highly ‘skillful’ practice, became an ideal mode of pedagogic conduct in many physiological texts. The rest of this chapter is devoted to the ways in which the physiological emphasis on bodily skill came to be adopted by experimental practitioners and lobbyists alike in their calls for the reformulation of learning. Laboratories, as sites in which bodies could be instructed in practical skills, came to be understood as critical to Britain’s future industrial success.

As far as giving evidence during government enquiries is concerned, Carpenter was amongst the most active of the various proponents of physiological notions regarding education. As well as being an important instigator of the move to constitute a faculty devoted exclusively to physical science at UCL, he acted as a key witness to the 1867-1868 committee on ‘Instruction in Theoretical and Applied Science'. His evidence to the committee draws heavily on the tropes regarding learning that were being articulated by Bain and others. For example, he emphasises the particular malleability of young students, and especially the

potential harm that then-prevailing conceptions of appropriate pedagogic conduct might do to them. Asked of his opinion on 'the bearing of elementary education on subsequent scientific education', he is recorded as having stated himself to hold a 'very strong opinion on the subject': The 'power of apprehending scientific facts', he claims, is 'more easily brought out' in children than it is in those whose faculties 'are left undeveloped, or even repressed, by ordinary systems of culture.'[93]

Carpenter's testimony emphasises two key points; that it is easier to harness the spontaneous energy of (male) children than adults; and that the best means of achieving this to be by encouraging participation in practice-oriented lessons. Asked which scientific subjects should be taught at 'the general preparatory schools to which our middle classes go', Carpenter considers 'the elements of natural philosophy, and, where practical in the country... botany' to be appropriate, commenting that 'I quite agree with those who consider that all these studies should be as practical as possible, and should be that which a pupil can acquaint himself with, objectively or tangibly.'[94]

He also claimed that a too-exclusive emphasis on text-based study had engendered problems at the university level as well as in early education - the alleviation of which would benefit learning in general. Responding to a question suggesting that the introduction of scientific instruction in schools might potentially have negative effects of on students' literary studies, Carpenter suggests that

> an hour a week is quite sufficient to impart this scientific knowledge. It is a change for them, bringing their minds into contact with external realities; and all our experience points to the fact that those who have really tried the system find that it acts by quickening the intellect and enabling it to move with greater energy.[95]

This statement is clearly reminiscent of Bain's comments regarding the possibility of maximizing intellectual endeavour through the alternation of different types of

93 Ibid. p. 107.

94 Ibid. p. 109.

95 Ibid. pp.

pedagogic activity. Connecting students' minds with 'external realities' through practical instruction would increase rather than diminish their capacity to learn other subjects.

Carpenter emphasises the rational efficacy of practice-oriented modes of instruction, portraying them as equivalent if not superior to text-centred modes of instruction. Asked whether the principal purpose of introducing object lessons in schools would be to train observation, he responds:

> Yes, and to train the mind in reasoning upon facts observed. In the case of natural history it is scientific classification and learning to estimate the value of characteristics which would be specially taught; the mode of determining the value of plants, or animals, or fossils, according to their special characters. On the other hand in experimental science it is reasoning with regard to the application of principles on which I should lay stress.[96]

For Carpenter, as with Spencer, a movement from object interrogation to experimental practice would encourage a parallel movement from narrowly empirical study of nature to a more theoretical inculcation of natural principles.

Given the physiological conceptions of learning related above, it might be seem unsurprising that Carpenter would advocate to the committee an educational policy conceived around objects and experimentation rather than text. Yet the broader persuasive efficacy of such claims rested on the linking of practice-oriented learning with industrial success. Playfair had outlined his principal concern at the start of the enquiry; that a lack of resources for 'practical' teaching in science was at the heart of a perceived lack of industrial momentum amongst British manufacturers:

> Although the great improvements in iron making have chiefly arisen in this country, we have far from exhausted the economy which science offers to the art.... I believe that there is cheaper production abroad in many cases, only from the science that is applied to it,

96 Ibid. pp. 111-112.

> where there is also a diminished cost of labour, which partly arises from the intelligence used in the application of that labour.[97]

Carpenter's evidence fully accords with this view. A presumed need for more 'scientific' knowledge in the so-called 'Bessemer' process (a then-new mode of steel manufacture) presents a commonly utilised example in witness statements, including his own:

> Take the manufacture of implements on the old method, it is mere rule-of-thumb work; of course, for the manufacturers of Bessemer's steel a very much higher scientific knowledge is necessary to carry it out thoroughly and effectively. It has always struck me that where the mere rule-of-thumb method constitutes the staple of the work, there is a less demand for intelligence.[98]

'Intelligence', as a manifestation of physiological force in the nervous system, had been as fully incorporated into the liberal economy of supply and demand as any other form of bodily labour.

Of course, the re-conceptualisation of 'intellect' in terms of economic capacity was not the only condition of possibility for the legitimation of governmental investment in pedagogy-oriented laboratories. Other factors should be recognised as important in the adoption and implementation from 1870 of many of the recommendations of the report. These include a resurgent regionalism centred around sites of urban and industrial expansion, coupled with anxieties surrounding the potential consequences of the extension of suffrage in 1867, as well as a growing interest in the 'Humboldtian' ideal of a liberal education (forcefully expressed in Mathew Arnold's *Culture and Anarchy* (1869)).[99] But such

97 Ibid. p. 58.

98 Ibid. p. 113. On the significance of a rhetoric of precision in the introduction of experimental discipline see Gooday, 'Precision Measurement'. Schaffer, 'Late Victorian Metrology' addresses relations between precision measurement and the 'industrialisation' of knowledge-practices.

99 Anderson, *European Universities*, 193-194, 199-203. On regional and inter-urban rivalries and debates surrounding the theological significance of correlation see Smith, *The Science of Energy*, esp. pp. 170-191. On the perceived threat of suffrage extension, see Stephens, *Education in Britain*, pp. 80-81. On relations between Humboldt's concept

factors do not explain the new legislative focus - as manifest in the constitution of the Department of Science and Art in order that government might foster working-class skill - on experiment-centred education as a means of cultivating a population of middle-class men suited to the specificities of industrial life.[100] It seems unlikely that fears surrounding the 'hand'-centred disciplining of Britain's potential 'proprietors and managers' could have been overlooked without the above-described incorporation of conceptions of learning into physiological life, grounded in the maximization of individual bodies' potential in labour.

Physiological-experimental discipline

Perhaps unsurprisingly, the shift from an ideal of pedagogy based around the role of the teacher to one focusing on the inculcation of skilled bodily action on the part of the taught is most evident in the publications of those experimental scientists of the time most closely involved in pedagogic training. By the late 1860's, the newly instigated government Department of Science and Art was searching for institutions that might be employed in training a new generation of school-teachers in principles of scientific instruction. The Royal College of Chemistry and the Government School of Mines attracted particular attention. The significance of these institutions in the broader re-constitution of laboratories as disciplinary spaces has been addressed elsewhere.[101] For the purposes of this chapter, the pedagogic writings of two of the principal lecturers in these institutions - namely the already-mentioned Edward Frankland, and Thomas Henry Huxley -

of liberal education and German materialism, see Daum, A.W. 'Humboldtian Thinking and the Transformations of Civil Society in Germany', *Osiris* [Second Series] 17 (2002), pp. 107-140.

100 Jarrell, R.A. 'Visionary or Bureaucrat? T.H. Huxley, The Science and Art Department and Science Teaching for the Working Class', *Annals of Science* 38 (1998), p. 223.

101 See Forgan and Gooday, ‘Constructing South Kensington’ and Forgan and Gooday, ‘A Fungoid Assemblage’. Historical analysis of the School of Mines is perhaps most prominent in accounts of Thomas Henry Huxley's career. See eg. Desmond, 'Redefining the X-Axis', pp. 29-34; Jarrell, 'Visionary or Bureaucrat?'. On the Royal College of Chemistry see Russell, C.A. Coley, N.G. and Roberts, G.K. *Chemists By Profession: The Origins and Rise of the Royal Institute of Chemistry* (Milton Keynes; Open University Press, 1977), esp. pp. 75-93.

are of particular interest.

In an 1860 address to the students of the Museum of Geology (part of the School of Mines) in South Kensington, its then demonstrator Thomas Henry Huxley presents a typically strident opinion of the role of a teacher of science:

> the great business of the scientific teacher is, to imprint the fundamental, irrefrangible facts of his science, not only by words upon the mind, but by sensible impressions upon the eye, and ear, and touch of the student...
>
> Now this important operation can only be achieved by constant demonstration, which may take place to a certain imperfect extent during a lecture, but which ought also to be carried on independently, and which should be addressed to each individual student, the teacher endeavouring, not so much to show a thing to the learner, as to make him see it for himself.[102]

By 1869, the desirability of tutorial demonstration of 'facts' via objects had been replaced by somewhat different learning process:

> in explaining to a child the general phænomena of Nature, you must, as far as possible, give reality to your teaching by object-lessons; in teaching him botany, he must handle the plants and dissect the flowers... Don't be satisfied with telling him that a magnet attracts iron. Let him see that it does; let him feel the pull of the one upon the other for himself.[103]

From advocating a mode of instruction whereby objects constitute a powerful means by which teachers might impress the lessons of nature on pupils' senses by their own demonstrative actions, Huxley had adopted physiological psychologists' rhetoric of discipline via pupils own individual bodily actions.[104] It should be

102 Huxley, T.H. *Collected Essays* [Vol. VIII] (London, 1893-1894), pp. 220-221.

103 Huxley, T.H. *Collected Essays* [Vol. III] (London, 1893-1894)., p. 127.

104 Huxley has been characterised as utilising laboratories as a means of advancing his institutional interests as a physiologist. See Gooday and Forgan, 'Constructing South

stressed that both elements are present in both texts. Nevertheless, the emphasis of his remarks undergoes a subtle but important shift.

The publications of Frankland undergo a more clear-cut change. His first pedagogic publication, *Lecture Notes for Chemistry Students* (1866) - drawn from his lectures at the Royal College - is almost entirely devoted to the introduction of new forms of notation of formulae for various chemical substances and reactions. This text, in its emphasis on written modes of instruction, pays scant attention to more practice-oriented activities that pupils might engage in during lessons.[105] Whether or not it reflects Frankland's pedagogic activity during this time remains uncertain. Frankland did nevertheless come to advocate practice-oriented instruction in his classes. His subsequent *How to Teach Chemistry: Hints to Science Teachers and Students* (1875) complains that 'Our scholars are told what other people have observed, but they are not taught to observe for themselves. In the teaching of science this ought not to be; and students ought to be shown what to look for, and required to make their own observations.'[106] This comment is followed by a series of terse descriptions of experiments, through the performance of which simple chemical forms are to be produced, and the atomic nature of elements demonstrated.[107] Such a dramatic shift, whilst potentially explicable in terms of the differing contexts in which Frankland expected his different texts to be used, is nevertheless indicative of a broad re-formulation of pedagogic practice during the 1870s.

The incorporation of experimental discipline as an uncontroversial and increasingly commonplace scientific practice in higher educational institutions was accompanied by a general re-constitution of pedagogic literature around investigative equipment. A wide range of literature offering guides to the use of laboratory equipment appears during this time. Texts such as Williamson's

Kensington'. Whilst I agree with this assessment, I am arguing here that such interests were also dependent on the more general prevalence of physiological notions of learning at this time.

105 Frankland, E. *Lecture Notes for Chemistry Students: Embracing Mineral and Organic Chemistry* (London, 1866)

106 Frankland, E. *How to Teach Chemistry: Hints to Science Teachers and Students* (London, 1875), p. 1.

107 Ibid.

Chemistry for Students (1866), UCL and Edinburgh professor of Civil Engineering Henry Charles Fleeming Jenkin's *Electricity and Magnetism* (1873), Huxley's own *A Course of Practical Instruction in Elementary Biology* (1875), and John Burdon Sanderson's controversial *Handbook for the Physiological Laboratory* (1873) present a very different mode of learning than had (for example) Carpenter's extremely popular *Principles of Human Physiology* (five editions, 1842-1855) referred to extensively in the previous chapter.[108] Whereas this latter text is concerned above all with propounding truths regarding nature, the former take it as their principal task to present students (and teachers) with the technical means by which such truths will (they presume) be revealed.

Conclusion

Literature articulating a specifically physiological notion of learning published during the late 1860's and 1870s does not merely indicate a change in the status of experimental equipment in conceptions of the purposes of instruction - it was also indispensable to attempts to conduct practice-centred investigation in general. As chapter one of this study makes clear, at the start of the nineteenth century, the status of different forms of epistemic equipment played a critical role in the sorts of questions that those concerned with the definition of life could aspire to address. Yet early-nineteenth-century physiologists and zoologists did not generally seek to instantiate their contentions by promoting particular forms of investigative practice (microscopic investigation, for example). Articulations of natural truth considered inappropriate were primarily understood to be so because

108 Williamson, A.W. *Chemistry For Students* (Oxford; Clarendon Press, 1868 [1866]); Jenkin, F. *Electricity and Magnetism* (London, 1873); Huxley, T.H. *A Course of Practical Instruction in Elementary Biology* (London, 1875); Sanderson, J.B. (ed.) *Handbook for the Physiological Laboratory* (London, 1973). See also George Carey Foster's translation of Prussian physicist Adolf F. Weingold's *Introduction to Experimental Physics, Theoretical and Practical: including directions for constructing physical apparatus and for making experiments* (London, 1875). As Foster declares in his preface to this work: 'The great secret of effectual teaching in any subject is to excite the pupil's interest, so that, instead of being passively receptive, and regarding it as his teacher's business to make him learn, he may actively assert his mind in order to understand the matter in hand. In the case of Physics no method is so nearly efficacious for this purpose as that of letting him make apparatus and try experiments with his own hands.' Foster, G.C. 'Preface', in *idem*, p. ix.

of their implications for the organization of human populations, not their relation to the use of specific kinds of equipment.

In contrast, as this and the following chapter of this study contend, physiologically-inspired, experiment-centred pedagogic literature places far greater emphasis on a need for investigators to operate and interact with equipment *itself* in an appropriate manner. In their emphasis on the interaction of physiological bodies with technical equipment, physiological psychological statements regarding learning effectively naturalise skilful individuals as principal producers of natural truth. It is no longer only the status of a disciplined community of 'knowers', but now also a relation between a single investigator and their equipment, that embodies this physiological ideal of truth-production.

This shift had profound implications as far as the articulation of conceptions of nature that might be considered subversive were concerned. In effect, the emphasis of physiological psychologists on the power of investigative tools to define psychological life is translated in these texts into a means of inculcating a certain set of attitudes and beliefs regarding the nature of self and world via the manipulation of equipment. Questions regarding natural truth come to be mediated less by questions of direct analogies regarding the organization of communities, and more by questions regarding individual knowledge-producers' possession (or not) of observational skill. Not only should learning now be conducted through experimentation, but the inculcation of 'correct' experimental practices agreed upon by a community of recognised specialists (or ‘men of science’) becomes the most efficacious means of eliminating 'incorrect' notions regarding nature. Unacceptably radical claims regarding nature can be regulated by training in the manipulation of scientific equipment. Indeed, as examined in the next chapter, epistemic tools come to play a significant role in the regulation of membership of a community of trusted knowledge-producers at this time.

More generally, the privileging of bodily skill in the conduct of learning contributed to a longer-term undermining of the status of representational objects in intellectual endeavour. In elevating the status of experimental tools, physiologically-constituted culture drew attention away from the texts and images contained in books, atlases and journals. The 'mechanically'-produced images that Daston and Galison engage with, though a powerful means of persuasion, were nevertheless understood by many as secondary to tool-centred practices themselves

in pedagogical endeavour. It was through a human-object interaction in the laboratory, rather than a specific approach to the representation of nature, that a subjectivity appropriate to the cultivation of industry was to be constituted. The training of 'judgement,' which later came to the fore as critical to the properly scientific interpretation of mechanically-produced images, had thereby been present at the beginning of organized laboratory science. It was in the judgement of one's relation to experimental equipment, as much as mechanically-constituted images, that scientists were to be trained and evaluated.

Chapter 4:

Appropriating Technique: microscopy as resistance in physiological culture (c. 1860-1880)

Introduction

Up to this point, this thesis has sought to chart some of the ways in which 'the' nervous system emerged as an object of concern during the nineteenth century. Specifically, it has examined the coming-to-pre-eminence of a conception of human nerves as fundamentally similar to those of animals, and sought to convey ways in which this re-figuring of human subjectivity came to accompany a re-orientation of scientific practice around investigative tools. The promotion of academic science as fundamentally a laboratory-based practice, it has been suggested, has been accompanied by a conception of human bodies and minds as energy-exchanging, inherently 'work'-oriented entities, subject to laws of nature in the same way as all other natural bodies. But one theme that remains under-acknowledged in this analysis is the ways in and extent to which such subjective modes, as well as helping constitute certain forms of identity (eg. 'the organically-defined individual' or the 'man of science'), could, for those that had largely been precluded from the definition of their own natures, also be made into tools of resistance. Physiological subjectivities and the institutions that accompanied their emergence did not unproblematically or irrevocably displace those (invariably theocentric) forms of life that both preceded them and helped constitute the conditions under which they were able to flourish.[1] But such emerging conceptions and environments did constitute a specific set of possibilities as regards political action. They presented groups that had historically been conceptualised as objects of natural philosophic concern (non-European peoples, women, the working classes) with a new means by which they might become recognised as definers of nature as well as the defined; technical engagement.

That broad swathes of humanity had historically been identified as objects of natural philosophic concern, and had thereby largely prevented from the

1 Smith, R. 'The Physiology of the Will'. On the inherently theological constitution of pre-nineteenth century science see Cunningham, A. 'How the *Principia* Got Its Name: or, taking natural philosophy seriously', *History of Science* 24 (1991), pp. 377-392.

possibility of contributing to natural philosophic debate in any direct way, is certain. Historians have highlighted at some length ways in which natural philosophic discourse had before the nineteenth century equated the attributes considered desirable in rational, knowing philosophers of nature with those of elite, Caucasian, heterosexual males.[2]

What seems to mark the nineteenth century out from previous eras is the extent to which groups that had historically been precluded (if not entirely excluded)[3] from natural philosophic discourse began to insist on their ability to participate in a newly-authoritative discourse of 'science.' Such claims mark an extension of the political valency of the category 'nature.' It increasingly comes to be recognised from this period that effective resistance to the dominance of the Western, male elites of nineteenth-century Europe does not merely entail challenging those institutions that establish and maintain highly asymmetric power relations directly. It also requires the articulation of challenges to those institutions' claims regarding the nature of the world. Representing nature differently comes to be understood as a means of counteracting the determination of life by aristocratic, imperial, or male interests.[4] Another way of saying this is that it came to be recognised that institutions constitute intellectual relations (and vice versa).

But, in addition to helping constitute different conceptions of nature, I argue that the efforts of groups that had historically been 'objectified' in European natural philosophic discourse to participate in science also helped constitute a science less beholden to representations than to the technical conditions under which such representations could be produced and maintained as plausible. My claim here is that the culture in which these groups found themselves during the nineteenth century paradoxically presented both justification for, and a mode of

2 See eg. Keller, E.F. *Reflections on Gender and Science* (New Haven; Yale University Press, 1985); Phillips, P. *The Scientific Lady: a social history of women's scientific interests 1520-1918* (London, 1990); Wertheim, M. *Pythagoras' Trousers: god, physics and the gender wars* (New York, 1995).

3 Some aristocratic women, for example, did participate in eighteenth-century natural philosophy. They were however always considered as 'exceptions' to their (or rather 'the') 'sex'. See Schiebinger, L. *The Mind Has No Sex?: women in the origins of modern science* (Harvard University Press; Cambridge, MA. and London, 1989); Findlen, P. 'Translating the New Science: Women and the Circulation of Knowledge in Enlightenment Italy', *Configurations* 3 (1995), pp. 167-206.

4 The publications of Karl Marx and Friedrich Nietzsche present key examples of intellectual forms of resistance during this period. On imperial subjects and the constitution of racial science see Anderson, *Race and the Crisis of Humanism*. On the re-constitution of science by groups that have historically been forced to acknowledge their 'partial' perspectives more generally see Harraway, 'Situated Knowledges'.

resistance to, their continuing status as natural objects. As the previous chapters of this thesis have shown, the nineteenth century saw the coming-to-pre-eminence of a notion of the human as organic object. This conceptualisation privileged the concerns of the middle-class men that helped constitute and adhered to it. The positive engagement of non-European, working-class, and non-masculine subjects with this discourse, I here suggest, was predicated on an emphasis on the *practical* constitution of scientific tools and techniques over any *representational* claims these 'men of science' made regarding the nature of life.[5] Non-Europeans, the working classes and women were, through their adaptation and constitution of technical forms, on occasion able to mount effective responses to what most nineteenth-century natural philosophers assumed to be their self-evident rational and authorial supremacy.

Although this claim is intended to comment on the status of technique within a physiology-centred culture in general, I attend here to only one group that had historically been categorised as 'within' nature, and thereby unable to comprehend it; middle-class women. Whilst the gender category 'woman' as a not-fully-developed kind of man had been present in Western Europe since antiquity, it was only from the seventeenth century onwards that such categories were explicitly and insistently founded on mutually differentiating 'male' and 'female' anatomies. Londa Schiebinger and Thomas Laqueur have identified a strong differentiation of sexual labour as emerging in post-Rennaisance European culture.[6] Pre-renaissance Europeans' assumptions regarding the sovereignty of (male) 'man' over nature begin to be brought into question, they suggest, with the re-configuration of political and economic spaces and the articulation of a de-corporealized (and thereby 'de-sexed') conception of mind from the late seventeenth century onwards. As minds came to be described as independent of human bodies (though nevertheless dependent on them for their interaction with the material world), some authors began to argue that the presumption of man's dominance over nature had arbitrarily made women into inferior citizens to men. In particular, with the revolutions of the second half of the eighteenth century, the formalization of men's rights in the constitutions of France and the United States

5 I take my contrast between practice and representation in science from Pickering, *The Mangle of Practice*.

6 Schiebinger, *The Mind Has No Sex?*; Laqueur, T. *Making Sex: body and gender from the Greeks to Freud* (Harvard University Press; Cambridge, MA. and London, 1990). See also Schiebinger, L. *Nature's Body: Gender in the Making of Modern Science* (New Brunswick, 2004 [1993]).

came to be understood by some as irrationally exclusive of women.[7] Schiebinger and Laqueur argue that a binary, male-female sexual anatomy is constructed from this time as both a recuperative response to women's claims to universal rationality, and as evidence for the continuing exclusion of women from such rational discourse.[8] The female body becomes a precluding factor in rational contemplation, distracting women from detached thought through its reproductive purpose and heightened sensuality in comparison with male bodies. Women, then, had been made into scientific objects in a particularly vehement way during the eighteenth and early nineteenth centuries. The nature of their bodies were thought to preclude all but a small number of exceptionally 'rational' of their number from the comprehension (let alone construction) of the world.

Rather than analyse British women's engagement with science in general during the nineteenth century, I concentrate here on microscopy as, firstly, a tool that had become (from the late 1840's) a key means of defining life, and, secondly, a form of scientific practice that was (during the 1860's) becoming particularly amenable to participation in by those coming to define themselves as middle class. In privileging a scientific tool rather than an object of explicitly natural concern (such as electricity, for example), I am following Paul Forman's recent comments on the place of 'technology' and science in contemporary politics.[9] Forman's articles suggest that our culture is not so much characterised by a concern with the nature of the world, as by the technical capacities frequently associated with our study and control of it. It is not so much our presently prevalent conceptions of 'nature', but those of 'technology' that Forman sees as underlying much present interest in profit, productivity and enterprise in science, as elsewhere.[10] If this is indeed the case, then a historical engagement with tools and techniques - and especially those tools and techniques that have participated in the definition of 'modern' science - is urgently needed for those (such as myself) who perceive their present as one in which economic exchange between biologically-differentiated

7 Eg. Wollstonecraft, M. *A Vindication of the Rights of Women: with strictures on political and moral subjects* (London, 1792).

8 Schiebinger, *The Mind Has No Sex?*, esp. pp. 214-244. Laqueur, *Making Sex*, esp. pp. 154-163.

9 On the problematic status of the term 'technology', see the discussion in the introduction to this thesis.

10 Forman, '(Re)cognizing Postmodernity'; Forman, 'The Primacy of Science'. For a recent critique of the lack of critical attention to notions of 'productivity' within science studies, see Herzig, R. 'On Performance, Productivity, and Vocabularies of Motive in Recent Studies of Science' *Feminist Theory* 5 (2004), pp. 127-147.

individuals has become an ideological norm rather than a means of empowerment.[11] The relative paucity of literature relating to women's engagement with technical entities (and especially with tools connected with scientific investigation) is a secondary but nevertheless significant motivation for the technical rather than scientific emphasis of this chapter.[12] The principal contrast that I draw here as regards the political possibilities experienced within differing nineteenth-century subjectivities, is between a culture in which scientific practice and scientific representation are equated, and a one in which technical competency is differentiated (if not divorced) from scientific representation itself

To this end, I concentrate in the initial section of this chapter on literature associated with women microscopists who tended to align themselves with a disembodied conception of cognition. Up until the middle decades of the nineteenth century, this mode of subjectivity appears to have been most frequently expressed in British culture in conjunction with natural theological conceptions of nature. For many natural theologians, the soul's nominal independence from and simultaneous reliance on the organic body constitutes a critical starting point for any scientific engagement with the material world. This presents peculiar difficulties for aspiring women microscopic writers, defined as they were in terms of their supposedly less-than-rational bodily capacities. Following this, I move on to consider the re-figuration of notions of microscopic perception around microscopic tools themselves. This development, I suggest, is paralleled by the emergence of a form of writing that privileges technical competence, and which is

11 This, of course, is not to deny that liberal individualism might present others with a source of inspiration. My position is inherently 'partial.' See Harraway 'Situated Knowledges.'

12 Whilst there is a large and rapidly expanding body of work on women' engagement with (especially digital) technologies developed during the twentieth century, few historians have paid much attention to women's relation to technologies before around 1914. Significant exceptions include Schwartz Cohen, R. *More Work for Mother: the ironies of household technology from the open hearth to the microwave* (London, 1989); McGaw, J.A. *Most Wonderful Machine: mechanization and social change in Berkshire paper making, 1801-1885* (Princeton University Press; Princeton and Guildford, 1987); Tucker, J. 'Gender and Genre in Victorian Scientific Photography', in Shtier, A.B. and Lightman, B. (eds.), *Figuring it Out: science, gender and visual culture* (Hanover, NH. and London, 2006), pp. 140-163. On the historiography of women and technology more generally, see especially Wajcman, J. 'From Women and Technology to Gendered Technoscience', *Information, Communication & Society* 10 (2007), pp. 287-298; Pursell, C. 'Feminism and the Rethinking of the History of Technology', in Creager, A.N.H., Lunbeck, E. and Schiebinger, L. *Feminism in Twentieth-Century Science, Technology, and Medicine* (University of Chicago Press; Chicago and London, 2001), pp. 113-127; McGaw, J.A. 'No Passive Victims, No Separate Spheres', in Cutcliffe, S.H. and Post, R.C. (eds.) *In Context: History and the History of Technology* (Bethlehem, London and Toronto, 1989), pp. 172-191.

adopted by women microscopic authors as a means of claiming authorial legitimacy regarding natural observation.[13] Finally, I conclude by contrasting this technical form of writing with a rather different - yet equally 'scientific' - form of authorship, in which microscopic tools begin to figure not as legitimating authorities outside of narrative, but as narrative forces in and of themselves.

Women microscopists and 'disembodied rationality'

The publication of Mary Somerville's *On Molecular and Microscopic Science* in 1869 marks a transitional point in British women's engagement with microscopy. By 1869, Somerville had built up an almost unassailable reputation as one of Britain's most respected women natural philosophers.[14] Like most women writers on scientific subjects up until the mid nineteenth century, Somerville relied heavily on her aristocratic status as a means of legitimating her activities.[15] Born in Scotland in 1780, her father (Sir William George Fairfax) had risen to become a Vice-Admiral in the British Navy, and she had received a small pension following the death of her husband in 1807. Using her independence as a widow and extensive family connections, she was able to devote much of her life to natural theological research and writing, a career that placed her in a highly unusual category for a woman of the period. Considered an exception to the generally irrational nature of her sex, Somerville's authoritatively rational style was both lauded by and unsettling to the gentlemanly culture of her age.[16]

13 This line of argument broadly follows Mussel, 'Private Practices and Public Knowledge'. On women as scientific authors see also Barton, R. "Men of Science': language, identity and professionalization in the mid-Victorian scientific community', *History of Science* 41 (2003), pp. 73-119.

14 On Somerville see Brock, C. 'The Public Worth of Mary Somerville', *British Journal for the History of Science* 39 (2006), pp. 255-272. On Somerville see also Neeley, K.A. *Mary Somerville: Science, Illumination, and the Female Mind* (Cambridge; University Press, 2001) and Fara, P. 'Mary Somerville: a scientist and her ship', *Endeavour* 32 (2008), pp. 83-85.

15 On the dependence of most women natural philosophers on their aristocratic connections before 1850 see eg. Findlen, 'Translating the New Science'; Algazi, G. 'Scholars in Households: refiguring the learned habitus' *Science in Context* 16 (2003), pp. 9-42, and Mascetti, Y.A. 'A "World of Nothing But Pure Wit": Margaret Cavendish and the gendering of the imaginary', *Partial Answers* 6 (2008), pp. 1-31.

16 Brock, 'The Public Worth'. On the construction of women scientific authors as exceptions to their sex prior to the nineteenth-century see Findlen, 'Translating the New Science.'

Since the 1830's, Somerville had been struggling to reconcile her ambition to establish original insight regarding nature, with a need to confirm herself as properly 'womanly,' and hence lacking in her capability for original rational insight in comparison to men. As Claire Brock has highlighted, the originality of her at times esoteric engagement with Laplacian mathematics, *Mechanism of the Heavens* (1831), and renowned series surveying scientific thought, *On the Connexion of the Physical Sciences* (ten editions, 1834-1877) were brought into question during that decade. This occurred largely in relation to a controversy in parliament over whether or not it had been appropriate to accord her a civil list pension (awarded in 1835). Subsequent to this (to-her highly embarrassing) episode, Somerville began to present herself - and to be presented - as both an unusually rational woman and, paradoxically, an un-original popularizer of others' insights regarding nature. Having attained public acclaim, Somerville's persona as an 'exceptional' woman came to be fashioned in accordance with post-Renaissance conceptions of women's proper place in public life as subordinate to that of men.[17] Nevertheless, despite Somerville's status during the later part of her life as an 'un-original' collator and expositor of others' work, *On Molecular and Microscopic Science* adopts a specific, and for the period potentially controversial, stance regarding microscopic nature.

I highlight here two aspects of Somerville's relation to the natural philosophic culture of her time; firstly, that the epistemic assumptions that underpinned Somerville's conclusions regarding the nature of the universe relied on a sharp differentiation between a sensorial or 'bodily' perception and a rational or 'mindful' reflection; and secondly, that this differentiation inhibited her ability to construct herself as an original contributor to natural philosophic discourse. Later, I will go on to suggest that the break-down of this differentiation during the 1860s and 70s presented women who sought acknowledgement as producers, as well as reproducers, of microscopic knowledge with a rather different set of possibilities than those that had been accorded Somerville. Somerville would characterize *On Molecular and Microscopic Science*, her final scientific work, as a failure, and lament that she had had to abandon analytical mathematics in favour of more general exposition of natural truth as defined by others.[18] Yet even as she was so doing, a new generation of women were beginning to fashion themselves in a very different way - as skilled manipulators of tools rather than rational interpreters of

17 Brock, 'The Public Worth.'

18 Neeley, *Mary Somerville*, p. 190; Brock, 'The Public Worth', p. 267.

sensation. As the previous chapter has made clear, such skill-centred notions of scientific subjectivity were predicated on a conception of cognition as the exclusive property of nerves acting in conjunction with the rest of an individual's body. It should come as no surprise then that these women engaged with physiological conceptions of psychology. Before moving on to consider these figures, however, it is necessary to situate their activities in the context of nineteenth-century microscopic practices more generally.

Microscopy and the extension of sensation

Before the 1860's, most British authors' evaluations of the status of microscopes in the study of nature remain firmly within the sense-reason duality described by Jonathan Crary and examined in chapter one of this thesis.[19] Above all, this literature portrays microscopes as means by which the sensory power of the eye might be extended, or the organ 'brought closer' to objects of concern. As Edwin Lankester's best-selling tract *Half-Hours with the Microscope* (1859) comments:

> Just in proportion as we bring our eyes close to objects, do we see more of them... the nearer we can get our eyes to the print [of a hand-bill, for example], the more we shall see. The most important part of a Microscope, then, consists of a lens, by means of which the eye can be brought nearer to any object, and is thus enabled to see more of it.[20]

In thereby extending the eye's vision, the mind is presented with a broader sensory vista, through the contemplation of which creative purpose might be revealed. The moral potential of such scenes appears as self-evident in much microscopic literature of the time. For example, John Passmore Edwards' single-issue journal *The Microscope* comments that

19 See also Schickore, *The Microscope and the Eye*, esp. pp. 83-132.

20 [Lankester, E.] *Half-Hours with the Microscope; being a popular guide to the use of the microscope as a means of amusement and instruction. Illustrated from nature by Tuffen West* (London, [1859]), p. 2. For a differentiation between seeing with single and compound microscopes according to this mode of subjectivity see Pritchard, A. and Goring, C.R. *The Microscopic Cabinet of Select Animated Objects; with a description of the jewel and doublet microscope, test objects, &c.* (London, 1832), pp. 103-106.

> The microscope, and its revelations... places us in the midst of a world before invisible, which, like a new creation in the freshness of beauty, stretches away in enchanting prospects on every side... our discoveries terminate not for want of unknown fields to explore, full of the developments of creative power, but because our sight grows dim, and we have no further means of pouring light upon what remains unseen[21]

Here the literary figure of 'the microscope' constitutes a instrument of revelation, a tool that furthers the cultivation of faith in both God and Nature. Yet for some, such revelation retained the potential to present problematic conceptions of the constitution of existence.

Crucially, without a simultaneous cultivation of a reason separate from sensory experience, microscopic augmentation of vision could constitute a threat to the divine order. Gideon Mantell's *Thoughts on Animalcules* (1846) portrays its exposition of the scenery of microscopic life as an act of faith in the rationality of its reader, implicitly indicating the potentially impious conclusions that insufficiently 'regulated' minds might draw from it:

> I would leave the intelligent reader to draw his own inferences from what has been advanced; being convinced, no well-regulated mind can rise from the contemplation of the marvels revealed by the microscope, without being so deeply impressed with a sense of awe, of humility, and of dependence, as to be secured from the arrogance and presumption of attempting to interpret the final purposes of the ETERNAL, even in the minutest of HIS works.[22]

The possibilities understood as being afforded by microscopic vision - chiefly the further penetration and comprehension of God's creation through the augmentation of visual sense - are clearly linked in these texts to the condition that such vision is accompanied by a sense of both internal and external fixity; external fixity, in the perception of the creative permanence and ultimate impenetrability of heavenly

21 Edwards, J.P [attr.] *The Microscope* 1 (London, 1852), p. 3. Similar comments can be found in much British microscopic literature during the first half of the nineteenth century. See eg. Prichard and Goring, *The Microscopic Cabinet*.

22 Mantell, G.A. *Thoughts on Animalcules; or, a glimpse of the invisible world revealed by the microscope* (London, 1846), p. 89. Mantell's emphases.

nature; and internal fixity, in the assertion that the principal condition of possibility for such perception lies in the individuals' possession of a well-regulated, assumedly universal standard of rationality.[23]

Somerville's texts subscribe whole-heartedly to this notion of an absolute distinction between an external, sensory realm and an internal, universal 'reason.' *On Molecular and Microscopic Science* cites the nervous anatomy of Sir Charles Bell to this effect:

> The sensory nerves convey external impressions to the brain, and by them alone the mind is rendered conscious of external objects... Conversely, the mind or will acts through the brain on the motor nerves, which by alternately contracting, relaxing, and directing the muscles, produces muscular motion... By these admirable discoveries, Sir Charles Bell has proved that 'we are placed between two worlds, the invisible and the material'; our nervous system is the bond of connection.[24]

Somerville's conviction regarding the distinction between mind and nerve is fully in accordance with the general beliefs of many Britons during much of the nineteenth century. Such beliefs were accompanied by an assumption that original thought is rational, and that male bodies are more conducive to rational thought than female.

Rational perception by ‘irrational’ bodies

From the point of view of women’s status as students of nature, this linking of correct perception with an at-best indeterminately embodied mind had profound consequences. The strong correlation between rationality, sex and gender noted in the introduction to this chapter was if anything more prevalent during the nineteenth century than the eighteenth. For example, texts such as Thomas Laycock's first book-length publication, *A Treatise on the Nervous Diseases of*

23 Another key natural theological work concerning microscopic creation is Philip Gosse's *Evenings at the Microscope* (1859). On this see Armstrong, 'The Microscope', pp. 36-40.

24 Somerville, M. *On Molecular and Microscopic Science,* Vol. II (London, 1869), p. 5.

Women (1840), posits an intimate connection between both sexes' reproductive organs and nervous activity. Laycock characterises the functions of ovaries (the principal female organ of reproduction in most nineteenth-century physiology) as subversive of rational contemplation:

> after the age of eighteen the [female] reproductive organs are fully - probably largely - developed, and strong passions, indolence, and luxury, fail not to produce their effects on the [nervous] system, and to develope [sic] the sthenic [ie. the pathologically energetic] form of of hysteria. It is to such that marriage... is so useful; although doubtless the asthenic [ie. the pathologically debilitated] forms are sometimes benefited from this procedure; the ovaria being excited to the performance of their proper function, and the cares of life dispelling the "vapours" so apt to congregate about the idle and well-fed.[25]

Such statements undergo considerable elaboration in many medical publications later in the century. For example, an 1863 article by Henry Maudsley integrates such claims with the notion of bodily energy, claiming that as a child-bearer and help-meet, 'a woman needs all her force at home, and has none to spare for the philanthropic enlightenment of humanity.'[26] In characterising nervous systems as linked to, and frequently defined by, organs of regeneration, physiological psychologies cemented an ideal of labour as sexually divided between workplace and home in the nature of the body.[27] As will be related later in this chapter,

25 Laycock, *A Treatise*. On W.B. Carpenter's characterisation of femininity see Beer, G. *Darwin's Plots: evolutionary narrative in Darwin, George Eliot and nineteenth-century fiction* (3rd ed.) (Cambridge University Press; Cambridge and New York, 2009 [1983]), pp. 212-214. Laycock's association of femininity with the ovaries was a common trope in medical discourse. See Oppenheim, J. *"Shattered Nerves": doctors, patients, and depression in Victorian England* (Oxford University Press; New York and Oxford, 1991), esp. pp. 141-232; Moscucci, O. *The Science of Woman: gynaecology and gender in England, 1800-1929*, (Cambridge University Press; Cambridge, New York and Melbourne, 1990), pp. 33-34.

26 Maudsley, H. 'Considerations with Regard to Heredity Influence', *Journal of Mental Science* 8 (1862-1863 [1863]), p. 497. Maudsley's concern regarding energy loss echoes many of the comments relating to onanism made during the eighteenth century. See Laqueur, T. *Solitary Sex: a cultural history of masturbation* (New York, 2003).

27 On the development of the science of sexual division in Britain see also Browne, J. 'Botany for Gentlemen: Erasmus Darwin and "The Loves of the Plants"', *Isis* 80 (1989), pp. 593-621 and Scheibinger, L. 'The Private Lives of Plants: sexual politics in Carl Linnaeus and Erasmus Darwin', in Benjamin, M. (ed.) *Science and Sensibility: Gender and scientific enquiry 1780-1945* (Oxford and Cambridge MA, 1991), pp. 121-143.

physiological psychology as a movement constituted a more ambiguous intellectual context for women concerned with the investigation of nature than that indicated by the quotes above.[28] It is important nevertheless to note the close ties between nervous anatomy, sexual anatomy, and notions of rationality that permeate nineteenth-century discourse.

Yet if the notion of a rationally destabilising female anatomy meant that women were conceived of as unlikely to be able to provide original insight into microscopic nature, this does not mean that they were excluded from such observation in general. If anything, the contrary seems to have been the case. Women participated fully in the culture of microscopic display, albeit adopting a reproductive rather than productive role *vis a vis* microscopic knowledge, and largely confining their engagement with microscopes themselves to domestic contexts.[29] The publications of the Irish natural theological astronomer and microscopist Mary Ward present a rather more representative example of women's engagement with these tools during the first half of the century than does Somerville's treatise.[30] Ward's first foray into microscopic publishing presents readers with a series of 'panoramas' of objects, an endeavour which she supplements in a second volume with hints on how to project images for the entertainment of guests at home.[31] Above all, these works are concerned with the exposition of and means of displaying already-known facts of nature, for 'rational recreation' rather than the constitution of an 'original' authorial voice.[32]

28 On the problematic status of sexual distinction in the nineteenth-century 'bio-' sciences more generally see Moscucci, O. 'Hermaphroditism and Sex Difference: The construction of gender in Victorian England', in Benjamin, *Science and Sensibility*, pp. 174-199; Krug, K. 'Women Ovulate, Men Spermate: Elizabeth Blackwell as a Feminist Physiologist', *Journal of the History of Sexuality* 7 (1996), pp. 51-72; Deutscher, P. 'The Descent of Man and the Evolution of Woman', *Hypatia* 19 (2004), pp. 35-55.

29 On engagement by women with science along these lines see Richards. J.L. 'In Search of the "Sea Something": reason and transcendence in the Frend/De Morgan family', *Science in Context* 20 (2007), pp. 509-536.

30 On Ward see Harry, O.G. 'The Hon. Mrs Ward (1827-1869) Artist, Astronomer and Ireland's First Lady of the Microscope', *The Irish Naturalists' Journal* 21 (1984), pp. 193-200.

31 Ward, M. *A World of Wonders Revealed by the Microscope* (London, 1858). Ward, M. *Microscope Teachings: descriptions of various objects of interest and beauty adapted for microscopic observation.* (London, 1864). For a further example of this kind of microscopic publication see Bury, Mrs. *Figures of Remarkable Forms of Polycistins, or Allied Organisms, in the Barbados Chalk Deposit* (Windermere, 1862 and London, 1865). On the construction of women as readers see Shteir, A.B. 'Elegant Recreations? Configuring Science Writing for Women', in Lightman, B. (ed.) *Victorian Science in Context* (Chicago University Press; Chicago and London, 1997), pp. 236-255.

32 On rational recreation see Bailey, P. *Leisure and Class in Victorian England: rational recreation and the contest for control* (London, 1987 [1978]).

Authorial agency in Ward's work is limited to the power of 'selecting a few from the multitude of lovely scenes presented by the microscope'.[33] Similarly, observation is of the simplest, least original kind. As she concludes:

> A teacher who truly loves his art or science is best pleased when those whom he has instructed outdo in after years their early lessons. And such is my feeling about this little book. I wish that those who read it may enter on many fields of observation to which I have not directed them... and also that they may study the objects which I do describe in more completeness, and with a far deeper understanding of their meaning than I have [attained].[34]

The role of women microscopic practitioners is to guide the novice in their initial encounter with microscopic nature, ensuring the accurate reproduction of reliably simple preparations within the domestic sphere. 'You will do well', she suggests, to have 'some of the beautiful microscopic preparations supplied by opticians... at hand... because if you wish to prepare objects for yourself, the ready-made ones will show you what your work ought to resemble.'[35] In keeping with the presumption that women are capable only of a passive reception of already-discovered truth, Ward, in a less ambiguous way than Somerville, constructs her scientific persona as one of a devoted wife and mother seeking to introduce children and friends to the entertaining visions afforded by the tool.

All of which is not to say that Ward articulates her activity as a negative, passive participation in scientific endeavour more generally. Indeed, her final remarks indicate the extent to which she seeks to foreground difficulties faced by middle-class women seeking to adopt the role of educators of their children:

> If my book has helped to place them [the readers] on the way to such studies as may enable them to add to the stock of knowledge, I shall not regret the time and application it has cost me - not as it might once have been, as the delightful employment of abundant leisure,

33 Ward, *Microscope Teachings*, p. viii. On the panoramic in Somerville's texts see Neeley, *Mary Somerville*, pp. 130-168.

34 Ibid. pp. 215-216.

35 Ibid. p. 17.

> but, on the contrary, a serious occupation, done amidst interruptions and under pressure of numerous home duties, in the feeling that I had a few things to say which might be pleasant and instructive to some readers at the present time, and to my own dear children by and by.[36]

Most middle class women of the middle decades of the nineteenth century sought to cultivate their children's interests in a manner appropriate to their expected place in the world - in the case of middle-class girls, as sophisticated hosts capable of engaging their husbands and guests in intelligent, entertaining, yet uncontroversial conversation - in the case of middle-class boys, initially as informed and energetic schoolboys, and eventually as respectable gentlemen able to turn their capacity for penetrative rationality into an occupation fit for a head of a family.[37] Ward's characterization of women educators as engaging in a 'serious occupation' constituted a means of articulating the confinement of many women to the home as demanding, necessary, and worthwhile. But it left little room for claims to originality.

Reviews of Somerville's *On Molecular and Microscopic Science* locate both its perceived virtues and its failings in what they imply to be her lack of rational ability.[38] The *Edinburgh Review*, whilst disappointed that she does not address the notion of conservation of energy to a greater degree, notes approvingly that 'Mrs. Somerville does not attempt to generalise, much less to bring forward any original observations of her own... she does not presume to describe the 'cosmos,' but simply aims to give in clear language some of the most interesting results of recent investigation.'[39] For this reviewer, Somerville is to be applauded for her modesty as a woman. Whilst she may have neglected the latest researches into the nature of nature's forces, her lack of 'presumption' regarding her ability to originate knowledge makes the treatise a success.

The Athenæum, in contrast, emphasises the exceptional abilities of the author: 'Mrs. Somerville is a woman gifted by nature with mental powers of a high order and of a rare character... We have evidence in her works... of an inductive

36 Ibid. pp. 215-216.

37 On middle-class family life see Davidoff, L. and Hall, C. *Family Fortunes: men and women of the English middle class, 1780-1850* (2nd ed.) (London, 2002).

38 On the reception of *On Molecular and Microscopic Science* see also Neeley, *Mary Somerville*, pp. 164-167.

39 [Roscoe, H.E.] [attr. - see Neeley, *Mary Somerville*, p. 166] 'On Molecular and Microscopic Science', *Edinburgh Review* 130 (1869), p. 138.

tendency which is rarely found amongst them [ie. women].'[40] Yet despite the hopes raised by such exceptionality, it is ultimately her inability to sustain her argument in a rational manner that lets the book down:

> Mrs. Somerville, as we have already intimated, intended to show that science has almost proved that the physical forces can resolve into forms of beauty the brute atoms... This has not, however, been effected; and although a most instructive book has been produced - one in which a very large amount of real knowledge can be gained - it does not satisfactorily sustain the argument upon which it is based, and it is therefore left in a state of incompleteness.[41]

Evaluated from this standpoint, Somerville might be exceptionally rational for a woman, but her work nevertheless remains unable to stand the scrutiny of its' (male) readers' rational interrogation. The very epistemic commitments that pervade nineteenth-century life, and that Somerville adheres to, contribute to her inability to define herself as an original researcher.

If the respectably scientific, predominantly male audience that *On Molecular and Microscopic Science* sought to address largely dismissed it, that does not imply that the work had no significance in the burgeoning culture of microscopy in 1860s and 1870s Britain. As will be related in some detail later in this chapter, literature on microscopy openly attributed to women becomes far more common from the late 1860's onwards.[42] The emergence of societies devoted to the promotion of microscopic practice, an elevation of the importance of the tool within the medical profession (a body that some women of this time begin to characterise as unjustly exclusive to men), as well as the convenience with which microscopes could be used at home (at least in those homes that could afford them), might all be cited as contributing to this trend. Nevertheless, the literary presence of so well-known and widely respected a female figure as Somerville must also have contributed to her contemporaries' enthusiasm for looking to a

40 Anon. 'On Molecular and Microscopic Science' *The Athenæum* 2154 (Feb. 6th, 1869), p. 202.

41 Ibid. p. 203.

42 A comprehensive list of publications by women microscopists during the nineteenth century can be found in Creese, M.R.S. *Ladies in the Laboratory? American and British Women in Science, 1800-1900: a survey of their contributions to research* (Lanham and London, 1998).

nature beyond the ordinarily visible. Indeed, one of Somerville's most famous mentees, Ada Lovelace, had entertained a range of speculations on the 'atomic' nature of organic matter (though in keeping with the presumption that women's engagement with science be 'passive', she did not publish on the matter).[43] Somerville's declaration in the preface to *On Molecular and Microscopic Science* that microscopic investigations had 'brought a new accession to the indefinitely small within the limits of modern science'[44] presented followers of Ward's domestically-oriented work with the tempting prospect of participating in as well as following such research. Though herself frustrated by a teleologically male world of disembodied rationality, Somerville's publication indicated to those of her readers that had hitherto confined themselves to recreational (and re-creative) aspects of microscopic practice that such tools might present means by which women might constitute, as well as reproduce, scientific truth.

Women's participation in London's microscopy societies

Underlying the previous chapter of this thesis is the contention that the articulation of embodied conceptions of cognition have been indicative of a broader elevation of the cultural status of epistemic tools in Western cultures. The above consideration of the possibilities one form of technical object (microscopes) are understood as affording one group of historically-objectified actors (women) within a specific regime of subjectivity (disembodied rationality) presents a very different evaluation of the place of tools in scientific practice. Where physiological psychological texts emphasise a connection between bodies' skilful engagement with natural and technical objects and the attainment of a corporeal rationality, the passages cited above posit a radical distinction between a technical extension of worldly sensation, and the cultivation of a disinterested, non-corporeal, rationally-knowing subject. Here, I wish to bring out this contrast in more detail by examining how physiological notions of subjectivity fed into a re-evaluation of microscopic practice during the 1860s.

It should not however be assumed that I wish to attribute physiological

43 Winter, A. 'A Calculus of Suffering: Ada Lovelace and the bodily constraint on women's knowledge in early Victorian England', in Lawrence, C. and Shapin, S. *Science Incarnate: historical embodiments of natural knowledge* (Chicago and London; University of Chicago Press, 1998), pp. 202-239.

44 Somerville, M. *On Molecular and Microscopic Science,* Vol. I. (London, 1869), p. 1.

psychology a primary, causative role in this re-evaluation. Rather, I consider the emergence of a new rhetorical emphasis on microscopic skilfulness as much a response to, as cause of, the rapid ascendancy in the cultural value accorded microscopes during this period.[45] Microscopic culture, centred on urban spaces such as Paris, Edinburgh and London, underwent a rapid expansion from around 1850 onwards. In Edinburgh, the development of pedagogic tools and techniques specifically designed to circumvent problems associated with collective witnessing such as those highlighted in the first chapter of this study accompanied the emergence of academic groups committed to the investigation of microscopic nature.[46] In a similar but contrasting development, London saw the rapid expansion and functional specialisation of microscopic societies, and a fashion for 'microscopic soirées' that seemed to some as potentially disturbing to moral order.[47] The articulation of skill-centred notions of microscopic practice derive as much from concerns engendered by these developments as they do from physiological notions of subjectivity.

The case of London is of especial concern in this chapter for two reasons; the extensive opportunities the fashion for microscopy afforded middle-class urban women for participation in science; and the particularly engaged responses to this participation from scientific leaders in the city. The first lasting association of microscopists in Britain, the Microscopical Society of London, had been founded in 1840, along the lines of many of the gentlemanly clubs of the period.[48]

45 On non-specialists and the constitution of scientific culture see Cooter, R. and Pumfrey, S. 'Separate Spheres and Public Places: reflections on the history of science popularization and science in popular culture', *History of Science* 32 (1994), pp. 237-267. Cf. Shinn, T. and Whitley, R. 'Editorial Preface', in Shinn, T. and Whitley, R. (eds.) *Expository Science: forms and functions of popularization* (Dordrecht, 1985), pp. vii-xi.

46 Jacyna, L.S. 'The Romantic Programme and the Reception of Cell Theory in Britain', *Journal of the History of Biology* 17 (1984), pp. 13-48; Jacyna, '"A Host of Experienced Microscopists"'. On microscopy in Paris, see La Berge, A.F. 'Debate as Scientific Practice in Nineteenth-Century Paris: the controversy over the microcope', *Perspectives on Science* 12 (2004), pp. 424-453.

47 On academic microscopy in London at this time see Bracegirdle, P.H. 'The Establishment of Histology in the Curriculum of the London Medical Schools: 1826-1886' (unpublished PhD thesis, University of London, 1996). On the fashion for microscopy in the United States, see Warner, J.H. ''Exploring the Inner Labyrinths of Creation': Popular Microscopy in Nineteenth-Century America', *Journal of the History of Medicine and Allied Sciences* 37 (1982), pp. 7-33. An overview of histories of microscopy published before 1999 is presented in La Berge, A. 'The History of Science and the History of Microscopy' *Perspectives on Science* 7 (1999), pp. 111-142.

48 For an overview of microscopic societies and their associated journals, see Brock, W.H. Patronage and Publishing: journals of microscopy 1839-1989' *Journal of Microscopy* 155 (1989), pp. 249-266.

Membership, though not officially restricted to men, was nevertheless presumed to be so. Seemingly minor opportunities for women to engage with the society did however exist. One important feature that grew up alongside its regular (exclusively male) meetings and excursions was an annual gathering that women were also allowed to attend. As microscopy began to gain in popularity, these microscopic 'conversaziones' were joined by similar events organised by other gentlemanly groups. The Society of Apothecaries held a series of well-attended microscopic gatherings during the 1850s, and such events became a key focal point for many practitioners following the establishment of self-consciously 'amateur' microscopic societies such as London's Quekett Club during the 1860s.[49] Microscopic conversaziones were well attended. As president of the Microscopical Society, Edwin Lankester boasted that about 'three thousand persons' had attended their meeting held at the Museum of Practical Geology in South Kensington in 1860.[50] These events presented middle-class women with the possibility of engaging with microscopy outside of domestic contexts - confinement to which increasing numbers of women were beginning to characterise as oppressive.

Although most women's role at microscopic functions (or at least those of the larger societies) appears to have remained one of passive observation of male society members' microscopic 'preparations', such meetings nevertheless signify the entrance of women microscopists into public life. Soirées were enthusiastically attended by women, not least early pioneers of female professionalism.[51] The North American surgeon and activist Mary Edwards Walker attended the first conversazione of the Quekett Club at University College London in 1867, being described in the widely-distributed journal *Hardwicke's Science Gossip* as one of the principal attractions of the event.[52] In touring around the numerous tables at a

49 On conversaziones and scientific culture see Alberti, S.J.M.M. 'Conversaziones and the Experience of Science in Victorian England', *Journal of Victorian Culture* 8 (2003), pp. 208-230. On microscopy at the Society of Apothecaries see Richardson, R. 'Microscopical Conversaziones', *The Lancet* 358 (2001), p. 2004. Newspaper articles concerning these meetings indicate a considerable crossover between the display of microscopes and of those illusory technologies identified by Crary as participating in the break-down of 'disembodied' conceptions of observation such as stereoscopes. See eg. *The Morning Post*, Apr. 30th 1858, p. 6, March 16th, 1868, p. 2 and Nov. 16, 1872, p. 6., and *The Standard*, March 20th, 1871, p. 6. ; [all accessed from *C19th British Library Newspapers*, 28/06/10]

50 [Lankester, E.] 'President's Address', *Transactions of the Microscopical Society of London* (New Series) 8 (1860), p. 91.

51 On women's involvement in these events see eg. [West, T.] 'History of the Postal Microscopical Society' *The Journal of the Postal Microscopical Society* 1 (1882 [1877]), p. 6.

52 'The Quekett Soirée', *Harwicke's Science Gossip* 3 (1867), p. 43. On Walker see

microscopic conversaziones, women could display their allegiance to an increasingly prominent culture of natural observation, and potentially even demonstrate the extent of their microscopic learning in conversation with prominent men active in the field.

Perhaps the best indication of microscopic conversaziones' role in the re-figuring of women's place in scientific culture can be found in the attitudes of members of the various societies to their involvement in such events. Where both sexes' simultaneous participation in microscopic soirées is defended in the larger societies' journals, it is done so in terms of a careful differentiation of gender roles. As one Quekett soirée report relates:

> The interest manifested by the members, and the satisfaction exhibited by visitors of both sexes, gave no sign of decadence. There was the same sturdy phalanx of members who had their microscope, and something under it, and the same smiling and blooming troop of female friends peeping anxiously down the hundreds of brazen tubes erected for the delectation. The prophecy that these "shows" would soon come to an end, which some crusty antiquarians have been known to utter, seems as far distant as ever.[53]

By the time these comments were published (1871) however, the heyday of women's involvement in the culture of microscopic display was coming to an end: the above-quoted article was published shortly after a suggestion from the council that women be admitted as members had been voted down.[54]

Simultaneous male and female participation in microscopic gatherings were understood by some as bringing their ostensibly moral purpose of cultivating the scientific awareness of the populace into question. The Apothecaries set aide separate 'ladies' days' at their soirées.[55] But most events included men and women, and seem to have presented clear opportunities for conversation between strangers

LeClair, M.K, White, J.D. and Keeter, S. *Three 19th-Century Women Doctors: Elizabeth Blackwell, Mary Walker, Sarah Loguen Fraser* (New York, 2007), pp. 43-86 and Synder, C.M. *Dr Mary Walker: the little lady in pants* (New York, 1974).

53 'The Soirée', *The Journal of the Quekett Microscopical Club* 2 (1870-1871), p. 185.

54 See 'February 28th, 1868' and 'March 17th, 1868', *The Journal of the Quekett Microscopical Club* 1 (1868-1869), pp. 50 and 84.

55 Richardson, 'Microscopical Conversaziones'.

of different genders. From 1871, the (increasingly professionalized, by that point 'Royal') Microscopical Society stopped hosting microscopic gatherings following a number of complaints to the effect that it was 'extremely difficult to unite the requirements of a scientific gathering with those of an evening party.'[56] Seeming incompatibility with specialised, technical endeavour such as that generally associated with the emerging ethos of professionalism begins to be cited from this time as justification for the abandonment of public demonstration and display. Women's involvement in this (now-prestigious) society thereby came to be severely restricted.

Yet the formalisation of the exclusion of women from the most prestigious microscopic societies does not imply that they were henceforth unable to engage with microscopy more generally. As intimated at the beginning of this chapter, a then-emergent re-configuration of scientific practice around tools of investigation presented some women with a very different set of possibilities to those that had accompanied the rational culture of display and witnessing described above.

Physiological psychology and microscopy after 1850

One of the most visible participants in the many of the major microscopical societies' meetings during this period was the popular zoological and physiological psychological author William Benjamin Carpenter. As has been observed in a previous chapter regarding his engagement with phrenology and mesmerism, Carpenter was especially concerned with the arbitration of who could and could not claim to speak on behalf of nature. Similar questions to those that mesmerism raised are addressed in his microscopic writings. But where mesmerism had only presented Carpenter with problems regarding the appropriate interpretation of trance-like phenomena (he was careful to acknowledge the effectiveness of mesmeric or hypnotic techniques), microscopy also brought the issue of technical competency to the fore. For Carpenter, microscopy presented less of a danger to scientific practice than had mesmerism, but nevertheless demanded more effort from established authorities such as himself (he had come to be recognised as the principal British expert on Foraminifera, a genus of

56 'Royal Microscopical Society', *The Monthly Microscopical Journal* 3 (1870), pp. 213-214; 'Royal Microscopical Society', *The Monthly Microscopical Journal* 5 (1871), p. 194.

microscopic fossil regarding which Charles Darwin sought his advice)[57] with regard to the guidance of less experienced practitioners' investigative skill.

Carpenter's first extensive comments on microscopy appear in a presidential address he gave to the Microscopical Society of London in 1855. The rhetoric of energy correlation and need for national economic efficiency that infuses his physiological writing is immediately apparent:

> I cannot but feel that a great deal of excellent *microscope power*, if I may use the expression, is running to waste... I would not be thought unmindful of the many admirable [British] memoirs and monographs, which may challenge comparison with those of any other country; they are excellent as far as they go; but I am sanguine enough to believe that these could easily be multiplied tenfold, if those who spend their time in desultory observation... would but concentrate their attention upon some particular topic, and work out this with patience and perseverance.[58]

Discipline in techniques of observation, along with a stronger division of microscopic labour, will enable Britain to compete with countries such as Germany, at that time generally recognised as leading the world in microscopic research.[59] But equally significant here is the principal direction that Carpenter's own efforts at stemming such 'waste' of 'microscopic power' took. Instead of seeking to organise the London Society more effectively, or founding a separate over-arching managerial body that might direct microscopists' activities more efficiently, he authored a text-book (*The Microscope: and its revelations* (1856) - hereafter *The Microscope*) that sets out his own conception of correct microscopic conduct - a guide to technical manipulation and observation, aimed at the large numbers of people that he supposes possess microscopes but remain unable to investigate nature effectively using them.

Carpenter's best-selling microscopic publication (it reached a seventh

57 Jardine, B. 'Between the Beagle and the Barnacle: Darwin's microscopy, 1837-1854', *Studies in History and Philosophy of Science* 40 (2009), pp. 386 and 388.

58 [Carpenter, W.B.] 'Address of the President at the Annual Meeting of the Microscopic Society, February 28, 1855', *Transactions of the Microscopical Society of London (New Series)* 3 (1855), p. 54. Carpenter's emphasis.

59 On microscopy in German science at this time see Schickore, *The Microscope and the Eye*, pp. 133-219.

edition in 1881), like his psychological and physiological statements, is permeated by a moralistic stance regarding the final purposes of scientific endeavour. It foregrounds what it portrays as a piety inherent to all investigations of nature, more in line with the natural theological treatises outlined above than with contemporary technical treatises on the use of the tool.[60] Accompanying such assertions is a similarly greater willingness to prescribe to its readers particular forms of behaviour regarding the conduct of natural investigation. *The Microscope* is filled with recommendations not only regarding microscopic observation, but also the constitution of legitimate observation more generally. These comments are marked by a tension between a desire to instil in his readership technical competency as a guarantor of observational accuracy, and a commitment to rationality as the final arbiter of sensory experience.

The Microscope is consistently critical of what it portrays as the over-simplistic assumptions of many microscopists regarding the activity of microscopic investigation itself. Above all, it suggests, microscopists have under-estimated the extent of technical skill necessary for the perception of many microscopic phenomena. Whereas early-nineteenth-century microscopists had generally evaluated the efficacy of their tools in terms of magnification power (either lauding their ability to penetrate nature, or cautioning against the use of high powers on the grounds that observational veracity could not be ensured),[61] Carpenter's text emphasises that such observation is equally dependent on observers' manipulation of a range of tools seemingly peripheral to the lenses themselves. Such is the author's feeling regarding what he regards as an over-emphasis on 'resolving power' at the expense of these other techniques that he quotes his own above-mentioned presidential address to the London Microscopic Society at length:

> This superiority in resolving power... is obtained at the expense of other advantages... the adequate performance of such a lens can only be secured by the greatest exactness of the [focal] adjustments. Only that part of the object that is precisely in focus, can be seen with any

60 Compare Carpenter, W.B. *The Microscope: and its revelations* (London, 1856), eg. pp. v, 30-33 with Quekett, J. *A Practical Treatise on the Use of the Microscope* (London, 1848), p. vii, or Beale, L. *How to Work with the Microscope* (London, 1857). On microscopic manuals as a genre see Schickore, *The Microscope and the Eye,* pp. 220-239.

61 Schickore, *The Microscope and the Eye*, pp. 83-104; Ratcliff, *The quest for the Invisible*.

> approach to distinctness... it is requisite too, that the adjustment for the thickness of the glass that covers the object, should exactly neutralize the effect of its refraction; and that the arrangement of the mirror and condenser must be such as to give the object the best possible illumination. If there be any failure in these conditions, the performance of a lens of very wide aperture is *very much inferior*... except in very experienced hands.[62]

What is especially notable here is the way in which this passage broadens the range of tools considered requisite for accurate observation. In addition to the lenses, stands and object-stages generally considered necessary to extend vision to the microscopic realm, *The Microscope* seeks to inculcate in its readers the ability to arrange and manipulate a multitude of lamps, measuring devices, slide-types, and dissection and fixing techniques.[63] Microscopy in this respect becomes as much about training the hand, as extending the eye.

As argued below, this emphasis on skilful manipulation helped constitute an intellectual milieu in which rational competency could begin to be evaluated not in terms of organic capacity, but rather as an expression of organic-technical interaction. For the moment, it is enough to note the way in which *The Microscope* displaces the responsibility for accurate sensation away from the eye, and onto a tool that had up until that point been conceptualised in terms of that organ's extension into the world. It is no longer the eye alone, so much as it and its host body's interactive relationship with a microscope that 'sees' an object of interest. In some respects then, the publication of this text can be understood as marking the emergence of a notion of perception that constituted the perceiving subject as an empowered alliance of 'man' and 'machine.'

Yet despite the seeming conflation of organism and tool in this text, it should also be noted that it also places a strong emphasis on the need for a somatically individualized, 'rational' approach to the evaluation of the results of such perception. Far from suggesting that the correct manipulation of microscopes will alone guarantee truthful observation, Carpenter is at pains to emphasise the

62 Carpenter, *The Microscope*, pp. 196-197. Carpenter's emphasis.

63 Ibid, pp. 108-184, 204-259. On the considerable work involved in constructing microscopic technologies as 'transparent' mediators of nature even in established institutional settings, see Gooday, G. "Nature' in the Laboratory: domestication and discipline with the microscope in Victorian life science', *The British Journal for the History of Science* 24 (1991), pp. 307-341 and Jacyna, '"A Host of Experienced Microscopists"'.

mutual constitution of observation and interpretation. Where observation is connected with the tool itself, interpretation is associated with the individual observer. In this respect, Carpenter fully accords with the conception of gentlemanly witnessing outlined in the first chapter. His publications insist that no single observer can ever claim observational authority. All are liable to project their expectations onto their observations: 'It is a tendency common to *all* observers, and not by any means peculiar to Microscopists, to describe what they *believe* and *infer*, rather than what they actually *witness*.'[64] Accompanying the above-described emphasis on technique as a means to observational accuracy is a conviction that, even given such technical competency, the attainment of objectivity is only achievable by recourse to mutual agreement between rational individuals. Indeed, disagreement is understood as a key indicator of the inadequacy of one or another part of the observational process:

> it will always be found here, as well as elsewhere, that - good instruments and competent observers being pre-supposed - the accordance in *results* will be precisely proportional to the accordance of *conditions*...The more completely, therefore, the statements of Microscopic observers are kept free from those fallacies, to which observations of any kind are liable... the more completely will it be found that an essential agreement exists among them all, in regard to the facts which they record.[65]

Ultimately, as his 1872 address as President of the British Association for the Advancement of Science indicates, when it comes to the production of observational truth, Carpenter places his faith in a community of technically competent observers:

> trustworthiness... arises from its dependence, not on any one set of experience, but on *our unconscious co-ordination of the whole aggregate of our experiences* - not on the conclusiveness of any one train of reasoning, but on *the convergence of all our lines of thought towards this one centre*.[66]

64 Carpenter, *The Microscope*, p. 8. Carpenter's emphasis. See also pp. 184-185.

65 Carpenter, *The Microscope*, pp. 9-10.

66 Carpenter, 'Man the Interpreter', p. 194. Carpenter's emphases.

A community of practitioners does not even have to be aware that they are acting in concert - their experiences are 'unconsciously co-ordinated' towards the common goal of attaining truthful representation of nature.

As far as microscopic culture during the 1860s and 1870s is concerned, Carpenter's statements place it in parallel with much a broader movement towards the construction of specialist, 'professional' communities as ultimate arbiters of scientific opinion that I have already noted in passing in relation to the efforts to constitute a faculty of science at UCL. It is significant that *The Microscope* makes a clear distinction between those practitioners who might contribute original insight, and those who must confine themselves to the reporting of observation:

> It has been the purpose of the foregoing sketch, to convey an idea, not merely of the services which the Microscope has already rendered to the *collector of facts* in every department of the Science of Life, but also of the value of these facts as a foundation for *philosophical reasoning*... But as it is not every one who is prepared by his previous acquirements to appreciate such researches, according to the scientific estimate of their importance, it may be well now to address ourselves to that large and increasing number, who are disposed to apply themselves to Microscopic research as amateurs, following the pursuit rather as a means of wholesome recreation to their own minds, than with a view to the extension of the boundaries of existing knowledge.[67]

This passage is followed by an extensive comment on the value of microscopy as a means of inculcating disciplined reason in those groups (such as young boys, and 'the Labouring population') deemed most likely to adopt 'evil habits' due to their 'wrong exercise of the natural powers' of the body.[68]

Carpenter's distinction between 'fact collectors' and 'philosophical reasoners' clearly resonates with the sense/reason duality highlighted at the beginning of this chapter. But at the same time, it subtly re-configures this duality as a difference between groups of people (or nervous systems) rather than aspects of existence. Just as the operation of the senses is critical to (but not sufficient for)

67 Carpenter, *The Microscope*, pp. 29-30. Carpenter's emphases.

68 Ibid. pp. 30-35.

rational perception, collectors of facts are critical to (but not sufficient for) philosophical reasoning. Instead of there being two kinds of entity in the world - mind (the rational philosopher) and matter (the object of philosophical concern) - there are now two kinds of practitioner - professional and amateur. In addition, both the conditions for correct observation and for the attribution of originality undergo a notable shift.

Carpenter re-states the sense-reason divide, but constructs sense as inevitably technically mediated, and the cultivation of reason as contingent not only on bodily anatomy, but also technical competency. It is no longer the working of the bodily eye alone, but that of the eye in conjunction with tools that augment sight, that constructs the conditions upon which a community that is able to judge perceptual truth can be built. In the world-view associated with belief in an inherent difference between spirit and matter, it is human bodies that constitute both a critical means of attaining, and the principal barrier to, rational insight. In that in which mind is understood as congruous with bodily presence, technical operations (and operators) perform a similar function.

Again, the assertion that cognition is a function of nervous action had profound implications as far as women's involvement in microscopic culture was concerned. As already noted, the construction of the female body as more liable to disrupt the rational operation of mind had presented women authors as a whole with a dilemma regarding claims to original insight. Women such as Somerville, who considered rationality to be the basis of originality, were understood as 'exceptions' to the general character of their sex. Yet where they sought to engage with men on a rational basis, their work was evaluated in relation to this 'more general' irrationality, and thereby comparatively easily dismissed as admirable, but ultimately inferior to that of the more 'naturally' rational sex. In contrast, women authors operating within the above-described regime of embodied subjectivity were faced with a choice. Either they could seek to construct authorial voices that elided the supposed cognitive disadvantages of womens' bodies, or, they could seek to challenge the technical authority that helped constitute professional exclusivity itself.

Medical women, nervous subjectivity, and microscopic science

Far from simply contributing to the enclosure of rationality as the

exclusive preserve of Western, male bodies, physiological psychological texts' emphasis on the skilful manipulation of tools helped constitute a new field of political action for groups that had historically been constituted as natural 'objects' rather than participants in natural philosophic discourse. Here, I claim that the emphasis on technical means of observation associated with embodied notions of cognition constituted one amongst a number of factors (including the gaining of admission to educational institutions, and constitution of campaigning organizations and networks discussed extensively elsewhere)[69] that presented some women with the possibility of articulating positive claims regarding their own professional abilities. From the late 1860's, a number of middle-class women began to build a reputation for scientific trustworthiness through an engagement with microscopic tools and techniques. By situating themselves as skilful operators and builders of investigative equipment, rather than as rational observers, these women began to substantiate then-increasingly vocal claims that women in general were as capable of contributing to scientific and medical culture as men.[70] In this section, I focus on two women who became especially prominent in medical and scientific discourse during this period, and chart the ways in which a skill-centred conception of microscopic practice constituted a resource with which they were able to construct themselves as legitimate participants within it.

The claim that women's engagement with microscopy helped constitute challenges to the male domination of professions should not be taken as militating against the notion that professionals themselves were becoming increasingly dominant in scientific and medical culture at this time. Indeed, medical professionals relied for the maintenance of their authority on the difficult-to-discern, microscopic nature of many of the new diseases and ailments that they claimed to be able to diagnose and/or treat. The increasing prominence of germ-centred notions of disease presents perhaps the most obvious example of the centrality of microscopic analysis in late-nineteenth-century medical science.[71] But other aspects of medical culture were also being re-oriented around the analysis of a nature that remained imperceptible to those unable to operate such tools. The

69 There is an extensive literature on these topics. On Britain see eg. Dyhouse, C. *No Distinction of Sex? Women in British universities 1870-1939* (London; UCL Press, 1995); Gates, B.T. *Kindred Nature: Victorian and Edwardian women embrace the living world* (University of Chicago Press, Chicago and London, 1998); Crawford, E. *Enterprising Women: the Garretts and their circle* (London, 2002).

70 See eg. Dyhouse, *No Distinction*, pp. 13-17.

71 Warboys, M. *Spreading Germs: diseases, theories, and medical practice in Britain, 1865-1900* (Cambridge University Press; New York, 2000).

attribution of conception to the coming-together of difficult-to-discern sperm and eggs,[72] the accompanying development of early-stage embryology,[73] as well as a mounting panic over the weakness of sperm in men[74] all point to microscopes as tools that were becoming increasingly prominent in the mediation of lay-professional relations at this time.[75] As far as women aspiring to engage in professional discourse were concerned then, demonstrating mastery of microscopic tools and techniques constituted a powerful means of indicating professional competency in both the science and medicine of the time.

Both of the authors I concentrate on here - Frances Elizabeth Hoggan (*née* Morgan),[76] and Alice Marian Hart (*née* Rowland),[77] - engaged extensively in microscopic research and practice. By the time Hoggan began publishing on microscopy in 1876, she had already established a reputation as a pioneer of women's right to participate in professional medical life. In 1870, she had become only the second woman to defend a medical thesis before the faculty of the University of Zürich, one of the earliest of the established European institutions to open their doors to women students. She had also become a physician at the New Hospital for Women in London, an institution set up during the 1870s by women

72 Farley, J. *Gametes & Spores: ideas about sexual reproduction, 1750-1914* (John Hopkins University Press; Baltimore, 1982).

73 Lenoir, *The Strategy of Life*; Nyhart, L.K. *Biology Takes Form: animal morphology and the German universities* (University of Chicago Press, 1995).

74 On the 'spermatorrhea panic', see Rosenman, E.B. 'Body Doubles: The spermatorrhea panic', *Journal of the History of Sexuality* 12 (2003), pp. 365-399, Stephens, E. 'Coining Spermatorrhea: medicine and male bodily fluids', *Sexualities* 12 (2009), pp. 467-485 and Walker, D. 'Continence for a Nation. seminal loss and national vigour', *Labour History* 48 (1985), pp. 1-14.

75 Cassedy, J.H. 'The Microscope in American Medical Science, 1840-1860', *Isis* 67 (1976), pp. 76-97; Warner, D.J. 'The Campaign for Medical Microscopy in Antebellum America', *Bulletin for the History of Medicine* 69 (1995), pp. 367-385; Smith, S.D. 'Coffee, Microscopy, and the Lancet's Analytical Sanitary Commission', *Social History of Medicine* 14 (2001), pp. 171-197.

76 Thomas Neville Bonner refers to Hoggan (*née* Morgan) as Morgan throughout his study of nineteenth-century women's medical education. See Bonner, T.N. *To the Ends of the Earth: women's search for education in medicine* (Cambridge, MA and London, 1992), esp. pp. 38-39. As I primarily engage with her post-matrimonial publications, I will refer to the authorial name given in these (ie. Hoggan). On Hoggan (*née* Morgan) see also Thomas, O. *Frances Elizabeth Hoggan, 1823-1927* (Brecon, 1970).

77 As with Hoggan, I refer to Hart (*née* Rowland) as Hart as that is the name under which she published her microscopic works. The only other substantial scholarly work on Hart relates to her later publication on colonial life, *Picturesque Burma: past and present* (1897). See Keck, S.L. 'Picturesque Burma: British travel writing 1890-1914', *Journal of Southeast Asian Studies* 35 (2004), pp. 387-414.

medics in response to their exclusion from already-established medical institutions.[78] Though Hart does not appear to have joined a professional organization, she trained at the Laboratoire d'Histologie at the Collège de France in Paris during the late 1870's, and her adoption of the microscopic techniques and practices developed there constitute the basis for a number of articles published during the early 1880s.[79] Of the two, Hoggan was the more outspoken regarding the politics of professionalism, authoring a wide range of articles and pamphlets calling for improvements to women's education, opposing vivisection, and resigning from the New Hospital due to her disagreement with her fellow physician Elizabeth Garrett Anderson's performance of ovarian surgery there.[80] What is of concern here however is the ways in which a technical conception of microscopic practice could be enlisted to confer a status of professional authority on women's opinions regarding such matters.

Perhaps surprisingly given the then-pervasive supposition that women were unlikely to be able to contribute to assumedly rational forms of knowledge such as psychology, evidence exists that both Hart and Hoggan engaged with physiological conceptions of cognition. Indeed, some of Hart's early scientific activities were facilitated by the renowned authority on neurological diseases (and favoured pupil of Thomas Laycock) James Crichton-Browne. A letter from him dated 29th of November 1874 describes his efforts to send a 'Sciopticon' (seemingly a kind of projector) for what he describes as Hart's 'school entertainments' from his base in the West Riding Lunatic Asylum at Wakefield.[81] Later, in 1879, Hart received a letter from another physiological psychologist, Daniel Hack Tuke, thanking her for sending him a review (which unfortunately I have been unable to locate) of a physiological psychological work, and offering a few words of encouragement regarding her evidently positive portrayal of connections between mind and brain: 'One cannot be too thankful that a man like Charcot has arisen in this our age, to take up obscure nervous phenomena in a scientific way.'[82]

78 Bonner, *To the Ends of the Earth*, pp. 38-39.

79 Hart mentions her training in Hart, A. ['Mrs. Ernest'] 'On the Micrometric Numeration of the Blood-Corpuscles, and the Estimation of their Hæmaglobin', *Quarterly Journal of Microscopical Science* 21 (1881), pp. 132 and 133-134.

80 'Frances Elizabeth Hoggan', *DNB* [accessed 20/08/2010].

81 James Crichton-Browne-Mrs Ernest Hart, 29th Nov. 1874. Wellcome Library, Western MS.5423/6

82 Daniel Hack Tuke-Mrs Ernest Hart, 19th Dec. 1879. Wellcome Library, Western

Evidence for Hoggan's personal engagement with physiological conceptions of psychology is more tenuous, but it is certainly the case that she, along with her husband and fellow activist George, undertook research on the functions of nerves. In an article published during the early 1880's, they challenge the then-widespread belief that different sites of nerve-endings were associated with different kinds of touch-sensation. Instead, using a then-familiar metaphor, they propose that all nerves operate in the manner of an electric telegraph, conveying messages to the 'nerve-centres of consciousness.'[83]

In support of my contention that physiological notions of subjectivity were accompanied by an emphasis on tools and techniques in observational practice, both women's microscopic publications concentrate, first and foremost, on the novelty of their claims regarding microscopic technique. Hart justifies her participation in scientific discourse on the pragmatic grounds that the efficacy of medical practice is being held back by the imperfection of techniques for analysing blood. As she comments in her first article, published in the *Quarterly Journal of Microscopic Science* in 1881, although 'micrometric numeration of the blood-corpuscles and the estimation of hæmoglobin' had only recently been developed, it had 'rapidly passed out of the sphere of laboratory experiment into practical use as exact methods of physiological and clinical investigation.'[84] However, she goes on to suggest, 'the methods and instruments hitherto in use are inconveniently imperfect and vitiated by numerous sources of error. Some recent improvements by M. Malassez, assistant in the Laboratory of Histology in the Collége de France, appear to me to have done much to remove these disadvantages.'[85] Above all, Hart's article's principal concern is not with histological nature itself, but with the improvement of microscopic practice. As one of the few British students at the

MS.5423/12. See also James Crichton-Browne-Mrs Ernest Hart, 5th Nov. 1895 Wellcome Library, Western MS.5423/32 and John Scott Burdon-Sanderson[-Mr and Mrs Hart], Wellcome Library, Western MS.5423/36. On Hart's husband Ernest's commitment to the 'nervous' interpretation of hypnotism see Leighton, M.E. '"Hypnosis Redivivus": Ernest Hart, the British Medical Journal, and the Hypnotism Controversy', *Victorian Periodicals Review* 34 (2001), esp. pp. 112-113.

83 Hoggan, G and Hoggan, F.E. 'On Some Cutaneous Nerve-Terminations in Mammals', *Journal of the Linnaean Society (Zoology)* 16 (1882), pp. 546-593. See also Hoggan, G. 'On the Functions, Character, and Positions of the Ultimate Nerve-Terminations in the Skin and Hairs', *British Medical Journal* 1146 (Dec. 16th, 1882), pp. 1197-1200.

84 Hart, 'On the Micrometric Numeration', p. 132. On microscopy and blood-research more generally at this time see Warner, J.H. 'Therapeutic Explanation and the Edinburgh Bloodletting Controversy: two perspectives on the medical meaning of science in the mid-nineteenth century', *Medical History* 24 (1980), esp. pp. 247-254.

85 Hart, 'On the Micrometric Numeration', p. 132.

Laboratoire d'Histologie, she constructs herself as already working within a professional context, and as merely 'translating' an (in this case technical) form of knowledge from one context to another (an activity conventionally understood as especially appropriate to women aspiring to scientific authorship).[86]

Women's claims to scientific originality during this period remained subject to a significant degree of scepticism, and on occasion attracted outright hostility from respected, well-qualified medical practitioners. If Hart's earliest microscopic publication retained a self-image as a cautious translator of others' work, Hoggan - to an extent already established as a medical authority through her attendance at Zurich - was more bold. Her first microscopic article, published in 1876 issue of *The Journal of the Quekett Microscopic Club*, describes what it claims to be an entirely new histological staining technique.[87] Yet even articulating this claim in print appears to have been a difficult process. Hoggan's first submission had been to the more prestigious *British Medical Journal*, but, as her Quekett article notes, there had been some difficulty in getting it published in that organ:

> Although that paper has been in the hands of the editor of the Journal [Alice Hart's husband Ernest Abraham Hart] for the last nine months, it has not been published, but inadequate, and in some cases erroneous, accounts of my process, have largely been circulated... I have, therefore, considered it advisable to give, as shortly as possible, the details of this very simple and effective process to your Society, whose members will, I doubt not, put it to every sort of test.[88]

Whether the *BMJ* article was held back because of Hoggan's gender identification, reputation as an activist, or because she was perceived as a rival to Ernest Hart's microscopist wife, what is of importance here is the emphasis her Quekett article places on the veracity of the technique she is putting forward. Hoggan, in inviting the 'amateur' members of the Quekett Club to put her staining method (which, she claims, requires no materials that cannot be obtained at a local chemist and

86 Findlen, 'Translating the New Science'; Neeley, K.A. 'Woman as Mediatrix: women as writers on science and technology in the eighteenth and nineteenth centuries.' *IEEE Transactions on Professional Communication* 35 (1992), pp. 208-216.

87 Hoggan, F.E. 'On a New Process of Histological Staining', *The Journal of the Quekett Microscopical Club* 4 (1874-1877), pp. 180-181.

88 Ibid. p. 180.

druggist)[89] to 'every sort of test', deflects attention away from her gender. It is not as a observer, reasoner, or woman that she wishes to be judged, but a microscopic inventor - her scientific reputation in this field is (she hopes) to be judged on the efficacy of her technique in the hands of others, rather than anything that might rely on her own bodily capacities.

Both Hoggan and Hart only begin to claim observational authority once they have established themselves as contributors to the development of microscopic technique. Even then, their statements regarding microscopic nature are continually referred back to their technical competency. For example, although Hart's second publication brings a question of observational interpretation, not technical skill, to the fore, she nevertheless emphasises the authoritative significance of technical matters. One year before her initial publication, in 1880, a physician - one Richard Norris - had claimed to have observed what he understood as a new translucent, or 'invisible' species of corpuscle during the formation of 'fibrine' (matter constitutive of blood-clots).[90] Hart contests this claim, suggesting instead (following the work of the German physiologist Alexander Schmidt) that these invisible corpuscles are in actuality blood corpuscles that have lost their red matter: 'Dr Norris discovers, by various means of staining, his invisible corpuscle. That it is there I do not deny, but that it is there because it previously existed in this condition in the blood in the living state is I think open to dispute.'[91] Despite the clear question of interpretation that seems to be at stake here, Hart does not emphasise her rational or observational perspicacity to substantiate this claim. Rather, her Paris-obtained technical skills constitute her basis for critique. It is, she claims, 'the staining agents recommended by Dr. Norris' that are 'not sufficiently powerful' for him to detect the red matter escaping from these corpuscles, not his vision, reason or observational capacity.[92] As in Hoggan's article, Hart removes her bodily self from the debate, emphasising the perceptive efficacy of technical processes above questions of personal interpretation. A similar rhetorical strategy can be found in the numerous other microscopic publications Hoggan authored in

89 Ibid. p. 181.

90 Norris, R. *The Physiology and Pathology of the Blood: comprising the origins, mode of development, pathological and post-mortem changes of its morphological elements in mammalian and oviparous vertebrates* (London, 1882).

91 Hart, A. [Mrs Ernest] 'Note on the Formation of Fibrine', *Quarterly Journal of Microscopical Science* 22 (1882), p. 255.

92 Ibid. p. 256.

partnership with her husband.[93] Through their engagement with technical aspects of microscopic practice, both Hoggan and Hart are able to construct an authorial voice for themselves as researchers with the ability to provide observational insight into the nature of the very small.[94]

In addition to adopting a technically authoritative rhetoric in her own researches, Hoggan sought to persuade other women of the liberation that she believed microscopic tools could provide. In a short article in the *Englishwoman's Review* for 1879 (reprinted in pamphlet form), she sets out ways in which microscopes might assist 'those who are looking about them and longing for work, but who are withheld from choosing a profession or trade by the authority or wishes of parents and friends, or by the silent but no less potent influences of their education and surroundings.'[95] Indeed, in a statement that plays up to the assumptions of anatomically determined differences of sex, she claims that women are particularly suited to the technical demands of microscopic observation: 'The quick eye, the neat hand, the habitual close attention to details which distinguish many of our sex are valuable qualities in this particular field of work.'[96] Above all, microscopes hold out the possibility that women might produce original insight into nature:

> A steady, conscientious worker is sure to discover new facts, and you may at any moment light on a discovery which may give the clue to the observations of others, which may revolutionize your section of the scientific world, which may lead to the elucidation of some obscure form of disease, which may promote the wellbeing or save

93 Hoggan, G. and Hoggan, F.E. 'On the Development and Retrogression of the Fat Cell', *Journal of the Royal Microscopical Society* 2 (1879), pp. 353-380; Hoggan, G. and Hoggan, F.E. 'On the Development and Retrogression of Blood-vessels' *Journal of the Royal Microscopical Society* 3 (1880), pp. 568-584; Hoggan, G. and Hoggan, F.E. 'On the Comparative Anatomy of the Lymphatics of the Uterus', *The Journal of Anatomy and Physiology, Normal and Pathological* 16 (1882), pp. 50-89.

94 Though she did herself not aspire to be a 'professional' scientist or medic, Ada Lovelace again presents a supporting example of the potential that scientific tools could have in the construction of authority. Lovelace (who also engaged with physiological notions of mind) only began to declare herself a 'real' natural philosophic thinker following her collaboration with Babbage on the latter's mathematical 'analytical engine.' See Winter, 'A Calculus of Suffering', pp. 227-228 and 230-233.

95 Hoggan, F.E. *The Microscope as Affording Employment and Recreation to Women, with hints for beginners on how to set to work* (London, [1879]), p. 4.

96 Ibid, p. 6.

the lives of thousands[97]

Hoggan's confident recommendation of microscopy as a particularly appropriate scientific pursuit for women is most plausibly seen not as a response to the latest fashion for microscopic display (which was by that time in terminal decline), but as emerging out of her extensive engagement with the tool during a period in which women's presence in professional organisations remained subject to much doubt and opposition.

What is not being suggested here is that Hoggan and Hart develop a form of rhetoric that is specific to women, or that seeks to privilege women as scientists or medics. Indeed as both the previous chapter and the above comments on Carpenter's publication make clear, technical competency is beginning to be held up as a scientific ideal for all aspiring professionals during this period. Rather, I wish to emphasise that it is precisely the technical constitution of this rhetoric that made it attractive to women seeking to attain professional status. The technical emphasis that emerged as an ideal of scientific practice alongside embodied notions of subjectivity paradoxically effaced the involvement of the 'naked' body in scientific observation. This elevation of technique-as-observation presented opportunities for groups that were considered inherently inferior to men with regard to their rational ability. With the physiological constitution of tool-manipulation as an indicator of rational competency, emphasis on technique could be made into a way of eliding the imputation that one's individual body constitutes a barrier to accurate perception.

Although the above comments have been confined to women's engagement with microscopy, it should be possible to expand this claim to encompass other historically 'lower' groups, such as non-European peoples and the working classes, and also other observation-related tools as photographic cameras, the pulse-inscribing sphygsmograph, and electrical monitoring equipment.[98] Nevertheless, in comparison to other investigative equipment of the mid-to-late nineteenth century, microscopes were particularly amenable to engagement with by women. The comparatively low cost of microscopes would have made them relatively easy to get hold of unlike other kinds of scientific equipment. In addition, they were easily

97 Ibid, p. 7.

98 On early photography and gender see Tucker, 'Gender and Genre'. On the sphygmograph as a human 'prosthesis' see Brophy, G. 'The Sphygmograph,' *Victorian Review* 35 (2009), pp. 13-17. See also Henchman, A. 'The Telescope as Prosthesis,' *Victorian Review* 35 (2009), pp. 27-32.

adapted for use in domestic contexts, a property that many writers on the tool (including Hoggan) pointed to when discussing their potential for enlightening the masses.[99] Hence the proliferation of women microscopists during the 1860s and 1870s can be understood as a particularly dramatic instance of more general shifts in women's relation to scientific practice at this time.

Yet increasingly, even microscopic research was being put out of the reach of those who did not have access to institutional resources. Microscopes considered appropriate for professional contexts were coming to be differentiated from those suited to home use. As Graham Gooday has shown, microscopes in laboratory settings became ever more complex (and thereby expensive) objects as greater attention was paid to the nature of the very small.[100] It was manufacturers of investigative tools that had most to gain from the cultural shift towards technical ways of knowing, and fields such as engineering and tool design remained particularly resistant to the involvement of women within them.[101] The period in which women working in domestic contexts were able to engage with the professional, laboratory-centred discourse of microscopy was thereby relatively short. As microscope-related tools, along with the formal scientific disciplines that they were was made to serve, became ever more specialised, barriers between recreational and work-centred observation became ever more marked. Nevertheless, a significant number of women scientists and medics did publish on both microscopic technique and nature between 1860 and 1880.[102] For a short period of time at least, the acceptance of technical conceptions of microscopic observation helped constitute a context in which professionally ambitious women

99 Hoggan, 'The Microscope as Affording Employment', pp. 5-6; Cooper, 'A Brief Sketch', p. 1; Carpenter, *The Microscope*, p. v; Beale, *How To Work With the Microscope*, pp. 3-4.

100 Gooday, "Nature' in the Laboratory.'

101 On women's (limited) involvement in trade in scientific tools during the nineteenth century see Morrison-Law, A.D. 'Women in the Nineteenth-Century Scientific Instrument Trade', in Benjamin, *Science and Sensibility*, pp. 89-117. On industrial culture and exclusivity more generally, see Berg, *The Machinery Questio*n.

102 Women authors on microscopy of this time include Miss E.F. Staveley, Eleanor Anne Ormerod, Alice Johnson, and Jessie A. Sallitt. On these figures and for lists of their publications see Creese, *Ladies in the Laboratory?*. Though she does not present a clear case of a woman aspiring to professional recognition, Ormerod's publications demonstrate perhaps the most extensive of all women's engagements with microscopy during this period. On Ormerod see Sheffield, S.L-M. *Revealing New Worlds: Three Victorian Women Naturalists* (London, 2001), pp. 139-194, and McDirmid Clark, J.F. 'Eleanor Ormerod (1828-1901) as an Economic Entomologist: 'Pioneer of Purity Even More than of Paris Green" *The British Journal for the History of Science* 25 (1992), pp. 431-452.

were able to construct themselves as original contributors to medical and scientific discourse. In so doing, they were able to challenge gendered barriers to professional membership, and thereby complicate future claims to sexual exclusivity that posited a direct relation between bodily constitution and perceptual capacity.

Techniques of resistance, or resistance to the technical?

The adoption of tool-centred modes of scientific writing were not the only - nor even the principal - way in which women wrote on science during the latter decades of the nineteenth century. I thereby wish to conclude this chapter by pointing to a rather different way in which epistemic tools such as microscopes appear in the scientific literature of the period. Scientific novelists and popular authors such as George Eliot and George Henry Lewes, and authors of texts aimed at children such as Arabella Burton Buckley, could command a far broader readership than the esoteric publications associated with the likes of Hart and Hoggan.[103] In the texts of these former authors - who adhere to notions of embodied subjectivity just as much if not more explicitly than the technical authors discussed in the previous section - tools are made to participate in, rather than constitute an authority for, the construction of scientific narrative. In making explicit the narrative capacity of tools, they indicate the emergence of a different form of resistance to Western, male dominance than that which aspired to break down the exclusivity of the professions through gaining admission to them.

Like Hart and Hoggan, Buckley - one of the most successful woman writers on science of late-nineteenth century Britain - engaged enthusiastically with physiological psychologists' claims regarding the embodied nature of perception. In taking on the position of editor of the tenth edition of Somerville's *On the Connexion of the Physical Sciences* (1877), Buckley was aware of the respect that her predecessor could command within certain sections of the scientific community. Nevertheless, she was also concerned with developing a scientific reputation of her own, having worked as the famed geologist Sir Charles

103 On Buckley see Gates, B.T. 'Revisioning Darwin With Sympathy: Arabella Buckley', in Gates, B.T. and Shtier, A.T. *Natural Eloquence: women reinscribe science* (Madison and London, 1997), pp. 164-176 and Lightman, B. *Victorian Popularizers of Science: designing nature for new audiences* (University of Chicago Press; Chicago and London, 2007), pp. 238-253.

Lyell's secretary between 1864 and 1875, and recently published her first book, *A Short History of Natural Science* (1876). Promising not to disturb any passage in which Somerville's 'own views' were expressed, even if they were in Buckley's view occasionally 'somewhat antiquated',[104] she nevertheless felt the need to update *On the Connexion* to address some the more recent scientific trends. Specifically, significant portions of molecular and energy science (including researches by James Clerk-Maxwell, Sir William Thomson, John Tyndall and, most notably, the pre-eminent physiologist and psychologist in Germany, Hermann von Helmholtz) had not been included in previous editions.[105] The publications of Helmholtz, in Buckley's opinion, offered an important update for Somerville's previous comments on the perception of colours. Somerville had relied on the work of Sir David Brewster, who had attributed the perception of colour difference to the nature of the solar spectrum. In contrast with Newton, Brewster considered that three 'primary' colours were pre-existent in nature, and that it was these natural colours which made up the spectrum as a whole.[106] Buckley's edition draws on Helmholtz to articulate a different conclusion. Rather than the three primary colours being present in a nature external to human perception, she suggests, Helmholtz's conclusions demonstrate that the perception of colour depends on the nature of the body - specifically, that of the eye and its associated nerves.[107] This linking of perception with bodily processes is a consistent theme in Buckley's work. In *A Short History*, she cites the most famous physiological psychologist, Herbert Spencer, as 'one of our greatest living thinkers', and makes a number of comments regarding what she understands as the close relations of nervous and psychological life in her later works.[108] Yet her engagement with investigative equipment presents a very different conception of the role of tools in scientific life than does Hart and Hoggan's publications.

104 Somerville, M. (corr. and rev. Buckley, A.B.) *On the Connexion of the Physical Sciences* [10th ed.] (London, 1877), p. vii.

105 Ibid. pp. ix-x.

106 Somerville, M. *On the Connexion of the Physical Sciences* [9th ed.] (London, 1858), pp. 160-162.

107 Somerville, *On the Connexion...* [10th ed.], pp. 183-186.

108 Buckley, A.B. *A Short History of Natural Science, and of the Progress of Discovery from the Time of the Greeks to the Present Day, For the Use of Schools and Young Persons* (London, 1876), p. 139; Buckley, A.B. *Life and Her Children: glimpses of animal life from the amœba to the insects* (London, 1880), eg. pp. 266-268 and 300-301; Buckley, A.B. *Winners in Life's Race or the Great Backboned Family* (London, 1882), eg. pp. 8-9.

Rather than look to tools and technical competency as means of guaranteeing observational truth, Buckley - like a number of her contemporaries - adopts an authorial voice which seeks to acknowledge the contingency of all truth-claims regarding nature. To this end, she emphasises the uncertainty of her own narrative suppositions. Gillian Beer has pointed to the articulation of a problematic relation between subject and object in late nineteenth century literature. The publication of such figures as Charles Darwin and Eliot, she suggests, are linked by their articulation of new forms of authorial voice, marked by their concern to acknowledge the indeterminacy of scientific investigation. Where Darwin emphasises the uncertain nature of his claims regarding nature, or Elliot brings the determination of her novels' protagonists futures into question, these authors privilege the contingent, transformative and relational aspects of perceptions of nature.[109] In a similar way, Buckley insists on the uncertainty of her claims regarding the Darwinian, naturally selected world of life that her publications portray. *A Short History* concludes with a eulogy to the power of scientific investigation, which not only encourages piety and devotion, but instils a profound sense of the unknowability of the universe:

> 'True science, like true religion, leads to an entire and childlike dependence upon the Invisible Ruler of the Universe... it leads even the most instructed to feel how extremely limited our knowledge is, and that we are after all, like inexperienced children, dependent on the love and power of our Maker to bring us safely out of the darkness into the light.'[110]

Science in this passage becomes the path to true enlightenment, to a belief in the 'love and power of our Maker'. But unlike the claims of those natural theological texts that seek proof of heavenly influence in God's creation itself, it does so above all through its inculcation of a sense of the incomprehensibility of creation as a whole.[111] Religious life does not end with an demonstration of the creative hand of

109 Beer, *Darwin's Plots*, pp. 33-43, 67-70, 139-155 and 175-185.

110 Buckley, *A Short History*, p. 237.

111 Buckley also appears to have authored two scholarly articles engaging with theosophy (ie. the possibility of re-incarnation) from an evolutionary perspective. See [Buckley, A.B.] 'Darwinism and Religion', *Macmillan's Magazine* 24 (1871), pp. 45-51 and [Buckley, A.B.] 'The Soul, and the Theory of Evolution', *University Magazine* 93 (1879), pp. 1-10.

god in nature (in this case natural selection), but the acknowledgement that the true nature of creation is not and (critically) cannot ever be completely known.

For those seeking to articulate a form of narrative in which the narrator is not - and cannot be - all-knowing, the supposition that any mode of practice might act as an infallible guarantor of perception becomes problematic. This was certainly the case as far as technical modes of objectivity are concerned. Going along with Buckley's articulation of an inherently unknowing subjectivity is a portrayal of investigative tools not as sources of observational authority, but as literal 'narrative devices.' *A Short History* describes the seventeenth-century microscopist Anton von Leeuwenhoek as someone who made the microscope tell a 'wonderful tale' of a world of invisible animalcules and the tiny offspring of larger creatures.[112] Her later *Through Magic Glasses* (1890) narrates the story of an illusion-producing 'magician' science teacher who introduces his class to the wonders of nature by speaking to them through the 'magic glasses' of telescopes, microscopes and spectroscopes.[113] Such strategies are strongly reminiscent of Elliot's use of microscopic metaphors in *Middlemarch* (1871-1872), in which the microscope figures as a narrative means of contrasting the technical confidence of a professional scientific observer with the perceptual difficulties experienced and acknowledged by the amateur of the tale.[114] The publications of Elliot's partner, the physiological psychological author and self-defined amateur microscopist George Henry Lewes, also relate a sense of microscopy as connected to self-examination as much as interrogation of an external world.[115] For Buckley, Elliot and Lewes, microscopic manipulation is not only a means of knowing the world, but also of narrating a sense of self as unable to know in any complete sense at all.

Though it is beyond the scope of this chapter to detail the specific beliefs of Buckley, Elliot or Lewes regarding the nature of the knowing subject, it is nevertheless important to note that these figure's notions of scientific subjectivity were both entirely compatible with embodied notions of cognition, and sharply divergent from the technical tropes of scientific observation outlined above in

112 Buckley, *A Short History*, p. 139.

113 Buckley, A.B. *Through Magic Glasses, and Other Lectures* (London, 1890). See Gates, 'Revisioning Darwin'.

114 Wormald, M. 'Microscopy and Semiotic in *Middlemarch*', *Nineteenth-Century Literature* 50 (1996), pp. 501-524.

115 Ibid, esp. pp. 512-517; Armstrong, 'The Microscope', pp. 40-43. See Lewes, G.H. *Sea-Side Studies at Ilfracombe, Tenby, The Scilly Isles, & Jersey* (Edinburgh and London, 1858), esp. pp. 36-38 and 53-55.

connection with it. These figures' comments on the narrative potential of investigative tools can be understood as indicating the presence of a strand of scientific culture that sought to constitute alternatives to the tool-centred, professional ways of seeing associated with technical conceptions of objectivity. Through its privileging of technical means of knowing the world, the nerve-centric culture of late nineteenth-century Britain emphasised technical competence as the means of - and thereby also the barrier to - participating in scientific discourse. As epistemic tools and techniques became ever more complex, esoteric, and expensive, the ability to be recognised as a scientific authority came to rest on access to institutions able to afford such equipment. For writers seeking to articulate wider narrative conceptions of nature, this mode of participation constituted a problem in and of itself, rather than a means of overcoming bodily barriers to rational contemplation. The figuring of tools as narrative devices in this sense becomes a means of resisting technique-centred notions of natural perception without necessarily bringing the observer's worldly presence into question (indeed, often by insisting on it all the more).

Conclusion

The articulation of diverse forms of embodied subjectivity during this period thereby marks a disjuncture in the conditions of possibility that women experienced regarding their participation in discourses relating to nature. Where a regime of disembodied subjectivity held up the possession of rationality as the pre-eminent key to the production of natural truth, the articulation of a notion of rationality as inherently embodied brought the means of its production into question. Within the regime of cognitive disembodiment, the organic body presents the sovereign medium through which perception of the material world might be effected. In contrast, the regime of bodily cognition is marked by a tension between the perceptive capacities of two kinds of body - the organic experiencing subject, and the technical means by which that subject's perceptual capacity is presumed to be extended.[116]

For middle-class women seeking to resist late-nineteenth-century efforts to confine professional participation to historically authoritative (ie. European, male) bodies, at least two possibilities presented themselves. On the one hand, they could

116 Ketabgian, 'The Human Prosthesis.'

seek access to those organisations that sought (increasingly effectively) to gain a monopoly over the production of natural truth. To this end, many women sought recognition as technical innovators. By emphasising the originality of their techniques rather than of their organic bodily experiences, they were able to elide the corporeal barriers to rationality that their organic bodies were thought to present. On the other hand, they could - in conjunction with other 'non-professional' sympathisers - seek to deny the scientific legitimacy of professional knowledge itself. For those to whom scientific professionalism constituted a problem as much as a solution, the tool-centred epistemology of professional science itself begins to figure as an object of resistance.

The divergence of these two forms of resistance appears to rest on a differentiation between two modes of scientific activity that accompanied the articulation of embodied notions of self. Where disembodied culture consistently elevates 'representation' above 'practice' - science pre-eminently consists in the rational sensation and interpretation of the material world by an immaterial soul - the nerve-centred culture of embodiment is marked by a tension between the two. Within this latter culture, attitudes towards tools and techniques constitute a point of departure regarding political action. For those seeking escape from the definition of their selves in terms of a determining, organic nature, a ‘practical’ engagement with epistemic tools and techniques could constitute a means of personal emancipation. Alternately, for those who saw the determination of culture in terms of nature as inevitable, it could only be through the articulation of alternative forms of ‘representation’ (ie. the re-constitution of narrative science) that any of those aspects of scientific culture then-increasingly coming to be perceived as excessive (vivisection, for example) might be curbed.

Chapter 5:

Technical Life: vivisection and the critique of nervous subjectivity (c.1870-1890)

Introduction

This chapter characterises the constitution during the 1870s and 1880s of what I term a 'post-physiological' dynamic regarding the place of the human in Western culture. This dynamic, I believe, both depends on, and seeks to differentiate itself from, the physiological psychological context out of which it begins to crystallize during the late nineteenth century. Where physiological conceptions of mind take as their central problematic the relation of matter to spirit, and human beings' place in this relation, the post-physiological tendencies addressed in this chapter are principally concerned with defining ways in which technicity and humanity, and humanity and life, relate to one another. Put another way, although the exclusively material presence of human being remains the principal explicit point of contention in physiological psychological culture during the nineteenth century, another discourse can be discerned that emerges alongside it. Within this discourse, the principal tension brings the very 'humanness' of individuals' bodies into question. Psychologically-concerned texts begin to emerge during the 1870s and 1880s that do not principally address the materiality or otherwise of mind, but rather the extent to which bodily presence can be thought as interaction between human animals and 'animal' others, and to which bodily organs can be thought in relation to non-organic 'tools'. Such texts thereby prefigure the 'cybernetic' and 'posthuman' subjectivities pointed to in the introduction to this thesis.

It should be emphasised that neither the re-thinking of humanity as an attempt to become more animal-like, nor belief that it might gradually being displaced by a potentially self-generating, 'technical' form of existence, can be seen as central to most nineteenth-century culture. Nevertheless, by focusing on the notion of tools as 'prosthetics' that could be attached to human bodies (and, indeed,

of humans as prosthetics that could be attached to tools), Tamara Ketabgian and Erin O'Connor have begun to chart the emergence during the latter half of the century of a culture in which it became harder to conceive of humans and machines as distinct, constitutionally unrelated categories. These writers privilege such sites as factories and such tools as artificial limbs as objects of concern. As such, their analyses address a re-constitution of humanity in relation to an unproblematically 'mechanical' set of tools and techniques.[1]

In contrast to O'Connor and Ketabgian's focus on human-machine interactions, this chapter takes as its focus the constitution of subjectivity in relation to an assemblage that *itself* embodied a relation between body and mechanism: the vivisected animal. In Britain, vivisected animals constituted the principal, most explicitly problematized figure of organic-technical interaction during the latter decades of the nineteenth century. Through a consideration of two late-nineteenth-century critics of nervous subjectivity that engaged with these entities - Edward Carpenter (1844-1929) and Samuel Butler (1835-1902) - a post-physiological subjectivity is seen to emerge. Within this notion of the self, the principal points of contention concern the extent and ways in which humanity might indeed come to reconcile itself to living nature, and the possibility that to be human might indeed also be to accommodate oneself to a self-generating, technical form of life.

The previous chapter indicated that nervous psychology constituted a key condition by which tools became important for the re-negotiation of gender roles during the second half of the nineteenth century. Extending this analysis to the notion of 'masculinity,' this chapter emphasises again that the technical discourse of physiology did not simply offer a means by which historically objectified 'subjects' could seek to participate in an unchanging, enlightened culture of rational empiricism.[2] On the contrary, the increasingly prevalent figure of the technically-

1 Ketabgian, 'The Human Prosthesis'; O'Connor, *Raw Material*, pp. 102-147. See also Ketabgian, *The Lives of Machines*.

2 On masculinity nineteenth-century in Britain see eg. Adams, J.E. *Dandies and Desert Saints: styles of Victorian masculinity* (Cornell; University Press, 1995); Sussman, H. *Victorian Masculinities: manhood and masculine poetics in early Victorian literature and art* (Cambridge; University Press, 1995); Tosh, J. *A Man's Place: masculinity and the middle-class home in Victorian England* (Yale; University Press, 1999); Tosh, J.A. *Manliness and Masculinities in Nineteenth-Century Britain: essays on gender, family and empire* (Harlow, 2005).

manipulated organism struck at the heart of eighteenth-century conceptions of ‘man’ as a singular and observationally privileged whole. Kay Anderson has noted that the latter decades of the nineteenth century can be read as being marked by a ‘crisis’ within ‘classical’ (ie. enlightenment) notions of the human. Anderson emphasises the agency of colonial sites and peoples in this crisis.[3] I wish to complement her account by pointing to the place of organic-technical entities in this break-down of the human subject.

Vivisected animals participated in the break-down of conceptions of humanity that had come to the fore during the eighteenth century in at least two respects. Firstly, the performativity of vivisectional practice dramatised the already-detailed contention that human life could not be conceived except in terms of an epistemologically prior, or more fundamental, living 'element.' The medical rationale for study of non-human nervous systems took as its basic premise the contention that all nervous systems were fundamentally similar. Re-thinking ‘man’ in terms of 'elemental' or 'animal' drives and desires, late nineteenth century texts concerning relations between animality and humanity contributed to a much longer-term undermining of the presumption that men are pre-eminently intellectual, 'rational' beings.[4] Secondly, and more specifically to the technical emphasis that accompanied physiological psychological thinking, the vivisected animal is made in and of itself a figure in relation to which humans begin to be re-constituted as inherently 'habitual' entities. Human bodies come to be linked to machines and animals simultaneously; or rather, human subjectivity is integrated into a representational world in which tools are conceived of as counterparts of the ‘living,’ and animals are portrayed as fundamentally reliant on the ‘technical’.

The spreading of vivisectional practice played a significant role in the fracturing of many of the certainties of nineteenth-century culture.[5] As an

3 Anderson, *Race and the Crisis of Humanism*, esp. pp. 109-145.

4 See the previous chapters of this thesis and Dror, O.E. 'The Affect of Experiment: the turn to emotions in Anglo-American physiology, 1900-1940,' *Isis* 90 (1999), pp. 205-237; Dror, O.E. 'Techniques of the Brain and the Paradox of Emotions, 1880-1930,' in *Science in Context* 14 (2001), pp. 643-660; White, P. 'The Face of Physiology,' *Interdisciplinary Studies in the Long Nineteenth Century* 7 (2008), pp. [http://www.19.bbk.ac.uk/index.php/19/article/view/487/0 accessed 01/02/11]; White, 'Darwin's Emotions’.

5 There is now an extensive literature on nineteenth-century vivisectional practices. See French, R.D. *Antivivisection and Medical Science in Victorian Society* (Princeton and London; Princeton University Press, 1975); Lansbury, C. *The Old Brown Dog: women,*

investigative technique, it both promised answers to long-held questions concerning the 'nature' of the human, and required as raw material elements of nature (animals) conventionally defined within Western culture as placed under man's care by God. Hitherto largely unquestioned assumptions regarding the inevitability of scientific progress, as well as the unquestionablility of man's place at the head of creation, become subject to doubt in Britain around the same time that vivisection becomes a focus of debate. The newly-constructed academic laboratories devoted to the technical revealing of the physiology of life witness the emergence of a newly-persuasive object of scientific concern during the 1870s and 1880s. Held up as 'the' technique by which the physiological relations of nerves and bodies to minds might be discovered, the results of interventions in animals' nervous systems are employed to support those psychologies that insist on the identity of matter and spirit. Yet, simultaneously, such practices also become a broader focus for concern. For many, the practice of vivisection heralded a cultural elevation of physical science, was motivated by a desire to reduce metaphysics to matter, and symbolized a descent into a state of moral degradation at odds with the teachings of the Christian church.[6]

Vivisection remains a focus of concern even amongst those texts that do not object to the proposition that mind is inherently material. Indeed, attempts to

workers , and vivisection in Edwardian England (University of Wisconsin Press; Madison, 1985); Rupke, N.A. (ed.) *Vivisection in Historical Perspective* (London and New York, 1990); Kean, H. 'The 'Smooth Cool Men of Science': the feminist reaction and socialist response to vivisection' *History Workshop Journal* 40 (1995), pp. 16-38; Menke, R. 'Fiction as Vivisection: G.H. Lewes and George Eliot,' *ELH* 67 (2000), pp. 617-653; Preece, R. 'Darwinism, Christianity, and the Great Vivisection Debate', *Journal of the history of Ideas* 64 (2003), pp. 399-419; Bittel, C. 'Science, Suffrage, and Experimentation: Mary Putnam Jacobi and the controversy over vivisection in late nineteenth-century America,' *Bulletin of the History of Medicine* 79 (2005), pp. 664-694; Pollock, M.S. 'Ouida's Rhetoric of Empathy: a case study of Victorian anti-vivisection narrative', in Pollock, M.S. and Rainwater, C. (eds.) *Figuring animals: essays on animal images in art, literature, philosophy and popular culture* (New York and Basingstoke, 2005), pp. 135-159; Degeling, C. 'Canines, Cosanguinity, and One-Medicine: all the qualities of a dog except loyalty', *Health and History* 10 (2008), pp. 23-47; Mayer, J. The Expression of the Emotions in Man and Laboratory Animals', *Victorian Studies* 50 (2008), pp. 399-417; Miller, I. 'Necessary Torture? Vivisection, suffragette force-feeding, and responses to scientific medicine in Britain c. 1870-1920,' *Journal of the History of Medicine and Allied Sciences* 64 (2009), pp. 333-372; Mayer, J. 'The vivisection of the Snark,' *Victorian Poetry* 47 (2009), pp. 429-448; Chakrabarti, P. 'Beasts of Burden: animals and laboratory research in colonial India,' *History of Scienc*e 48 (2010), pp. 125-151. For an historiographic overview see Mayer, J. 'Ways of Reading Animals in Victorian Literature, Culture and Science', *Literature Compass* 7 (2010), pp. 347-357.

6 Preece, 'Darwinism, Christianity, and the Great Vivisection Debate'.

re-think an embodied psychology in more holistic terms than those adhered to by physiological psychologists are frequently accompanied by doubts regarding the appropriateness, efficacy, and plausibility of vivisection as a means of psychological investigation. One response to this concern was to regulate the practice of vivisection, enclosing it as the exclusive right of a 'professional' scientific community. But even though vivisectional practice itself came to be regulated out of the sight of a citizenry no longer judged competent to evaluate its' effects, the *representational* figure of the vivisected animal proliferated.[7] This figure became a means by which the very historically differentiated categories that physiological psychologists had sought indelibly to fuse within the human body - matter and spirit - would be re-thought in relation to and at the conjunction of two rather different figures - that of the animal and the machine. It is thereby the purpose of this chapter to emphasise the active role that the representation of vivisectional assemblages played in reconstitution of 'man,' and the breakdown of historically-established attitudes and beliefs during the latter decades of the century. Animals combined with physiologically-intrusive tools - and, by implication, bio-technical entities more generally - can, I believe, be understood as participatory actors in the deconstruction of the nerve-centred discourse that has played (and still does play) a critical role in the constitution and maintenance of liberal individualist forms of subjectivity.[8]

7 Burt, J. 'The Illumination of the Animal Kingdom: the role of light and electricity in animal representation,' *Society & Animals* 9 (2001), pp. 203-228; Lawrence, C. 'Cinema Vérité? The Image of William Harvey's Experiments in 1928', in Rupke, *Vivisection*, pp. 295-313.

8 In this respect this chapter draws its theme from studies of the place of the 'cyborg' in contemporary culture (see the notes to the introduction of this thesis). It also draws on a burgeoning literature addressing the representation of animals. See eg. Rothfels, N. (ed.) *Representing Animals* (Indiana University Press; Bloomington, 2002), esp. Fudge, E. 'A Left-handed Blow: writing the history of animals', in *idem*, pp. 3-18; Pollock, M.S. and Rainwater, C. (eds.) *Figuring Animals: essays on animal images in art, literature, philosophy and popular culture* (New York and Basingstoke, 2005); Kete, K. (ed.) *A Cultural History of Animals in the Age of Empire* (Oxford and New York, 2007), esp. Magnum, T. 'Narrative Dominion or The Animals Write Back? Animal genres in literature and the arts', in *idem*, pp. 153-173; Ritvo, *The Animal Estate*.

Vivisection and the 'man of science'

Firstly, it should be noted that, as 'the' characteristic form of experimentation with life during the late nineteenth century, vivisection was intimately associated with the constitution of physiology as the scientific equal of other experimental disciplines such as physics and chemistry.

A perceived need for laboratory settings in which to conduct vivisection helped constitute new spaces in which scientific identities could be formed. The widespread adoption of vivisection, and of the notion of the British physiologist as a scientific man who works exclusively as a researcher, emerge at around the same time.[9] Vivisection's bloody nature, and the need for specialist equipment to conduct it, meant that it was largely practised in the laboratory or laboratory-like settings associated with the emerging identity of the 'professional' scientific or medical researcher. Conversely, as texts place increasing emphasis on laboratory experimentation as 'the' principal characteristic of scientific practice, inquiry regarding the nature of physiological life comes to be identified closely with sites designed specifically for experimentation with animals. Like the chemical laboratories of Thomas Thomson or Lord Kelvin's rooms devoted to physical experimentation at Glasgow University earlier in the century, physiological laboratories such as those founded by Michael Foster at Cambridge during the early 1870s[10] had become emblematic of an enhancement of cultural status for their associated field of study.

Animal experimentation also took place in museological or even (as anti-vivisectionists frequently emphasised) domestic settings.[11] Nevertheless, it is only along with the dedication of rooms and buildings (and particularly rooms and buildings within established academic settings) to such practices that British writers begin to identify them as critical to the conduct of investigation within the field as a whole.[12] The need for personnel that went along with the construction of

9 French, *Antivivisection and Medical Science*, pp. 42-44. Rupke, N. 'Pro-Vivisection in England in the Early 1880s: arguments and motives', in Rupke, *Vivisection*, pp. 188-208.

10 Geison, *Michael Foster*, pp. 162-163.

11 Kraft, and Alberti, ‘'Equal though Different''.

12 French, R.D. *Antivivisection and Medical Science*, pp. 33-46. Rupke, 'Pro-Vivisection in England'.

physiological laboratories both swelled the numbers of physiologists employed by institutions devoted to experimental research and pedagogy, and helped create a perception that experimental physiology was attaining increasing influence within those institutions themselves.

The widespread adoption of vivisection also accompanied efforts by laboratory-trained physiologists to claim exclusivity regarding the ability to define physiological life. As well as being perceived as the principal means by which physiology could be made into a 'laboratory' science like chemistry and physics, the proliferation of laboratory-based vivisection is accompanied by an expansion in the use of technical terms relating to it. As noted in previous chapters, physiologists employed in laboratories and museums at this time begin to demarcate their activities from what are increasingly characterised as 'amateur' investigations into the nature of life. One important means of achieving this is through the use of esoteric terminology. *The Handbook for the Physiological Laboratory* (1873) - a text considered critical to the formation of experimental physiology as a discipline - insisted in its introductory statement that it belonged 'in the laboratory rather than the study', and spared its readers none of the technical terms associated with the academic study of medicine.[13] The perception that vivisectional investigation could be unreliable if conducted without due care and attention contributed to a wider feeling that hands and heads that had not been trained in the language of physiology were not capable of pronouncing on the significance of experimental phenomena. Whilst entirely capable of observing apparently unadorned 'facts' in the field, amateurs were not generally considered masters of the tools and language that were becoming requisite for the admission of physiological articles into respected, specialist scientific publications.

These two tendencies regarding the justification of allocation of resources to physiological investigation, and the increasing exclusivity of the community that benefited from such resource allocation, indicate ways in which vivisection came to be associated with the formation of the identity of the 'professional' physiologist rather than that of the 'man of science.'[14] As one means by which the exclusive

13 Sanderson, J.B. 'Editor's Preface', in Sanderson, *Handbook for the Physiological Laboratory*, p. vii.

14 On the gendering of the emerging identity of the 'scientist' during the late nineteenth century see Barton, "Men of Science"; White, *Thomas* Huxley; Mussell, 'Private

spaces and rhetoric now associated with a professionalizing scientific discourse could be constructed, vivisection might be said to have constituted a set of tools and techniques by which a community seeking to define the nature of life was able to exclude others (such as untrained laypeople, and spokespeople for faith-based institutions).[15] However, I wish to point here to another assumption associated with the spread of laboratory vivisection that is perhaps more specific to the practice itself (rather than held in common with other experimental assemblages); the consideration of intervention in animals' nervous systems as a pre-eminently 'manly' activity.

That nineteenth-century commentators on vivisection understand it as a practice particularly unsuited to women is well recognised. Historians such as Coral Lansbury and Mary Anne Elston, as well as highlighting the for-the-time unusual prominence of women in campaigns against animal experimentation, have also noted a concurrent tendency to portray those women who did vivisect as particularly immoral or dangerous.[16] To many, women's participation in such practices directly contravened their responsibility of upholding a stringent ideal of domestic virtue and innocence. 'Sensibility' (discussed below) towards those on whom pain might be inflicted constituted an unquestionable feminine duty. Women who experimented with animals (dogs presented a key example) that might constitute objects of affection in other contexts seemed to have abandoned all notion of feminine responsibility, whether towards God the father or the father of the home.[17] Such assumptions held, despite protestations from women practitioners that vivisection was critical to the attainment of professional competency in medicine (a significant object of feminist agitation at the time).[18] As a set of techniques the mastery of which could be taken to indicate both observational competency and the infliction of pain on 'innocent' life, vivisection attracted a

Practices'.

15 On the teleology of 'profession' as object of explanation see Burnham, 'How the Idea of Profession'.

16 Lansbury, *The Old Brown Dog*; Elston, M.A. 'Women and Anti-Vivisection in Victorian England', in Rupke, *Vivisection*, pp. 259-294.

17 On the status of dogs as both companion animals and experimental subjects see Degeling, 'Canines, Cosanguinity, and One-Medicine'.

18 Bittel, 'Science, Suffrage, and Experimentation'.

particularly contentious discourse regarding women's status and notions of femininity.[19] Less well understood however are the specific conceptions and re-formulations of manliness that accompanied and paralleled these debates.

In asserting the cultural value of experimental physiology, advocates of vivisection also articulate a conception of such physiology as a manly pursuit. In his study of Thomas Henry Huxley (one of the key advocates of the practice during the second half of the nineteenth century), Paul White describes a tension that characterises many late-nineteenth-century scientific men's attempts to define their activities as crucial to British culture. Early in his career, Huxley strove to construct a scientific persona that was autonomous from and authoritative over the domestic aspects of his life. For example, when discussing his suitability as a partner in his private correspondence, Huxley appealed to his self-sacrifice and the nobility of his cause, rather than the material prospects that a zoological career might bring. Becoming a 'man of science' was in one sense a means of legitimising his choice of career in the face of doubts regarding his ability to support a family (or even bring his future wife Henrietta Heathorn to England from Australia, where she had been born). Huxley's articulation of his scientific ideal was thus also an assertion of a masculinity in which self-sacrifice for a ‘greater cause’, rather than the cultivation of material wealth, was critical.[20] Later in his career, during the 1880s, Huxley sought to re-define science in relation to what he portrayed as more literary, less 'useful' pursuits. Here, the nobility or idealism of the practical experimentalist was understood as comparable to that of gentlemen of letters. Scientific practitioners deserved an at least equal role to classicists in elite culture because of their highly trained organic senses, and their elevation of the authority of 'nature' over that of any individual.[21] Yet at the same time, it was by workers in a laboratory - rather than by disinterested gentlemen at home - that Huxley envisioned most science would be conducted.[22] In establishing buildings intended for the training of scientific workers, Huxley implicitly acknowledged that the

19 Lansbury, *The Old Brown Dog*; Elston, 'Women and Anti-Vivisection'.

20 White, *Thomas Huxley*, pp. 6-31.

21 White, *Thomas Huxley*, pp. 67-99. See also White, P. 'Ministers of Culture: Arnold, Huxley and liberal Anglican reform of learning', *History of Science* 43 (2005), pp. 113-138.

22 Forgan, and Gooday, 'Constructing South Kensington’.

inclusion of natural philosophic concerns within an elite culture entailed a profound shift in what it meant to be a scientific ‘man’. Scientific culture would become something that was generated outside of the home - and hence largely in conjunction of the earning of a living by a ‘professional’ man of the household.

The construction of a laboratory culture in Britain at this time is accompanied by the emergence of new ideals of gender relations, as well as of manliness. In the new scientific ideal, a gentlemanly, 'leisurely' notion of detached observation of a distinct, feminized ‘nature’ begins to be combined with a 'worklike' notion of reactive experimentation *with* nature that typifies the emerging ethos of professionalism. This re-formation of notions of gendered experience is evident in perhaps the most widely read text dealing with the proper conduct of the experimentalist, Claude Bernard's *An Introduction to the Study of Experimental Medicine* (1865). Discussing the need for the good experimentalists to alternate between distinct modes of observation and experimentation, Bernard insists on the desirability of both active and passive stances towards their objects of concern:

> I may say that our experimenter puts questions to nature; but that, as soon as she speaks, he must hold his peace, must note her answer, hear her out and in every case accept her decision. It has been said that the experimenter must force nature to unveil herself. Yes, the experimenter doubtless forces nature to unveil herself by attacking her with all manner of questions; [but] he must never answer for her nor listen partially to her answers by taking, from the result of an experiment, only those that confirm his hypothesis... he must submit his idea to nature and be ready to abandon, to alter or supplant it, in accordance with what he learns from observing the phenomena which he has induced.[23]

The good experimentalist will approach nature as he would a potential wife: politely, sensitively, but nevertheless with the ultimate goal of forcing or persuading her to 'reveal' herself. In contrast to previously-articulated, 'gentlemanly' codes of scientific conduct, this is not to be achieved by a penetrative

23 Bernard, C. (trans. Greene, H.C.) *An Introduction to the Study of Experimental Medicine* (New York, 1929 [1865]), pp. 22-23.

observation and representation of 'passive' objects of concern alone. It is also a matter of inducing nature to act, and of passively submitting *oneself* to whatever actions one induces.[24] Moreover, such activities are to be conducted in specially-constructed (predominantly masculine) spaces of work, and hence appear to constitute both a vantage point over, and a refuge from, the (increasingly feminized) gaze of the home.[25]

As the epitome of late-nineteenth-century physiological practice, vivisection played a critical role in experimentalists' attempts to define what it meant to be a scientific man. Well-known practitioners of vivisection such as Huxley and Bernard were also key figures in the articulation of an experimental manliness. The new scientific man was to be both an active, penetrating builder and operator of experimental apparatus, and a passive, submissive observer of the phenomena that they thereby induced. In so doing, they were to combine qualities of both elite gentlemanly and middle-class professional masculinity. Yet experimentalists' concern regarding such matters did not spring from their attempts to introduce new epistemic practices alone. Manliness in general was being re-negotiated in many different parts of British life during the latter decades of the nineteenth century.[26] A reputation as a talented experimentalist did not confer an unquestionable right to define gender norms. Indeed, the 'experimental' notion of masculinity evident in Bernard's text emerges in conjunction with claims articulated in the context of explicit opposition to vivisectional practice - as a negotiation between a small but coherent community of gentlemen and 'professionals', and a larger and more diffuse group seeking to critique their activities.

24 Daston and Galison, *Objectivity*, pp. 115-190.

25 Bernard's comments regarding the necessity of passing through a 'costly, ghastly kitchen' also seem relevant here. See Dror, O.E. 'Creating the Emotional Body: confusion, possibilities, and knowledge', in Stearns, P.N. and Lewis, J. (eds.) *An Emotional History of the United States* (New York and London; New York University Press, 1998), pp. 173-194, and Dror, 'The Affect of Experiment'.

26 See the literature cited in note [2] above, esp. Tosh, *A Man's Place*.

Questioning the manliness of vivisection

Many of the concerns regarding masculine conduct evident in vivisectionists' writings are equally apparent in texts opposing technical intervention in animals' bodies. For example, a similar tension between gentlemanly and occupational concerns can be discerned in anti-vivisectionist literature. However, whereas the experimentalists' texts are principally engaged in defining a positive vision of what it means to be a student of nature, their opponents chiefly occupy themselves with stating ways in which experimental physiology exemplifies or produces undesirable, negative forms of masculinity.

I here highlight two connected tendencies regarding the accusation that practising vivisection is not an appropriate activity for a man; firstly that vivisection is not compatible with a gentlemanly code of conduct; and secondly, that those that do engage with it expose themselves and others to the possibility of moral degradation.

Many of the texts opposing vivisection emphasise that in subjecting animals to what they characterise as painful experiments, physiologists display a lack of the 'sensibility,' or sympathetic feeling considered critical to the conduct of a gentleman. Sensibility had formed an indispensable element of gentlemanly identity since at least the eighteenth century. A term initially denoting both perceptual sensitivity and a more general susceptibility to one's environment, it had by the middle of the nineteenth century come to refer primarily to empathetic emotional experience.[27] Sensibility to the feelings of others - and especially to those placed under one's care - was a key duty for a gentleman. Properly controlled by a superintending rationality, the expression of one's emotional life was considered crucial to the maintenance of fruitful relationships, especially within marriage.[28] Whilst during the nineteenth century the public display of affect came increasingly to be frowned upon in the light of revolutionary 'excesses', private expressions of feeling nevertheless remained critical to gentlemanly identity.[29] To

27 Barker-Benfield, G.J. *The Culture of Sensibility: sex and society in eighteenth-century Britain* (Chicago and London; University of Chicago Press, 1992), esp. pp. 65-77 and 382-395.

28 Barker-Benfield, G.J. *The Culture of Sensibility*, pp. 247-250.

29 On the post-revolutionary reaction to overt expressions of emotion see Kete, K.

lack sensibility, then, was to indicate one's lack of awareness of social convention. If, as its opponent claimed, vivisection could only be undertaken in good conscience by those with little emotional awareness, its status as a legitimate practice for a scientific gentleman would be open to question.

Anti-vivisectionist texts deny the possibility that the practice of animal experimentation is compatible with the possession of gentlemanly sensibility by emphasising what they represent as a need for animals to be 'protected' from 'painful' experimentation. In her essay *The Scientific Spirit of the Age*, Frances Power Cobbe - perhaps the most active, and certainly one of the most famous agitators against experimental physiology during the 1870's and 1880's - articulates a notion of gentlemanliness that places particular emphasis on its 'sympathetic,' protective character. Cobbe bridles at a suggestion of Sir James Paget (a defender of vivisection) that a 'scientific' education offers an appropriate means of training men in the skills requisite for living a civilized life:

> To train a MAN it is surely indispensable to develop in him a superior order of powers from these? His mind must be enriched with the culture of his own age and country, and of other lands and ages... a human education making claim to completeness should cultivate the imagination and poetic sentiment; should 'soften manners'... widen the sympathies, dignify the character, inspire enthusiasm for noble actions, and chivalrous tenderness towards women and all who need defence; and thus send for the accomplished student a *gentleman* in the true sense of the word.[30]

'Introduction: Animals and Human Empire', in Kete, *A Cultural History of Animals*, p. 7. The centrality of sensibility to nineteenth-century conceptions of gentlemanliness is now well recognised. See for example Wagner, T.S. '"Overpowering Vitality": nostalgia and men of sensibility in the fiction of Wilkie Collins', *Modern Language Quarterly* 63 (2002), pp. 471-500; Endersby, J. 'Sympathetic Science: Charles Darwin, Joseph Hooker, and the passions of Victorian naturalists,' *Victorian Studies* 51 (2009), pp. 299-320. On sensibility in psychological discourse, see Lanzoni, S. 'Sympathy in Mind (1876-1900),' *Journal of the History of Ideas* 70 (2009), pp. 265-287.

30 Cobbe, F.P. 'The Scientific Spirit of the Age', in Cobbe, F.P. *The Scientific Spirit of the Age and Other Pleas and Discussions* (London, 1888), pp. 10-11. Cobbe's emphases. see also eg. Kingsford, A. 'The Uselessness of Vivisection', *Nineteenth Century* 11 (1882), p. 181.

Key to Cobbe's argument is the 'chivalrous tenderness' that she expects gentlemen to display towards those under their care - a trope also prevalent in the growing number of novels and poems addressing the issue of vivisection from this time.[31] To inflict pain on animals, it seems, constitutes a clear breach of this code, posing severe problems for those physiologists seeking to defend animal experimentation as a gentlemanly practice.

A second line of attack concerned an anxiety that even if those that experimented came to the laboratory with the best of intentions, the degrading nature of the practice would leave them incapable of appreciating the distress of others. The articulation of this concern owes more to the emerging middle-class physiological psychological culture than to any elite notion of masculine identity. Specifically, it draws on the notion that 'habit', or the repetition of the actions of experimenters' muscles and nerves, might result in the gradual and unconscious adoption of potentially undesirable kinds of behaviour. A pure-hearted innocent entering a physiological laboratory could, given long enough to habituate themselves to the cruel practices undertaken there, leave with little or no ability to recognise signs of pain or discomfort in the animals or human beings they encounter in their day-to-day lives.

The 'habitual' critique of vivisection emphasises a possibility that involvement in experimental physiological training might be a cause, rather than (as was the case in discussions of the relative gentlemanliness of the practice) an indication, of a wider debasement of morality. In this respect it strikes at a key means by which experimental physiologists' sought to justify the construction of physiological laboratories for the instruction of university students and teachers. George Hoggan relates that

> my own personal experience has taught me, and on the continent especially, that amongst physiologists you have the kindest, most gentlemanly, and amiable people, but that the glaring fault that was to be noticed was an entire want of feeling, that their feelings were entirely blunted; they seemed to be unconscious that they were

31 Coral Lansbury addresses vivisection in nineteenth-century fiction at some length in Lansbury, *The Old Brown Dog*, pp. 63-129. See also Menke, 'Fiction as Vivisection'and Mayer, 'The vivisection of the Snark'.

> inflicting the greatest pain; they did not do it intentionally.[32]

For many opponents of vivisection, it is the sensibility of the nation's youth as well that of its gentlemen that experimental physiology threatens to undermine. George Richard Jesse, secretary for Cobbe's Society for the Abolition of Vivisection, asserts in his evidence to the Commission for example that 'these practices are becoming a moral ulcer... they tend to demoralise mankind, and are by education vitiating the minds of the young.'[33]

Vivisection, by habituating the nation's youth into the acceptance of the infliction of pain on animals, could be identified as a source of many of the problems that we now associate with industrial culture more generally. This tendency to associate experimental or 'scientific' education with wider concerns is articulated most emphatically by the novelist 'Ouida'.[34] In an 1886 article opposing vivisection published in the *North American Review* (much of which was later incorporated into a subsequent, more general critique of scientific culture entitled *The New Priesthood* (1893)), Ouida connects the spread of laboratory training in Germany with an insidious autocratic mindset:

> [Lyon] Playfair [also a defender of vivisection] speaks much of the superior wisdom, the superior education, the superior devotion to science, of Germany as contrasted with those of any other nation... but the only result of all this expenditure and instruction is a military despotism so colossal that, whilst it overawes and paralyses both German liberty and European peace, it may yet fall over from its own weight any day.[35]

32 *Report of the Royal Commission*, p. 211.

33 *Report of the Royal Commission*, p. 219. See also eg. Macauley, J. 'Vivisection: is it scientifically useful or morally justifiable?', in Grant, B. and Wall, A. *Vivisection, Scientifically and Ethically Considered in Prize Essays* (London, 1881), pp. 82-83, Wall, A. 'Painful Experiments on Living Animals', *idem*, pp. 293-295, and Sarel, E.A. 'Letter to *The Zoophilist*, April 2nd 1883,' *The Zoophilist* 3 (1883-1884), p. 62.

34 Ouida is the pseudonym of Maria Louise Ramée. See Pollock, 'Ouida's Rhetoric of Empathy'.

35 Ouida, 'Some Fallacies of Science', *North American Review* 142 (1886), pp. 139-152. See also Ouida, *The New Priesthood* (London, 1893), esp. pp. 14-18 and 59-60.

For some, the habit of vivisection threatened to escape from the laboratories where it was practised and engulf the liberal values that had become such a mainstay of late-nineteenth-century Anglophone culture. It typified a cultural malaise into which it seemed industrial Britain was plunging, along with a growing concern that the nation's empire might fall into decline.

Anti-vivisectionists thereby brought to the fore the possibility that physiological experimentation might be playing a role in corrupting boys who would be better off trained in more sympathy-inducing topics. Understood as a critical tool for the formation of future rulers of the Empire's attitudes and beliefs, education of the nation's male youth constituted a significant point of debate during the latter decades of the nineteenth century.[36] Concern regarding the morals of children combined readily with the insistence of authors such as Henry Maudsley or Francis Galton that organic inheritance might be degenerative as well as progressive.[37] Although experimentation with animals' nervous systems was critical to the establishment of notions that this could occur at psychological (nervous) as well as generative (non-nervous bodily) levels, the rhetoric of 'unconscious cerebration' was also easily adapted to critique of experimental epistemology in the study of life.[38] In adapting physiological psychological rhetoric in this way, critics of vivisection separated faith in the notion that mind and nerve are congruous from the epistemic conditions under which such notions were initially articulated. Despite many of those sceptical of the scientific value of vivisection agreeing that mind and nerve were congruous, they nevertheless began to employ the concept of habituation against the experimental practices that had helped legitimate the concept in the first place.

36 See chapter three of this thesis. On the close relation between British attitudes towards colonial peoples and non-human animals towards the end of the nineteenth century, see Chakrabarti, 'Beasts of Burden'.

37 On education, degeneration and childhood see Shuttleworth, S. *The Mind of the Child: child development in literature, science, and medicine, 1840-1900* (Oxford University Press; Oxford and New York, 2010), esp. pp. 181-206, 233-244, and 353-354. On degeneration more generally see Pick, D. *Faces of Degeneration: a European disorder, c.1848-1918* (Cambridge, New York and Melbourne; Cambridge University Press, 1993).

38 Eg. 'Editorial', *The Zoophilist* 4 (1884-1885), p. 230. The notion that heredity could only occur via the organic production of offspring (ie. by natural selection), on the other hand, came to be understood as offering powerful support to vivisectionists' activities. See for example Cobbe, F.P. 'The New Morality', *The Zoophilist* 4 (1884-1885), pp. 167-169.

Both those committed to physiological experiment and those who opposed such practices adopt remarkably similar positions regarding the desirability of certain kinds of masculinity. Though different antagonists place differing emphases on such categories as gentlemanliness and professionality, proponents on both sides of the debate are agreed on the importance of both. At different times, either the private expression of sentimentality, or the need for men to earn a living outside of the home, remains the pre-eminent concern. The vivisection debates that occur during the late nineteenth century might then be characterised as accompanying a more general re-positioning of gender norms of masculinity. In this debate, the character-ideal of the 'man of science' is articulated in terms of a figure residing along a continuum that runs from the personal integrity (or otherwise) of the reputable gentleman on the one hand, to the self-regulating capacity (or otherwise) of a group of working professionals on the other.[39]

Animal-machine hybrids and the constitution of self

Historians have pointed to the relevance of questions of class and professional exclusivity in the vivisection debates.[40] Their conclusions indicate that the questioning of experimental physiology by practitioners and non-practitioners alike are not motivated by concerns regarding gender politics alone. Nevertheless, what I wish to indicate here is that vivisected animals - and by implication bio-technical entities more generally - have historically constituted representational loci by which gender norms - along with other aspects of subjectivity - have been brought into question. Another way of saying this is that cultures centred on nervous psychology have tended to produce certain kinds of artefact (such as vivisected animals) and certain kinds of debate (such as whether or not it is 'manly' to vivisect) that have tended to undermine established norms regarding the constitution of the self. If nothing else, the late-nineteenth-century debates over vivisection signify the introduction of a symbol of organism-machine interaction

39 White, *Thomas Huxley*. See also White, 'Darwin's Emotions.'

40 Harrison, B. *Peaceable Kingdom: stability and change in modern Britain* (Oxford; Clarendon Press, 1982), pp. 82-122; French, *Antivivisection and Medical* Science, eg. pp. 27-30; Lansbury, *The Old Brown Dog*, esp. pp. 26-62; Kean, 'The 'Smooth Cool Men of Science'.

into a much broader cultural arena than had hitherto been the case. This proliferation should, I believe, be accorded more prominence in explanations of the emergence during the final decades of the nineteenth century of a critical literature that targets the liberal individualist assumptions of its time.

The rest of this chapter expands on these claims by pointing to the publications of two late-nineteenth-century figures who articulate - and to a certain extent embody - a then-nascent effort to critique conventional science as a whole, rather than just experimental physiology. Firstly, a series of lectures by Edward Carpenter - a late-nineteenth century opponent of capitalism and advocate of 'natural' living - exemplifies a more general attempt amongst those opposing liberal individualism to re-constitute science on an emotional rather than a rational or systematically objective basis. The second figure I address here - Samuel Butler - takes a very different view of physiological experimentation. Rather than oppose the practice per se, he articulates a radical re-interpretation of the significance of such investigations (at least as far as they relate to psychology). Publications attributed to both of these figures have been recognised as influential in the breaking-down of nineteenth-century assumptions regarding the inherent desirability of outward expressions of piety, and the undesirability of overtly emotional - and especially sexual - display by men.

What I want to emphasise here is the connection of such critiques to the vivisectional techniques that were increasingly being held up as symbolic of the dangers of moving towards an exclusively ‘scientific’ culture. Carpenter and Butler set out their critiques of nerve-centred subjectivity in contrasting ways, as detailed below.

In Carpenter's texts, discovering ways in which we might empathise and communicate as human animals will enable humanity as a whole to begin to participate in, rather than dominate, ‘nature’. In developing this position, these texts draw heavily on 'romantic' tropes such as the need to acknowledge the observer's presence in observation, and the desirability of 'transcending' the assumptions of the present. But texts identified with the romantic movement almost invariably focus on contending the rationalist insistence that existence can be understood entirely in terms of the interaction of material entities – that 'spirit' has no causal effect in day-to-day life.[41] Carpenter's texts, in contrast, identify not the reduction

41 On romanticism and the constitution of 'life' as an object of study see Richards, R.J. *The*

of existence to matter, but the belief that 'technology' offers an unproblematic means by which humans can control nature, as their target. They aim to render obsolete any attempt to subsume non-human elements of the world to the human via the introduction of tool-centred modes of investigation such as vivisection. They thereby, through critique of vivisection, begin to bring the 'non-humanness' of the built world to the fore.

In contrast to Carpenter's writings, those of Samuel Butler target physiologists' assumption that the provocation of phenomena through intervention in animals' nervous systems (ie. vivisection) will produce knowledge relating to an unadorned 'nature'. They insist that one of the foundational categories relating to physiological psychology - 'habit' - is as applicable to the tools used to intervene in animals' bodies as it is to the psychology of the animal itself. In this way, they promote the notion that self-perpetuation is a phenomenon characteristic of non-organic entities hitherto generally considered to have been the construction of ‘human’ subjects just as much as it is of 'natural', organic ones. In these critiques of nerve-centred subjectivity, the notion of individual humans as unitary, independent actors on a world stage comes to appear as an illusion brought about by our own elevated sense of self-worth.

Both Carpenter and Butler thereby draw on the figure of the vivisected animal to articulate radically different notions of self, both of which serve to call conceptions of humans as beings independent from and able to define the nature of the non-human into question.

Taken together, such notions as these, I suggest, are indicative of the emergence of a 'post-physiological' dynamic. I am not claiming here that contemporaries understood Carpenter and Butler as working together to go 'beyond' liberal individualist assumptions regarding the capacities of human life. I am however suggesting that, as modes of thought that have historically associated themselves with (whether through their direct opposition to, or radical re-interpretation of) figures of organism-machine interaction, their publications indicate an intimate link between the articulation of critical perspectives on conventionally ‘scientific’ subjectivity, and such hybrid entities.

Romantic Conception of Life: science and philosophy in the age of Goethe (Chicago; University Press, 2002).

Edward Carpenter: human animality

Edward Carpenter is best known for his work articulating and identifying with the notion of an 'intermediate sex' - a sexual identity that does not adhere to nineteenth-century culture's hetero-normative ideals of emotional fulfilment. In his *Love's Coming of Age* (1896), Carpenter characterises femininity as an identity that has historically been made subject to masculinity. He positions his own 'intermediate' or 'Uranian' identity as a mixture between the two gender extremes, able to mediate between them. Positing sexual desire fundamental to human psychology, Carpenter develops his 'intermediate sex' in terms of a critique of the taboos regarding the expression of sexuality that he portrays as permeating the late nineteenth century. Nevertheless, sex for Carpenter is not the end of life. Men and women, he suggests, should seek to develop their emotional capacities as a means of transcending their natural sexual desire into a higher form, achievement of which is denoted by the attainment of worldly love.[42] Carpenter can thereby be understood as a champion of a masculinity that seeks to reconcile itself with a feminine nature via assimilation. By apprehending and accepting the natural, feminine aspects of themselves, men might participate in the constitution of a world in which sexual expression is constituted in terms of loving emotion rather than simply (as he suggests had previously been the case) procreation.[43]

Carpenter is also recognised as influential in the codification of radical ideals and practices as they come to be established in Britain during the latter decades of the nineteenth century. Though particularly attracted to anarchism as a political doctrine, his speeches and essays have since been noted by socialists and anarchists alike. Carpenter (who hailed from a conventional, well-respected family), sought not only to develop a critique of liberal capitalist culture, but also

42 Carpenter, E. *Love's Coming-of-Age* (Manchester, 1896).

43 Thiele, B. 'Coming-of-Age: Edward Carpenter on Sex and Reproduction,' in Brown, T. (ed.) *Edward Carpenter and Late-Victorian Radicalism* (London and Portland, Oregon, 1990), pp. 100-125. Carla Hustak points to this aspect of Carpenter's activities in her recently-completed doctoral thesis on early twentieth-century trans-Atlantic radicals' notions of love, intimacy and bodily emotion. See Hustak, C.C. 'Radical Intimacies: affective potential and the politics of love in the transatlantic sex-reform movement, 1900-1930' (unpublished PhD thesis, University of Toronto, 2011), esp. pp. 379-402. On Carpenter more generally see Rowbotham, S. *Edward Carpenter: a life of liberty and love* (London and Brooklyn, 2008); Tsuzuki, C. *Edward Carpenter 1844-1929: prophet of human fellowship* (Cambridge University Press; Cambridge and New York, 1980).

insisted on a need to put such ideological convictions into practice. He played an important part in the foundation of the Labour Party and Fabian Society, and corresponded with many of the leading radicals of his day including (amongst many others) Havelock Ellis, William Morris, Marie Stopes, Mahatma Ghandi, and Annie Besant.[44] By living in a manner at odds with the assumption of capitalism - specifically, by seeking a return to nature via the attainment of personal self-sufficiency - Carpenter hoped to inspire in others the idea that profit maximization and the expression of personal self-interest were not inevitable conditions of human life.

Both of these well-known aspects of Carpenter's work come together in his efforts to articulate an explicitly anti-vivisectional, yet nevertheless 'organic' notion of person-hood.[45] Carpenter's early, formative commitment to the opposition of vivisection is demonstrated by his for-the-time substantial subscription of £20 to the Victoria Street Society in 1882, before he came to be widely recognised as a cultural commentator and critic of liberal capitalism.[46] He may well also have been, along with his friend Edward Maitland, and Anna Kingsford, an author of the radical anti-vivisectionist tract "*The Woman" and the Age* (London, 1881). Maitland claimed in the anti-vivisection journal *The Zoophilist*, objecting to censorship of the document, that it had multiple authors (although he later claimed it as his own).[47] It is certain that Carpenter and Maitland later published a joint work attacking vivisection,[48] and that anti-vivisectional rhetoric infused Carpenter's comments on science.

44 On this aspect of his life see also Goodway, D. *Anarchists Seeds Beneath the Snow: left-libertarian thought and British writers from William Morris to Colin Ward* (Liverpool University Press, 2006), pp. 35-61; Brown, T. 'Figuring in History: the reputation of Edward Carpenter, 1883-1987 Annotated Secondary Bibliography, I,' *English Literature in Transition, 1880-1920* 32 (1989), pp. 35-64. See also 'Fabian Economic and Social Thought: Series One: the papers of Edward Carpenter, 1844-1929, from Sheffield Archives' (Adam Mathew Publications: http://www.ampltd.co.uk/collections_az/Fab-Carp-1/description.aspx accessed 08/04/2011).

45 Shaw, C.E. 'Identified with the One: Edward Carpenter, Henry Salt and the Ethical Socialist Philosophy of Science,' in Brown, *Edward Carpenter*, pp. 33-57.

46 *The Zoophilist* 3 (1883-1884), p. 19.

47 See *The Zoophilist* 1 (1881), pp. 58 and 71, and Maitland, E. *Anna Kingsford: her life, letters, diary and work* [Vol. II] (London, 1986), p. 8.

48 Carpenter, E. and Maitland, E. *Vivisection* (London, 1893).

Carpenter's statements on organic identity can be characterised in terms of an attempt to resolve the tension already discussed in relation to both anti- and pro-vivisectional literature - that between the personal integrity of (gentlemanly) individuals, and the self-regulating ability of (professional) groups of workers. On the one hand, Carpenter the individual became a vehement critic of the notion of gentlemanliness and what he saw as its perniciously stifling influence on the abilities of Britons to express themselves emotionally.[49] On the other, Carpenter the activist built a reputation as a commentator on and theorist of social democracy through his insistence that communal forms of identity could best be established through the combined efforts of groups of mutually committed individuals.[50] Both themes address the related notions of the possibility of group interaction between individuals, and the potential impact that groups of politically-directed individuals striving towards communal forms of consciousness might have on liberal, capitalist culture.

Carpenter's conception of natural science, expressed in a series of articles published under the title *Civilisation: its cause and cure* in 1889, is articulated in terms of a need to oppose what is portrayed as the overly 'selfish' or anthropocentric tendency of conventional, individualistic experimental culture. This tendency is characterised as springing from scientists' unwillingness to recognise themselves as active participants in the constitution of conceptions of nature. Science, as practised conventionally, has come to deny its inevitably human origins. It has sought to:

> enounce facts independent of Man, the observer. Seeing that the ordinary statements of daily life are obviously inexact and relative to the observer - charged with human sensation in fact - Science [sic] has naturally tried to produce something which should be exact and independent of human sensation; but here it has of course condemned itself beforehand to failure; for no statement of isolated phenomena or

49 As expressed in such essays as Carpenter, E. 'England's Ideal,' in Carpenter, E. *England's Ideal, and Other Papers on Social Subjects* (London, 1887), pp. 1-19 and 'The Enchanted Thicket: an appeal to the well-to-do', in *idem*, pp. 166-177.

50 See eg. Carpenter, E. 'Social Progress and Individual Effort', in Carpenter, *England's Ideal*, pp. 45-61, and 'Does it Pay, in *idem*, pp. 100-105.

> groups of phenomena *can* be exact... and no statement obviously can be really independent of human sensation.[51]

It is the undeniably of fallible, individual humans' involvement in the constitution of facts relating to nature - and thereby the certainty that human inaccuracy will creep into observation - that undermines the project of defining a single, true conception of nature. This denial of the role of human subjectivity in the constitution of fact is also a denial of the unity of nature - an assumption that humanity, as the entity able to comprehend nature absolutely, is not itself a part of it.[52] The project of constituting a value-free notion of science has reached its limit in the physiological constitution of a 'primitive consciousness of muscular contraction and its abstraction "mass" or "matter".'[53] Indeed, 'in truth Science has never left the great world, or cosmos, of Man.'[54] It is thereby only by starting with a conception of science as a human construct that it is possible to consider the articulation of different interpretations of life.

For Carpenter, the assumption that conventional, individualistic conceptions of scientific practice are correct is a specific case of what he had previously portrayed as a tendency to assume that competition between individuals and adherence to the profit motive constitute immutable, fundamental laws of social order. In many of his essays, Carpenter insists on the seeming inalienability, but actual mutability, of social order as described in liberal political economic texts.[55] 'Society' seems to be governed by laws beyond human control, yet (Carpenter insists) such laws might be transcended by the expression of humanity's natural agency. This belief is perhaps most clearly expressed in a lecture given in Sheffield in 1885 and reprinted in the collection *England's Ideal* (1887). Discussing the notion that 'natural selection' presents a confirmation of the doctrine

51 Carpenter, E. 'Modern Science: a criticism', in Carpenter, E. *Civilisation: its cause and cure* (London, 1889), p. 74. Carpenter's emphasis.

52 Carpenter, 'Modern Science,' pp. 52-53, 69.

53 Carpenter, 'Modern Science,' p. 81.

54 Carpenter, 'Modern Science', p. 80.

55 See for example the essays in *England's Ideal*, especially 'England's Ideal', pp. 1-19, 'Social Progress and Individual Effort', pp. 45-61 and 'Does it Pay?', pp. 100-105.

of freedom of competition, Carpenter demurs:

> It is often pointed out that this law of competition [natural selection] rules throughout the animal and vegetable kingdoms as well as through the region of human society... granting [this], I say that competition has hitherto been the universal law, the last word, of Nature, still if only one man should stand up and say "It shall be no more," if he should say "It is not the last word of *my* nature, and my acts and life declare that it is not," - then that so-called law would be at an end.[56]

Activism by individuals could potentially undermine the presumed 'natural' state of competition between individuals. Nevertheless, individuals find themselves largely determined by the effects of a 'society' that maintains a presence more powerful than their own:

> The more I think of it, the more I am persuaded that the true explanations, theories, of the social changes which we see around us… lie deep, deep down unsuspected… individuals, institutions, nations [seem] more or less like puppets or pieces in a game;- the hand that moves them altogether unseen.[57]

This bind presents Carpenter with the problem of defining which kinds of actions are worth undertaking in the face of the impersonal forces of society - a problem addressed in terms of the epistemology of science and life in *Civilization: its cause and cure*.

Nature versus the technical

The limits of a science produced by humanity alone have (according to

56 Carpenter, 'Social Progress,' p. 46.

57 Carpenter, 'Social Progress', p. 45.

Carpenter) been reached. It is only through the adoption of a subjectivity that embraces non-human organic entities that this now-stale, 'objective' science might be superseded. An activist, non-capitalist science will differentiate itself from the exceptionalist, domineering attempt to establish eternally valid objective knowledge via its fulfilment of the goal of reconciling human with non-human life. The comparative anatomical proposition that all parts of all bodies can be considered expressions of a single natural unity, Carpenter claims, brings the humanity of organic identity into question:

> The only conceivable answer to the question, "What is that which is now a mollusc and now a man and now an inorganic atom?" is given by man himself - and his answer is, I fear, not scientific. It is "I Am." "I am that which varies." And the force of his answer depends on what he means by the word "I." And so the only conceivable answer to the absolute datum question [ie. the question of what the single thing called 'nature' in fact is] is to be found in the meaning of the word "I" - in the deepening back of consciousness itself.[58]

Invoking (albeit vaguely) a form of consciousness that 'deepens back', and thereby uncovers, a more profound state of being, Carpenter hints at a possibility that humanity does not necessarily hold exclusive possession of the ability to apprehend itself. Nature as a whole is posited as the probable source of this extra-human form of cognition:

> That there is in every man a local consciousness connected with his quite external body; that we know. Are there not also in man the makings of a universal consciousness?... may there not be then the makings of a perception and knowledge which is here and now, but which shall be good for all time and everywhere?[59]

In the connection of humanity with a deity-like consciousness embodied by nature,

58 Carpenter, 'The Science of the Future,' p. 95.

59 Carpenter, 'The Science of the Future,' pp. 97-98.

the elucidation of true knowledge can begin again on a new footing.

As part of the old order in Carpenter's projected non-capitalist culture, vivisection would be an anathema to the man of science, who would aspire to commune with, rather than analyse, nature:

> Is it not a strange kind of science that which wakes the mind to pursue the shadows of things, but dulls the senses to the reality of them... [which allows a man] to vivisect a dog, unconscious that he is blaspheming the pure and holy relation between men and animals in doing so? Surely the man of Science (in its higher sense, that is) should be lynx-eyed as an Indian, keen scented as a hound - with all senses and feelings trained by constant use and a pure and healthy life in close contact with Nature, and with a heart beating in sympathy with every creature.[60]

But whether or not this vision is realised will depend on the will of the social body as a whole. As Carpenter had commented in his above-mentioned Sheffield lecture:

> It is a common notion... that science may as it were take Society by the hand and become its high priest and guide to a glorious kingdom... but whither it leads society will depend entirely on whither Society desires to be led. If Society worships a god of selfish curiosity, the holy rites and priesthood of science will consist in vivisection and the torture of the loving animals; if Society believes above all things in material results, science will before long provide those things.[61]

What Carpenter offers is the statement that another social order is possible, and himself as an exemplar regarding the kinds of practice that will bring such an order about. His radical notion of science constitutes an effort to reconcile his vision of human social life as law-defined, and his affirmation of the effectiveness of activism on an individual level.

60 Carpenter, 'The Science of the Future,' p. 87.

61 Carpenter, 'Social Progress', p. 55.

This re-constitution subjectivity in terms of a human-nature interaction appears here to be above all a representational one. It is in the act of enunciating dissent from the established order that its demise is to be brought about. Yet as noted above, Carpenter also sought to persuade his fellow activists to adopt different kinds of economic *practice* - different ways of living - that would not appear to follow the logic of individualist political economy. This call to change the way we live - as well as what we say about life - is for Carpenter as applicable to the life of the man of science as it is to any other.

Carpenter's emphasis on inter-personal and inter-species relationality is indicative of the emergence of concerted efforts to reconsider and develop alternatives to individualist notions of the organic self during the latter decades of the nineteenth century. Others, such as the psychologist and aesthetic Vernon Lee, and the political and gender activist Edith Simcox, similarly sought to privilege a communality grounded in mutual emotional expression above the identification of self with nerve and body.[62] Thomas Dixon has pointed to the emergence of the concept of 'altruism' in the works of such figures as George Henry Lewes, Herbert Spencer and Arabella Buckley, and the centrality of notions of sentiment to mutually assistant conceptions of natural human life.[63] Edward Carpenter's publications highlight many of the dilemmas faced by such thinkers - for example the extent to which it is possible to differentiate absolutely between an 'internal' and an 'external' nature, and the difficulties associated with representing 'animal' subjectivities in 'human' linguistic forms. Perhaps the most expressive of Carpenter's attempts to constitute non-liberal, non-capitalist forms of life are those which he says relatively little about in his essays on science - the hope that he could institute political change through his adoption of self-sufficiency as a means of communing with nature. What is certain is that Carpenter seeks to develop a notion of scientific practice that would constitute a holistic guide to conduct in human life - the production of food and construction of shelter, the conduct of

62 Lanzoni, S. 'Practising Psychology in the Art Gallery: Vernon Lee's Aesthetics of Empathy,' *Journal of the History of the Behavioural Sciences* 45 (2009), pp. 330-354. Beer, G. 'Passion, Politics, Philosophy: the work of Edith Simcox', *Women: a cultural review* 6 (1995), pp. 166-179 and Beer, G. 'Knowing a Life: Edith Simcox - sat est vixisse?' in Anger, S. (ed) *Knowing the Past: Victorian literature and culture* (Cornell; University Press, 2001), pp. 252-266.

63 Dixon, T. *The Invention of Altruism: making moral meanings in Victorian Britain* (Oxford and New York; Oxford University Press, 2008), pp. 10, 41-61, 151-158 and 181-221.

relations with humans and other animals, the expression of desire, and so on. In this respect, his thinking offers an intriguing response to the physiological emphasis (related in previous chapters) on and elevation of a notion of a non-representational experimental practice as a means of producing economically useful citizens.

Yet despite Carpenter's conviction regarding the 'selfishness' of experimental science, what is most notable by its absence from his texts more generally is any sustained attempt to engage positively with the technical entities that had become so prominent in the industrial culture in which he writes. This is even more surprising given that he resided for much of his life near Sheffield, one of the longest-established industrialised towns in England. To continue the above-quoted declaration that vivisection is the inevitable accompaniment of 'selfish curiosity',

> if Society believes above all things in material results, science will before long provide those things, - it will surround men with machinery and machine-made products, it will whirl them about (behind steam-kettles as Mr. Ruskin says) from one end of the world to the other... but through all the whistling of the kettles and the rattling of toys it will not make the still small voice of God sound nearer.[64]

Indeed, it is in opposition to technical intervention in the human body that Carpenter grounds his most extensive critique of vivisection. Fully admitting experimental physiologists' claims that vivisection presents humanity with the possibility of curing illnesses that have hitherto been incurable, he nevertheless argues that the practice has a pernicious influence on culture precisely because of its apparent utility. The ability to cure some diseases through the administration of vaccines, Carpenter claims, threatens to lead to a culture in which all medicine is assumed to be interventionist. People will neglect to care for their own and others' healthy bodies, and hence no longer seek to prevent disease, merely to cure it.[65]

64 Carpenter, 'Social Progress', pp. 55-56.

65 Carpenter, E. 'Medical Science: the true method and the false', in Carpenter, E. and Maitland, E. *Vivisection* (London, 1893), pp. 3-17.

This hostility to industrial aspects of life (also evident in the publications of other anti-vivisectionists such as Ouida)[66] points to an unwillingness to engage with one of the central problems of urban existence during the nineteenth century - how to live in an environment in which technical entities (not an unadorned nature) constitute the principal conditions under which human relations take place. Carpenter, along with many opponents of vivisection, might be said to have responded to the economic (and indeed physiological) demands of urban existence by rejecting them outright.[67]

Samuel Butler: technical organicism

If Edward Carpenter's publications can be understood in terms of an effort to constitute a natural ideal shorn of technology, those of his contemporary, the evolutionary critic, photographer, painter, novelist and composer Samuel Butler, portray relations between organisms and machines as fundamental to the understanding of life. Where Carpenter seeks to constitute a form of subjectivity that would provide an explicitly organic alternative to liberal individualism, Butler's publications articulate a need to take the organically-determined aspects of individuals' lives themselves less seriously. Where Carpenter advocates a deistic subjectivity in which the unity of one's emotional expression constitutes a foundation for the affirmation of an alternative individuality, Butler brings the very possibility of the unity of the organic self into question. Butler develops a critique of conventional, liberal individualistic manliness that centres on a re-evaluation of the constitution of knowledge and ignorance. He not only engages with the

66 Ouida, 'Some Fallacies of Science.' A parallel scepticism appears to have existed amongst the medical profession regarding technical intervention in human bodies. See Miller, 'Necessary Torture?'. On the critique of technical culture more generally at this time, see MacLeod, R. 'The 'Bankruptcy of Science' Debate: the 'creed of science' and its critics', *Science Technology and Human Values* 41 (1982), pp. 2-15 (reprinted in MacLeod, R.M. *The 'Creed of Science' in Victorian England* (Aldershot, Burlington and Sydney, 2000).

67 On connections between urban culture and laboratory spaces see Dierig, S. 'Engines for Experiment: laboratory revolution and industrial labour in the nineteenth-century city', *Osiris* 18 (2003), pp. 116-134.

technical aspects of experimental life, but places machinery at the centre of his critique of it. The effect of all of this is to elaborate a form of self-hood in which humanity is no longer able to define its own existence without the assistance of extra-human, technical means. This raises the prospect of a future in which human self-interest comes to be accommodated to a form of power embodied by active yet non-organic entities (ie. self-sustaining technical entities).

The text that Butler is most generally understood as establishing his reputation as a serious writer with - an autobiographical novel entitled *The Way of All Flesh* (1903) - has been accorded a crucial role in the early-twentieth-century reaction against what early-twentieth-century writers were beginning to characterise negatively as 'Victorian' attitudes and values.[68] As an inspiration for the works of such twentieth-century figures as Edward Morgan Forster, Bernard Shaw, Robert Graves and Aldous Huxley, Butler has been understood as developing (like Edward Carpenter) a critique of nineteenth-century culture that has had a particularly lasting influence on twentieth-century conceptions of manliness (and subjectivity more generally).[69] Nevertheless, Butler himself did not allow *The Way of All Flesh*, the work now emphasised as playing the most significant part in this critique, to be published during his own lifetime. What is of particular interest for this chapter then is the context in which such a critique of nineteenth-century manliness came to be articulated.

During Butler's own lifetime, he was known primarily as a critic not of a 'Victorian' repression of sexual expression and individuality, but of 'Darwinian' ideas regarding inheritance and natural selection, and as a speculative novelist. Specifically, he was (and is) recognized as one of the earliest and most persuasive British advocates of a 'neo-Lamarckian' conception of development.[70] In this final

68 Eg. Ganz, M. 'Samuel Butler: ironic abdication and the way to the unconscious,' *English Literature in Transition, 1880-1920* 28 (1985), pp. 366-394. On Butler more generally see the essays in Paradis, J.G. (ed.) *Samuel Butler, Victorian Against the Grain: a critical overview* (University of Toronto Press; Toronto, Buffalo and London, 2007), and Raby, P. *Samuel Butler: a biography* (London, 1991).

69 Ganz, 'Samuel Butler'. See also Sussman, H. 'Samuel Butler as Late-Victorian Bachelor: regulating and representing the homoerotic,' in Paradis, *Samuel Butler*, pp. 170-194.

70 Pauly, P.J. 'Samuel Butler and His Darwinian Critics,' *Victorian Studies* 25 (1982), pp. 161-180; Bowler, P. *The Eclipse of Darwinism: anti-Darwinian evolution theories in the decades around 1900* (Baltimore; John Hopkins University Press, 1983), pp. 72-75; Morton, P. *The Vital Science: biology and the literary imagination, 1860-1900* (London, Boston and Sydney, 1984), pp. 174-193; Otis, L. *Organic Memory: history and the body in the late nineteenth and early twentieth centuries* (Lincoln and London; University of

section I point to Butler's engagement with physiological psychological conceptions of life and mind. I highlight ways in which the notion of habit is adopted and deployed in his work as an especially effective means of casting doubt on the notion that mind (like other aspects of bodily existence) is determined exclusively by one's organic lineage. Above all, I emphasise ways in which Butler was able to use the notion of habit to pose the question of technical development as a problem for, rather than a corollary of, organism-centred explanations of consciousness.[71]

Most nineteenth-century conceptions of relations between evolution and technology - for example those of Herbert Spencer - tend to treat technical development as entirely analogical with organic development. The laws of evolution of 'society' could be drawn from already-established insights regarding the development of non-human life.[72] In emphasising that technical entities might not necessary accord with such laws - or rather that organic entities might be subject to forces made manifest by technical entities - Butler elevates the notion of habit to the status of a general well-spring of development, rather than a psychological category only applicable to entities with nervous systems.

A technical critique of physiological authority

Butler's early publications on life and mind pose the possibility of a form of reproduction and development that is not specific to 'life' - or, indeed, 'nature.' As a means of escaping the expectations of his own family, Butler had left England

Nebraska Press, 1994), pp. 18-27; Lightman, B. "A Conspiracy of One': Butler, Natural Theology, and Victorian Popularization,' in Paradis, *Samuel Butler*, pp. 113-142; Shuttleworth, S. Evolutionary Psychology and *The Way of All Flesh*,' in *idem*, pp. 143-169; See also Forsdyke, D.R. 'Heredity as Transmission of Information: Butlerian 'Intelligent Design'', *Centaurus* 48 (2006), pp. 133-148.

71 Butler's engagement with technology is addressed in Sussman, H.L. V*ictorians and the Machine: the literary response to technology* (Cambridge, MA; Harvard University Press, 1968), pp. 135-161; Edwards, E. 'Samuel Butler's Photography: observation and the dynamic past', in Paradis, *Samuel Butler*, pp. 251-286.

72 Compare eg. Spencer's treatment of scientific tools in *The Principles of Psychology* (London, 1855), p. 484 with the below-cited quote from Butler's *Erewhon* (1872) addressing men of science's use of 'seeing-engines.'

for New Zealand in 1859, in the hope that he could make a living and achieve financial independence from his father.[73] It was in this largely pastoral setting that he first encountered Charles Darwin's *The Origin of Species* (1859), and published his first (satirical) comment on the book, suggesting that eventually humans could be superseded by machines in the race of existence.[74] His first novel, *Erewhon* (1872), develops this concept into a full-blown satire on nineteenth-century Britons confidence in the capacities of man, positing in the Antipodean colony a lost tribe of humanity that has, following the guidance of a great analyst of technical evolution, abandoned all technical accoutrements in order to preserve their own species' dominance.[75] The inversion of nineteenth-century values that Butler portrays as accompanying this Luddite existence was sufficiently shocking to his father for him to claim that it had hastened his mother's death (which occurred in 1873).[76] *The Way of All Flesh*, and his first serious commentary on nineteenth-century organicism, *Life and Habit* (1877) (started in 1873 and 1874 respectively) develop the technical and personal themes of this earlier work.

Butler begins *Life and Habit* by drawing on his own experiences as a pianist and composer. He poses a problem regarding the explanation of why, after musicians have learnt to play a piece, they no longer think of the specific physiological actions that their bodies undertake to produce it. Butler describes how, if we ask a competent (implicitly male)[77] pianist to play a piece that they know well, but insist that he attends to the performance of each of the notes rather than the piece as a whole,

73 Robinson, R. 'From Canterbury Settlement to Erewhon: Butler and Antipodean counterpoint', in Paradis, Samuel Butler, pp. 21-44.

74 Butler, S. 'Darwin among the Machines', *Press* [Christchurch, New Zealand], 13th June 1863.

75 Butler, S. *Erewhon: or over the range* (London, 1947 [1872]).

76 Raby, *Samuel Butler*, pp. 20, 119-122.

77 On gender and musicianship in this period see Weliver, P. *Women Musicians in Victorian Fiction, 1860-1900: representations of music, science and gender in the leisured home* (Aldershot and Burlington, VT, 2000) and Law, J. 'The 'Perniciously Homosexual Art': music and homoerotic desire in *The Picture of Dorian Grey* and other fin-de-siècle fiction', in Fuller, S. and Lossef, N. *The Idea of Music in Victorian Fiction* (Aldershot and Burlington, VT, 2004), pp. 173-196. On the piano in nineteenth-century culture see also Lustig, J. 'The Piano's Progress: the piano in play in the Victorian novel', in Fuller, and Lossef, *The Idea of Music*, pp. 83-104.

> we shall observe that he finds it hardly less difficult to compass a voluntary consciousness of what he has once learnt so thoroughly that it has passed, so to speak, into the domain of unconsciousness, than he found it to learn the note in the first instance. The effort after a second consciousness of detail baffles him - compels him to turn to his music or play slowly.[78]

It should go without saying that this passage is highly reminiscent of physiological psychologists' comments on 'unconscious cerebration.' Butler explains the learning of music - and extends his example to address learning more generally - as an accumulation of habit, or the repetition of certain actions until they are no longer dependent on conscious effort.[79] What is of particular interest, however, is the context in which Butler articulates the notion of habitual learning - that of an individual's engagement with an aspect of the technical environment (the piano) which he encounters in every-day experience.

The notion of habit articulated by Butler can be differentiated from that utilised by contemporaries by reference to the particularly pervasive and fundamental role that it plays in his thought. For Butler, 'habit' consists in nothing more than repeated action - in this respect it is not specific to human psychology, or even to organic life.[80] If organic bodies cannot originate energy, and the acquisition of new forms of behaviour can only be explained by reference to the repetition of actions (Butler claims), machines might develop and assimilate habits in the same way as living entities. The only quote of contemporary science in *Erewhon* - given by the English narrator who has fortuitously re-discovered the anti-technical 'Erewhonians' - is of William Benjamin Carpenter's claim that energy cannot be created or destroyed by life, but is merely a transformation of other forms of it (such as heat and electricity). 'I do not know how he has found this out,' the narrator pointedly comments, 'but he is a man of science - how then can it be

78 Butler, S. *Life and Habit* (London, 1877), p. 4.

79 On the more general use of music and piano-playing as a metaphor in nineteenth-century philosophy of mind see Weliver, *Women Musicians*. pp. 59-97.

80 In contrast with this reading, Laura Otis addresses Butler's texts as concerned above all with the assertion that memory is organic. See Otis, *Organic Memory*, pp. 18-27.

objected against the future vitality of machines that they are, in their present infancy, at the beck and call of beings [ie. humans] who are themselves incapable of originating mechanical energy?'[81] However seemingly incapable of self-development (what we might now call) technological assemblages may seem from a human perspective, their use of energy and repetition of actions indicate that they have the potential to become conscious.[82] It is in this potential to develop functions generally associated with nervous psychology that machines retain a capacity to render humanity obsolete.

Acknowledging the universality of habit entails - as with the recognition of the humanness of science in Edward Carpenter's publications - a radical re-orientation of humanity's awareness of its own place in the world. Reason or intelligence is manifest where bodies of any sort are unable to reconcile themselves to their present situation without the habitual accumulation of new behaviours. Consciousness is the development of new forms of action which subsequently recede into unconsciousness:

> For the embryo of the chicken... we claim exactly the same kind of reasoning power and contrivance which we claim for the amœba, or for our own intelligent performances in later life. We do not claim for it much, if any, perception of its own forethought, for we know very well that among the most prominent features of intellectual activity that, after a number of repetitions, it ceases to be perceived, and that it does not, in ordinary cases, cease to be perceived till [sic] after a very great number of repetitions.[83]

As fundamentally repetitive creatures, humans possess no superiority over amoebae or embryos regarding their capacity for self-awareness. Rather, all struggle through the repetition of particular actions to reconcile themselves to the environments in which they find themselves. Habit is a constant generative force that acts throughout existence, and is not something possessed by some entities

81 Butler, *Erewhon*, pp. 242 and 248.

82 Butler, *Erewhon*, p. 238 and Butler, 'Darwin amongst the machines'.

83 Butler, *Life and Habit*, p. 73.

more than others.

The universality and fecundity of habit also implies for Butler that conceptions of existence that rely on the perceptions of an unadorned humanity are inadequate. Again, in *Erewhon*, an ancient, great philosopher of 'machines', writing against the then-still-technically-enthusiastic culture of his now-Luddite tribe, attempts to point out the extent to which even the most respected intellectuals of his society remain at the mercy of their built environment:

> Is it man's eyes, or is it the big seeing-engine which has revealed to us the existence of worlds beyond worlds into infinity? What has made man familiar with the scenery of the moon, the spots on the sun, or the geography of the planets? He is at the mercy of the seeing-engine for these things, and is powerless unless he tack it on to his own identity, and make it part and parcel of himself. Or again, is it the eye, or the little see-engine, which has shown us the existence of infinitely minute organisms which swarm unsuspected around us?[84]

Perception in this account is not dependent on man's senses alone (as would be the case in Edward Carpenter's critique), but on an interaction between, or amalgamation of, the organic and the technical. Men of science do not speak from a vantage point primarily attained through the disciplined training of their bodily senses, but are rather privileged in their access to certain forms of apparatus.

The notion that technical entities might develop habits - and thereby intentions - alien to already-established, human modes of thought constitutes for Butler a powerful source of critique of exclusive and esoteric forms of rhetoric. Claims such as those of William Benjamin Carpenter regarding the constitution of a 'professional' community, or of Huxley concerning the need to develop a 'scientific priesthood' are, from this vantage point, clearly misguided.[85] Butler introduces what might be termed his 'techno-physiological' psychology in *Life and Habit* in terms of a critique of specialist scientific authority, and of an appeal to

84 Butler, *Erewhon*, p. 242

85 For a consideration of the morality of vivisection in relation to an explicitly 'professional' ethos, see Carpenter, W.B. 'The Ethics of Vivisection', *Fortnightly Review* 31 (1882), pp. 237-246, esp. on pp. 238-239 and 243.

what he terms the 'unconscious' knowledge of his lay audience.

For Butler, the ability to express a truth-claim is not, as had (he claims) hitherto been assumed, an indication of its likelihood, but rather an expression of its uncertainty. Indeed, only those forms of knowledge that have been repeated until they are unconscious can be considered as 'perfectly' known: 'on becoming intense, knowledge seems also to become unaware of the grounds on which it rests, or that it has or requires grounds at all, or indeed even exists.'[86] This implies that scientific authors, whilst they may be understood as 'pioneers' of knowledge, cannot claim to be certain regarding the knowledge that they express. Certainty can however be attained by those who do not articulate claims about the world:

> we should recognise more than we do, that there are two distinct classes of scientific people... The one class is deeply versed in those sciences which have already become the common property of mankind... whilst the other class is chiefly intent upon pushing forward the boundaries of science... pioneers, as important to an army as they are, are still not the army itself, which can get on better without the pioneers than the pioneers without the army. Surely the class which knows thoroughly well what it knows, and which adjudicates on the value of discoveries made by the pioneers - surely this class has as good a right or better to be called scientific than the pioneers themselves.[87]

This advocacy of what would later be called 'folk' psychology over that of the (also later) 'specialist' scientist is informed and supported by a critique of physiological psychology as a pioneering, 'conscious,' and therefore not certain, form of knowing.

Life and Habit deploys this inversion of the distinction between an authoritative consciousness and a subordinate unconsciousness to undermine the authority of those seeking exclusivity in the interpretation of physiological experimental practices. The principal object of concern in this respect are the

86 Butler, *Life and Habit*, p. 34.

87 Butler, *Life and Habit*, pp. 30-31.

claims of William Benjamin Carpenter in his *Principles of Mental Physiology* (1877 edition). As Butler's text comments (in relation to Carpenter's critique of mesmerism), the

> only issue between myself and Dr. Carpenter would appear to be, that Dr. Carpenter, himself an acknowledged leader in the scientific world, restricts the term "scientific" to the people who know that they know... while I say that the term "scientific" should be applied (only that they would not like it) to the nice sensible people who know what's what rather than to the discovering class.[88]

By re-defining science in terms of what is commonly known rather than a community of 'men of science', Butler casts doubt on any authority that being recognised as a 'man of science' might confer on the former.

Central to Butler's critique of William Benjamin Carpenter is that an explanation of non-human animals' construction of technical (ie. non-biological) entities can only be achieved by replacing the latter's notion of 'instinct' with an elevation of the concept of 'habit' to that of a universal generative force. In *Mental Physiology*, Carpenter had pointed to a particularly intractable problem for the notion that simpler animals could be considered 'lower' on a scale of intellectual development than more complex. Small amoeba-like organisms, named *Gromia*, had been observed to construct dome-like ‘tests’ or casings as they reached maturity. These seemingly indisputably ‘lower’ animals appeared to be completely conscious of the requirements for building such highly efficient architectural forms, 'selecting' tiny pieces of grit and fitting them together to do so. But they did not appear to possess the extent of nervous development that would (Carpenter believed) indicate a capacity for consciousness. If *Gromia* were not conscious, how was it that they were able to act as designers of their own habitats, like humans? The explanation given in Carpenter's text had been that such formations could only be explicable in terms of an these animals' possession of an 'internuncial,' instinct-like impulse to build them.[89] Having related Carpenter’s comments, Butler chooses

88 Butler, *Life and Habit*, p. 34.

89 Carpenter, W.B. *Principles of Mental Physiology: with their applications to the training of the mind, and the study of its morbid conditions* [4th edition] (London, 1877), pp. 41-45.

this point in his narrative to assert the primacy and universality of his own preferred explanation; that such structures could only be constituted by the gradual accumulation of conscious habits possessed jointly by the organism and its built environment simultaneously. To Carpenter's insistence that 'we can scarcely conceive that a creature of such simplicity should possess any distinct consciousness of its' needs', Butler replies: 'why not?'[90] From this simple contradiction, Butler quickly extends his insistence on the habitual constitution of organism-tool relations to include the sand tube-like houses of the slightly more complex *terebella* worms, birds and their nests, and, by implication, the humans and their constructed environments.[91] The heritability of habit, not instinct (or of any other exclusively organic force), is conceived as the only plausible means of accounting for the presence of technical entities of any sort.

Butler's emphasis on relations between technical and organic entities leads him to a profoundly different interpretation of the experimental assemblages that were being created by physiologists in laboratories. For example, discussing the fact that frogs' legs can still be induced to move after the animals had been decapitated, he arrives at conclusions almost diametrically opposed to standard interpretations. William Benjamin Carpenter had suggested that the independence of such movements from the brain must indicate that certain forms of muscular movement are 'instinctive' - ie. that movement in frogs' legs is not necessarily accompanied by conscious awareness. Butler objects to this interpretation on the grounds that Carpenter arbitrarily associates the head of the animal with the totality of the animal itself - that for Carpenter, having severed the source of the animal's will from its body, the continued existence of movement must indicate that movement can occur 'automatically,' without willed intervention.[92] Butler, on the other hand, attributes the movement of decapitated frogs' legs to the independent will of the legs (and remaining parts of the body) themselves:

> One can see the absurdity of maintaining that we can make one frog

90 Butler, *Life and Habit*, p. 67.

91 Carpenter, *Principles of Mental Physiology*, pp. 43-44. Butler, *Life and Habit*, pp. 67-74.

92 Carpenter, *Principles of Mental Physiology*, pp. 68-70.

> into two frogs by cutting a frog into two pieces, but there is no absurdity in believing that the two pieces have minor centres of sensation and intelligence within themselves, which, when the animal is entire, act in such concert with the brain, and with each other, that it is not easy to detect their originally autonomous character.[93]

For Butler (like Darwin), organic individuality is an ultimately arbitrary classificatory denotation. This contention serves him as a literal tool with which he is able to undermine any attempt to define the physiological nature of naturally-occurring species, as the entity being analysed in such experimental set-ups will inevitably be technically constituted by the experimentalist.

The disunity of technical beings

Butler's re-orientation of subjectivity in terms of technical entities and a universally generative 'habit' is accompanied by severe doubts regarding the unitary existence of any real entity which might be identified as constituting the human individual:

> We regard our personality as a simple and definite whole; as a plain, palpable individual thing... But in truth this "we," which looks so simple and definite, is a nebulous aggregate of many component parts which war not a little among themselves, our perception of our existence at all being perhaps due to this very clash of warfare, as our sense of sound and light is due to the jarring of vibrations.[94]

A few pages later, the relation of this confusion to technical entities is articulated more clearly:

> we find that we are rooted into outside things, and melt away into

93 Butler, *Life and Habit*, pp. 113-123, on p. 119.

94 Butler, *Life and Habit*, p. 78.

> them, nor can any man say that he consists absolutely in this or that, nor define himself so certainly as to include neither more nor less than himself...
>
> A man's clothes, for example, as they lie on a chair at night are no part of him, but when he wears them they would appear to be so, as being a kind of food which warms him and hatches him, and the loss of which may kill him cold.[95]

As well as not constituting a unitary whole in and of itself, the human body is an arbitrary category dependent on a wide-ranging panoply of 'external' aids for its survival.

Butler does not specifically critique the practice of vivisection. He does imply in a later lecture on 'Thought and Language' (presented to the Working Men's College in Great Ormond Street in 1894) that he considers technical intervention in physiology of the nervous system to be futile as far as nervous psychology is concerned.[96] An indication that Butler did not conceive of vivisection as problematic on moral grounds is indicated by *Erewhon*, which (through another fictional 'great philosopher') articulates a lengthy *reductio ad absurdum* of the notion of 'animal rights'.[97]

Butler's chief concern is with what vivisectional experiments might mean, rather than their relative legitimacy. His radical re-interpretation of physiological phenomena is accompanied by an equally radical sense of doubt regarding many of the certainties of nineteenth-century British culture - especially those concerning the primacy of humanity's place in the world.

Butler's engagement with and critique of physiological individuality is directly related to his portrayal of masculinity in *The Way of All Flesh*. Above all, the novel emphasises that, despite our ambitions, we are not able to maintain ourselves as unitary beings with the capacity to regulate our goals and desires accordingly. Its central character, Ernest Pontifex (who most critics identify with

95 Butler, *Life and Habit*, pp. 80-81. See also p. 110, and Butler, *Erewhon*, pp. 266-269.

96 Butler, S. 'Thought and Language', in Butler, S. (Streatfield, R.A. ed.) *Essays on Life, Art and Science* (New York and London, 1970 [1908]), p. 179.

97 Butler, *Erewhon*, pp. 273-292.

Butler) takes on a series of identities - intellectual, preacher, shopkeeper - which, despite his full belief in them at the time, are overthrown by desires and aspects of his self of which he is not conscious. Faith in self-discipline, the Anglican church, and biblical literalism is, through a series of mistakes and misdemeanours, gradually supplanted in Ernest by his irrepressible need to express sexual desire and the stifling influence of his respectably religious family. Indeed, his transition between these identities is marked by the involuntary expression of parts of himself which he had sought to repress. When, as a preacher, he visits a prostitute, his initial intention to convert her becomes mingled with a (hitherto unacknowledged) feeling of sexual attraction. Having been interrupted in his conversion, he then transfers his sexual desire onto another, more 'reputable' woman, resulting in his arrest and departure from the priesthood.[98] Later, as a shopkeeper, his intention to build a business with the woman he has married is subverted by a combination of her alcoholism, and his own blindness to it.[99] Critically, these 'falls' also constitutes a form of emancipation for Ernest, who gradually gains independence from and power over his domineering father.[100] *The Way of All Flesh* and *Life and Habit* both call established norms of nineteenth-century masculinity into question via their representation of subjectivity as contradictory, habit-defined, and ultimately unable to be characterised in terms of any singular will or consciousness.

Butler's texts indicate ways in which an intense interest in relations between life and technicity might accompany a breakdown of organism-centred notions of subjectivity. Re-considering subjectivity in relation to organic-technical assemblages threatens - as had the reconsideration of subjectivity in relation to human-animal relations in Edward Carpenter's work - to dissolve the category of the human observer as an independent entity. The representative power of physiological experimental phenomena, and their importance in the definition of late-nineteenth-century notions of self, meant that they retained the capacity to subvert the medical and scientific goals of the vast majority of the physiologists who set such experiments up in the first place.

98 Butler, S. *The Way of All Flesh* (New York, 1965 [1903]), pp. 259-261

99 Butler, *The Way of All Flesh*, pp. 323-333.

100 Butler, *The Way of All Flesh*.

Conclusion

The emergence of vivisection as a practice central to the discipline of physiology was dependent on a physiological psychological conception of learning as practice. Physiological psychologists stressed that it was in the interaction of hand and head that habit could best be formed, and their rhetoric was effectively taken up by advocates of laboratories as places of learning. One cultural phenomenon associated with this proliferation of experimental practice was an re-evaluation by experimental physiologists of the status of 'men of science' in nineteenth-century society. Physiological researchers such as Huxley and Bernard sought to redefine masculinity in relation to their experimental activities, thereby creating a discourse in which the man of science was to be upheld as at least as (if not more) 'cultured' than any gentleman of letters.

Nevertheless, within British society, the perception of humanity as owing a moral duty of care to non-human animals meant that the very animal-tool hybrids which physiological psychologists used to support their conclusions - vivisected animals - became a focus for debate. Though (or perhaps more accurately because) anti-vivisectionists frequently arrived at diametrically opposed conclusions to physiologists regarding the appropriateness of experimentation on animals, they adopted remarkably similar attitudes regarding the desirability or otherwise of 'masculine' characteristics. Both experimental physiologists and their opponents articulated a notion of scientific manliness that sought to reconcile a middle-class notion of 'professional' community with a longer-standing ideal that upheld the un-impeachability of gentlemanly virtue. It is this proliferation of representations of vivisection - rather than any specific judgement regarding its validity - that can be identified as playing an active part in the deconstruction of nineteenth-century assumptions regarding the nature of 'man' more generally. This representational field constituted a condition of possibility for the articulation of post-physiological conceptions of subjectivity such as those expressed in the works of Edward Carpenter and Samuel Butler.

Taken in isolation, neither Samuel Butler's nor Edward Carpenter's reactions against the ideals and assumptions of their time can be understood as offering a fundamental re-alignment of subjectivity away from that that had been constituted by physiological psychological culture. Edward Carpenter's faith in the

unity of nature was ultimately grounded in an assumption regarding the undesirability of technical change - an assumption which few of his contemporaries were willing to go along with. Butler, despite adopting a radically different attitude regarding technical entities, and even appealing to them in his critique of the organically-focused culture of his time, did not develop an alternative to this latter culture. Where he did seek to articulate a positive vision of action within a world constituted by technical as well as organic entities - in *Erewhon* and to a certain extent in *Life and Habit* - he did so tentatively, always deploying irony as a means of mitigating any sense of certainty in his readership.

Neither Edward Carpenter nor Butler appear to have known of each others work. Yet together the texts of these figures can be understood as representing two poles of a nascent, 'post-physiological' tension as it begins to emerge during the latter decades of the century. The principal concerns of this subjective dynamic can be conceived as, on the one hand, a tendency to appeal to nature not as an object to be known, but as a being that one might learn to commune with. On the other hand, an insistence on the independence and ultimate unknowability of technical entities in relation to humanity begins to appear that threatens to efface the human as an object of intellectual concern. The relevance of Carpenter's appeals to the environmental movements that have come to the fore during the twentieth century should be obvious. Similarly, his critique of science will be familiar to many, especially those who have engaged with the history of science as a discipline. Perhaps less familiar to some historians (though not cultural theorists) will be Butler's appeal to technical self-development, and his deconstruction of humans' belief in their own unitary selves. This technical emphasis points to the ever-more-critical place that tools have come to hold in life and thought over the last hundred and fifty or so years.

Conclusion

Like many studies before it, this thesis has articulated a conception of the nineteenth century as a period marked by the re-figuring of humanity as a zoological organism. The concerns of eighteenth and early-nineteenth-century authors with relations between matter and spirit, it has shown, came together in contentions regarding the nature of the living and experiencing body. As spirit and matter were thought together, a notion of the self as an amalgamation of both came to the fore.

Debates regarding the relative explanatory powers of natural law and spirit were conducted in relation to a range of epistemic tools. As far as living bodies were concerned, microscopes and museums constituted two of the most important of such tools during the first half of the century. The relative merits of each as means of perceiving the nature of life were evaluated in relation to an epistemology of gentlemanly witnessing and agreement. In this conception of perceptual activity, museum specimens were valued because they could be made were visible to many witnesses at once, as well as because they constituted symbols of imperial power.

The relative status of such tools as microscopes and museums became directly relevant to the articulation of embodied notions of human psychology at this time. Because of the increasing status of zoology within the academy, intellectuals hoping to instantiate psychology as a 'discipline' began to appeal to the very tools and techniques that zoologists were holding up as able to demonstrate the nature of both human and animal bodies. In positioning psychology as a science of the nervous system, these authors placed particular emphasis on the ability of epistemic tools to reveal humanity's internal as well as its external nature.

Though much of the above has been articulated in some way before, the importance of tools in nineteenth-century zoological endeavour is not so well recognised.[1] In addition, most histories of nineteenth-century organicism concern themselves almost exclusively with interrogating means by which the category of

1 Though see Pickstone, *Ways of Knowing*, and Hopwood et. al,. 'Seriality and Scientific Objects'.

'life itself'[2] came to be defined and understood. In contrast, this thesis has characterised the notion of organic subjectivity as a *participant* in the construction of alternative subjective modes.

The second half of this thesis shows ways in which the articulation and instantiation of embodied notions of cognition not only constituted the human as a zoological object, but also became critical to the emergence of notions of self that did not take the individual organic body as their primary object of explanation. In the first instance, the emergence of microscopes as epistemologically significant tools was accompanied by the articulation of energy-centred, movement-oriented notions of cognition. Physiological psychology rhetoric, in merging with the broader science of energy that came to the fore in Britain during the 1860s and 1870s, was critical to the instantiation of science as a practice- as well as representation-oriented activity. In this instantiation, an epistemic field came to the fore in which human-tool interaction, as well as bodily perception, became paramount. Finding themselves in a position in which their bodies were deemed to incapacitate their ability to perceive the nature of things, middle-class women seeking to participate in the culture of medical and scientific professionalism began to appeal to their technical competency rather than their sensory capacities in the constitution of themselves as authorial observers.

By the late nineteenth century, modes of subjectivity were coming to be articulated that sought to escape from the bodily confines of physiological ways of conceiving of the self. In the writings of George Eliot, Arabella Buckley, and Samuel Butler - all of which committed to embodied conceptions of self - tools begin to take on a 'life' of their own. They appear as narrators of tales, as well as self-generating entities. Butler's texts, especially, begin to position life as something that cannot be thought except in conjunction with the tools by which it is perceived and enabled to continue. As an entity reliant on a highly technical, constructed environment, the human subject begins to appear as unstable in relation to its surroundings. In addition, and as significantly, those who perceived in industrial culture a threat to their own ideals and ways of life (such as Edward Carpenter) began to adopt and articulate modes of conduct that might reconcile humanity with an imagined nature. Where much nineteenth-century natural

2 On the notion of 'life itself', see Rose, N. *The Politics of Life Itself: biomedicine, power, and subjectivity in the twenty-first century* (Princeton; University Press, 2007).

philosophy had been pre-occupied with the relation of matter to spirit, twentieth-century thought would be equally pre-occupied with relations between animality and machinery.

The texts of Edward Carpenter and Samuel Butler analysed in chapter five foreshadow the technical and cybernetic anxieties of the late twentieth and early twenty-first centuries referred to at the beginning of this thesis. On the one hand, Butler's appeal to 'habit' as a means by which machines might be understood as entities as potentially capable of self-generation as any animal point to one means by which bodies and tools might be thought together more rigorously. On the other, Carpenter's concerns regarding the tendency of scientific machinery to dominate and thereby efface prior 'natural' modes of being brings the risks inherent to such endeavour to the fore. Stretched between a nostalgia for an imagined, non-technical 'past', and fear of a projected, technically-determined future, the constitution of the self as both technical and organic seems to be accompanied by a considerable measure of uncertainty regarding its positioning in time and place. Indeed, though they purport to be describing a real world that exists 'out there', even Butler's texts acknowledge the impossibility of defining a conception of self and world that can hold good for all time and all places. *Life and Habit* represents enunciation as an expression of uncertainty rather than of belief. Butler presents himself as unwilling to determine his reader's notions of self: 'Above all things, let no unwary reader do the injustice of believing in me. In that I write at all I am amongst the damned.'[3] Such a comment is pertinent to the contention mooted here that the technical or 'cybernetic' conception of self is itself historically contingent. To conclude this thesis, I wish to offer a few speculations regarding what it might mean to practice history in our cybernetically-constituted present.

As touched upon in the introduction to this thesis, Geoffroy Bowker's recent text *Memory Practices in the Sciences* indicates that whether we position ourselves as fact-gatherers seeking to construct a 'more complete' representation of 'the' past, or (as has been the case in this thesis) as certain kinds of subjects offering a 'reading' of a nominally stable 'archive', we participate fully in the concerns that emerged in conjunction with the historical sciences and industrial environments of the nineteenth century. Acknowledging the contingency of historical explanation

3 Butler, *Life and Habit*, p. 41.

does not present an escape from the notion that what it is we are interpreting - the 'archive' - participates in and constitutes a critical condition of possibility for our narration. By considering bodies and texts as entities *co*-constituted by 'developmental' life and 'mediating' tools, we can begin to move away from debates regarding the indeterminacy or otherwise of objective, scientific observation that were already becoming stale by the end of the nineteenth century.[4] To do so would be to participate in the constitution of a different set of concerns to those that animate the vast majority of historical accounts of nineteenth century Britain, if not history as a discipline more generally.

One way those concerned with the constitution of historical narrative might help disarm the seemingly pervasive trap of having to choose between subjective and objective commitments might be to emphasise more vehemently the participation of a broader range of participants than the 'interpreting' author (or authors) and the set of archival 'information' that they are able to access. As this thesis has shown, the assertion that ‘we’ can comprehend our own ‘nature’ (and with it, as Bowker shows, our own history) in any absolute sense is fraught with questions relating to who or what is to do the comprehending in the first place. The way we experience or remember the past is contingent who or what we believe ourselves to be.

Since we now find ourselves in a situation in which we are able to acknowledge that we are co-constituted by both tools and living bodies, historians’ own texts might henceforth be thought more carefully as, inescapably, 'assemblages', built or emergent from networks of interactions. They might be understood as the sedimentation of sets of experiences or contingencies present at certain locations (e.g. London, University College, The British Library) at certain times (c. 2007-2011) and for certain entities (that of a white, middle class twenty-something from the British midlands, along with the co-workers, friends, companion animals, communication networks and word-processing machines they engaged with). Such conceptions would entail a re-working of the notion of historical authorship and archivization, away from the assumption of 'active' authorship in relation to a 'passive' set of archival information or 'data'. 'Archives' have recently begun to be re-thought as entities that emerge in conjunction with the

4 Kittler, *Discourse Networks*; chapter five of this thesis.

narratives and concerns of those that engage them: as tools created by as much as constitutive of specific forms of subjectivity.[5] The continued theorizing of posthuman notions of self will, this thesis implies, further this process.

To acknowledge such a broad range of contingencies as those referred to above in the constitution of historical narrative would be to position recent work interrogating linkages between embodiment and technical subjectivity as critical matters of concern. The introduction to this thesis pointed to Friedrich Kittler's interrogation of the years around 1900 as marked by a sense of narrative and bodily disintegration and doubt. This was, he suggests, brought on by a de-centering of the human as an 'authorial' subject. With the mediation of texts, speech and sight via mechanical typewriters, gramophones and film equipment, reading could (he claims) no longer be conceived as an 'internal', 'imaginative' projection, or the written word be thought as an interpretative medium for a passive, feminine 'nature'.[6] As Kittler implies, in continuing to cast ourselves as sovereign 'authors' offering *either* objective or subjective accounts of history, we abandon our narratives in the face of ever-more-sophisticated and persuasive modes of non-linear and/or non-textual narration.

Kittler's implication that it is only such 'mediating' tools as typewriters, gramophones and film projectors that effectively efface the authority of the printed word (and with it the human authorial subject) begins to appear somewhat over-stated once the centrality of notions of life in the constitution of technical subjectivities are brought to the fore. As this thesis contends, the thinking of the human as a developing, organic 'animal' has been a critical condition of possibility for the technicalization of power. The constitution and proliferation of techno-organic bodies such as the vivisected animals constructed in physiological laboratories during the nineteenth century should be accorded at least as central a role in the cultivation of posthuman subjectivities as Kittler accords such tools as the typewriter. A more intense interest in similar sites of techno-organic interaction

5 Waterton, C. 'Experimenting with the Archive: STS-ers as analysts and co-constructers of databases and other archival forms', *Science, Technology, and Human Values* 35 (2010), pp. 645-676. Bowker, *Memory Practices*; Derrida, J. (trans. Prenowitz, E.) *Archive Fever: a Freudian impression* (Chicago and London; Chicago University Press, 1995).

6 Kittler, *Discourse Networks*. See also Kittler, F.A. (trans. Winthrop-Young, G. and Wutz, M.) *Gramophone, Film, Typewriter* (Stanford; University Press, 1999).

would further this claim. The zoological gardens that sprung up throughout Europe and North America during the nineteenth century would be one site of interest in this regard.[7] As would the intensive cultivation techniques that became increasingly pervasive in agriculture from the late nineteenth and early twentieth centuries. A privileging of such sites and techniques as matters of historical concern would further emphasise that 'animal' - and more generally 'natural', 'developmental', 'narrative' - bodies have been implicated in the constitution of technical subjectivity from its very beginning.

The figuring of technical modes of subjectivity entails a projection of certain kinds of future as much as it does a narration of particular conceptions of past.[8] This thesis has emphasised the latter at the expense of the former. It has done so not out of a desire that our posthuman future be foreclosed. Rather, it has been motivated by a hope that we might begin to construct tools with which we are able to re-work 'nature' in ways that do not preclude the survival of aspects of our planet presently under threat from human over-population and its concomitant technical excesses. To me, it suggests that to seek a return to a world-imaginary in which 'culture' or 'technology' figure as entities super-added to an a-priori (and therefore more 'fundamental') 'nature' would be to idealise nature as something that could be unproblematically differentiated from humans and/or tools. Yet, equally, to abandon certain forms of 'nature' to the to-them existence-threatening conditions that technical 'progress' has constituted seems also to risk the dissolution of the very conditions upon which the technical has come to be recognised as constituting subjectivity in the first place.

To return to the initial question of this thesis: at stake in the identification of ourselves as technical beings is, precisely, 'life' itself. Forms of life are continually being (re)constructed to feed, clothe, and otherwise administer to a rapidly expanding world population. In such a context, the technicalization of living appears to some as a threatening spectre in which humanity organises the planet around itself via its project of technical 'progress'. Life, it appears, is being

7 Ritvo, *The Animal Estate* and Rothfels, N *Savages and Beasts: the birth of the modern zoo* (Baltimore; John Hopkins University Press, 2002) implicitly address the emergence of zoological gardens as sites of animal-technical interaction.

8 See eg. Fuchs, C.J. '"Death is Irrelevant": cyborgs, reproduction, and the future of male hysteria', in Gray, *The Cyborg Handbook*, pp. 281-300.

articulated, through technique, to the human. Humanity is figured as life's superior and beneficiary rather than its offspring and collaborator. Rather than recommend reclaiming or returning to a 'natural' state that has never existed, this thesis figures 'life' as something that cannot be so subordinated. To the extent that it insists on the animality as well as the technicality of human being, it implies that continued, uncritical belief in technical 'development' also, paradoxically, constitutes a subordination of the human animal to its own technical ideals.

I believe that to raise such spectres as the technical determination of non-human nature is to neglect the capacity of technical entities to exceed the purposes intended for them by humans. I have sought to emphasise the capacities of technical entities to cultivate certain forms of (both human and non-human) life, as much as the ability of living entities to determine technical operations. It is not through the elevation of one or another of these categories that a viable technical future is to be found, I suggest, but through their mutually constitutive articulation.

The kinds of activities by which we might seek to constitute sustainable forms of life will entail the construction of new tools and the learning of new techniques, and not just those related to the production of electricity or the cultivation of crops. For those without leverage in either the highly inert, slow-moving politics of industrial nations, or the technically-exclusive and -excluding 'global' economy of electronic investment and share trading, such learning and such construction must, I believe, begin with those entities that are most readily available, and which are thereby most readily brought to bear: narratives, languages, and living bodies. As N. Katherine Hayles has convincingly shown, the effective mobilization of such entities will, increasingly, also involve an unprecedentedly intense engagement with digital software, computational hardware, and their associated communication networks.[9] The imperative of this thesis is that we must learn to interact with and deploy this latter set of entities in ways that do not efface the fleshy, expressive, story-telling elements of our biotechnical selves.

9 Hayles, *My Mother Was a Computer*.

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