5
Cognition, chaos, and control in English responses to Descartes' theory of memory

MEMORIE
A comon Inne all comers to reteyne.
A sive where good run out and bad remayne.
A burrow with a thousand vermin hylles.
A den where nothing that is good abides.
(Thomas Jenner, *c.* 1650. Appended to an engraving entitled 'A Man Writing, Representing the Facultie of Memorie')

that is to be judged *knowledge*, as I see it, which does not disquiet the mind, but settles it (Henry Oldenburg to Thomas Coxe, 1657, in Shapin and Schaffer 1985: 299)

The tranquillity which I now enjoyed did not endure. Memory brought madness with it . . . (Mary Shelley, *Frankenstein* (1818/1974: 187))

And then we acknowledging Man to dwell as it were in the borders of the Spiritual and Material world . . . we shall not wonder that there is such tugging and pulling this way and that way, upward and downward, and such broken disorder of things; those that dwell in the confines of two Kingdoms being most subject to disquiet and confusion. (Henry More, *AAA* II.12.16)

5.1 'A great deal of preposterous confusion'

The Cartesian animal spirits theory of memory was loathsome and morally abhorrent in the eyes of English critics. The idea that memories are just patterned motions of spirits through brain pores denies the systematicity, stability, and structure characteristic of true thinking, reducing all cognition to mere association and the chance fusion of jumbling motions.

Henry More complained that such an idea would 'force a great deal of preposterous confusion' on memory and mind (*IS* II.2.7: 68). Memory traces which naturally interfere and blend were too irregular, too disordered. Animal spirits models of memory were linked in the minds of their opponents not only with materialism and atheism, but also with a dangerously irrational picture of remembering and cognition. Many, like Lucy Hutchinson (Jones 1989: 195–6), did decry the men 'reviving the foppish casual dance of atoms': but resistance to materialism, though strong (Mintz 1962), was less significant than fear of the loss of sovereign control of one's own psychophysiology. How could the soul direct the fleeting animal spirits in the secret channels of the brain? Glanvill could not see how the spirits 'should not lose their way in such a wilderness': the soul's authoritarian task seems too hard if memory is just

motion, since it is 'as inconceivable how it should direct such intricate Motions, as that one that was born blind should manage a Game at Chess, or marshal an Army' (EACP: 5).[1]

Approval of a theory of mind and memory thus depended in part on whether it allowed the requisite inner discipline in cognition, the imposition of central psychological control over spirituous anarchy. Various ways of theoretically reintroducing control of the processes of remembering were offered as alternatives. Cognitive discipline had to be imposed over the mere babble of Cartesian automata. Memories could be disciplined in both personal and theoretical contexts, in the intimacy with which the self dealt with its unruly brain, or in the public ridicule and denigration of theories which overemphasised that unruliness. Discipline, in other words, was as much prescription and wish as description and observation. While angels needed no memory (Locke, *Essay* II.10; Sutton 1994a), human confinement in sequential time required ongoing struggles to order and tame the personal past.

The force of these English critiques is obviously limited: they assume just those facts about order in memory for which they needed to argue. But their complaints reveal both the perceived implications of the animal spirits theory of memory, and the coherence of the set of concerns about control over mental contents which seemed threatened. The detailed examination in this chapter of four critical responses to Descartes will demonstrate the connection between localist models of memory and strong views of executive control over physiological processes, and show why distributed models seemed to lead to distasteful psychological chaos. Chapter 6 will then aid historical clarification of the distinction between local and distributed representation.

In a selective rather than exhaustive survey of early responses to Descartes, I focus on Digby, More, Glanvill, and Hooke. Philosophers on the Continent found more sympathy with memory as patterns of spirit motions (Diamond 1969; Clarke 1989: 183–6). I concentrate on specifically English changes in views of subjectivity and rationality in the later seventeenth century. The English reaction to the Cartesian physiology of memory was not part of a democratic revolt of free spirits against the authoritarian implications of mechanical models of mind (Mayr 1986: 122–36). It was, rather, a gradual realisation that Descartes' account left authority much too fragile, vulnerable to fluid material processes which are unconstrained by the soul. Mayr lists imagery of balance, equilibrium, feedback, and self-regulation in English culture and philosophy which (he thinks) proves the value placed on liberty in the English Enlightenment (1986: 139–89): but, significantly, his examples cover political, physical, and economic discourses, with nothing from philosophy of mind or

1 Both SS and EACP are revised versions of *VOD*: see Willey 1934/1962: 158–75; Medcalf 1970; Vickers 1987: 212–17.

neurophysiology. In fact, Cartesian mind/brain theory was not authoritarian *enough* for the English. Immanent order in mixtures of memory motions never seemed possible, and order had to imposed from outside.

Even in England, there were many more approaches to memory than I discuss. I omit Willis' puzzling psychophysiology (Frank 1990; Kassler 1998), and concentrate on responses to Descartes rather than the reception of Hobbes' ideas about memory (Kassler 1991, 1995: 110–18, 1997). More and Glanvill in particular criticise Hobbes as well as Descartes for not ruling out unacceptable confusion in memory: the points made against the two are not always clearly distinguishable, and I will, with caution, use some of them interchangeably.

The texts I do deal with are a series of snapshots spanning the period from 1644 to 1682, a time of intense struggles in English natural philosophy. Treating them together risks neglecting the context in which each was written, and the analysis needs integration with historians' increasingly nuanced accounts of Restoration science and society, and of the reception and cleansing of Cartesian mechanism. But there are conceptual connections across these texts which a focus on memory renders apparent, and as excuse I plead the neglect in previous research of this domain between physiology and cognition.[2]

Kenelm Digby, Henry More, Joseph Glanvill, and Robert Hooke knew Descartes' work and each other's. Glanvill, for example, knew Digby, had meals and coffee with Hooke, and was a long-term ally of More in a joint campaign to prove the ubiquity of spirits: More told Anne Conway in 1671 that he was 'well assured of his [Glanvill's] virtue' (Cope 1956: 33, 38–9, 60, 87–103, 123; Hall 1990: 175–8). Hooke owned an impressive collection of books on medicine, physiology, and philosophy (Rostenberg 1989).

Although Descartes' *L'Homme* was published only in the 1660s, when it was immediately sought by natural philosophers from England to Italy (Brown 1968/1982: 80–4), there were sufficient clues in the work published in

2 General treatments of the reception of Cartesianism in England (Lamprecht 1935; Heilbron 1982: 26–35; and Rogers 1985) say little on physiology. There are outstanding microstudies of the development of English physiology on both sides of the Restoration by T.M. Brown (1968/1982, 1977) and Bob Frank (1980), but both authors explicitly steer clear of many problems which their subjects addressed about the relations between physiology and the philosophy of mind. Heilbron (1982: 30) outlines a chronological scheme of initial uncritical acceptance of Descartes by the English followed by increasingly wary revision, according to which 'Descartes' day in England was brief... the British had shivered before the materialist consequences of Cartesianism and drawn back' (compare Gabbey 1982, 1992). This may fit the special case of cardiology, in which defence of Harvey against Descartes was paramount (Anstey forthcoming), but it is not easy to apply to the general history of physiology: Brown (1977: 26,54) argues that initial ambivalence towards mechanistic physiology before 1660 changed 'to a fuller, less qualified enthusiasm' and 'would remain entrenched for at least 60 years'. Attention to issues of control, rather than materialism, in the sciences of mind may help work this out.

Descartes' lifetime to make the tendency of his spirits physiology clear. Indeed, these texts clearly confirm that something like what I have called a 'distributed' model of memory (involving superposition and interference) was the subject of considerable debate, and that it was located by critics in Descartes' neurophilosophy. Descartes' doctrine of the intellectual memory, on the other hand, is not mentioned. Digby, More, and Glanvill specifically criticise Descartes' theory of memory; Digby, More, and Hooke construct their own accounts; Glanvill, trying to discredit existing psychological theory, has a purely critical focus.

There is a fair amount of work on More, Glanvill, and Hooke, but Digby is less well known.[3] He was an early English mechanist of an idiosyncratic sort (Petersson 1956; Henry 1982), attending more (though critically) to Descartes' natural philosophy than to his metaphysics. Digby believed in continually emanating 'spirits or little bodies', and is better known for his quasi-mechanistic accounts of 'occult' phenomena like the weapon salve and alchemical transmutation (Dobbs 1971–4). Of his *Two Treatises*, the first (on body) is three times longer than the second (on soul), and his eclectic engagement with contemporary problems in physics and physiology was intense. Each of these four writers' accounts of memory meshed with the rest of their natural philosophy. But here I stick to memory and brain, my historical purposes being as much polemical as exegetical.

It is not surprising that memory should have increasingly preoccupied English philosophers through the seventeenth century. The obsession with order after the Civil War, and after the Interregnum's uncontrolled multiplicity of opinion, produced not only impositions of unity in worship, dress, and conduct, but also attempts to keep the past in place. Both collective and cognitive memory had to display unity and concord, even at the cost of imposing false continuities on the political and personal past, by developing clear narrative structures to organise uncertain events. A fixation on sameness required external discipline to be applied as much to internal, potentially anarchic, psychophysiological flux as to unruly social forces (compare Martensen 1992 on relations between social order and Willis' 'physiology of reason'). Many descriptions of memory did not encourage confidence in its stability or accuracy: Margaret Cavendish in 1656 described memory as 'Atomes in the Brain set on fire' (in Singer 1976: 126). So Royal Society members, pursuing Bacon's desire to pry into the 'secret motions of things', sought control over research in the body as in the cosmos: in 1667 Secretary Oldenburg asked a correspondent in Connecticut 'to remember, that we have taken to taske the whole Universe' (Hunter 1981: 13, 37). The fact that

3 Digby, Glanvill, and Hooke are treated together by Jamie Kassler in *Inner Music* (1995: 108–47), and I am much indebted to her work (also Kassler 1984), although our evaluations of seventeenth-century theories of memory are quite different. I am grateful to Kassler, James Jacob, and Mark Pallas for helpful conversations about this chapter.

English philosophers were disappointed in their desire to play wider roles in running the country (Hunter 1981: 136, 1994: 35–54) makes cognitive theory, the vision of what mind and memory are and ought to be, as good a case as any for teasing out their assumptions, fears, and wishes.

I take an issue-based approach to the writings on memory of Digby, Glanvill, and Hooke, and follow with an overview of More's position which confirms and extends the same points.

5.2 Distributed representation and the preservation of motions

An 'insuperable' problem for Descartes' physiological psychology of animal spirits, says Digby, is its inability to explain 'how thinges are conserved in the memory' (TT 32: 282). Memory seems impossible on Descartes' assumption that 'nothing but motions do come into the braine. For it is impossible, that in so divisible a subject as the spirits, motion should be conserved any long time as we evidently see in the ayre' (TT 32: 282).[4] Only dry, hard bodies can conserve motion, and even they cannot 'conserve it very long, after the cause which made it, ceaseth from its operation'. Long-term storage, vital for 'the use and service of a man', would be impossible if memory is, or contains, only 'a multitude of pure motions' and fleeting spirit patterns (TT 32: 283).

Descartes, of course, did not think that every memory motion was always actually (explicitly) conserved: the enduring changes were not in spirits but in brain pores. Digby refers briefly to this idea that only dispositions for the re-evocation of explicit patterns are 'stored'. Descartes, he notes, could reply to his complaint by saying 'that it is not necessary the motions themselves should always be conserved in actual being; but that it is sufficient, there be certain causes kept on foote in our heades, which are apt to reduce these motions into act, whensoever there is occasion of them' (TT 32: 283). But Digby complains that this is *ad hoc*, 'meerely a voluntary position' lacking any supporting evidence.

Descartes was vulnerable to problems about the preservation of motion. The laws of nature, for him, depend 'on God's preserving each thing by a continuous action, and consequently on his preserving it not as it may have been some time earlier but precisely as it is at the very instant that he preserves it' (*Le Monde* ch. 7, AT xi.44, CSM 1.96). This is the occasionalist strand in Descartes: the

4 To replace Descartes' view of sensation as 'a pure driving of the animal spirits' upon the brain, Digby postulated 'the driving thither of solid material bodies (exceeding litle [*sic*] ones) that come from the objects themselves' (TT 33: 284). Actual particles from objects enter the body and are 'removed' by 'locall change . . . within our body from one place to another' by the animal spirits, 'the porters of all newes to the braine' (TT 32: 276). So spirits are only the 'instruments of this conveyance' (TT 32: 277), rather than the active representations themselves.

only continuity across instants of time is provided by God's incessant intervention to preserve the world as it is. This seems to be in tension with the account of memory as distributed patterns of activation, thus justifying Digby's worry. But even if Stephen Gaukroger's defence of real forces in Descartes' *general* metaphysics (chapter 3 above) fails, it is safe to bracket the problem in discussing *particular* physical problems: God's action has to be assumed or ignored in dealing with ordinary natural phenomena (Gaukroger 1995: 375). Descartes' reliance on God is in no way a *special* difficulty for the theory of memory as the preservation of motions: it applies to all physical continuity and cannot be raised *only* in this psychophysiological context. Digby, indeed, is arguing *within* the physiological framework rather than metaphysically. What remains to be debated is how, within a world in which some things do endure across time, patterns of animal spirits in the brain can be among them.

Digby thought they could not be: no dispositional account will explain how animal spirit motions could remain constant 'for so long a time as [a man's] memory is able to extend unto' (TT 32: 283). Glanvill, pertinently, queried the preservation not only of motions of the spirits, but of the changes in the pores of the brain which are meant to ground the relevant dispositions. The brain is so 'pervious' and 'of such a clammy consistence' (*VOD*: 35, 38) that

> it's difficult to apprehend, but that these *avennues* should in a very short time be stopped up by the pressure of other parts of the matter, through its natural *gravity*, or other alterations made in the *Brain*; And the opening of other *vicine passages* might quickly obliterate any tracks of these; as the making of one hole in the yeelding *mud*, defaces the print of another near it. (*VOD*: 35)[5]

Glanvill cannot see how spirits should be determined to pass through one passage rather than another: or how diverse superpositionally stored items can be distinct from each other when recalled if their 'Images without doubt pass through the same *apertures* [in the brain substance]' (*VOD*: 34).[6]

Hooke, significantly, does not stress this difficulty in his 1682 Royal Society lecture on memory.[7] While his model of memory is very different from Descartes', he shares Descartes' confidence that, as theories of matter and motion in other domains of natural philosophy were suggesting, matter in

5 This charged passage was toned down, and its second part (from 'And the opening . . .') cut, in the 1676 version.

6 Mintz (1962: 76) compares Thomas Tenison's 1670 *The Creed of Mr Hobbes Examined*. Tenison accepts that a quivering or trembling in the brain can remain after an object of sight is removed, but asserts that in a machine such motion will soon vanish: whereas, 'the Re-action must remain extremely long, in such Men (for Instance), who at the seventieth year remember most perfectly, and will repeat with pleasure, the passages of their School-play, even those who retain not the things more newly passed'. Mintz quotes the Glanvill passages only from the 1676 version (EACP), and claims that Glanvill has repeated Tenison's argument. The priority is in fact the reverse.

7 On the occasion of this lecture see Singer 1976: 115–21; Oldroyd 1980.

certain arrangements may be specifically 'adapted' for the retention and 'containing' of particular inputs.[8] The 'Repository' of memory 'is continually supplied' with the relevant 'kinds of Substances' fitted to 'imbibe' and retain various impressions (LL 7.3: 142). As I suggested in discussing theories of light (chapter 4 above), Hooke's optical and acoustical analogies for brain matter set his psychophysiology in the wider contexts of theories of vibration, elasticity, and resonance (Gouk 1980: 585–91; Kassler and Oldroyd 1983: 574–89; Kassler 1995: 129–39), and of that variety of mechanical philosophy which allowed intelligible active powers, including the power to preserve motions, to specific organisations of matter (Henry 1986a, 1989a). The differences between Hooke and Descartes relevant here, then, are not over continuity of motion in matter. Nor are they over mind/body dualism, on which Hooke's position is far from clear. Instead they lie on the axis between distributed and local representation, where Hooke is closer to Digby and the anti-Cartesian tradition.[9]

5.3 Local representation, order, and fidelity

For memory to conserve anything on Descartes' assumption that 'nothing but motions do come into the braine', says Digby, it would have to be the case that 'the impressions upon the common sense . . . must be actually conserved, always actually moving in our head, to the end they be immediately produced, whensoever it pleaseth our will to call for them' (TT 32: 282–3). This is, he thinks, as implausible as that 'a lessen played upon the lute or virginals' could be conserved 'ever continually playing'. Note the requirement Digby is placing

8 Hooke describes how impressions of each sense might be retained, comparing 'Bononian [Bologna] Stone' which can (albeit briefly) retain impressions of light; for impressions of sound he compares bells, vases, and strings (LL 7.3: 141–2). Commentators variously compare memory models like Pribram's 'laser-produced holograms' (Singer 1976: 129) and radar (Oldroyd 1980: 22). Colville-Stewart (1975: 117–97, 120–1 on Hooke) has a more principled treatment of historical analogies between memory and various physical and chemical phenomena which display the influence of past on present events over a temporal gap. For a provocative account of the relation between Hooke's studies of bells and his theory of memory see Kassler 1995: 143–59.

9 Although Hooke does not explicitly attack Descartes' theory (which he knew from his edition of *L'Homme*), and although he shares Descartes' commitment to physical continuity in the brain between past and present, my analysis below shows how antithetical the two approaches are on the key issue of *how* this continuity is realised. These differences have been missed by previous commentators, with Hooke's theory characterised as everything from 'thoroughly materialist' (Richards 1992: 69) to 'a basically sympathetic extension and reformulation of easily identifiable Cartesian notions' (Brown 1971: 5) or 'essentially a form of Cartesian dualism' (Oldroyd 1980: 21). The correct diagnosis is that Hooke and Descartes differ not so much about the relation of soul to mental representations (although the ontological status of soul in Hooke is unclear (Henry 1989a: 153), and although his use of concepts like radiation, attraction, and vibration is an attempt to sidestep the problems of interaction), but, crucially, about whether the memory representations themselves are local or distributed.

on a theory of memory: stored items, whatever they may be, must always be actually present, available for inspection by the will at any moment. Digby is led from here to formulate his own theory of memory. The demand that memories be always explicitly represented requires the discrete storage of every memory at a separate location.

The 'exceeding litle' bodies from objects which are driven against the brain, according to Digby, 'must rebound . . . upon other partes of the braine; where at length, they find some vacant cell, in which they keepe their rankes and files, in great quiett and order; all such sticking together, and keeping company with one an other, that entered in together: and there they lye still and are at rest, untill they be stirred up' whether by appetite, chance, or the will (TT 33: 284–5). Any of these three causes 'rayseth them up, and giveth them the motion that is proper to them; which is the same with that, whereby they came in at the first'. Referring to Galileo's teachings on the proper motions of undisturbed bodies, Digby describes how, after memories 'slide successively through the fantasie' in their original order, they 'return gently to their quiett habitation in some other part of the braine, from whence they were called and summoned by the fantasies messengers, the spirits' (TT 33: 285).

The important point here is that the bodies resting in the memory do not change as processing continues elsewhere in the system. Storage is separate from processing, so that the original order of memories is preserved intact: each individual memory in its once vacant cell keeps company with the other memory corpuscles with which it is associated. Even after a processing episode, when a group of memories is called out of storage by the executive will, no change normally occurs: each conveniently returns to its storage location, untouched by the context of retrieval. Not motions but bodies themselves are preserved over time.

Digby's picture gives us the flavour of local memory representation. There is no obvious place for the blending or reconstructive patching up of memories in different contexts which others take to be characteristic of human remembering. Connections between the individual elements of memory occur not by overlap or fusion but by the juxtaposition of their 'cell' addresses. This makes it hard to see, for instance, how a change in knowledge which affects one memory can affect other memories (without some explicit updating by soul, will, or other executive). Localist models of memory do not easily catch relevance and context, or allow experience automatically to influence background knowledge.

Digby's idea of the physical transfer of material atoms from objects to sense organs and into memory cells received little support. But the general notion of local storage recurred in Hooke's model. Memory, which is 'really Organical', is 'nothing else but a Repository of Ideas' (LL 7.1: 140) seated in the 'spirals' of the brain. David Oldroyd (1980: 22) describes this as a typically mechanist

vision: the brain is like a 'butter factory, storing various pats of butter in a bizarre helical warehouse'. But the brain according to Hooke maintains much greater stability than do the incessantly shifting and refolding flows of Descartes' *L'Homme*. For Hooke, corporeal ideas, formed from the material of the brain substance, are throughout the course of one's life incessantly laid down in 'a continued Chain of Ideas coyled up in the Repository of the Brain, the first end of which is farthest removed from the Center or Seat of the Soul where the Ideas are formed, which is always the Moment present when considered'. It is by way of this spatial layout of ideas in the coils of memory that the soul becomes 'apprehensive of the Time interposed' (LL 7.2: 140). The price of an explanation of time perception is a theory of local representation.

Describing ideas emitted from 'the Center' (of which more below), Hooke outlines the features of local memory traces:

> These Ideas I will suppose to be material and bulky, that is, to be certain Bodies of determinate Bigness, and impregnated with determinate Motions, and to be in themselves distinct; and therefore that not two of them can be in the same space, but that they are actually different and separate one from another; and as they have their distinct Figures, so have they each of them their distinct Qualifications of Motions and Constitutions. (LL 7.4: 142)[10]

This is clear. Ideas in the memory which are 'in themselves distinct' are local memory representations, whereas distributed traces *can*, in contrast, be two partly in the same space, in overlapping superpositional storage.

Hooke's defence of a localist theory is illuminated further by Lotte Mulligan's work on Hooke's other writings on memory and natural history, suggesting sources of his theoretical desire for ordered and distinct memories. Aubrey (1949: 243) thought Hooke's own memory was poor. His 'inveterate list-making', in recording the weather, his health, and his sexual encounters, as well as in collating and organising data for the Royal Society, was meant to guard against 'the Frailty of the Memory' (Mulligan 1992: 58, 60). This frailty, invoked by Hooke in the preface to *Micrographia* and elsewhere, is a barrier to scientific progress: it is because 'man's memory seems very shallow and infirm, and so is very prone to forget Circumstances', that the understanding is 'more apt to be sway'd' erroneously, 'very apt to be seduc'd' into false opinions (Hooke, in Mulligan 1992: 49). Diaries, lists, memory aids, *and* the right sort of

10 Boyle also assumed the independence of items in memory, being amazed that 'in so small a portion of matter as the memory is seated in, there should be so many thousands or myriads of distinct traces, footsteps, impressions, or whatever you please to call them, [which] lie not only unconfounded, but so distinct, that at the bare will and pleasure of the learned man' any set of items will spring up 'in the right order': he is persuaded that the brain contains 'an amazing structure' which 'in a little room can afford distinct traces or cells' (Boyle 1772/1965: VI:742; compare IV:454). Peter Anstey, to whom I am grateful for these references, confirms that this localist theory appears to be Boyle's only account of memory (see Anstey 1996: ch. 3).

theory of memory could reassure, and prompt the self toward the requisite regularity. This fear of seduction by the shallow memory is a common theme in early modern memory theorists, who are driven towards imposing order on memory. This is done in two ways: by stressing the role of external systems and aids, and by favouring local models of memory, which alone gratify the wish for order and defend against the fear that distributed models will leave the understanding unprotected.

Firstly, as Mulligan has documented (1992: 61), Hooke obsessively constructed external aids to memory, using systems of recording as 'well-honed epistemological tools' in warding off confusion and forgetfulness.[11] Sprat portrayed Royal Society members as plain, diligent, and laborious observers (Hunter 1981: 8–31), seeking a 'strict purity of procedure' ('Espinasse 1956: 28). Hooke thought that lists and 'a proper History' would aid the storage of 'plain, simple, clear, and uncompounded representation[s]' (in Mulligan 1992: 58, 57). When the intellect, 'like a skilful Architect', is collating such a history, 'those materials are to be carefully sought for and collected and safely laid up in so convenient an Order that they may not be far to seek when they are wanting . . . and cleansed . . . so as not to perplex the User' (Hooke, in Mulligan 1992: 58).

This points towards the second, less explicit tactic for supporting the frail memory. The processes of purification of memories and of laying them up in convenient order do not occur only in Hooke's Baconian sorting techniques. It is also, perhaps, at the level of psychological theory that the materials of memory are 'cleansed'. In imposing on memory theory, hypothetically as it may be, stored ideas which are 'in themselves distinct . . . [and] actually different and separate one from another', Hooke expresses a specific view about what counts as, respectively, 'the Perfections and Imperfections of Humane Nature' (Hooke, in Mulligan 1992: 48). I pursue this theme by examining remarks in Digby and Glanvill which suggest *why* they are so hostile to distributed models of memory.

5.4 'Borrow'd from midnight': interference and the fear of chaos

Glanvill sees no major difference between Descartes' and Digby's accounts of memory: both, though 'ingenious attempts', are not only false but unintelligible, 'sad evidence of the infirmities of laps'd humanity' (*VOD*: 33–4).[12]

11 Mulligan also refers (1992: 53) to his schemes for improving the conduction of ideas along the coils of memory by taking silver filings, mercury, and gold. On Hooke's strange medical practices see Beier 1989.

12 Glanvill's initial praise of Descartes' progress in natural philosophy, like More's, was strongly toned down in later versions (Medcalf 1970), but it had never extended to Cartesian memory theory: in *SS*: 24–30 (1665) he reorganises the chapter on memory to

Glanvill equates Digby's travelling particles ('arbitrary precarious Creatures') with Descartes' patterns of animal spirits roaming through the pores of the brain: he does not understand the difference between local and distributed models. He criticises Digby's theory for being as incapable as is Descartes' of preserving memories faithfully and separately from each other: the expression of this complaint reveals a rhetorical division between order and chaos constructed to match the distinction between faithful local storage and reconstructive distributed memory.

Even if each of Digby's active particles, 'which have no *cement* to unite them, nothing to keep them in the order they were set', has a distinct and separate cell allotted to it, Glanvill fears for the preservation of that order:

> And how is it conceivable, but that carelessly turning over the Idea's [*sic*] of our mind to recover something we would remember, we should put all the other Images into a disorderly floating, and so raise a little *Chaos* of confusion, where Nature requires the exactest order. According to this account, I cannot see, but that our *Memories* would be more confused then our Mid-night compositions. (*VOD*: 35–6)[13]

It is, for Glanvill, an indispensable requirement that a theory of memory allow its traces to be 'capable of Regularity', a regularity which, he thinks, is present in nature. The opposition of chaos to order sets the 'tumultuary agitations' of the liquid brain against the 'uniformity in motion' which memories *ought* to have. The reader is made complicitous in accepting that human remembering in no way resembles 'a disorderly floating': and, especially, in seeing psychological anarchy as the only alternative to the strict regimenting of memories, which 'should so orderly keep their Cells without any alteration of their site or posture, which at first was allotted them' (*VOD*: 36).

On similar grounds, Digby had qualms about Descartes' animal spirit motions as the medium of memory. Querying the possibility of the preservation of motions, Digby's doubt had been that all the motions could 'be kept on foote in [man's] braine, without confusion' (TT 32: 283). In Descartes' model interference between traces is inevitable, and increases as more traces are added into the system. It is the idea of such interference that is met with hostility by the critics, whose language becomes coloured with moral force. Digby, though looking forward to explication in an unpublished work of Descartes,[14] cannot

stress that there is 'no security neither' in Descartes' account, and cuts Descartes and Gassendi from *VOD*'s list (*VOD*: 240) of 'illustrious Heroes', replacing them with 'the Royal Society'. Glanvill's sceptical destruction of existing theories leaves memory 'obscure' (*VOD*: 32), as Reid's attack on Hartley's model would leave it unaccountable (chapter 14 below).

13 In 1676, the metaphoric critique is altered: 'I cannot see but that our Memories would be more confused than our Dreams, and I can as easily conceive how a heap of Ants can be kept to regular and uniform Motions' (*EACP*: 8–9).

14 I have no confirmation, but assume that this 'worke of his, which the world of learned men so much longeth for' is *L'Homme*.

understand how 'any determinate motion should long be preserved untaynted in the braine; where there must be such a multitude of other motions in the way, to mingle with it, and bring all into confusion' (TT 33: 284).

The promiscuous distributed traces are the source, then, of confusion, disorder, and cognitive chaos: the infection lies within. This is a repeated theme in writers reacting to the distributed animal spirits model of memory. There was a basis in Descartes for concerns about the tainting by physiology and matter of pure intellect and divinely given motion. In *Le Monde* he runs an analogy between, on the one hand, that theodicy which gives the human will responsibility only for evil action while making God the author of all good action, and, on the other, the relation between rectilinear motions, of which God alone is author, and 'the various dispositions of matter which render [motions] irregular and curved' (AT xi.46, CSM 1.97). Then in the *Passions of the Soul* (written after Digby's *Two Treatises*) Descartes, in an extended discussion of psychological conflict, converts all alleged conflict between different parts of the soul into oppositions between the movements of the animal spirits in the body and the movements or tendencies produced by the soul 'by means of its will'. The spirits and the soul fight for control of the motions of the pineal gland (*Passions* 1.47, AT xi.364–5, CSM 1.345–6). This theme, of a physiological site for epic conflict between soul or will and mischievous corporeal spirits, has an enormous subsequent literature from morality to medicine. Here just note the immediate effect on theories of memory. The interference characteristic of distributed models of memory is perceived as a threat not merely to the regularity of remembering, but to a moral order which depends on excluding chaos from the psychological realm.

The dangers of distributed memory are even more explicit in Glanvill's related critique of Hobbes' theory of memory as 'a *Mixing of Parts in an Object*' (*VOD*: 37–9). After voicing the usual concern about the conservation of motions in the '*Quagmire*' of the brain and the fluid spirits, Glanvill says that even if a motion were preserved, 'it would be quickly deadned even to an utter cessation, by *counter-motions*; and we should not remember any thing, but till the next impression'. Catastrophic interference, Glanvill is suggesting, would dampen away all distinct memories. It is inconceivable 'how such an abundance of *motions* should orderly succeed one another, as things do in our *memories*'. Glanvill continues instructively:

> And to remember a *song* or *tune*, it will be required, that our Souls be an *Harmony* more then in a *Metaphor*, continually running over in a silent whisper those *Musical Accents* which our retentive faculty is preserver of. Which could we suppose in a single Instance; yet a multitude of *Musical Consonancies* would be as impossible, as to play a thousand tunes on a *Lute* at once. One motion would cross and destroy another; all would be clashing and discord: And the *Musicians Soul* would be the most *disharmonious*: For according to the tenour of

> this opinion, our *memories* will be stored with infinite variety of divers, yea contrary motions, which must needs interfere, thwart, and obstruct on another: and there would be nothing within us, but Ataxy and disorder. (*VOD*: 39)

In this passage Glanvill first requires the continual *explicit* representation of memory traces (the soul must *continually* run over what the memory preserves). Announcing, rightly, that the models he is attacking do not have such explicit representations, he disparages the results of such models and the interference they encourage as leaving only ataxy and chaos inside us. But Glanvill's belief that human remembering is *not* a matter of confused, disordered, chaotic motions is not simply a description of indisputable explananda. It can be read, rather, as a normative or perhaps nostalgic wish for how our memories *should* orderly succeed one another.

A clue to this reading is given by Glanvill's reference to the disharmonious nature of the musician's soul on the distributed-memory hypothesis. He might wish that motions should not cross and destroy each other, and that there should be less clashing and discord. For the context of the chapter on sensation and memory in *The Vanity of Dogmatizing* is one of lament for the loss of human perfection, the deprivation of which has left us unable to understand the least part of the creation or of ourselves. Mysteries and ignorance are our lot after the Fall (*VOD*: 1–16; Medcalf 1970). Memory was not obscure in the beginning, for 'Adam needed no Spectacles' (*VOD*: 5) or other imperfect aids to his understanding (aids of the kind Hooke was so to exert himself in perfecting). Whence then does disharmony arise? From the fall of man: 'Man was never at odds with himself, till he was at odds with the commands of his Maker. There was no jarring or disharmony in the faculties, till sin untun'd them' (*VOD*: 4).

This wistfulness at the clashing discord of our post-lapsarian faculties echoes in Glanvill's complaints against distributed memory. He cannot even raise the possibility that the truth about fallen humanity, and thus about the explananda for a scientific psychology, could be closer to the ataxy and disorder of distributed memory traces than to the localist vision of distinct items which quietly keep their rank and file until called on by the will.

5.5 The soul and the centre

There is a final set of connections to be made through this set of texts. Glanvill's worry about clashing and discord in the musician's soul points the way. What implications have local and distributed models of memory respectively for views about the origin of action, the relations between personal-level psychology and subpersonal or subcognitive parts, and, generally, for ways of thinking about control, mind, and self?

In distributed models, storage is not separate from ongoing processing, whereas local models need some means by which passive memories can be

fetched from a repository or memory bank by some executive mechanism. This means that local models all but require a central executive of some sort, whether an immaterial soul or a central processing unit in a computer. These links between local memory traces and strong conceptions of a powerful central executive, often identified with the will or the soul, are apparent in both Digby and Hooke.

Digby needs an account of what happens when the fancy calls for things conserved in the memory, of how, for example, the will can raise 'the litle [*sic*] similitudes, which are in the caves of the braine wheeling and swimming about' (TT 33: 285). How is control imposed and maintained over the atomic memories? The 'tribunall of the braine' has to 'judge' the bodies that rebound 'to the circle of the memory' (TT 32: 282, 34: 293).

> Now as soone as the braine hath lighted on any of those it seeketh for, it putteth as it were a stoppe upon the motion of that; or at the least, it moveth it so, that it goeth not farre away, and is revocable at will. (TT 33: 285)

This even allows some mutual inhibition of unrelated ideas to help in avoiding misassociation, for this process

> by this means hindereth other objects, not pertinent to the worke the fansie hath in hand, from offering themselves unseasonably in the multitudes that otherwise they would do. But if the fansie should have mistaken one object for an other, by reason of some resemblance they have betweene themselves; then it shaketh againe the liquid medium they all floate in, and rooseth every species lurking in remotest corners, and runneth over the whole beaderoule of them; and continueth this inquisition and motion, till eyther it be satisfyed with retriving at length what it required, or that it be grown weary with tossing about the multitude of litle inhabitants in its numerous empire, and so giveth over the search, unwillingly and displeasedly. (TT 33: 285–6)

In these wonderful passages, Digby refers to the agent as the brain as a whole, as the will, and as the fancy.[15] The agent, whatever it be called, has the power to halt, rein in, and control the physical whereabouts of the locally stored memories at a 'common rendez-vous' (TT 33: 287). Scanning its liquid empire, it engages in a systematic search, running over its whole dominion of inhabitant traces, prone even to boredom and petulance when unsuccessful. The important point here is the necessity, on the assumption of passively stored independent memories, for exhaustive search by some such all-powerful intra-

15 Of the three causes which Digby says (TT: 285) can 'raise these bodies that rest in the memory', he dismisses chance (because 'the principles that governe it, are uncertaine ones'), and allows that appetite and will 'have a power . . . of moving the braine and the nerves depending of it, conveniently and agreably to their disposition'. Yet in the other passages quoted in the text above both brain and fancy are also used as the subject doing the seeking, shaking, and inquiring. It is far from clear that the principles governing the operations of appetite and will are much less uncertain than those of chance.

cognitive agent. There can be no automatic activation of a relevant memory in the course of processing, as in the content-addressable memories characteristic of distributed models. Because the agent of processing is itself active and wholly distinct from the stored things it processes, its laborious search into the remotest recesses of the storage system becomes necessary.

Hooke has a more developed account of the accessing mechanisms for a local memory system. He sees the intimate connection of the problem with the explanation of attention, and refuses any possibility of cognitive functioning, for instance in the laying down or encoding of memories, without the explicit intervention of the central executive, which he is happy to identify with the soul: 'no Idea can really be formed or stored up in this Repository without the Directive and Architectonical Power of the Soul' (LL 7.1: 140). It is at the primary (physical) location of this directive power that any new impressions are formed by the soul into ideas to be laid down in the memory. This process follows the strict order of input, as 'the present always pushes those that were formed before it further into the Repository' (LL 7.4: 144), where they take their ordered places in the coils of memory. New ideas continually intrude, filling out the encircling Orbs which spiral out from the centre in the same way that planets circle the sun, to which Hooke compares 'the Soul in the Center of the Repository' (LL 7.5: 147). This is not a relic of outdated sun-worship, but a strict analogy: the soul, like the sun, has an attractive power over the bodies which it regulates and governs in their motions.[16] While it may have effects elsewhere in the body, it has 'a more than ordinary and commanding Power over all the Ideas placed within its Repository' (LL 7.5: 147).

Hooke, then, embraces a central executive with a vengeance. Human memory is not only a passive faculty, receiving stamps from the world, but also an active faculty, 'in the most secret parts and passages of the body', which can regulate defective impressions and spot the disfiguring of true figures (Hooke, 'Philosophicall Scribbles' MS [1681/2], in Oldroyd 1980: 17–20). The will even has the power of 'fixing or darting its Radiation more powerfully upon this or that Idea' (LL 7.4: 145). Resonance and irradiation are not, however, symmetrical forces between cognitive centre and mnemonic periphery, for in normal function only the central soul genuinely acts on the items it holds captive in the memory coils, snatched from the past for future use. Hooke explicitly baptises the soul's prime location, whence it exercises its power over the ideas of the memory, mentioning 'this place, which I will henceforward call the Center', surrounded with a sphere of memory (LL 7.4: 142). Even though the soul is not always only at this 'Center' as it darts its radia-

16 On the analogy of light and soul see also Henry 1989a: 151–7. Compare a looser use of the same image by Richard Burthogge (1694/1976: 242), who says that the soul puts congealed spirits in motion, as the sun communicates required motions to the planets.

tion round the memory spirals, the hierarchical implications of Hooke's model are clear. Hooke finds that this powerful, imperious 'Center' fits well with his hypothesis of order in memory by way of the passive local storage of memory ideas in ever increasing coils.

When the executive processing is divided from the storage system in this way, the moral undertones of support for local models become more apparent, as did those of hostility towards anarchic distributed models. Local-memory systems not only allow the strict isolation of the ruling will from the passive storers of information, but also open up a gap between the locus of control in the soul or self and the locus of potential disorder, the memories, which are outside the true self in the passive storage circuits of the brain. Thus late seventeenth- and early eighteenth-century moral physiologists were able to construct moral principles out of the need for control to be imposed by the soul over what John Smith called 'the undisciplin'd petulancy of our Animal Spirits' (1660/1979: 119). Psychological conflict is located in a psychophysiological interior space, not all of which is really owned by the supposed unified subject in its perpetual struggle with physiology. Worries about virtue, soul, and self easily entwined with the disputes over local and distributed memory traces.

5.6 More on memory

As an appendix to this issue-based analysis of responses and alternatives to the distributed model, this is a brief examination of the way the same problems surface in the work of the Platonist Henry More. Good philosophy of mind, for More, helps to render us 'safe from all seduction', to 'rectifie what is perverse' (IS preface, p.2), and to evoke repugnance at those 'that are so sunk into the dull sense of their Bodies' as to deny the incorporeal realm (quoted in Hall 1990: 140), who reduce all change to 'the result of an Eternal Scuffle of coordinate Causes, bearing up as well as they can' (AA 1.9.2).

More's early *Platonical Song of the Soul* sought to prove the existence of 'memorie after death' (compare IS III.11: 187–92). Memory is 'the very bond of life'. This 'very intimate' faculty, 'the watchman of the soul, lest she should flie / Or steal from her own self', must have 'a sure fixation' independent of the body, and win 'her deep'st desire' in heaven (1647/1969: 292–5). But the dangers of memory are also evident, as More imagines what would be the case if, impossibly, remembrance should 'spill'.

> If it were cut away
> Our being truly then you might contrive
> Into a point of time. The former day
> Were nought at all to us: when once we lay
> Our selves to sleep, we should not know at morn

That e're we were before; nor could we say
A whit of sense: so soon as off we turn
One word, that's quite forgot. Coherence thus is torn.
(1647/1969: Stanza 33)

A dynamic sense of temporal continuity is necessary for human coherence: on memory depends 'the very selfnesse of the soul' (1647/1969: 295) and the continuity of personal identity on which morality depends. But it must be imposed from outside: More's hatred of immanence makes memory dangerous, for while our souls 'tumble and wallow in matter' (*AAA* 3.1: 149), memory operates 'onely by virtue of a fit tenour of Spirits and due temper of Brain', so that everyone's memory is different (*IS* preface, p. 10). In life, animal spirits are a 'necessary instrument' of memory, which will be 'more perfect after death' (*IS* III.11.1: 187). But in this coarse life they bring only temptation, when even 'the sweet motions of the animal spirits' in love 'can hardly be commanded from bordering' on shameful lust (in West 1955).

Like Digby and Glanvill, More is sceptical about any long-term preservation of memory motions in the brain. Arguing in his *Antidote against Atheism* that the soul cannot be a modification of the body, More claims that it is impossible for the animal spirits themselves to have '*Animadversion, Memory* and *Reason*': the spirits (being 'nothing else but matter very thin and liquid') are capable of nothing but motion, and 'being loose from one another, fridge and play up and down according to the measure and manner of agitation in them' (*AA* 1.11.2: 33). These ill-disciplined spirits are clearly 'utterly uncapable of *Memory* . . . it is as impossible to conceive *Memory* competible to such a Subject, as it is how to write Characters in the water or the wind' (*AA* 1.11.3: 33). The brain, through which Descartes thought the spirits pass in leaving reconstructable traces, is just a 'loose Pulp' of 'a laxe consistence', which is pervious to much grosser juices than the animal spirits: it is no more likely to perform our noble cognitive operations than is 'a Cake of Sewet or a Bowl of Curds' (*AA* 1.11.5: 34). The irrelevance of the brain is proved by the survival of some people without brains (*AA* 1.11.7: 35).[17]

More too was attracted to the idea of local representation and the freedom it allows the unified soul, expressing distaste for the potential chaos of distributed models. The central context of the treatments of memory in the *Antidote against Atheism* and *The Immortality of the Soul* is the rejection of various possibilities for a material seat for the soul and its faculties. He considers stomach, heart, animal spirits, brain, and the pineal gland, which in 1668 he mocked for

17 More is still rejecting the preservation of memories in brain matter in his *Enchiridion metaphysicum* of 1671: 'for if it is fluid, the images will suddenly disappear . . . if the matter is hard or viscid, the vibration will cease suddenly and memory will immediately perish' (in Singer 1976: 128). This is more sceptical about memory in hard dry bodies than was Digby (*TT* 32: 283).

its 'ridiculous Noddings and Joggings . . . encountered by the animal Spirits rudely flurting against it' (in Gabbey 1982: 243).

After ridiculing those who locate memory and reason in any particular 'part or parcel', any 'knot, loop or interval' of the brain, More remarks:

> And if you will say in all together, you must say that the whole Brain is figured into this or that representation, which would cancell Memory, and take away all capacity of there being any distinct Notes and places for the several Species of things there represented. (*AA* I.11.5: 34)

For More too, memory requires distinct, independent representations. The difficulty he sees in any alternative is that, unless individual items are explicitly represented continually, newly activated representations in the same system will erase all the old. This applies both to the brain as a whole and to Descartes' pineal gland theory. If different parts of a representation are superimposed on each other 'upon every part of the Conarion [pineal gland] wherein the Image is, it will be utterly impossible but that the whole Image will be confused' (*AAA* 10.2: 169). Memory in turn cannot be located in the pineal, ridiculed as 'a mere pulpous protuberant knob' (*AAA* 10.6: 170), because memory is 'the standing seal or impression of external Objects': for if impressions did 'stand' (if they were explicitly present), 'it would spoil the representation of things present, or rather after-Objects would be sure to deface all former impressions whatsoever'. Continuing perception is incompatible with anything other than a local model of memory, for otherwise memory impressions will always be obliterated by new impressions 'which must needs displace them' (*AAA* 10.3: 169). More is denying not that the brain is 'the seat of Memory', but that any 'impression once wiped out' could ever be reconstructed or recognised by the soul as having been previously encountered (*AAA* 10.3–4: 170).

The only kind of memory traces possible, then, are local representations with their distinct notes and places. To be 'compleat', a representation must be 'intirely in the same circumstances' as in its original encoding (*IS* II.10.9: 105). The need for such 'distinct and perfect representations of things' (*IS* II.7.16: 93) is in fact what proves to More that matter is not sufficient for memory. If 'the bare laws of matter' were responsible for the impressing and retention of representations, they would become 'strangely depraved, if not obliterated' (*IS* II.10.9: 105; More uses 'depraved' twice on this page for the effects of matter on images).

Earlier in *The Immortality of the Soul*, More analyses Descartes' *Passions of the Soul* and confirms that it is the dispositional account of memory in the distributed model which he is attacking. For Descartes, the openings by the animal spirits of 'such and such Pores of the Brain'

> remain as tracts or footsteps of the presence of these Objects after they are removed. Which tracts, or signatures, consist mainly in this, that the Spirits

> will have an easier passage through these Pores then other parts of the Brain. And hence arises Memory, when the Spirits be determined, by the inclining of the Conarion, to that part of the Brain where these tracts are found. (IS II.5.1: 80)

More argues that these 'mere Mechanical reasons' do not include sufficient variables to explain the memory of colours. Perception of colours, for Descartes, depends on the varying speeds of particles moving into and through the brain: More thinks, for unspecified reasons, that these differences in speed could not be encoded in the distributed model (IS II.5.7: 82–3).[18] 'Mere matter', says More in a more revealing criticism, could not allow for the 'distinct remembrance' or 'distinct memory' of every one of many simultaneously presented items: without the soul, 'there would be a necessary confusion of all' (IS II.5.7: 83).[19]

More further takes the incompatibility of distributed models with strong assumptions about the unity of the soul and about the nature of its control to be evidence *against* such models. The soul, an indivisible immaterial substance distinct from the body (*AA* 1.11.11: 36; *AAA* 10.9: 172–3), is like the 'radiant Center' of a sphere or orb of light: when its 'exteriour parts' are 'affected by the parts of the Object with such circumstances as they are in, the inward Center receives all so circumstantiated, that it has necessarily the intire and unconfused images of things without' (*AAA* 10.10: 173). Only such a spiritual 'inward Center' could receive 'multitudes of particular figurations' while keeping them 'yet distinctly represented' (*AAA* 10.10: 173).[20]

In some difficult pages, which also include analyses of forgetting and of the causes of prompt or slow recall, More does provide a positive account of memory, 'a Faculty of a more peculiar consideration' than reason or imagination (IS II.11.4: 106). The thinking is that only a local model of memory can work, but that, since the spirits and brain are too unstable to support local

18 Henry (1989b: 103) seems to endorse this criticism. But the variables listed in *L'Homme* included differences in the agitation of the spirits and in their uniformity of motions as well as in the nature of the 'easy aperture of the same Pores' (IS II.5.7: 82). There seems no obvious reason to suppose that colours would be particularly difficult to remember: and even if there was some special problem, the theory of colour perception could be rejected while maintaining the distributed model of memory.

19 That the unsuitability for human cognition of matter is due to the body's endemic irregularity is clear too in his rejection of the view that the heart is the seat of the soul. The control of 'Free and Spontaneous progressions [actions]' and 'Perceptions also would be horribly disturbed by its squeezing of it self, and then flagging again by vicissitudes' (IS II.7.8: 91). Stability and order, for More, must be a cognitive given, unchanging and pure rather than rhythmic or cyclic. The 'foulness and coursness of Matter' is the only threat to the exquisiteness of the living creation, which therefore could not have arisen out of 'the tumbling of Atomes' (IS II.10.2: 102).

20 At IS II.7.2: 79, the soul is compared to the centre of a circle on the circumference of which are the external senses. More also defends intriguing and unorthodox views of the peculiarly intimate connections between the soul and the animal spirits (IS II.8–11): see chapter 9 below.

representations, the soul must be involved in all remembering. More accepts that 'the *Pith of the Brain*' is especially important for memory. 'But that the *Brain* should be stored with *distinct images* (whether they consist of the Flexures of the supposed *Fibrillae*, or the orderly puncture of Pores, or in a continued modified Motion of the parts thereof, some in this manner, and others in that)' has been proved impossible (IS II.11.4: 106–7). What then *is* the role of the brain in memory? Although only the soul 'her self' can retain the requisite local and distinct representations,

> it were admitted that she might make an occasional use of some private marks she impresses in the *Brain*; which haply may be nothing at all like the things it would *remember*, nor of any considerable magnitude nor proportion to them. (IS II.7.16: 93)

Representation operates without resemblance, but only with the (homuncular) soul there to code and interpret. These marks, More tells us in an intriguing passage,

> must be a kind of *Brachygraphie*, some small dots here and there standing for the recovering to Memory a series of things that would fill, it may be, many sheets of paper to write them at large. (IS II.11.4: 107)

Hooke too wondered if cryptography, hieroglyphics, shorthand, and brachygraphy might more securely perpetuate truth through brevity (Cope 1956: 150–3).

Wittgenstein (1967: sect. 612) imagines 'jottings', marks on paper which are necessary for someone to reproduce a passage of text, and yet which are *not* a rendering, translation, or storage of the text. Like Wittgenstein, More thinks that the rejection of straightforward resemblance between the hypothetical memory trace and the object of memory implies that nothing is stored. Again like Wittgenstein, More takes this to entail the falsity of any mechanical account of memory: he concludes from this discussion of 'brachygraphie' that 'it is plain that the *Memory* is in the *Soul*, and not in the *Brain*' (IS II.11.4: 107; compare Sutton 1997: sect. 3). But there are still patterns in compressed and transformed jottings: strangely condensing their contents, private marks or dots in the brain may yet be constrained, complex and mechanical at once.