“The Sixth Sense”: Towards a History of Muscular Sensation

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Summary

This paper outlines the history of knowledge about the muscular sense and provides a bibliographic resource for further research. A range of different topics, questions and approaches have interrelated throughout this history, and the discussion clarifies this rather than presenting detailed research in any one area. Part I relates the origin of belief in a muscular sense to empiricist accounts of the contribution of the senses to knowledge from Locke, via the *idéologues* and other authors, to the second half of the nineteenth century. Analysis paid much attention to touch, first in the context of the theory of vision and then in its own right, which led to naming a distinct muscular sense. From 1800 to the present, there was much debate, the main lines of which this paper introduces, about the nature and function of what turned out to be a complex sense. A number of influential psycho-physiologists, notably Alexander Bain and Herbert Spencer, thought this sense the most primitive and primary of all, the origin of knowledge of world, causation and self as an active subject. Part II relates accounts of the muscular sense to the development of nervous physiology and of psychology.

In the decades before 1900, the developing separation of philosophy, psychology and physiology as specialised disciplines divided up questions which earlier writers had discussed under the umbrella heading of muscular

* The stimulus for writing up this paper, which I had long put off because I hoped to do something more rounded, came from the participants, and especially from the organisers, Vincent Barras and Guillemette Bolens, of a project ‘L’intelligence kinesthésique et le savoir sensorimoteur: entre arts et sciences’, at a conference of World Knowledge Dialogue, ‘Interdisciplinarity in action: a practical experience of interdisciplinary research’, Villars-sur-Ollon, Switzerland, 10–14 October 2010. I have tried to retain the interdisciplinary openness of that meeting, for which I thank the participants, one of whom, Irina Sirotkina, also commented on a draft of this paper.

sensation. The term ‘kinaesthesia’ came in 1880 and ‘proprio-ception’ in 1906. There was, all the same, a lasting interest in the argument that touch and muscular sensation are intrinsic to the existence of embodied being in the way the other senses are not. In the wider culture – the arts, sport, the psychophysiology of labour and so on – there were many ways in which people expressed appreciation of the importance of what the anatomist Charles Bell had called ‘the sixth sense’.

Keywords: muscular sense, touch, perception, empiricism, psychology, physiology, movement

Introduction

During the nineteenth century, some writers began to refer to the feeling of the posture and movement of the body, or parts of the body like the limbs or vocal cords, as ‘the sixth sense’, additional to the five senses traditionally distinguished – touch, taste, smell, hearing and sight.¹ It was attention-catching language, but the path to determine the nature of this sense, its structure and function in bodily and mental life, proved slow and complicated. Discussion of the muscular sense (*Muskelsinn* or *Muskelgefühl*, *sens musculaire*) initially ranged over a number of questions and fields, crossing categories of mind and body, which were only subsequently differentiated. Thus, writing about this history, there can be no one story to tell: there is no single subject. Discussion encompassed both phenomenal consciousness of *mental effort* and of *physical movement*. Writers attributed both *conscious* awareness and *unconscious* knowledge of physical movement to processes originating in both *central* and *peripheral* structures, and among the latter they variously included muscles, tendons, joints, skin and other tissues. There was nothing self-evident about relations between sensations of touch, attributable to the skin surface, general bodily feelings, like fatigue, the feeling of mental and physical effort, and feelings specifically attributable to position and movement of muscles and joints. Further, much of the early interest grew out of debate about the sense of sight and the perception of space, a topic which itself proved to be of enormous philosophical as well as empirical complexity. The history of the muscular sense is therefore tied to the history of psy-

1 This must be distinguished from usage in which ‘the sixth sense’ refers to intuition as opposed to sensory knowledge. In English, description of the muscular sense as ‘the sixth sense’ is associated with Charles Bell (Bell 1833, 195). There was also reported to be Renaissance precedent, in J. C. Scaliger, for referring to the sexual appetite as ‘the sixth sense’: Hamilton 1859/60, vol. 2, 156.

chophysics and the rise of scientific psychology. The literature on the muscular sense spread over the endlessly debated relations between physiology, psychology and philosophy. In addition, clinical case studies of morbidity were a major source of information, though open to different interpretations, about relevant sensory and motor capacities.

Contemporary references to the body, not least innovative use of the body in performance, have paid little attention to these historical ramifications. People rather take for granted the existence of this sense, as if it had always been there, waiting only for modern insight to see its potential. Self-consciousness about bodily posture and movement was, however, not always present: it has a history. This paper simply shows when and why a language about muscular sensation came into use. It is a separate question, which I do not discuss, but we should not take it for granted that there are cross-cultural universals in bodily awareness, movement skills (or indeed stillness) and in characterization of effort and will. Of course, ancient and other peoples had and have dance, weaving, hunting, language, fighting and innumerable subtle and not so subtle expressions of bodily activity and gesture. Nevertheless, it is a question well worth the asking, though it remains for future research to answer, as to whether new forms of consciousness of movement, which we can call ‘modern’, developed along with the science of the perception of movement in the nineteenth century.

In writing this one paper I must make clear what I can and cannot attempt. The paper’s primary purpose is to provide a resource for taking research further, for dialogue: to locate the history of the muscular sense in the history of psycho-physiology and philosophy of sensation in general; to contribute to the long and continuing argument that there is something primary or fundamental about touch (broadly conceived to include bodily feeling) in our knowledge of both the world and ourselves; and to understand more deeply the place of awareness of the body in the history of the cultural life of language, gesture, the arts and indeed also medicine and the sciences. Elements needed for a basic history exist scattered in many sources and across several disciplines; I draw them together to provide an introduction.² This is original. I do not here attempt to engage debates about the historiography of science and medicine or about historical epistemology, and I do not investigate any particular argument or idea at the level of detail. I intend this paper to be a resource for those who are not specialists as well as for the few who are.

Throughout the nineteenth century, writers on mind and body referred to ‘the muscular sense’ or its equivalents in other languages. In 1880, the Lon-
2 I return to a number of sources presented in Smith 1973.

don neurologist H. Charlton Bastian introduced the term ‘kinæsthesia’, which he defined simply as ‘the sense of movement’.³ Bastian’s term has lasted in preference to ‘muscular sense’, because the sense of movement, scientists now think, depends on the inner ear, the retinal image in the eye, tendons, joint surfaces, the skin and other tissues, not especially, and perhaps not much at all, on muscles themselves. Already at the end of the nineteenth century, Victor Henri wrote: “Le terme ‘sens musculaire’ ... est mauvais”.⁴ The specifically muscular component of sensory information may be principally unconscious, concerned with muscular coordination, and hardly a ‘sense’. The first edition of the *Oxford English Dictionary* (completed 1928), however, defined kinaesthesia as ‘the sense of muscular effort that accompanies a voluntary motion of the body’. This was, even then, undoubtedly too restrictive a definition, since much research on the muscular sense concerned unconscious stimuli from muscles (e.g., in learned skills), but the dictionary did rightly indicate that there had been heretofore a large psychological interest in the muscular sense and its connection with effort and volition. This connection of the sense to psychological enquiry substantially weakened about 1900, as I shall try to elucidate.

For many Victorians, reference to the muscular sense conjured up associations with the active, conscious individual will; this perhaps reached its apogee in ‘muscular Christianity’ and belief in the male body as a vessel for Christ’s message.⁵ By contrast many modern references are to the unconscious, physiological ‘wisdom of the body’, its capacity to self-regulate.⁶ In the nineteenth century, as the neurophysiologist C. S. Sherrington observed, with English understatement of which he was a master, the term ‘muscular sense’ could refer to many things: “Authorities have not been perfectly concordant in their use of the term. It may perhaps best be taken to include all *reactions on sense arising in motor organs and their accessories*.”⁷ By ‘motor organs’, Sherrington meant muscles, joints and so on; many of his predecessors writing on this topic would have wanted to include *central* motor structures or

3 Bastian 1880, 543 note. Bastian introduced the term in a book for a general audience, a volume in the International Scientific Series in Britain and the United States, a major venture in popular science publishing; thus Bastian’s term had a public as well as specialist audience. For an alternative approach to ‘the search of a sixth sense’, Wade 2003, 2011. Bastian (1887, 5) intended his word to describe sensations “which result from or are directly occasioned by movements” and also those which are hardly perceived or are unconscious and which guide voluntary activity in the light of the existing state of the muscles.

4 Henri 1899, 400.

5 See Hall 1994. This was closely connected with secular zeal for mountain-climbing, overcoming internal and external ‘resistance’: Haley 1978, 254.

6 I borrow the phrase from W. B. Cannon’s famous study of the automatic defensive and self-regulatory responses, *The Wisdom of the Body* (1932).

7 Sherrington 1900, 1002.

processes, that is, the brain concomitants of effort and volition.⁸ The psychologist William James was near the mark when he wrote, referring to ‘the muscular sense’: “This word is used with extreme vagueness to cover all resident sensations, whether of motion or position, in our members, and even to designate the supposed feeling of efferent discharge from the brain.”⁹

We should be sympathetic to nineteenth-century imprecision. The difficulties which researchers on the topic stumbled over concerning epistemology, the relation between mental and physical categories and the linkage of mental acts to passive structures remain. In spite of the separation in the twentieth century of philosophy, psychology, physiology and medical neurology as disciplines and occupations, many topics, of which kinaesthesia is only one, confound clear-cut divisions. In the nineteenth century, institutional and intellectual specialization was in development and had not taken its modern form, frequently resulting in the muddling of questions which, with hindsight, we might think should have been kept separate. Further, it hardly needs saying, kinaesthesia was not, and is not, only of interest to natural science and medicine. Performance in everyday life, work, sport, speech and the arts added boundlessly to the dimensions of discussion.

I distinguish two main strands in the intellectual sources, and hence the paper divides fairly naturally into two parts. Part I discusses the history, following Locke, of the empiricist approach to knowledge which showed a keen interest in touch and then, in the early nineteenth century, distinguished muscular sensation from touch. Part II discusses the experimental approach to sensation in general and the muscular sense in particular, interwoven, in the nineteenth century, with study of the nervous system, using physiological, anatomical and clinical methods. It is not possible to keep these two strands fully separate, especially in explaining the claims made for the special contribution of muscular sensation to knowledge of psychological and physical reality. These claims, at least in the terms in which they had been formulated earlier, broke down around 1900, leaving different specialist programs of

8 I shall have recourse to the word ‘concomitant’. It was a common Victorian term (used notably by the neurologist J. H. Jackson), and it served well then, and it serves well now, to signal the dependency of mind on brain without any commitment to one rather than another belief about what the relationship actually is.

9 James 1950, vol. 2, 197. The terms ‘afferent’ and ‘efferent’ describe, respectively, (sensory) nervous impulses coming inwards to the centre, the brain, and (motor) impulses going outwards. It was made clear, early in the nineteenth century, that the pairs of nerves which leave the spinal cord at each level of the body have two roots entering the cord, the anterior root carrying efferent (motor) neurones, the posterior roots carrying afferent (sensory) neurones (though this arrangement is now thought not to be quite so simple). The nervous system is said to have a sensory-motor organisation. Knowledge of the neuronal structure of the nervous system dates from the 1890s.

research.¹⁰ At the turn of the century, there was also an excited, vivid awareness of movement in sport and the arts. The new dance of Mary Wigman and Isadora Duncan signals this.

Part I: The empiricist background to the muscular sense

The empirical source of knowledge

John Locke's *Essay Concerning Human Understanding* (1690) was the starting point for a number of thoughtful studies of the particular senses and their respective contributions to experience and knowledge. Locke, in the terms of his time, understood his work to be a contribution to logic, to make 'clear and distinct' the manner in which it is possible to have knowledge, and for the subsequent two centuries there was little awareness of or interest in the demarcation, enforced by twentieth-century analytic philosophers, between epistemological and psychological statements. The history of the muscular sense, it follows, does not belong to a history of philosophy or of psychology or of physiology, but to a history in which these divisions themselves come into existence.

In *A New Theory of Vision* (1709), George Berkeley made large claims about the role of touch in visual perception of space, that is, extension ('tangible figure') and distance. He thought the touch sense the origin of spatial ideas, ideas which seeing subsequently calls up and which we thus experience as if they were given in vision. Even earlier, Locke's Irish correspondent, William Molyneux, had posed a question which has continued to fascinate: "Suppose a Man born blind, and now adult, and taught by his touch to distinguish between a Cube and a Sphere ... Suppose then the Cube and Sphere placed on a Table, and the Blind Man to be made to see. *Quaere*, Whether by his sight, before he touch'd of them, he could now distinguish, and tell, which is the Globe, which the Cube?"¹¹ Locke and Berkeley thought not: sight in itself conveys no idea of space. These arguments had long-lasting influence. In Britain, only in the 1830s and 1840s were William Hamilton and Samuel Bailey to question the role Berkeley had attributed to touch in

10 There was a very large amount of work on the muscular sense in the second half of the nineteenth century. I attempt only an introduction, especially as regards German-language experimental and clinical research, and I have drawn on accessible contemporary summaries, especially Bastian 1880, 540–544, 691–700; Henri 1899 (with bibliography); James 1950, vol. 2, 189–202, 486–522; Sherrington 1900. Later commentators draw on Boring 1942, 524–535, 566–568.

11 The form of the question rephrased in Locke 1975, II.ix.8. See Berkeley 1910; Morgan 1977. In practice, the answer to Molyneux's question, though much studied, is far from simple, especially because of the confusions of the postoperative state.

vision, and even then J. S. Mill and others returned to champion the basic position Berkeley had argued for.¹² I will say no more about this. But it was this topic which focused interest on touch as the primary and principal sense through which we have contact with the world and, in the process, differentiate self and world and lay the basis for knowledge. In due course, this led to the examination of touch as a complex sense and recognition that a significant part of what was included in touch originates in the depth, not the surface, of the body. Knowledge of the nature of, and the anatomical structures responsible for, the different modalities of ‘touch’ for a long time remained speculative. In the nineteenth century, very gradually, new knowledge of the nervous system, along with the new technology of microscopical anatomy, opened possibilities for firmer conclusions. Meanwhile, by the 1820s, Thomas Brown and James Mill, both Scotsmen, had elevated muscular sensation, as opposed to touch more strictly called, to the dominant position in empiricist theories of the perception of the external world, and indeed in the differentiation, in the first place, of a notion of self from a notion of world.

David Hartley’s *Observations on Man* (1749) is in retrospect famous among neuroscientists for proposing an account of nervous vibrations in parallel to mental events, and famous among psychologists for elaborating systematically the idea of ‘association’ as the means by which ideas originating in sensation join up to form the content of the mind. Both of Hartley’s proposals were elements in a natural theology, a philosophy of the nature of God based on knowledge of the creation, which guaranteed the providential arrangement of the world to cause human moral and material progress. Dealing with the sense of touch, which he called ‘feeling’, along with sensations of heat, cold and so on, Hartley distinguished two aspects: feeling derived from ‘muscular contraction’ and feeling derived from ‘pressure’, though the two frequently exist in combination. In muscular contraction, ‘we overcome the *Vis inertiae* of our own Bodies, and of those which we have occasion to move or stop’, and by this means vibrations in the senses give rise to knowledge of material objects.¹³ While he thought the nervous vibrations from the eye to the mind might be stronger than those from touch, he suggested that the vibrations responding to pressure were more fundamental. It is the experience of pressure, caused by resistance to touch, he argued, which gives

12 Bailey 1842; Hamilton 1859/60, vol. 2, 159–184, and 1863, 861 note. The critical arguments were drawn together and directed against Bain’s claims on behalf of muscular sensation in Abbott 1864. For history of the large topic of visual perception, Boring 1942; Pastore 1971; Hatfield 1990. On this, as on so much else, William James, a critic of Berkeley’s theory, is an invaluable commentator: James 1950, vol. 2, chapter 20.

13 Hartley 1749, vol. 1, 130. Because Hartley suggested conduction in nerves in terms of pressure waves (‘vibrations’) and knowledge of the world from pressure, some readers have claimed that he pointed towards a unified mind-body theory; see Allen 1999.

us knowledge of the essential properties of matter, its *vis inertiae* and its extended, ponderable and impenetrable qualities. Sight is not so reliable a source of knowledge of matter: “And it is from this Difference that we call the Touch the Reality, Light the Representative.”¹⁴ In certain respects, it is possible to compare Hartley’s views with those of the somewhat younger *genevois* natural philosopher, Charles Bonnet, who in an unorthodox Christian *psychology* claimed to know nothing about the immaterial soul in itself but to trace knowledge to sensory experience mediated by nerve fibres, each fibre having its own predisposition to convey a particular sensation, as the strings of a musical instrument are tuned to different pitches.¹⁵

In assigning to the feeling of pressure primary status in knowledge, Hartley and others who were to take this position linked touch and the so-called primary qualities of matter. This had large significance. The changes in natural philosophy in the sixteenth and seventeenth centuries, once simply called the scientific revolution, resulted in ‘the mechanization of the world picture’.¹⁶ Most clearly in Descartes, but also, with whatever complexities and qualifications in Newton, Huygens, Leibniz and other architects of mechanics, a philosophy of matter developed which conceived of matter in essence as extended and impenetrable – the primary qualities, significantly qualities *measurable* in terms of mass and motion. This philosophy assigned the qualities of the conscious world, the qualities which give it its poetry – form, warmth, colour – secondary status as products of extended and moving matter as it affects the senses. Thus, when philosophers following Locke and Berkeley began to distinguish the contribution of touch to knowledge, they were concerned with touch as the sense through which we learn about the primary qualities, ‘reality’, as opposed to other senses which give us the experience of secondary qualities.¹⁷ Eighteenth-century natural philosophy recreated Cartesian soul-body dualism as a dualism between the real qualities of matter and the mentally formed qualities not really in nature (though

14 Hartley 1749, vol. 1, 138.

15 Bonnet, *Essai analytique sur les facultés de l’âme* (1760); see Grober 1995; Hatfield 1995, 205–207; Vidal 2006, 160–172. Though Bonnet stressed the existence of ‘force’ as the active principle in nature, I am not aware that he paid particular attention to the feelings of touch or resistance to movement. (Here and in a number of notes, but not in the lists of references, I give, for convenience, the titles of texts which have relevance but which I have not tracked down.)

16 The phrase is from Dijksterhuis 1969. There is a large debate about the viability of continued reference to a scientific ‘revolution’ and the identity of the ‘revolutionary’ changes as changes in metaphysics; but this is not the place to go into that. For a classic statement of the view that the new science abstracted mechanical properties from the richness of the experienced or phenomenal world, Whitehead 1953.

17 See Bennett 1965. For a philosophical critique of the distinction between primary and secondary qualities, Bennett and Hacker 2003, 128–135.

nature has the power to form them in the mind). As a result, the early history of the muscular sense is part of the history of claims that we have a sense which makes possible direct awareness of primary qualities and thus have authoritative empirical knowledge.

There was a further layer of argument. When Newton and Leibniz developed mechanics as the basis for scientific knowledge, both, though differing in their formulations, attributed active principles, as well as passive matter, to nature. Active principles, in a huge variety of forms, often collectively named in English by the term ‘force’, became a feature of natural philosophy, put forward to explain, for example, electric phenomena and the properties of living things.¹⁸ A number of influential writers claimed that knowledge of these active principles, ‘forces’, originates in direct awareness of touch, subsequently refined into muscular sensation, understood as interaction between active principles in organism or self and active principles in the physical world. The muscular sense therefore came into view as the sense in which awareness of movement and resistance to movement reveals *the active constitution of being* of self and other.

Hartley’s younger contemporary, the abbé de Condillac, provided a more secular analysis of sensory experience as the basis of knowledge. The statue in his famous thought experiment, in the *Traité des sensations* (1754), began its sensory life by moving in response to the touch of the external world, and during this movement it encountered both the world and its own body as forms of resistance. Touch, according to Condillac, reveals the resistance of bodies, their impenetrability or materiality, and their extension, their spatiality.¹⁹ At one and the same time, the statue perceived the essential, or primary, qualities of bodies and its own self or individuality. In his later work, Condillac situated this psychology of the individual’s acquisition of knowledge in a comprehensive educational programme, a systematic course of rational education in sixteen volumes. After the Revolution, this account of the origin of ideas, corrected and amplified, became the basis for *idéologie*, an elaboration of the empiricist theory of knowledge which built up knowledge from sensory ideas into a comprehensive *science de l’homme*.²⁰ This involved making far-reaching claims for the muscular sense.

Neither Hartley nor Condillac clearly differentiated or described a muscular sense separate from touch. It was possibly Erasmus Darwin (Charles

18 Heimann and McGuire 1971.

19 Condillac 1930, 84–90. For Condillac’s writings, Sgard 1981. There was also an emphasis on ‘*tact*’ as the primary sense in the *Encyclopédie*: Jaucourt 1765, 819.

20 For Georges Gusdorf, *idéologie* was the culmination of a long history leading to *les sciences humaines*: Gusdorf 1978. Also Head 1985; Picavet 1891. For French thought and the British utilitarians, Halévy 1952, 434–445.

Darwin's grandfather) who was the first to do this, as part of an account of the animated, irritable, character of all bodily fibres. Interested in the active principles of life, and influenced by Hartley and the editor of a later condensation of Hartley's work, Joseph Priestley, in his *Zoonomia; Or the Laws of Organic Life* (1794/6), Darwin discussed the production of 'ideas' as the sensitive response of bodily fibres to the world around them. He distinguished the different responsiveness of different fibres and hence the different sensitivities of skin and muscles. The feeling of pressure, at the root of perception of extension, which we ordinarily attribute to touch is, he claimed, properly attributable to muscle fibres. The muscles are, in effect, a distributed sense organ, though we may be hardly conscious of what we perceive by this route: "The organ of touch is properly the sense of pressure, but the muscular fibres themselves constitute the organ of sense, that feels extension ... Hence the whole muscular system may be considered as one organ of sense, and the various attitudes of the body, as ideas belonging to this organ, of many of which we are hourly conscious, while many others ... are performed without our attention."²¹ We may perceive the position and state of muscles just as we may perceive a full bladder or a distended heart. It is all part of the economy of life.

Darwin was one of a number of speculative writers, including J. C. Reil in Halle and Lamarck in Paris who at this time advanced general theories of life in which the whole body was thought sensible.²² Using modern terms, we might say that they recognised specifically biological properties. In this medical and intellectual context, it was natural to describe muscle as sensible; but such description did not necessarily clearly separate muscular sensibility from the general sensibility of the body or the feeling of effort which accompanies voluntary bodily activity. There was no conception of distinctions between the central nervous system and the autonomic (vegetative) nervous system, or between the mental feeling of effort and the sensory system from muscles and joints.

It was Darwin's critic on religious and philosophical grounds, the Edinburgh professor of moral philosophy, Thomas Brown, who examined at length and spread the notion of the muscular sense in the English-speaking world. His *Lectures on the Philosophy of the Human Mind*, though Brown died in 1820 in the year the lectures first appeared, became staple fare in university education in both Britain and North America for three decades. Brown

21 Darwin 1794/6, vol. 1, 122–123. Darwin contributed to the debate about organic properties which had Albrecht von Haller's category of irritability as point of reference: Haller 1756/60, and 1936.

22 Figlio 1975.

stressed the different modalities of touch and muscular sensation and attributed knowledge of the primary qualities of bodies, indeed of externality itself, to the latter. Brown argued that touch, strictly speaking, in this like vision, is a sense which establishes derivative knowledge and leads to perception of extended and resisting bodies only because of 'suggestion'. By 'suggestion', touch (or vision) calls up ideas derived from a more fundamental source. This more fundamental source, he claimed, is the feeling of *resistance to muscular movement*. Brown thought the feeling of resistance fundamental to knowledge of bodily reality, equally our own body or other things, and he claimed that it is the temporal duration of resistance which lies at the root of perception of spatial extension. The muscles form a sense organ: "The feeling of resistance ... is, I conceive, to be ascribed, not to our organ of touch, but to our muscular frame, ... as forming a distinct organ of sense."²³ It is this sense, Brown went on to argue, which leads the young child to differentiate self and an external world: every time the infant moves it feels its own movement, and when this movement encounters resistance the child naturally assumes the existence of a new antecedent to the movement in something external to self. It is resistance which is fundamental to knowledge of the difference of self and other. "The infant, who as yet knows nothing but himself, is conscious of no previous difference; and the feeling of resistance seems to him, therefore, something unknown, which has its cause in something that is not himself."²⁴ Going even further in emphasising the muscular sense, Brown linked it to the feeling of effort, the effort characteristic of voluntary action: "We cannot make a single powerful effort, at any time, without being sensible of the muscular feeling connected with this effort."²⁵ Thus he linked the perception of resistance from outside the self with the exercise of action or effort by the self. The ramifications of this interweaving of discussion of the muscular sense with discussion of volition were enduring – and, as it turned out, confusing.

The Scottish philosopher William Hamilton was to claim that Brown simply took his ideas from French writers. The matter, though, is probably more complicated, since there was a rich intellectual interchange, in both directions, between Britain, especially Scotland, and continental Europe between about 1790 and 1820. Brown certainly responded to Darwin's writings; equally, he was familiar with French writers, including Destutt de Tracy, who had specifically criticised Condillac's analysis of sensation for failing to incorporate the sense of movement. Tracy was the most systematic exponent

²³ Brown 1824, vol. 1, 460–461.

²⁴ Ibid., 509.

²⁵ Ibid., 462.

of *idéologie*, the attempt to provide a socially and politically applicable science of human nature, a political economy, appropriate for the new age of the citizen, based on the analysis of mind in terms of the sensory experience which was thought intrinsic to its nature. Like Condillac, Tracy believed that perception, that is knowledge of something as opposed to simple sensation, must be composite (in itself contain a relation). But whereas Condillac derived perception of existence from the composite experience of double touch – touching oneself and feeling the touch at the same time – Tracy thought the composite experience an experience of movement and resistance. He thus attributed knowledge of the external world, and with it knowledge of self, to the simultaneous presence of two sensations of different kinds, the one of activity and the other of resistance to it. The feeling of movement is composed of polarised but inseparable modalities, the one active, ‘la faculté de vouloir’ (a faculty of the organisation of the living body, not of soul), and the other passive, resistance. This is the source of our notion of *le moi* and *le soi*. «La propriété de résister à notre volonté de nous mouvoir, est donc la base de tout ce que nous apprenons à connaître.»²⁶

Whether derived from Tracy or not, a similar notion of the doubleness, or relational character of experience, in basic human awareness was at the heart of Brown’s account of knowledge acquisition. For some writers at this time (though not Brown), this way of thought merged seamlessly with German *Naturphilosophie* and a romantic sensibility for the human being as one force in a natural world of forces. Thomas Carlyle wrote that the universe “is a Force, and thousand fold Complexity of Forces; a Force which is *not we*. That is all; it is not we, it is altogether different from *us*. Force, Force, everywhere Force; we ourselves a mysterious Force in the centre of that.”²⁷ Carlyle did not concern himself with the details of how we acquire knowledge but showed how claims about the experience of ‘force’ could translate into romantic, even spiritual, philosophy.

By contrast, Tracy’s analytic argument for effort-resistance as the constituting ‘idea’ of being was developed into arguments for the *embodied* reality of ‘ideas’. The group which formed around him at L’Institut national included Cabanis and other physicians, and Cabanis’ *Rapports du physique et du moral de l’homme* brought the outlook of *idéologie* into medical thought on the body. Cabanis himself, familiar with Tracy’s work in the 1790s, discussed touch

26 Tracy 1800, 333; also 102–22 (from the *idéologie, première section*). For his account of volition (from the *idéologie, seconde section*), Tracy 1815, 53–92. Also Hallie 1959, 27–29. The publication and influence of Tracy’s work was closely tied to the history of the Section on the analysis of sensation and ideas in the Second Class (Sciences morales et politiques), suppressed in 1803, of the Institute national. See Leterrier 1995.

27 Carlyle (first publ. 1841) no date, 190–191.

but not specifically muscular sensibility, as «le type ou la source commune de tous les autres [sens]» which is present in all sensory activity.²⁸ «Le tact est le premier sens qui se développe, c'est le dernier qui s'éteint. Cela doit être, puisqu'il est la base des autres, puisqu'il est, en quelque sorte, la sensibilité même.»²⁹ Touch, the feeling of life, originates first of all the senses, before birth. His medical colleague Xavier Bichat, in his influential *Anatomie générale*, similarly held touch to be different from and fundamental to the other senses. In particular, he argued that it is the organism itself which initiates touch (unlike the other forms of sensation) – «le sens est volontaire; il suppose une réflexion dans l'animal qui l'exerce».³⁰ It is touch which at base makes possible an active, intelligent animal, able to adapt to its surroundings. Bichat, however, did not discuss a muscular sense, only the general sensibility of 'organic life', that is, of the smooth muscles of internal organs.³¹

There was even more innovative use of Tracy's analysis of movement in the acquisition of knowledge in the work of Maine de Biran. This was the starting point for a distinctive emphasis on the active will in French enquiry, visible down to existentialist thought in the mid-twentieth century. Biran initiated a kind of phenomenology, in which he described the will as the irreducible core of the self, an unmediated perception; but he firmly understood this will to be embodied, and to be known because of *resistance*. He thus did not simply restore a kind of Christian idealism, though it was possible for his writing to be put to Christian uses. Put briefly, Biran, using a Cartesian method to arrive at what is indubitable in awareness, concluded that feeling of effort (understood as the expression of volition not the simple sensation of strain) is the uniquely irreducible '*fait primitif*'. Examining subjective (phenomenal) consciousness, he described the '*fait primitif*' as awareness of personal effort, activity or will, which he called '*l'effort voulu*'. This he made the starting point, in his account of mental development as in his theory of knowledge, for a psychology which took the self, an intrinsically active self, to be the subject. Rather than separating *l'âme* and *le corps*, as Descartes had done, Biran's dualism distinguished between personal activity and external resistance, '*l'effort voulu*' and '*les impressions*'.³² It

28 Cabanis 1824, Dixième mémoire, vol. 3, 177. The *Rapports* were first published together in 1802. For Cabanis' relations to Tracy and *idéologie*, Staum 1980; on rethinking sensations in relation to instinct and very early (ontogenetic) organic activity, Richards 1982, 160–161.

29 Cabanis 1824, Troisième mémoire, vol. 1, 179.

30 Bichat 1812, vol. 1, 117.

31 Ibid., vol. 3, article III.

32 Ideas accessible, with a clear introduction, in Biran 2005 (also in 1984/99, vol. 4); also, *Mémoire sur la décomposition de la pensée* (written 1804), in 1984/99, vol. 3, 99–131, and *Essai sur les fondements de la psychologie* (begun 1811, mostly dating from 1812), in 1984/99, vol. 7, 115–200. The publication history of Maine de Biran's work is complex. See Azouvi 1995; Hallie 1959; Moore 1970.

must be remembered, however, that Biran, with some exceptions among idealist philosophers, was not well known outside the French-speaking world. This is in part because he published only a few essays and no accessible synthesis.³³

Biran wrote at length; the outcome, however, was a body of unfinished writing and, significantly, a diary in which the personal nature of his intellectual enquiry into human nature and its dependency on the will became evident. For this reason, literary historians have linked his name with Stendhal's, as Biran and Stendhal shared a narrative voice which stressed the idealist and romantic will – and the will's vicissitudes.³⁴ This side of Biran's work, along with an emphasis on the active nature of mind in knowledge and conduct taken from the Scottish 'common-sense school' headed by Thomas Reid, entered into *éclectisme*, the philosophical synthesis, with appropriate religious colour, which dominated French higher education teaching after the Restoration in 1815. In the hands of Victor Cousin, under the heading, '*psychologie*', an emphasis on the soul's activity became the intellectual foundation of a comprehensive system of philosophical, moral and psychological education which had influence in France well into the period of the Third Republic.³⁵ A markedly voluntaristic strand developed in French thought through Biran and down to Bergson and beyond.

The feeling of muscular activity, which Darwin had described as an organic property of sensitive fibres, and Tracy had described as the sense of movement, a psycho-physiological feeling, reappeared in Biran as a description of a person's awareness of irreducible will, the core of personhood. Thus, empirical (though introspective) claims about awareness of effort bifurcated, leading in one direction to belief in the existence of muscular sense, explaining the experience of effort as encountered resistance to movement, and in the other direction to belief in volition, explaining the experience of effort as the encounter of the soul, or at least the spontaneous power of mind, with resistance. Reference to the awareness of effort and resistance as elementary feelings historically linked accounts of muscular sensation and theories of will. Later observers might think different questions confused here – questions about the muscular, physiological, sensory system, the psychological sense of effort and the moral as opposed to psychological category of volition. But the historical fact, as we shall see, is that throughout the nineteenth century investigation of effort and of muscular sensation continued to be

33 For English-language appreciation of Biran: Hamilton 1863, Note D, 866–867; Morell 1847, vol. 2, 471–478; James 1920, 181 note; and, making him the beginning of a tradition leading to Bergson, Stebbing 1914.

34 Smith 1972.

35 Brooks 1998; Carroy/Ohayon/Plas 2006, 14–19; Goldstein 2000.

related. Nor was this simply confusion. It was the ideological burden of psycho-physiological knowledge to represent the human subject *as active*, indeed knowingly active, and hence to represent a person as a moral and responsible, creative and civilised, subject. The muscular sense, because as a sense it appeared bound up with awareness of activity, was part of normative discourse about the human subject or self. The attempt to separate mechanistic physiology, including the physiology of kinaesthesia, from the values thought intrinsic to being human came later.

The high point of muscular sensation in British thought

Brown, along with French writers, was an influence on James Mill, whose *Analysis of the Phenomena of the Human Mind* (1829) was a monument to abstract analysis based on associationist principles. ‘Association’, a social metaphor, was the preferred term for describing the way supposedly elementary units of sensory experience group together, by resemblance, temporal proximity or whatever, to form complex content of the mind. Acknowledging a debt to Hartley, Darwin and Brown, Mill assigned a crucial role to the muscular sense in the genesis of notions of space and motion. For Mill, sensations of touch are merely signs to introduce the ideas of resistance and extension, with which touch sensations have become associated, ideas at base indebted to the muscular sense of resistance. The muscular sense is composite, a sense of a force opposing a force: “We could not have had the idea of resistance, which forms so great a part of what we call our idea of matter, without the feelings which attend muscular action. Resistance means a force opposed to a force; the force of the object, opposed to the force which applies to it. The force which we apply is the action of our muscles, which is only known to us by the feelings which accompany it.”³⁶ Out of the experience of resistance, Mill built knowledge of the world. For Mill, however, a staunch necessitarian and utilitarian in moral and political philosophy, there is no autonomous will in the sense of a spontaneous power of mind or soul. This marked the distance of his secular thought from the kind of Christian idealism found in Biran and even more in *éclectisme*. Every action, for Mill, is a response to the pleasurable or painful character of sensations. It is, he argued, the sense of action reported by the muscular sense, force acting against force, which is at the root of what we call experience of the will, the sense of effort; but this sense is, in the final analysis, a passive one. Certainly,

36 Mill 1869, vol. 1, 43. The first edition of the *Oxford English Dictionary* cited the original edition of Mill’s *Analysis* for the first use of ‘muscular sensation’: Mill 1829, vol. 1, 31–35.

overall, he conveyed a strong impression that he thought of the mind as having a passive nature. As Mill's main motive in writing was to base pedagogy, and thereby social and political reform, on a scientific theory of the human mind, he explicitly put to one side the physiology and anatomy of the muscular feelings. Later writers were to draw the embodied feelings back in.

By 1830, then, the notion of a distinct muscular sense was firmly established. (This was also the case, if in different terms, in German-language countries, but I defer discussion of this.) In Britain, the philosophical pretensions of 'the Experience school', the tradition of analysis of the mind originating with Locke, came under attack in the work of Hamilton in the 1830s. Hamilton, in Edinburgh, taught many of those who became academic philosophers in the next generation and who re-expressed idealist theories of knowledge. In eighteenth-century Scotland, Reid and others had emphasised the *active* power of mind, which 'the Experience school' was believed to deny. In the context of public debate about religious beliefs, continuing in the nineteenth century, this amounted to a defence of free will, with all the rich moral, legal, political and theological associations which such a defence had. Hamilton attempted, somewhat like Kant, a logical resolution of the relations between *a priori* ideas (such as, he believed, the idea of space) and those derived *a posteriori* from sensation. This is noteworthy now because when Hamilton discussed 'immediate perception', in which he thought *a priori* and *a posteriori* sources combine, he attributed to the muscular sense among other senses a role in making possible a unified conceptual and experiential knowledge of reality. In addition to the primary qualities of matter ('triunal extension' and 'ultimate incompressibility', Hamilton's terms for three-dimensional space and impenetrability), which he thought known *a priori*, and the secondary qualities (colour, temperature, etc.), he described 'Secundo-primary Qualities', knowledge of which, he stated, stems from sensation of resistance.³⁷ When *a priori* and *a posteriori* elements of knowledge combine, when we 'perceive' the 'Secundo-primary Qualities', we know them as really present in matter; but when we merely 'sense' these qualities they appear as due to contingent relations among bodies. The point now is not the logic of the argument but the historical presence of belief about muscular sensation in the roots of modern epistemology. Hamilton also referred to a 'locomotive faculty', a capacity which is significant to knowledge as it mediates perception of motion based on muscular sensation.³⁸

37 Hamilton 1863, Note D – this included (864–869) an erudite but not especially helpful history of knowledge of the muscular sense, back to the late Renaissance. I cannot but note that, among a cluster of difficult, even bad, writers, Hamilton is the worst.

38 Hamilton 1863, 864–865.

While Hamilton was teaching in Edinburgh, William Whewell was teaching at Cambridge, and Whewell's philosophy of science, accessible to a wider audience than Hamilton's writings, was central to the early Victorian accommodation of science and religion in natural theology.³⁹ I mention this because it shows the importance of knowledge attributed to the muscular sense, knowledge of forces, to a religious metaphysics. This metaphysics underpinned claims about the real causal activity of a transcendent power, God, in the world. The result was, I think we may fairly say (adapting Weber's celebrated description), a picture of an 'enchanted' world, since it rendered hopes about the ideal as really present in active powers in nature. Whewell discussed the muscular sense in a way which was important to the, perhaps complacent, Victorian sensibility that human action has meaning in a purposeful world. Discussing the perception of space, Whewell argued that we have direct awareness of 'force' when we exercise the mind's active powers and when these powers encounter resistance. This subjective awareness is, he claimed, the root of our notion of causation.⁴⁰ As others had done before in the tradition of Christian natural philosophy going back to Newton and the seventeenth century, he linked supposedly unmediated knowledge of 'force' to knowledge of God's providence. Whewell described phenomenal experience of 'force' as the source of knowledge of *real causal power*, and he then drew the analogy, which had ancient roots, between the human will and the Divine Will. Just as we know the self as a causal agent, so we can know God, working through the 'forces' of nature, as ultimate cause. Both self and God are a real cause (*vera causa*).

Like Reid earlier, responding to Hume's notorious sceptical attack on belief in causal powers, Whewell distinguished knowledge of proximate or 'physical' causes and 'efficient' causes. Hume, his critics judged, in limiting knowledge of causes to knowledge of the constant conjunction of the elements of sensory experience, had dealt with the former but not the latter.⁴¹ According to Whewell, people have an idea of causal relations not attributable to the fact that one thing just happens to follow another, but known to be the "result of faculties which the mind actively exercises".⁴² We have

39 See Yeo 1993.

40 Whewell 1840, vol. 1, Aphorism XXIX, xxi; also 158–184.

41 Ibid., 159: "By Cause we mean some quality, power, or efficacy, by which a state of things produces a succeeding state. Thus the motion of bodies from rest is produced by a cause which we call Force." J. S. Mill, criticising this idealism (and the political conservatism which he thought it intellectually underpinned), restated the Humean analysis of causation: Mill 1900, Book 3. His followers Bain and Spencer, however, as I show, did analyse causation, in this respect like Whewell, in the light of our supposed awareness of muscular feeling and 'force'.

42 Whewell 1840, vol. 1, 169.

knowledge of this activity, which Whewell and his contemporaries described as knowledge of 'force', given in awareness of effort and its accompaniment, muscular feeling. Even language was thought to indicate this, since the roots of the ubiquitous word 'force' denoted muscle (Whewell wrote): 'The Latin and Greek words for force *vis*, *ἰς*, were probably, like all abstract terms, derived at first from some sensible object. The original meaning of the Greek word was a *muscle* or *tendon*.'⁴³ In the mid-century, this complex of ideas attracted a lot of attention: it sustained a religious natural philosophy, and there was widespread scientific interest in the correlation of all kinds of physical forces (linking phenomena such as heat, light, electricity and magnetism) and the further correlation of these physical forces with mental ones. At this time, investigations of correlation and interconvertibility of forces made a major contribution to the way the principle of the conservation of energy in physics was formulated.⁴⁴

The thought which linked muscular sensation, 'force' and claims about causal relations in the world was not restricted to Christian idealists like Whewell. Indeed, it had its most developed form in the secular writing of two followers of John Stuart Mill, Alexander Bain and Herbert Spencer. They developed to its limit the earlier argument that the basis of all knowledge of what is real lies with the experience of resistance when we move: phenomenal awareness, or subjective experience, of 'force', that is of activity encountering resistance, is the most fundamental knowledge we have of our being.

Whewell was the immediate stimulus for J. S. Mill's *System of Logic* (1843), the book which shaped the empiricist stance for the rest of the century and was a reference point for German-language attempts to deepen understanding of *die Geisteswissenschaften* and to respond to the cultural crisis which natural science was perceived to have precipitated.⁴⁵ Seeking to outargue the conservatism which he found in Whewell, Mill fostered the work of two younger men, Bain and Spencer, who turned empiricist argument into an influential body of writings in psychology (specifically so named). Bain and Spencer transformed earlier associationist analysis, Bain by stressing the role of activity in knowledge, Spencer by embedding everything in an evolutionary framework. Both men also firmly coupled analysis of mind to analysis of the nervous system. In the process, they both discussed the muscular sense at length. They took subjective awareness of 'force' to be the most fundamental and irreducible datum of knowledge of being and the source of differentiation of self and other. They thus brought claims made on behalf of

43 Ibid., 178.

44 Related to subjective experience in Jackson 1967.

45 Feest 2010.

the muscular sense in relation to knowledge to a high point. Their views were widely known: Spencer was read throughout Europe, and indeed further afield, as *the* philosopher of evolutionary progress, and Bain's work informed later functionalist and experimental psychology in the English-speaking world.⁴⁶ Yet, as I show in part II, the particular claims they made for knowledge deriving from the muscular sense did not last.

Bain considered feelings of muscular movement to be both distinct from and more important than the feelings deriving from the traditional five senses. His reason was that he thought organisms, including the human embryo, move *prior to* any sensation from the five sense organs: "I have thought proper to assign to Movement and the feelings of Movement a position preceding the Sensations of the senses; and 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."⁴⁷ Hence, Bain argued, the sensation, the muscular feelings, accompanying this prior movement must be primary. He described these muscular feelings as representing "the Active side of our nature", in contrast to the feelings derived from the other, passive, senses.⁴⁸ He differentiated three modalities of muscular feeling: the organic condition of muscle (felt, for example, as pain or fatigue); feelings of exercise and effort; and "the discriminative or intellectual sensibility" of muscle, which registers strength, degree, velocity and place of muscular contraction.⁴⁹ Significantly for his wider philosophy, he also thought that muscular feeling gives us a sense of 'force' or energy expended. Putting all this together, he concluded on theoretical grounds that the awareness at the basis of knowledge accompanies motor activity: "Our safest assumption is that the sensibility accompanying muscular movement coincides with the outgoing stream of nervous energy."⁵⁰

In Bain's texts, then, 'muscular sensation' denoted a sense of activity, the basis for an empiricist theory of learning which, in contrast to earlier empiricist theories (at least as their critics represented them), took the organism to be fundamentally active rather than passive. Bain's theory of the muscular sense was an attempt to make an empiricist account of the will, of

46 Ribot 1870; Young 1990; Richards 1987; Buxton 1985.

47 Bain 1864, vii. J. S. Mill's and Bain's enthusiasm for the theory of spontaneous action, answering idealist critics of the passivity of mind found in empiricist theories, led them to republish James Mill's *Analysis*, with its account of the muscular sense, with notes by Bain on activity: J. Mill 1869, vol. 1, 41–44, 58–59, and vol. 2, 327–395.

48 Bain, in J. Mill 1869, vol. 1, 4.

49 Bain 1864, 91–116.

50 Ibid., 92. I return to the physiological dimension of Bain's position in Part II.

active volition, possible, and thus to take from idealists the moral high ground in claims about human nature – that only idealist theory does justice to human agency. When Bain used such phrases as “the feeling of energy put forth” and “the experience of force or resistance”, he claimed to describe “an ultimate phase of the human consciousness” in which “we *body forth* to ourselves a notion of force or power, together with the great fact denominated an external world”.⁵¹ In the beginning, is the act.

Spencer wrote independently of Bain, yet he also assigned the feeling of resistance, the feeling claimed to be present in muscular sensation, fundamental status in empiricist philosophy and psychology: “The perception of resistance is fundamental, ... as being the perception into which all other perceptions are interpretable, while itself interpretable into none.”⁵² In fact, he took the feeling of resistance to be the elementary sensibility of any and every interaction between all organisms and their environments, and in this way it played a large part in his evolutionary account of the origin of mind. For Spencer, the feeling of muscular movement is the most elementary or primitive starting point of mind. In his ‘Synthetic Philosophy’, on which he worked for thirty years, the feeling of resistance became the basic empirical datum, the experiential representation of the ultimately unknowable ‘force’ out of which the universe, from the cosmos to human ethical society, has evolved and continues to evolve.⁵³ Spencer stated that “the consciousness of muscular tension forms the raw material of primitive thought”, and he derived ideas of space, time, matter and motion from the elementary feeling of resistance.⁵⁴ His writing style was dry, yet, however intellectualised, he exhibited sensibility for the meaningful place of human agency in the cosmos, agency known in experience of movement and resistance.

The legacy

With Bain and Spencer, then, claims about the fundamental character of muscular sensation in the history of life and in human knowledge reached their apogee. These British writers, especially Spencer, had a large audience elsewhere. Thus, Ribot’s book on the British psychologists was a significant plank in the house he constructed for scientific psychology in France in the

51 Ibid., 98; italics added to draw attention to the language of embodied action.

52 Spencer 1855, 272.

53 Spencer 1862; for his philosophy and sociology, Peel 1971.

54 Spencer 1870/2, vol. 2, 242; in general, *ibid.*, Part VI, chapters 11/18. This second edition of his *Principles of Psychology* was reorganised and expanded, and it attracted attention in the way the first edition (1855) had not.

1870s, opposing the reigning eclectic psychology (which had its own conception of the active self).⁵⁵ Biran and his heirs in one way, and Bain and Spencer in another, demonstrated the potential which discussion of the muscular sense had to open up thought about the embodied being of self in the world. Beyond France, the Russian promoter of physiology as the basis of medicine in the 1860s, Ivan Mikhailovich Sechenov, read the British literature as part of his search for a secular, scientific psychology. Late in life, he published a number of informal studies of the sources of knowledge of the material world in which he hinted at a direct awareness of form and motion mediated by the muscular sense. It then became possible in the Soviet period for writers, searching for Russian roots for Lenin's philosophical realism, to claim that Sechenov's statements added up to an insight of world historical importance, as they had advanced a dialectical, materialist understanding of the relations of active subject and passive object.⁵⁶

Empiricism as a theory of knowledge was under attack by 1900, and not just by idealists or neo-Kantians. Frege, Russell and other logicians severely criticised the confusion, evident in the writers I have been discussing, of statements appropriate to epistemology with psychological statements appropriate to empirical science. The Oxford philosopher F. H. Bradley scathingly dismissed the notion that resistance might somehow uniquely manifest reality: "It is mere thoughtlessness ... For resistance, in the first place, is full of unsolved contradictions ... And in the second place, what experience can come as more actual than sensuous pain or pleasure?"⁵⁷ The decisive point, I think, as far as claims for muscular sensation as the privileged route to knowledge of reality is concerned, was put concisely by A. N. Whitehead: "So far as reality is concerned all our sense-perceptions are in the same boat."⁵⁸ In modern epistemology, questions about reality are one thing, a matter for philosophy, questions about how we perceive, another, a matter for psychophysiology, and professional analytic philosophers took one road, while equally professional natural scientists, including those who studied kinaesthesia, took another.⁵⁹ For scientists in the twentieth century, the muscular sense, a topic reshaped and renamed into a number of more precise areas of

55 Ribot 1870; Carroy/Ohayon/Plas 2006, 29–33, 40–42; Nicholas/Murray 1999.

56 Yaroshevsky 1968, 104–108. Sechenov gave a lecture, 'Impressions and reality' (1896 version in 1968, 392–402) citing theories about awareness of muscular movements of the eyeballs and the role of this in visual perception; Helmholtz was his authority. Also Sechenov 'The elements of thought' (1903 version), in 1968, 444–452.

57 Bradley 1969, 199 note; also 99–101.

58 Whitehead 1920, 44.

59 Critical rejection of precisely this separation was to be at the centre of claims made, late in the twentieth century, on behalf of the neurosciences as the way forward for studying mind's place in the world. For defence of the separation, Bennett and Hacker 2003.

study (of kinaesthesia, proprio-ception, biomechanics, locomotor control and so on) had no special philosophical status. Psychological investigation and physiological experiment often proceeded independently, and at the extreme the former treated the mind as disembodied and the latter treated body as mindless. The nineteenth-century speculative quest to find philosophical treasure in psychological feelings of action and resistance had no place in this.

Nonetheless, there continued to be voices which found in awareness of movement and resistance to movement grounds for a more unified description of being human in the world. There is much more to say about this, a larger history to write, a history of the kind intimated by Jean Starobinski, Marcel Gauchet and others, which relates kinaesthesia to the sense of the body in general and that sense to our fundamental notions of self and world.⁶⁰ In the 1920s, the German psychologist David Katz carried out extensive studies in the experimental phenomenology of touch in which he significantly referred to ‘the touch world’. As Ernst Cassirer then commented (which comment would have applied equally to Bain and Spencer): “The tactile sense [subsuming the muscular sense] has sometimes even been called the true sense of reality ... and an epistemological primacy over all other senses is often imputed to it.”⁶¹ In Britain, the philosopher H. H. Price, in the 1940s, returned to the idea that ‘the tactuo-muscular sense’ is the source of a qualitatively different kind of knowing to that deriving from the other senses. He attributed to the special sense our ‘voluminous life-feeling’ at the basis of the whole experience of being alive.⁶² Before this, Whitehead had set out to replace, root and branch, Hume’s analysis of causation into constant conjunction with a process philosophy more true, he believed, to phenomenal reality.⁶³ However esoteric the language in which Whitehead expressed his metaphysics, it gave expression to the ordinary person’s experience of being active, an agent with value, the experience which, as I have discussed, a number of nineteenth-century writers described in terms of movement and resistance. Whitehead turned to awareness of ‘power’ not ‘substance’ as the starting point of knowledge, the kind of awareness which others earlier had attributed to muscular sensation. The notion that movement is central to the differentiation of self and object also persisted in work as apparently far apart as G. H. Mead’s ‘philosophy of the act’ and Husserl’s phenomenology.

60 Compare Gauchet 1992, 87–98, discussing *«cénesthésie»*, coenaesthesia, the sum of bodily sensations. For metaphors of the passive/active couple in movement, Starobinski 1999.

61 Cassirer 1957, 130, referring to David Katz, *Der Aufbau der Tastwelt* (originally publ. as supplement 11, *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, 1925), trans. into English as Katz 1989.

62 Price 1944.

63 Whitehead 1958, 25–28, and 1969, 193–209.

These twentieth-century writers, however, detached discussion of perception of movement and resistance from the muscular sense narrowly understood, and they instead discussed it as a feature of the general being of the subject in the world.⁶⁴ Husserl's phenomenology was in turn part of the background to Maurice Merleau-Ponty's *Phénoménologie de la perception* (1945), the best known and most influential text to restore to the knowing subject its active, embodied being. His arguments for an ontology of 'presence' started out from embodiment, that is, I would say, from the kind of phenomenal awareness of being which earlier writers had attributed to the muscular sense. "Thus", Merleau-Ponty wrote, "the permanence of one's own body, if only classical psychology had analysed it, might have led it to the body no longer conceived as an object of the world, but as our means of communication with it, to the world no longer conceived as a collection of determinate objects, but as the horizon latent in all our experience."⁶⁵ Interestingly – whatever he meant by 'classical' psychology – he appears to have been unaware of the possible precedents for his approach, precedents in the empiricist arguments I have outlined.

Taking a large view, we might think that 'the enchantment' which had informed earlier thought, the belief that each person feels in movement her or his meaningful being in the world in relation to larger powers, had, by the late nineteenth century, passed out of science. The heart of belief in the specialness of the muscular sense had, perhaps, passed from intellectual analysis into performance, into the new modernist forms of dance, acting, film and gesture, into aesthetic rather than scientific knowledge of the riches of the sense.

Nevertheless, as I have so briefly indicated, there were still philosophers who claimed that 'tactuo-muscular' experience may "be fundamentally important, and certainly ... something which a purely visual being could never even have conceived of".⁶⁶ In addition to artists, there have been philosopher-scientists, not to mention ordinary people, who, seeking to 're-enchant' the world, have understood the metaphor of 'being in touch' as more than metaphor. The physicist Erwin Schrödinger, for example, conscious of the displacement of the subject-object distinction in quantum physics and the possible connections this might open up between western

64 See Still and Good 1998; these authors provide background to J. J. Gibson's study of visual kinaesthesia as well as Merleau-Ponty. See Mead 1938, 141–148, for a general theory of perception as contact-resistance in manipulation; and for discussion of this, Joas 1997.

65 Merleau-Ponty 2002, 106.

66 Price 1944, xxix. Most recently, Matthew Ratcliffe (in two forthcoming papers) has argued that this sense is not localised but is intrinsic to possessing an animal body which is responsive to its surroundings. I am grateful for copies of these papers.

science and ancient eastern thought, especially in the *Upanishads*, wrote: “We cannot make any factual statement about a given natural object (or physical system) without ‘getting in touch’ with it. This ‘touch’ is a real physical interaction.” It is, he thought, in touch (presumably subsuming the muscular sense) that we know “subject and object are only one”.⁶⁷

Such argument, though not about kinaesthesia in a narrow sense, drew upon experience of gesture, posture and movement in order to find new language for the value of being embedded as a ‘subject’ in ‘the world’. This was to reimagine touch and movement, in their broadest meaning. For those for whom the quest was ‘reality’, the argument was about taking metaphor literally – to be in touch, and to move and be moved.

Part II: The physiological and psychological understanding of kinaesthesia

The years to 1850

The once standard view of the history of psychology held that it developed as an experimental, and hence scientific, discipline in the last three decades of the nineteenth century, principally through the institutional and intellectual achievements of Wilhelm Wundt in Leipzig. It was modelled on an earlier experimental physiology. In fact, ‘the new psychology’, as it came to be called, was very diverse. It was a cluster of competing programmes.⁶⁸ Moreover, experiment, especially on the senses, had a long history: in the eighteenth century, there were experimental as well as analytic studies of the senses, such as those which reported the existence of a ‘blind spot’ where light falls on the area where the optic nerve meets the retina in the eye.⁶⁹ Already by the end of the eighteenth century, experiment and philosophy together had constructed a long-lasting, and frequently exceedingly technical, debate about visual perception, with implications for the other senses. Many investigators did not conceive of or accept the distinction between logical and empirical enquiry which Kant introduced and twentieth-century analytic philosophers enforced. Throughout the nineteenth century, as a consequence, reference to the *a priori* in forms of knowledge remained associated with nativist theories of spatial perception (i.e., belief that space is innately

67 Schrödinger 1967, 135, 137.

68 For a narrative history of approaches to human nature, Smith 1997, part rewritten as a history of psychology in Smith forthcoming 2013.

69 Hatfield 1995, 204. Though it was common in the eighteenth-century to use the word ‘experimental’ to mean ‘empirical’, there was some experimental work in the modern sense.

perceptible), and, the converse, *a posteriori* forms associated with empiricist theories (i.e., belief that the ability to perceive space is acquired).

In the context of the assimilation of Kant's work and new thought about Berkeley's account of the contribution of touch to spatial perception, J. G. Steinbuch published, in 1811, his *Beytrag zur Physiologie der Sinne*, "the most comprehensive attempt to develop a physiological and psychological theory of the senses in Germany during the first two decades of the nineteenth century".⁷⁰ The book was studied in Germany, for example by the influential physiologist Johannes Müller, but it does not appear to have been known elsewhere. Steinbuch placed *movement* at the centre of visual perception, arguing that a young organism's spontaneous movement gives rise to phenomenally distinct ideas, *Bewegideen*, or, we might say, motor ideas. They are conscious (even if not attended to). These ideas subsequently themselves become the cause of movement, and their activity, in Steinbuch's account, forms the will. The ideas vary qualitatively according to the particular muscles brought into action and according to the degree of muscular contraction. They also associate together according to their similarity and successive relations in time, and it is these associations, of simultaneous or successive sensations of muscle states, Steinbuch argued, which lie at the root of spatial perception. This was thus a theory which made considerable claims on behalf of a kind of muscular sense. It was a radically empiricist theory: the experience of *Bewegideen*, which begins with the embryo's spontaneous movements, is the basis of the capacity to perceive in general and the later capacity visually to perceive space in particular.⁷¹ Through the association of ideas accompanying contraction of the muscles which move each eyeball (each has two pairs of rectus muscles), we acquire the basis of spatial representation: "according to the successive ordering [of *Bewegideen* ... they] must be intuited as lying next to one another along a direction or dimension".⁷² When the embryo is born and moves into the light, visual stimuli to the retina serve as signs to call up the learned spatial representations. Experimental and clinical research on the evidence for and against such argument, especially based on increasingly refined studies of eye movement, long continued.

70 Hatfield 1990, 131. For Steinbuch (ibid., 131–143) and the German-language debates, down to Helmholtz, I am indebted to Hatfield's work. For the later period, also Turner 1994. Horst Gundlach long ago also drew my attention to the historical significance of Steinbuch. Also, Ritter/Grunder 1971/2007, vol. 9, columns 851–856, 'die Sinne E.'

71 Steinbuch, like Erasmus Darwin, hoped to explain organic processes by the organisation of matter; and, indeed, Darwin had influence in Germany, being read, for example, by J. C. Reil, whose physiological theories were part of the background to Steinbuch's work.

72 Steinbuch 1811, 36, translated in Hatfield 1990, 135.

Steinbuch did not specify the anatomical and physiological basis of ideas of movement; rather, he discussed these ideas in terms of a psychology of what he called ‘will’, itself originating in spontaneous action. In these same years, the London teacher of anatomy Charles Bell, also interested in eye movement in visual perception, advanced a very different approach to muscular sensation. Investigating the VIIth cranial (facial) nerve, Bell observed a plexus of nerve fibres covering muscle in which he thought sensory nerves joined with motor nerves. Linking anatomy to analysis of function, he claimed that muscle must be a source of sensation and this sensation must have a controlling role, through ‘*a circle of nerves*’, in movement: “The muscle has a nerve in addition to the motor nerve, ... [which] however has no direct power over the muscle, but circuitously through the brain, and by exciting sensation it may become a cause of action.”⁷³ Bell therefore put forward evidence for a muscular sense, for a sense physically located in muscles and connected to the nervous centre, the brain, and thus to motor action. He likened this sense to the standard five senses and indeed, as I have said, called it ‘a sixth sense’. Discussing the control of muscles and movement, he posited a causal role for peripheral muscular sensations rather than central ideas of movement. And he introduced clinical evidence to support his argument.⁷⁴ One anecdote, taking various forms, became standard in the literature. It described a woman insensitive in her limbs who, unlike a normal person, could hold her baby safely only so long as she was able to use her eyes. The conclusion was that the woman had lost muscular sensitivity and that this sensitivity is necessary for normal muscular control. Like his contemporaries Brown and James Mill, Bell differentiated the muscular sense from the sense of touch, though when he discussed the sense crucial for awareness of existence he treated them together.⁷⁵ In drawing attention to ‘a circle of nerves’, he also, in a study of the hand and its abilities, marvelled at the goodness of the Creator for His design of such fine, co-ordinated control. Not coincidentally, Bell was himself a master at drawing and a devoted student of expression.

It is noteworthy that though Bell attributed the sense of muscular movement to sensory nerves, he still loosely thought of the sense as connected, in

73 Bell 1826, 170; italicised throughout in the original. Also Bell 1823a, 178–181, and 1823b, 299. In addition, noting the pairing of muscles to the eyeballs, Bell thought that there must be relaxation in one muscle simultaneously with contraction in its partner if the muscles are to work together in effecting movements: Bell and Bell 1826, vol. 3, 103–109. This was the phenomenon Sherrington later studied in detail as ‘reciprocal innervation’ of antagonistic muscles.

74 Bell 1830, Appendix.

75 Bell 1833, 195 note. Bell here acknowledged his reading of Brown.

some way, to experience of effort. Other writers linked consciousness of the degree of effort made to *awareness of central activity*, rather than to a peripheral organ, to will or initiation of movement as Steinbuch argued or to what Biran identified as the most elementary act of the soul. To professional physiologists a century later it was Bell's work which appeared to have laid the basis for true knowledge of the muscular sense, and they credited him with being "the first to definitely postulate the existence of a muscular sense on a physiological parity with the other senses".⁷⁶ All the same, other views, perhaps more indebted to Steinbuch, were held for many decades.

By the 1820s – I generalise – there were two ways of conceiving perception of movement, one in terms of ideas linked to centrally originating action (Steinbuch), the other viewing muscles themselves as the source of sensory ideas leading to motor response (Bell).⁷⁷ Both ways of thought allowed for a variety of views. For example, among those who focused on central events, there was much room for different opinions about volition and perception of effort; among those who emphasised the importance of the peripheral muscular sense, there was no agreement about the relative contributions of the musculature itself, joint surfaces, tendons and skin (with all its varied sensations of pressure, temperature, folding and so on), as well as of general bodily sensations. There was always much which awaited further research. Only at the end of the nineteenth century was the interpretation of the muscular sense as peripheral in origin conclusively to prevail.⁷⁸ When it did so, this involved drawing distinctions, not so evident earlier, between general bodily feeling, the feeling of effort, volition and the role of specific sensory systems in conscious and unconscious knowledge of movement.

Working in Bonn in the 1820s, Müller reinforced interest in centrally originating ideas or feeling in a number of ways, which he confirmed in his standard *Handbuch der Physiologie des Menschen* (1833/7). He followed Steinbuch in stressing spontaneous activity at the foundation of the organism's relations to the world. He also proposed, on theoretical rather than empirical grounds, the general principle that each type of nerve is the concomitant of a specific type of sensory modality. (This was the theory of specific nerve energies.) Taken together, these beliefs pointed towards muscular sensation being a central processes in the brain taking place with

⁷⁶ Sherrington 1900, 1006. Also Carmichael 1926.

⁷⁷ For a history in terms of the contrast between 'feeling of afference' and 'feeling of efference', Jeannerod 1985, 91–98.

⁷⁸ Even now, this is not a simple matter. Though all would agree that there is a complex peripheral feed-back system in posture and movement, the psychological basis for effort, perception of weight and so forth may involve central elements – efference may modify afference; see Ross/Bischof 1981.

the activation of nerve fibres from brain to muscle. Debate about this conviction, always controversial, later centered on claims for the existence of a ‘feeling of innervation’ (*Innervationsgefühl*) accompanying the central activation of movement and thus being the source of muscular sensation. These claims entered the English-language world in the work of Bain, work which strongly coloured the way English-language discussion of muscular sensation developed. The existence of this approach to sensation as the concomitant of central processes, an approach largely cast aside after 1900, complicates the history of the muscular sense, not least by perpetuating a place for belief about the psycho-physiology of effort and volition, and even the very idea of causation, which I discussed earlier, in the history.

Müller’s own discussion of spatial perception reiterated belief that knowledge of extension begins with knowledge of the sensations of the self’s extended body: “At the outset of sensibility, the individual senses only himself spatially extended, only himself filling out space.”⁷⁹ He did not commit himself to stating whether the idea of space is innate or acquired. In a way, the question was a false one, since even if “the idea of space did not originally exist as an obscure faculty in the sensorium, which is afterwards called into action and applied when sensations begin to be perceived, it would assuredly be obtained by experience in the first [foetal] acts of the sense of touch”.⁸⁰ The first muscular sensation belonged to that time when the distinction between innate and acquired broke down. Research on muscular sensibility subsequently enlarged on Müller’s claim that the origin of the external world/internal self-distinction can be “recognised most easily in the sense of touch”.⁸¹

Bell’s argument for the existence of sensory nerve fibres from muscles (and perhaps other organs, like tendons) was widely though not universally accepted. (Anatomically, it was hard to come to conclusions; the structures concerned are exceedingly fine.) Many investigators, however, like Müller, thought that these fibres could not be the whole story in relation to muscular sensation. Distinguishing between sensations relating to the organic condition of muscles (fatigue, pain) and feelings of muscular contraction, Müller argued that sensory fibres from muscle might be the source of the former, while the latter must have, at least in part, another origin. Since fatigue and pain are not “always proportionate to the degree of muscular contraction ... [it] is probable that the motion and sensation of the muscles

79 Translated from Müller, *Vergleichende Physiologie des Gesichtssinnes* (1826) in: Hatfield 1990, 153–154.

80 Müller 1839/42, vol. 2, 1081–1082.

81 Ibid., 1080.

are not due to the same nervous fibres”.⁸² In accordance with his principle of specific nerve energies, he proposed different nervous bases for organic sensibility and the sense of movement, and he attributed the latter to sensation accompanying the innervation of motor nerves in the brain. Discussing E. H. Weber’s contemporary research on weight discrimination, Müller concluded: “The mind has ... a very definite knowledge of the changes of position produced by movements; and it is on this that the ideas which it conceives of the extension and form of a body are in great measure founded. The sensorium may possibly derive this knowledge, independently of sensations in the muscles, from the consciousness of the groups of nervous fibres to which it directs the current of nervous energy.”⁸³ This argument had a long life. It appeared to a number of authors that only central processes could explain the extraordinarily fine control which animals and humans in motor skills, and humans in speech, have over muscles.

By 1850, as a consequence of the relatively rapid development in German-language countries of experimental physiology as an institutionally distinct discipline, study of the senses had become systematic, experimental, specialised and difficult for those without appropriate training to follow. Even so, the close relations between philosophical and empirical enquiry lasted, albeit with much disagreement about what the relation was or should be. The largest influence on experimental psychological, rather than physiological, research on tactual and muscular sensibility was Weber’s study of touch discrimination, the variable sensibility of the skin over different parts of the body in distinguishing two close points of contact, and of weight perception (in which he developed the technique of study of ‘just noticeable difference’). The former research drew attention to the spatial distribution of surface nerve endings and the role this has in knowledge of space. By analogy, the argument extended to the study of the spatial distribution of nerve endings in the visual retina. Discussing weight discrimination, Weber suggested quantitative relations between stimulus and sensation which, after the work of Fechner, acquired ‘classic’ status for pioneering quantitative psychophysics.⁸⁴ In the judgment of the historian of psychology, E. G. Boring,

82 Ibid., 1329.

83 Ibid., 1330.

84 Weber first published *De subtilitate tactu* (usually known as *De tactu*) as the substantial part of his dissertation (in Latin) in 1834, and then Weber 1846. They are translated into English and introduced in Weber 1978. See also Hatfield 1990, 157–158; Boring 1942, chapter 13. This research did not decide which sensations pertained to touch, which to the muscles and joints. Bastian (1869a, 438–439), for example, attributed the capacity of weight discrimination to skin, whereas Weber had attributed it to muscular sensibility. Bastian cited (ibid., 461) Trousseau (1868/72, vol. 1, 158–67) for clinical evidence for attributing to skin (pressure, folding) what others attributed to muscles.

Fechner “made the discrimination of lifted weights the representative psychophysical experiment. There must have been lifted within the next sixty years hundreds of thousands of pairs of weights.” This indicated the path experimental psychology took, which “contributed much more to the development of the psychophysical methods than to a knowledge of kinesthesia”.⁸⁵

Experimental and clinical argument, 1840–1890

Experimental research and philosophical argument about vision came together in Hermann Helmholtz’s massive study, both synthetic and reporting his own work, *Handbuch der physiologischen Optik* (1856–66).⁸⁶ This included an examination of eye movements of unprecedented detail and precision, work which had value even for those who, opposing Helmholtz, rejected the empiricist theory of space perception. In general, Helmholtz tried, in this like Steinbuch, to explain spatial perception as a result of associative learning – of associations between eye movements (known by unconscious sensation), information about the position of the body, the central mental impulse (or will) to fix the eye on what attracts interest and the conscious awareness which accompanies motor action.⁸⁷ A baby, according to this kind of understanding, learns to localise visual sensations coming from the retina with the sensations coming from the initiation (or willing) of muscular contraction and movement. The retinal sensations become ‘local signs’ of the spatial field. Though Helmholtz’s research did not lead him to discuss muscular sensibility in its own right, he assumed that there is direct awareness, phenomenal consciousness, concomitant with motor innervation.⁸⁸ This was an unexceptional, though certainly not agreed, position at the time; other scientists, including the physiologist Carl Ludwig as well as Ernst Mach, accepted it.⁸⁹ While Helmholtz was publishing his study, his younger colleague in Heidelberg, Wundt, also gave an account of the way, in his view, spatial representation originates with awareness of muscular feelings (*Mus-*

85 Boring 1942, 529–530. An authoritative exemplification of this research was Müller/Schumann 1889; they opposed the theory of innervation.

86 3rd edition (1909/11) translated into English as Helmholtz 1924/5.

87 See Hatfield 1990, chapter 5, especially 173–176. Helmholtz took into account the work of Rudolf Lotze, who, discussing visual perception in his *Medizinische Psychologie* (1852), had systematically discussed the role of unconscious as opposed to conscious ‘sensory’ stimuli; see Hatfield 1990, 158–162, 197–198. Lotze (1852, 304–313) claimed that there is no immediate consciousness of movement; it is, he thought, mediated by afferent impulses after the event.

88 Helmholtz 1924–5, vol. 3, 243, 533, 537, and comment by J. von Kreis in appendix (1910), 604.

89 Ludwig 1852, 446–451; Mach 1959, 168–180.

kelgefühle). In what became a standard text, *Grundzüge der physiologischen Psychologie* (1874), Wundt specifically referred to *die Innervationsgefühle*, ‘the feeling of innervation’.⁹⁰ Head movement, eye movement and the sense of balance, dependent on the inner ear, were all recognised as complicating factors.⁹¹ In addition, there was a contemporary German-language philosophical literature on the will which sometimes touched on sensibility of different kinds.

J. M. Baldwin’s later *Dictionary of Philosophy and Psychology* defined the feeling of innervation as “a mode of consciousness having the characteristics of actual sensation, supposed to accompany discharge from the central nervous system into the motor apparatus, and to vary in intensity with the intensity of the out-going current”.⁹² For a time, in Germany, because of his central position in debate about the future direction of psychology, Wundt was its best-known exponent, though he did not deny the presence also of a sensory system. Part of Wundt’s reasoning was that there appears to be an intimate relation between the fine gradations of the sense of effort and the energy expended in muscular contraction, and this suggested to him that there is an awareness of central innervation. Other persuasive evidence for the feeling of innervation came from clinical observation of patients with complete or partial paralysis of one of the eye muscles, one of the muscles, say, which causes an eye to turn to the right. In such cases, a person willing the eye to follow an object in sight subjectively feels that the movement is carried out, though no such movement actually occurs. It appeared natural to attribute this subjective feeling to the efferent impulse stemming from the act of will.⁹³

Much of the experimental work which followed, and which cited Helmholtz and his principal opponent, Ewald Hering, who argued the case for a nativist theory of space perception, lies beyond the scope of this paper. I refer only to the open-minded discussion of the Viennese scientist Mach to give a glimpse of the issues. His own experimental studies of sensation concentrated on the perception of movement, relating the retinal image, the movement of the eyes, the posture and movement of the body and the

90 Wundt 1862, 151–152, 166–167, 400–422. He described *die Innervationsgefühle* in 1874, 315–317. See also Wundt’s hopelessly truncated expression of his views in English translation, Wundt 1876. Also Hall 1878; Ross 1980; Ross/Bischof 1981; Woodward 1982, 180; more generally on Wundt’s psychology, with bibliography of his writings, Rieber/Robinson 2001.

91 See Mach 1959, chapter 7.

92 ‘Innervation’, by E. B. Titchener, in Baldwin 1940/9, vol. 1, 549.

93 The view criticised in James 1950, vol. 2, 506–508. There was a large literature on the sensory implications of eye movements. For James, these movements provided some of the most convincing evidence for the *afferent* nature of muscular sensation, since it was hard to link the fineness of eye muscle control to anything conscious like feelings of innervation.

apparatus of the inner ear. He was interested in phenomena like the sense of movement ('optical vertigo') we have in a stationary train when the adjacent train begins to move. As he wrote: "That space-sensation is connected with motor processes has long since ceased to be disputed. Opinions differ only as to how this connexion is to be understood."⁹⁴ Is the motor component to be regarded as a centrally initiated process or as a consequence of sensory input from sensory apparatus, including muscles, or are both elements present in some combination? He wrote, rather obscurely, that "the will to perform movements of the eyes, or the innervation to the act, is itself the space-sensation", but also left it "an open question whether innervation is a consequence of space-sensation, or *vice versa*".⁹⁵ By 'will', he meant "nothing more than the totality of those conditions of a movement which enter partly into consciousness and are connected with a prevision of a result". His questions therefore focused on the place of what he called 'motor-sensations' in experiences which leave traces and form the conditions of future actions.⁹⁶ In the light of reading Hugo Münsterberg and James, he recognised the clinical evidence supporting belief in sensory input from muscles; but he reached no firm conclusion, thinking that however much there is a sensory basis for kinaesthesia, it may still be supplemented by central sensation. He turned his own experience of a stroke, which along with poor eyesight brought an end to his experimental work, into a contribution to the discussion.⁹⁷

In much of the literature, as the example of Mach shows, the nature of the muscular sense was not the central topic of research. In order to understand the literature where it was, it is necessary to know something about the physiological processes thought to be involved.

Though writers on sensory learning and experience from Locke onwards claimed to be empirical in their approach, their method was, in fact, primarily analytic, based on thought about what must be the case rather than observational study of the anatomy, physiology or psychology of actual minds and bodies. From the early nineteenth century, however, there began to be some precise knowledge of the nervous system, and in particular knowledge of its sensory-motor structural and functional organisation, to which, for example, Bell contributed.⁹⁸ This, in the long term, put study of the muscular sense on a new footing. It situated discussion of the sense in a framework of

94 Mach 1959, 127. This source is a translation of the 5th edition of *Beiträge zur Analyse der Empfindungen* (1906), first published in 1886. Mach had earlier published *Grundlinien der Lehre von den Bewegungsempfindungen* (1875).

95 Mach 1959, 129 and note.

96 Ibid., 100.

97 Ibid., 173–180. See Münsterberg 1888; James 1950, vol. 2, 486–522.

98 For sensory-motor physiology: Young 1990; Clarke/Jacyna 1987.

knowledge, with the nervous reflex as a model, about the manner in which the organism translates sensation into movement. Muscular sensation appeared bound up with “the psychical life within us [which has] an overruling tendency to express itself, to exhibit itself in motions and acts, [and which] depends upon this general fundamental fact which meets us everywhere in the nervous system – namely, that peripheral excitations transform themselves in the central organs into motory impulses”.⁹⁹ As with other areas of human psycho-physiology, in the nineteenth century and later, clinical knowledge of the failure of normal capacity and skills played a large part in the arguments, not least because experimental knowledge of the brain and nervous system, in spite of advances, remained very limited.

Alongside studies of sensory perception, there were more exclusively anatomical and physiological studies of nerves and the structure and regulating function of the nervous system. From the 1830s onwards there was a considerable body of research, much on the poor frog, on the reflex control of movement. The studies tended to complicate rather than simplify ideas of the processes discussed under the umbrella heading of the muscular sense. For instance, the German researcher J. W. Arnold suggested that there are ‘refluent’ impulses in the motor nerves, impulses returning from the periphery in *motor* nerves, mediating sensation of motor processes.¹⁰⁰ Other researchers thought sensation accompanying both efferent impulses and afferent impulses was involved in perception of resistance and weight, as opposed to perception of movement.¹⁰¹ In England, the independent researcher G. H. Lewes accepted Arnold’s position. More distinctively, Lewes promoted the theoretical principle that similar organic tissues must have similar functions and hence that if nerve fibres are concomitant of sensation

99 Griesinger 1965, 39; this was a translation of *Die Pathologie und Therapie der psychischen Krankheiten*, first published in 1845.

100 See the review of J. W. Arnold, *Über die Verrichtung der Wurzeln der Rückenmarksnerven* (1845) in [Review] 1845; ‘refluent’ is Sherrington’s term (1900, 1003). As Sherrington noted, both Wundt and Exner suggested the existence of branches of motor nerves running ‘by cellulifugal processes’ (again Sherrington’s term) to cortical sensory areas. In Exner’s case, this came in a speculative modelling of attention processes: Exner 1894, 163–171. Earlier, C. E. Brown-Séquard (1860, 8–10) also supported Arnold’s view that there is a ‘recurrent sensation’ effect and that some sensory fibres from muscle may run in the anterior nerve roots.

101 Commented on critically in James 1950, vol. 2, 501–503. Because of the special interest of weight perception for psycho-physics, with associated experimental techniques, there was a large body of research, sometimes addressing the muscular sense, sometimes not. The Anglo-French physiologist A. D. Waller (1891) developed an ingenious method to ‘mirror’ the sense of effort, in supporting weights, with the sense of muscular fatigue. But he recognised that his work did not prove the afferent or efferent nature of the muscular sense; because of the fineness of muscular adjustments to weight, he favoured the efferent theory.

in some cases we should suppose that they are concomitant of sensation in all cases. Physiologists, Lewes wrote, should therefore expect motor nerves to have a sensory function connected with movement. And, “if the [motor] muscle-nerves can excite any Sensibility at all, it must be that of what we call the Muscular Sense, by which we adjust the manifold niceties of contraction required in our movements”.¹⁰²

In the course of research on nervous organisation, especially in the studies of A. W. Volkmann, it became clear that a good deal of the coordination of muscles occurs at the spinal level or at the lower levels of the brain.¹⁰³ This implied that if there is some kind of sensory input essential to posture and movement, it need not be conscious and may originate in muscles (or tendons or joints) not centrally. Volkmann took up an experimental technique much used in debate about nervous function, cutting one of the spinal nerve roots in order to study which function is lost. He observed that cutting the posterior nerve root (containing sensory nerves), contrary to expectation on the model of spinal level control, did *not* affect muscular control. This result suggested either that the muscular sense had a central origin or that sensory nerves from muscle, anomalously, ran in the anterior roots (containing the motor nerves). But other researchers obtained different results: Claude Bernard contradicted Volkmann and reported that sectioning the posterior spinal root *does* have a large effect on muscular control.¹⁰⁴ It was, as this divergence shows, extremely difficult to get consistent results from experiment, not least because of the uncontrolled, differing states of experimental animals. It was the achievement of Sherrington in the 1890s to impose a new level of order and precision in experimental technique, making agreed results possible, and (as we shall see) this transformed the physiological study of the muscular sense into the study of muscular coordination, integration, through a peripheral sensory apparatus.

The United States surgeon S. Weir Mitchell, who confronted an unprecedented number of injuries in the Civil War, brought his knowledge of damaged nerves to bear on the issues. In particular, he thought that symptoms of the ‘phantom limb’, feelings of movement in an amputated limb, point to a central, rather than peripheral, origin of the feeling of muscular effort. Or, he wrote, there may be some kind of reflexive impulse from spinal ganglia when

102 Lewes 1859/60, vol. 2, 35; also Lewes 1878.

103 Volkmann 1844; for research on the reflex, Eckhard 1881. Volkmann, in later studies of vision (*Physiologische Untersuchungen im Gebiete der Optik*, 1863), classified muscular feelings with general internal sensibility rather than sense organs providing spatial information; see James 1890, vol. 2, 198.

104 Bernard 1858, vol. 1, 250. For other results, Bastian 1869a, 395. Trousseau (1868/72, vol. 1, 210–211) also thought that Bernard’s results were inconclusive.

motor nerve impulses attempt to move the nonexistent limb. “In some of my cases, the amputations took place so early in life that there was no remembrance of the lost limb, and yet twenty years after, a volition directed to the hand seemed to cause movement which appeared to be as capable of definite regulation, and was as plainly felt to occur as if it had been the other arm which was moved.”¹⁰⁵

Even where there was sympathy for the sensory, peripheral nature of the muscular sense, there was no agreement about where the sensory apparatus was actually located. Moritz Schiff strongly attributed to the folding and pressure on skin what his colleagues attributed to muscle or joints.¹⁰⁶ When James in his turn reviewed the whole matter, he assigned importance to sensation coming from articular surfaces, the cartilages of joints, rather than skin, but in any case he denied that there is any role for muscular feelings in the *perception* of space.¹⁰⁷ His principal evidence came from new research by A. Goldscheider, who had studied the perception of movement during passive manipulation of fingers, arms and legs. Other researchers also cited this work, to show “that the joint surfaces and these alone are the starting point of the impressions by which the movements of our members are immediately perceived”.¹⁰⁸

There was thus a complicated mosaic of topics, evidence and argument, no one thing denoted by reference to ‘the muscular sense’. Henri Beaunis, the first director of the psychological laboratory in the Sorbonne, made this clear in his review of *sensations musculaires* as part of a systematic survey of ‘the internal senses’. He covered the psychological and some of the physiological evidence and provided a useful overview, but he reached no integrated conclusion.¹⁰⁹

The British debate and the term ‘kinaesthesia’

I propose to illustrate this mosaic with a little more detail on the British debate and in this way also describe the context in which ‘kinaesthesia’ became a term of choice. Such was the central position of the muscular sense in the literature on mind and brain, and on psychology and physiology, that the first editor of the British journal, *Mind: A Quarterly Review of Psychology*

105 Mitchell 1872, 358.

106 Schiff 1858/9, 156.

107 James 1850, vol. 2, 189–202.

108 Ibid., 193. See Goldscheider 1898, containing papers which first appeared in 1888 and 1889.

109 Beaunis 1889, chapters 7–14.

and *Philosophy*, founded in 1876, declared that the sense is “of the first importance in the psychology of the present day”.¹¹⁰ My comments will show why debate went on for decades and how, as specialist practice in philosophy, psychology and physiology became the norm at the end of the century, it became clear that different kinds of answers were needed to different kinds of questions. It was specific answers to specific questions which then acquired authority.

Bain, as I have discussed, made the muscular sense central in English-language psychology, especially because he emphatically stated a *theoretical* basis for belief in feeling accompanying central innervation. He thought that what for him was the fundamental psychological contrast between passive sensory states and mental acts had a nervous concomitant in the sensory-motor division in the nervous system. All this in turn underpinned his introduction of the active basis of sensation into the empiricist theory of learning. Bain therefore pronounced – and it turned out to be a hostage to fortune – that if there is no mental feeling accompanying motor activity, effort and willed movement, in contrast to the feelings accompanying sensory processes, “the most vital distinction that it is possible for us to draw within the sphere of mind, is bereft of all physiological support”.¹¹¹ He was not alone in holding these views. The neurologist John Hughlings Jackson, who worked at the Queen Square Hospital in London and was to be a major influence in twentieth-century British neurology, made the same theoretical point. Like Bain, he thought that sensation and the initiation of movement, the passive and active dimensions of mind, and the sensory-motor structure of the nervous system must parallel each other.¹¹² Bain and Jackson both appear to have believed in the existence of a direct or phenomenal awareness of central innervation in willed movements.

Bain’s arguments prompted systematic opposition from a London physician specialising in disorders of the nervous system, H. Charlton Bastian. Bastian turned to clinical evidence, in opposition to theoretical principle, to determine the nature of the muscular sense, and in this context introduced the term ‘kinæsthesia’. Bastian’s long-term ambition was to understand the brain mechanisms of thought, a provocative research project in the culture of the time, and his interest, like Bain’s, was therefore in the way psychological activity could be reconceived in terms of sensory-motor physiology.¹¹³ But,

110 Robertson 1877, 98.

111 Bain 1864, 92 note.

112 Jackson 1958, vol. 1, 167–168, 501. Also Jackson, in discussion to Bastian 1887, 107: “Since it is agreed upon that the lower parts of the nervous system are sensori-motor, I think it *a priori* likely that the higher parts, the physical bases of consciousness, are so too.”

113 Bastian 1869b; 1880.

unlike Bain, he was also a physician, and he claimed that clinical evidence of locomotor ataxy (inability to control movements) demonstrates that muscular sensation is peripheral and sensory, not central and motor, in origin. Moreover, the evidence, he thought, is that muscular sensation is largely unconscious, or at least not perceived. This was also the position of the Paris physician, Armand Trousseau: “Normally ... we have no consciousness of muscular activity, but merely the consciousness of the movement itself, which is a perfectly different thing.”¹¹⁴

The relevant question was whether cases of loss of sensation in muscular parts of the body (anaesthesia) and of breakdown of control (ataxia), in some cases accompanying anaesthesia, were due to lack of sensory information from muscles, spinal cord failures or central brain disorganisation (lesions). Bastian took a key case from the French physician J. B. O. Landry’s study of paralyses, a case of a woman able voluntarily to initiate movement but unable to know what she actually did: “The woman was ignorant of the position of her limbs, and unconscious of any movements which she might execute. The volitional centres, the spinal motor centres, the motor nerves and the muscles were capable of being called into activity as before – yet all the information usually supposed to be derived through the ‘muscular sense’ had vanished.”¹¹⁵ On the basis of such cases, Bastian opposed Bain’s whole stance: there is no conscious muscular sense as a result of central initiation of action; instead, there is primarily unconscious sensory input from muscles, the function of which is to control movement. “Although there is no evidence to lead us to believe that we derive any conscious impressions through the intervention of this so-called ‘muscular sense’, there is evidence to show that the brain is assisted in the execution of voluntary movements by guiding impressions of some kind ... not being revealed in consciousness at all.”¹¹⁶

David Ferrier, a pioneer of studies of cerebral localisation by direct electrical stimulation of the cortex, who became a colleague of Jackson’s at the Queen Square Hospital, took Bastian’s side in the argument. He cited another French case, a case of hemi-anaesthesia (insensitivity on one side) reportedly showing that sensations of movement come from deep structures

114 Trousseau 1868/72, vol. 1, 159.

115 Bastian 1880, 700; also Bastian 1869a, 395. Bastian drew on Landry, *Traité complet des paralysies* (1859), which in turn relied on Landry, ‘Mémoire sur la paralysie du sentiment d’activité musculaire’ (1855); see James 1950, vol. 2, 490. For Bastian, Jones 1972. On ataxy, the contemporary authority was Trousseau 1868/72, vol. 1, Lecture VI, ‘Progressive locomotor ataxy’. For a survey of relevant nineteenth-century medical writings, Spillane 1981, 286–287, 309, 320–322, 332, 407–408; 1982.

116 Bastian 1869a, 463.

in muscles not from either surface skin or central innervation.¹¹⁷ It was also possible to interpret his pioneering experiments on stimulating the cortex, which demonstrated different areas for sensory and motor activity in the higher brain, as indirect evidence for the separation of muscular sensation from motor innervation.¹¹⁸ In addition, Ferrier drew attention to the work of G.-B. Duchenne (de Boulogne), whose extensive exploratory and therapeutic work with electricity demonstrated the lively sensitivity of muscle. Duchenne, also working with a patient who, without looking, could not tell the position of a limb, showed that the patient could not feel electrical stimulation to the limb's muscles. This implied a lost sensory capacity in muscle. He did not discuss the details of nervous process but very generally postulated (at least for a time) the existence of *«la conscience musculaire»*, which, he thought, serves voluntary movements and is present in perception of weight and resistance, and he distinguished this from *«le sens musculaire»*, postulated by Bell, which follows muscular contraction.¹¹⁹ This distinction was not widely taken up. Speaking for himself, Ferrier concluded in favour of the sensory origin of the muscular sense: “In all instances the consciousness of effort is conditioned by the actual fact of muscular contraction.”¹²⁰ Working with Lauder Brunton, he carried out what he thought of as the crucial test of the afferent nature of the muscular sense, showing “that muscular discrimination can still be exercised, when the muscles are made to contract artificially by means of an electrical stimulus”, when there has been no effort, no motor innervation.¹²¹

On the margins of these discussions, perhaps surprisingly not at the centre, was yet another thread of the tangle of issues for which muscular sensation had implications – speech. If Bell had marveled at the subtleties of control of hand movements, we might anticipate other researchers would marvel at the control of breathing, vocal chords, tongue and lips in speech and song.

117 Ferrier 1876, 181, citing a Paris *Thèse* by Dumeaux, *Des hernies crurales* (1843), and cited in turn in Bastian 1880, 698–700. Bastian thought Ferrier's and his own interpretation confirmed by Charcot's demonstrations, which Bastian witnessed at La Salpêtrière in Paris. The evidence opposing the involvement of skin sensations was directed against the claims of Schiff (mentioned above).

118 A number of localisers, including E. Hitzig, H. Munk and C. Wernicke, along with Ferrier (1876, 215–219), discussed the possibility of there being a kinaesthetic centre in the brain, though I have not looked into what they might have meant by this. See Jeannerod 1985, 61–65.

119 Duchenne 1861, 424–437. (Parts of this work were later translated into English; see 1883, 378–398.) Duchenne (1861, 547–620) also experimented at length with the different forms of ataxy and paralysis. For criticism of Duchenne's notion of *«conscience musculaire»*, Trousseau 1868/72, vol. 1, 212–213.

120 Ferrier 1876, 223.

121 *Ibid.*, 227. Ferrier acknowledged that the same experiment had been carried out by the German researcher Bernhardt in 1872.

Yet, though there was a huge medical and psycho-physiological literature on aphasia, loss of speech, central to debate about localisation of function in the brain, this contributed little, it would seem, to analysis of muscular sensation.¹²² Speech, however, did feature as a topic for writers linking thought to concomitants in the nervous system, and as the argument between Bain and Bastian, for instance, showed, this merged with the issue of the muscular sense. In Bain's view, thought processes are the mental accompaniment of nervous efferent impulses to the muscles responsible for speech; thought belongs with the active, conscious, motor side of life.¹²³ We associate sounds produced by activating the muscles of speech with conscious mental processes, learning to think from making speech gestures. Jackson, having more precisely restated Bain's position, concluded: "The inference is irresistible that there must be a motor, as well as a sensory, element in the nervous arrangement in the 'organ of mind' which is faintly discharged when we 'think of' an object."¹²⁴ Bastian, by contrast, claimed that in thought we repeat originally unconscious afferent sensations from the muscles of speech and associate them with the sounds of words. When we speak, we exercise a voluntary recall over words, not over muscular exercise.¹²⁵ He even argued that there is a 'kinaesthetic centre' in the motor cortex of the brain, the higher brain region concerned with motor control, where nervous pathways from the organs of the muscular sense terminate.

A somewhat wider perspective is helpful at this point. It was at this time that Ferrier and Sechenov (and, I assume, other researchers) speculated that thinking is a form of inhibited speech. Ferrier wrote: "we recall an object in idea by pronouncing the name in a suppressed manner".¹²⁶ Sechenov provocatively stated: "A thought is the first two-thirds of a psychical reflex."¹²⁷ There was later to be considerable work on the place of kinaesthetic imagery in thinking and on the importance of the association of movements to

122 This conclusion may reflect my familiarity with one kind of literature rather than another; yet the authors I have consulted on muscular sensation did not write on speech, though there surely were clinical cases of partial or complete loss of speech due to paralysis or anaesthesia of speech muscles (as opposed to central lesions, as in Tourette's syndrome). Research is needed into the literature of elocution and speech and singing training and therapy, and perhaps also into philological studies of the evolution of speech sounds. For aphasia studies, see especially Jacyna 2000.

123 Bain 1869.

124 Jackson 1958, vol. 1, 54.

125 Bastian 1869a; 1869b; 1869c.

126 Ferrier 1876, 285. Ferrier was generally interested in what he called 'the muscular element in thought'.

127 Sechenov 1968, 320–321. But this had no international audience. It appeared in an essay, translated as 'Reflexes of the brain', written, in its first version in 1863, for a non-specialist audience, and it was available only in Russian before 1884, when there was a French translation.

thought. In the United States, where experimental psychology had, by 1910, become a significant institutional presence, E. B. Titchener identified kinaesthesia and verbal images as the psychological source of meaning: “the meaning on the printed page may ... consist in the auditory-kinaesthetic accompaniment of internal speech”.¹²⁸ Margaret Floy Washburn went so far as to claim that “the whole of the inner life is correlated with and dependent upon bodily movement”.¹²⁹ Indeed, she thought it “obvious that kinaesthetic excitations are constantly present, a continuous common factor in all our experience”, and she linked this insight to the then very large US psychological interest in ‘attitude’.¹³⁰ Research on kinaesthesia, understood as a sensory phenomenon, thus became a dimension of the work of psychologists whose approach to psychological activity lay through the study of motor functions and movement.

There was no quick agreement between the two sides, the followers of Bain and of Bastian. Acutely aware of this, the Neurological Society of London, in 1887, organised a paper by Bastian, followed by discussion, in which Jackson, Ferrier and other doctors participated, to settle the evidence.¹³¹ They did not do so. It was a cause for some embarrassment, as Waller subsequently commented: “Indeed I cannot, otherwise than by the supposition that the expression ‘muscular sense’ denotes very various objective phenomena, understand the flagrant and fundamental contradictions dogmatically enunciated by the highest clinical authorities.”¹³² Some thought the looseness of introspective and clinical reports itself at the root of the problem and rested their hopes on finding new and rigorous experimental methods. A. Chauveau in France used electrical excitation to re-examine Bernard’s results on sectioning nerve roots, and he concluded that there are ‘retropulsive waves’ of excitation in motor nerves, and that these centripetal ‘waves’ are involved in muscle coordination.¹³³ The experimental work of Goldscheider (already mentioned), as well as that of Waller, contributed here. There were also extraordinarily detailed, almost unbelievably patient, studies of the psychophysics of weight discrimination.

128 Titchener 1909a, 177. Titchener (ibid., 185), following research by Washburn, also recognised ‘motor empathy’ with a kinaesthetic character. There was a considerable body of experimental research on perception of rhythm, widely thought to originate with kinaesthetic imagery; see Ruckmich 1913a, 1913b.

129 Washburn 1916, xiii. The full reduction of thought to motor activity was proposed by the behaviourist, J. B. Watson (Watson 1920).

130 Washburn 1930, 89.

131 Bastian 1887. Also commentary in McKenzie 1887; Delabarre 1892 (based on a 1891 thesis, *Über Bewegungsempfindungen*).

132 Waller 1891, 238.

133 Chauveau 1891, 153–154, 175–177.

By this time, William James, in a large paper on ‘The feeling of effort’ (1880), had announced himself a resolute critic of feeling of innervation theories. In *The Principles of Psychology*, it was the psychological topics of space perception and the will which housed what he had to write on muscular sensation. James commented, I think rightly, that lurking in the background of feeling of innervation theories was inchoate belief that only recognition of an unmediated awareness of innervation does justice to the active side of being human. Before we act voluntarily, there appears to be a ‘weighing’ of the movements needed, and we finely judge what kind and degree of movement is necessary. “This premonitory weighing feels so much like a succession of tentative sallyings forth of power into the outer world ... that the notion that *outgoing* nerve-currents rather than mere vestiges of former passive sensibility accompany it, is a most natural one to entertain.”¹³⁴ All the same, James argued, there is no such ‘outgoing sensibility’; there is only a memory of previous experience of movement – the ‘idea’ of movement – and this idea, he claimed is sensory in origin, perhaps kinaesthetic, perhaps originating in other senses. He made the general point that when we acquire a skill, like the ability to hit a target, we do not think about the individual muscle movements involved but rely on the idea of the end in view, and the muscles cooperate unconsciously to bring about that end. He was confident that empirical evidence was on his side. In particular, he thought, Helmholtz’s and Mach’s key evidence for the role of a feeling of innervation in movement to eye muscles, and hence visual perception, failed to take account of the second eye as a possible source of kinaesthetic feeling (even though Helmholtz, conscious of the way the two eyes coordinate, had referred to ‘the Cyclopean eye’).¹³⁵

James also had a large conceptual point to make. An act of will, he wrote, is the result of tension between mental ideas: it is a *psychological*, and indeed *moral*, event, and as such does not presuppose one physiological basis rather than another. There is no need, as Bain thought, and indeed (to use modern terminology) it involves a category mistake, to defend the reality of *activity of mind* with a specifically *motor* theory of feeling. “The advocates of inward spontaneity may be turning their backs on its real citadel, when they make a fight, on its behalf, for the consciousness of energy put forth in the outgoing discharge. Let there be no such consciousness; let all our thoughts of movements be of sensational constitution; still in the emphasising, choosing, and

134 James 1950, vol. 2, 493.

135 Ibid., 506–515. James cited the rigorous experimental psychologist, G. E. Müller, *Zur Grundlegung der Psychophysik* (1878), and also Münsterberg 1888, in support. For the Cyclopean eye, Helmholtz 1924/5, vol. 3, 258, 327.

espousing of one of them rather than another, in the saying to it, 'be thou the reality for me', there is ample scope for our inward initiative to be shown. Here, it seems to me, the true line between the passive materials and the activity of the spirit should be drawn."¹³⁶ James detached the psychological theory of the will from the physiological science of muscular control. This, I think, was the decisive step in the 1890s. The arguments of James and the authors he cited then proved persuasive. In the literature of experimental psychology of the early twentieth century, the topic of volition was a psychological topic separate from any particular claim about concomitants in the nervous system.¹³⁷ In the literature of physiology, the norm was rigorous experimental reports detached from psychological knowledge. Moreover, though Victor Henri regretted the way recent discussions ignored the work of Maine de Biran, Brown and their contemporaries and successors, his late-nineteenth-century peers, by and large, thought that empirical research had left earlier philosophical speculation far behind.¹³⁸

The resolution of debate

It was still possible in the opening years of the twentieth century to state that the argument about the nature of the muscular sense was not settled.¹³⁹ The weight of opinion, all the same, had overwhelmingly swung behind belief in the sense's afferent nature. Even Bain, in old age, somewhat qualified his position, while Wundt silently elided reference to *die Innervationsgefühle* in the fourth edition of his *Physiologische Psychologie* (1893).¹⁴⁰ According to Boring, reference to central innervation died out as references to will in

136 James 1950, vol. 2, 518: Also James 1920.

137 E.g. Ach 1910; Michotte/Prüm 1910.

138 Henri 1898, 406–413. Henri included an extensive bibliography, which he compiled building on the work of Edouard Claparède in Geneva, *Du sens musculaire, à propos de quelques cas d'hémitaxie posthémiplégique* (1897). The proposal to return to Maine de Biran, rather than to develop psycho-physiology, as a basis for a psychology appropriate for the study of *personnalité* was made in Bertrand 1889. The book, really a series of separate essays on Biran, subsumed the topic of *les sensations musculaires* under that of *l'effort musculaire*.

139 G. F. Stout/J. M. Baldwin, 'Effort, bodily (consciousness of)', in: Baldwin 1940/9, vol. 1, 311. See also articles on 'Innervation', 'Kinaesthetic sensation' and 'Muscular sensation', and bibliography on 'Other senses' (vol. 3, 1172–1174).

140 Bain 1891, 11–12; 1894, 79–80; Wundt 1893, vol. 1, 431. For the complexity of Wundt's views and changes, Ross/Bischof 1981. In James's opinion, Wundt changed his text in the light of Münsterberg's experimental work, done in Wundt's laboratory, though Wundt objected to it and Münsterberg had to take another topic for his dissertation and to publish on muscular sensation separately (Münsterberg 1888). Wundt also opposed Münsterberg's applications for academic positions, which very likely included an expression of anti-Semitism. Offended by Wundt's silence over the contribution of other researchers, James issued a public reprimand (James 1894). Also Roback 1964, 213–215.

general died out in the psychological literature – the kind of references which Steinbuch, Helmholtz or Bain had made, correlating felt activity with central initiation of movement.¹⁴¹ Around 1900, however, when the feeling of inner-
 vation theory was on its last legs, there was much discussion of volition among psychologists; the ‘dying out’ was evident only in later US experimental psychology. I suggest that a more important factor in the settlement of debate was specialization and the consequent separation of different research programmes in experimental physiology and in psychology. Researchers thought the topic of volition and effort belonged in psychological and moral enquiry, not in physiology or psycho-physiology, but this was not the same as dismissing the topic as of no scientific account.

For much of the nineteenth century, thought on muscular sensation contributed to philosophical theories of reality and of causation, to notions of physical ‘forces’ and their interrelations, to psychological theories of perception and of volition, to physiological accounts of the sensory-motor organisation of the nervous system and to clinical studies of movement disorders. Such were the rich connections of what James dubbed “the will-muscle-force-sense theory”.¹⁴² With the increasing specialisation of philosophical, scientific and medical researches, however, these connections became ever more difficult to maintain. Specialist communities refined investigative methods and disparaged argument which did not meet professional standards, and this excluded all but precisely focused research from highly trained cadres. This was especially evident in experimental physiology and, in turn, in experimental psycho-physiology of the senses. One body of relevant research, for example, examined the variety of sensory endings in deep structures and in skin, and the technical difficulties of doing this were far removed from speculative parallels between the sensory-motor organisation of the nervous system and the passive-active modalities of the conscious mind. Researchers stopped making claims about particular feelings mediating knowledge of ‘reality’. ‘Reality’ was for specialist epistemological enquiry, philosophers claimed. There appeared to be no reason, in terms of the *logic* of a theory of knowledge, to identify the muscular sense in particular as the source of veridical knowledge.¹⁴³ It might be possible to describe sensations *in general* as ‘signs’ of the external world, but it is false, it was concluded, to describe

141 Boring 1942, 525.

142 James 1920, 215–216.

143 James (1950, vol. 2, 135) held that a quality of spatiality is inherent in each and every sensation. Bradley (1969), for example, argued, as later philosophers of language were to do, that science, as opposed to philosophy, has no business making statements about ‘truth’ or ‘reality’.

visual sensations, in particular, as ‘signs’ of tactual or muscular knowledge of what is ‘real’.

I have indicated the British frustration with inconclusive debate about the muscular sense. In part, it reflected confusion and differences about the nature and function of nerves, a situation which the spreading acceptance of the neurone theory during the 1890s greatly improved. The English physiologist C. S. Sherrington applied the neurone theory to analysis of the muscular sense. His research exemplifies, as historically it became an admired model for, specialisation in the interests of precision. It consolidated what became the modern physiological view of muscular sensation as part of the motor control system. With F. W. Mott, Sherrington sectioned the sensory nerve in the forelimb, producing anaesthesia and, as a consequence, paralysis of the limb. This authoritatively established that sensibility is necessary for movement.¹⁴⁴ He sectioned one or other of the spinal nerve roots and then, observing which nerve fibres subsequently degenerate, correlated the intervention with loss of function. As I have mentioned, many others had undertaken such research, though with contradictory results. Sherrington showed, his peers thought conclusively, that cutting the posterior root causes some fibres in nerves to muscles to degenerate, i.e., there *are* sensory nerves from muscles. Further, he investigated the endings, which others had seen, in muscles, especially near tendons, which were called ‘spindles’ and showed that they function as end organs for these sensory fibres to muscle.¹⁴⁵ Finally, he had the comprehensive grasp to give systematic shape to all this work, along with studies of the reflex as the elementary organised unit of nervous function, using the concept of ‘integration’, his preferred term for the general organising function of the nervous system. In his synthesis, *The Integrative Action of the Nervous System* (1906), Sherrington described the muscular sense as part of ‘the proprio-ceptive field’, the term he introduced to indicate the place in organic life where “the stimuli to the receptors are given by the organism itself”, by the state of muscles, internal organs or other tissues, rather than by the environment (stimuli from which constitute ‘the extero-ceptive field’).¹⁴⁶ He did not use the word ‘kinaesthesia’, implying perhaps

144 Mott/Sherrington 1895. This repeated in a controlled way what other experimenters had long been aware of. It is significant that many of Sherrington’s experiments were not ‘new’, but they were systematic and systematically grounded in studies of the background condition of the experimental animals (monkeys, cats), and this made authoritative results possible. His methods required rigorous training and created a specialist community. For Sherrington’s high reputation in the English-speaking world, Smith 2000.

145 Sherrington 1894. See Swazey 1969, 60–63. According to Sherrington, the spindle had been observed in 1860, named by Willy Kuhne in 1863 and understood as a sense organ by Angelo Ruffini in 1889.

146 Sherrington 1961, 132; also 1906.

that the term was too loose, properly a psychological term, like ‘vision’, describing a modality of conscious awareness but not anything which the physiologist might investigate. Reference to ‘proprio-ception’ directed research to the diverse but integrated afferent stimuli not just from muscles and joints but from deep pressure, the vestibular apparatus and organ sensibility.¹⁴⁷ It rendered the sense of effort, the subjective awareness of the mind’s active contribution, through attention or volition, to attitude, speech and movement, as well the subjective experience of posture and movement, matters outside the domain of physiological research. Sherrington treated theories of a feeling of central innervation as scientifically dead. As for philosophical questions, he and his peers and students had no place for them in day-to-day scientific life.

‘Kinaesthesia’ stayed in use as a psychological term to describe different forms of sensory awareness of bodily posture and movement, mediated by the afferent nervous system, studied as part of cognitive or other processes.¹⁴⁸ ‘Proprio-ception’ served as a physiological term to denote the system of sensory endings and associated nerves which integrate deep structures – internal organs, muscles, etc. – in bodily life.¹⁴⁹ Researchers put to one side questions about how there could be awareness or consciousness of any kind.

The wider view

Yet a swathe of larger interests continued to impinge on thought about experience and control of movement. Muscular sensation never became an exclusively psycho-physiological topic but, rather, had a place in the expression of modernity in social change and of modernism in the arts. Massive, disruptive shifts from rural to urban life, from agricultural to industrial and commercial work, turned scientific interest towards processes of human adaptation. There were many proposals about health, of mind and body equally, covering the individual, together with social hygiene, social order and efficiency in work and leisure. It appeared natural to compare the individual human body with the factory or commercial enterprise, and to investigate

147 For the research of the Viennese physician Josef Breuer on the function of the vestibular apparatus, Hirschmüller 1989, 58–86.

148 E. B. Titchener, for example, in a text-book discussion (1909b, 160–182) referred to ‘kinaesthetic senses’, in the plural.

149 For a summary of the mid-twentieth-century position, Rose/Mountcastle 1959. By this time it had been concluded that conscious perception of movement depends on receptors from joints, while proprio-ceptors in muscle function as part of an unconscious system of control of posture and movement.

muscular activity – skills, energy, fatigue and aesthetics – in connection with the organisation of production, or indeed destruction, in the individual body and the body of society alike.¹⁵⁰ In the years between approximately 1890 and 1930, there was a great range of studies of labour efficiency, the fatigue of industrial workers, the biomechanics of movement, and so forth. The subject, of course, was not so much the mechanism of muscular sensation but the motor system itself, just as it had been in earlier studies of speech and thought. Étienne-Jules Marey, Eadweard Muybridge and others had pioneered the use of photography to study limb movements in animals and people.¹⁵¹ Film then emerged as a medium peculiarly suited to the investigation and aesthetics of posture, gesture and movement. In the last decade of the nineteenth century, there was a marked interest in sport, gymnastics and rational exercise as the route to both bodily and moral efficiency. In Russia, beginning soon after the Revolution and supported by a government interested in the rational organisation of work, N. A. Bernshtein, began a programme of research into motor organisation, for example, filming gymnasts with lights attached to their bodies.¹⁵² This work directed attention to the central organising capacities of the body, then and over many decades providing an alternative to the Pavlovian approach to learning and organisation through conditional reflexes.

Facing criticism on a number of fronts, including the judgment that much written on ‘force’ failed to understand the new concept of energy, as well as new analysis of the muscular sense, the Victorian intellectual edifice which had stressed ‘efficient’ causes, collapsed. This is a fine example of ‘the disenchantment’ of the worldview. Nonetheless, many people continued in multifarious ways to invest their moral and spiritual hopes in ‘force’ thought of as phenomenally real. This was evident, late in the nineteenth century, in popular spiritualism, the energetics of Wilhelm Ostwald, the theosophy of Madame Blavatsky, Bergson’s *élan vital* and other attempts to modify or replace the mechanistic worldview to which natural science appeared to have led.¹⁵³ These social and intellectual movements are a reminder of the living hopes invested in claims to have direct knowledge of human agency and of human action as the expression of purposive forces at work in the world. It mattered to people to understand muscular sensation as representing the activity of self, and it mattered when this understanding appeared to lose its foundations. In the decades before World War I, cosmic theories of the place

150 E.g., Rabinbach 1992; Pick 1993.

151 Exposition virtuelle Marey; Braun 1992. Muybridge famously took successive photographs to show the movement of the galloping horse.

152 Sirotkina 2011a.

153 For vitalism, Burwick/Douglass 1992.

of human agency in a world of 'force' were widespread. Anthroposophy is one well-known example.¹⁵⁴

Further, belief in the activity of self carried a heavy moral and ideological load (signaled now by the very word 'Victorian'). The notion of 'effort' was a mainstay of Victorian moralism and the cult of manliness; and presumptions, not to say prejudice, abounded about the varying capacity for effort of different groups, such as men and women or black and white races, as well as of different individuals. Late in the century, attention to effort and the muscular skills and strength needed for it entered into the discourse of social hygiene generally and into numerous new practices in sport, gymnastics and dance. If all this did not need or display detailed knowledge of the muscular sense, it did take the importance of the sense in human performance for granted.

These interests brought kinaesthesia out from the laboratory and back into public culture, where discussion of it had originated. The arts, especially dance but also acting, occupied an ambiguous, open-ended social space, since the modernist theatre with its innovative technique and expression was a kind of laboratory, though performance was in its nature public. There were those, like the theatre director V. E. Meyerhold and the innovator and theorist of dance Rudolf Laban, who intended to link science and the arts.¹⁵⁵ But though they sometimes used the language of science, their ideas, concerned with posture, expression, rhythm, energy fields and position in space and the like, perhaps owed little to the specialist research of psycho-physiology. Similarly, I think, at the beginning of the twentieth century at least, people interested in a science of human adaptation and bodily efficiency often enough reached practical conclusions without going into underlying mechanisms. We should be wary of mistaking references to science and to machines as evidence for a debt to what scientists were actually doing.¹⁵⁶ It was possible to train the kinaesthetic sense to appreciate refinements of distance or weight, as a sports trainer might do, without knowledge of the underlying physiology. It was possible to change the movement of dancers without knowledge of motor control mechanisms. There is clearly scope for a closer look. Beyond all this, there remains the large historical question: did the spread of knowledge of 'the sixth sense' discussed in this paper lead to a new kind of perception (or even new *mentalité*) of the human body, its movement and performance? Or should we interpret the development of knowledge of kinaesthesia and

154 See Ahern 2009.

155 See Reynolds 2007; Sirotkina 2011b. For the extraordinary riches of the Russian visual material, Mislér 2011. For remarks pointing to the importance of the muscular sense for aesthetics, especially *geste*, Beaunis 1889, 138–141.

156 See Sirotkina 2009.

the emergence of new artistic and commercial bodily practices as parallel, but only contingently interacting, expressions of modernity?

Readers of Nietzsche – and, by 1900, his writings had a distinct and at times ecstatic international following – would have been aware of his repeated use of the metaphor of dance. “Lift up your hearts, my brothers, high, higher! And do not forget your legs! Lift up your legs, too, you fine dancers; and better still, stand on your heads!”¹⁵⁷ The *reading* of his work was at this time first and foremost an act of emancipation: it was the assertion of the freedom of the individual, the freedom of the body and the freedom of dance as the metaphor of ‘life’. It was possible for the aesthetic ideal of the moving person and the science of the mechanism, the spirit and the body, to have a common referent in kinaesthetic experience. That was indeed new. A century earlier, there was no language for such an experience. The science of ‘the sixth sense’ gave rise to novel possibilities of representing being human, and, it might even be, new possibilities of being human. Whatever interest there was in science, there remained ‘artists’, most of whom were in fact not professional performers but ordinary people, who possessed modes of knowing not grounded in natural science but in ways of life, grounded in awareness of their embodied selves.

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157 Nietzsche 1969, 304–305 (Part IV, “Of the higher man”, sect. 17); also 227–228 (Part III, “Of old and new law-tables”, sect. 23).

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