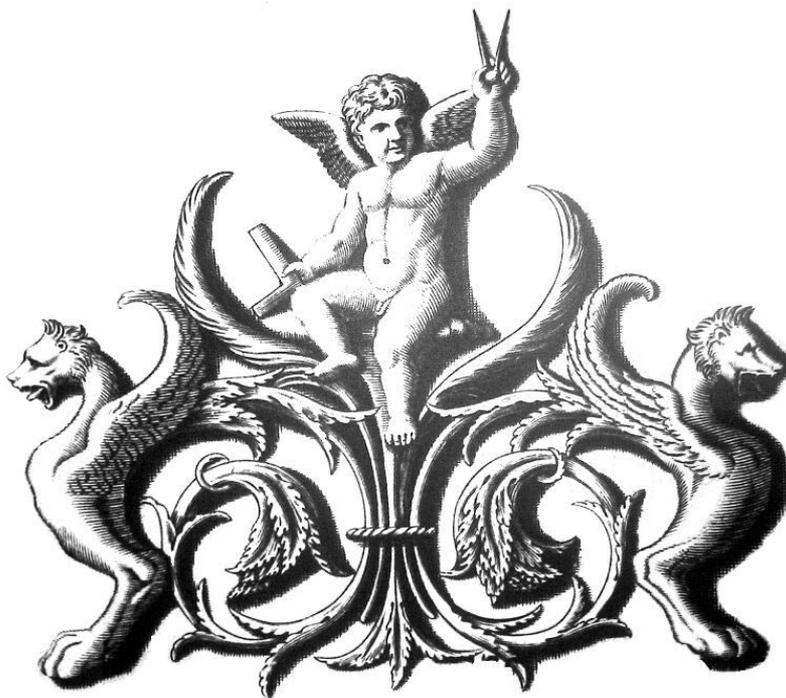

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Time, Soul, Memory

*Robert Hooke's
"Lecture explicating the Memory,
and how we come by the notion of Time"*



*Read at meetings of the Royal Society,
May–June 1682*



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Typeset in Frantisek Storm's Regent II and Regula,
<<http://www.stormtype.com>>.



A C K N O W L E D G E M E N T S

Now seems as good a time as any to thank all the members of the InfoDesign-Café list who so generously share experiences, ideas, and arguments with me. I rely on this dialogue more than you know.

In addition, a public acknowledgement is long overdue

CONRAD TAYLOR, for raising my level of visual literacy, slowly but surely. Conrad has patiently analyzed digital images for me, initiated me in the mysteries of bitmap editing, and inspired me by example when I have—all too frequently—just wanted to chuck it all. His brilliant edit of the *Cyclopædia*'s 1783 frontispiece hangs on my office wall, and is still teaching me a thing or two about the process.

NORMA KARRAM and **PAUL HARRIS**, librarians at UCSD, for their ongoing support, collegiality, and genuine interest in the experimental projects of independent researchers.

FRANTISEK STORM (www.stormtype.com), for his inspired Baroque typeface designs, and encouragement of a novice typographer.

JAMES SOUTTAR, for turning me on to Storm Type in the first place. But more than this, James, for a rich and enduring dialogue concerning all matters C17. Over the past few years, we have tried one another's patience to good effect. I am a better scholar for it.



I N T R O D U C T I O N

Robert Hooke's "Lecture explicating the Memory, and how we come by the Notion of Time" capped his fascinating lecture series known as "Lectures of Light, Explicating its Nature, Properties, and Effects, &c." Hooke's course of Lectures on Light covered a two-year span. The first lecture was delivered before the Royal Society of London beginning ca. March/April 1680, and this last one, in June 1682.

Hooke had first raised the subject of a human moment in time on 3 May 1682, as recorded in the Royal Society's Journal book for that date:

Mr. HOOKE read a discourse about the manner and reason of the propagation of light, whereby he explained the difficulties of DESCARTES' propension to motion, and Mr. HOBBS' conatus to motion, by showing how they might both be understood to be actual local motion: which was done by showing what was to be understood by a human moment and a sensible space, and how much shorter moments, how much smaller bodies, how much shorter spaces, how much quicker motions might suffice to perform the several propagations of the local motions of light through a sensible particle of body thousands of various ways successively, without interfering with one another.

This occasioned much discourse, and some difficulties supposed therein were removed by some further discourses thereupon.¹

Then again on 17 May 1682,

Mr. HOOKE read a discourse of his own about local motions, sensible and insensible times, and celerity, being a further continuation of the discourse read by him to the society in the meeting of the 3rd of May, which was well approved.²

These, in turn, evolved into Hooke's lecture on memory and time, delivered 21 June 1682:

Mr. HOOKE read a long discourse, being the substance of three lectures, which he had missed the reading of at two last meetings, concerning the means, how the soul becomes sensible of time, explaining the organ of memory, and its use for retaining and producing ideas therein stored up.³

This intriguing lecture caused quite a stir. John Evelyn noted the event in his diary:

To our Society, where Mr. Hook read to us his ingenious Hypothesis of Memorie, which he made to be an Organ of sense, distinct from any of the five; placed somewhere in the braine, which tooke notice of all Ideas and repositied them; as the rest of the senses do of their peculiar objects.⁴

At the next weekly meeting, Hooke was asked to deliver his lecture again. We get some sense of audience response from the Society's Journal record for 28 June 1682:

The minutes of the preceding meeting being read and discoursed of, there being several persons present, as Sir JOHN HOSKYNES, Sir WILLIAM PETTY, Sir ROBERT SOUTHWELL, Mr. HENSHAW, Monsieur JUSTEL, Monsieur AUZOUT, and others, who were not at the last meeting when Mr. HOOKE's discourse was read, it was desired by them, that Mr. HOOKE should read the same again, which he accordingly did.

After which some objecting, that this discourse seemed to tend to prove the soul mechanical, Mr. HOOKE answered, that no such thing was hinted, or in the least intended in it; it being only designed to show, that the soul forms for its own use certain corporeal ideas, which it stored up in the repository or organ of memory, and that by its power of being immediately sensible of those ideas, whenever it exerts its power for that end, it thereby becomes sensible of those ideas formerly made, as if they were made at that instant, but with this difference, that the farther they were removed from the centre or seat of its more immediate momentary residence, the more faint are the reflections or reactions from them; and that this occasions the notion of the distance of time.⁵

As Hookeian lectures went, this one was relatively easy-going on the auditors. No one asked Hooke for schemes and models to explicate his hypothesis, as they did on so many other occasions. Everyone simply looked inward, as had Hooke himself, following, with his friends and colleagues, in the footsteps of so many great thinkers before him.⁶



Hooke's lecture on memory is rooted in a physiopsychological tradition, inherited from Aristotle, and refashioned in the popular writings of Renaissance theorists such as Hieronymus Cardanus (1501–1576), Bernardino Telesio (1509–1588), Giovanni Domenico Campanella (1568–1639), and the very influential Juan de Dios Huarte, whose *Examen de ingenios para las ciencias* (original publication, 1578) was translated into English in 1594, reprinted multiple times thereafter, and despite some of its more scandalous content, closely studied by English women as well as men. The Renaissance tradition of naturalist psychology was further reinvigorated in the work of Francis Bacon (1561–1626) and Thomas Hobbes (1588–1679), both of whom influenced Hooke, along with that

flamboyant “Queen of Sciences,” Margaret Cavendish (1623–1673), the duchess of Newcastle.

Although Hooke’s lecture on memory was never printed during his lifetime, I suspect his “ingenious Hypothesis” did circulate by way of more informal socio-intellectual networks, such as family circles. Clearly, the hypothesis struck a chord with contemporaries, as Richard Waller (1646?–1714/5) must have known when he selected the lecture for inclusion in the 1705 edition of Hooke’s *Posthumous Works*, taking great care in how he framed it for readers.

Waller was Hooke’s friend, as well as his editor and biographer. And he, too, belonged to an interesting family circle.

Twice secretary to the Royal Society in 1687–1709 and 1710–1714, and a talented natural philosopher and graphic designer in his own right, Richard Waller was the son of Mary More (fl. 1674–1713).⁷ Mary More was an accomplished artist (a Holbein portrait of hers was gifted to the Bodleian in 1674), a classical scholar, and author of *The Womans Right*, a protofeminist tract addressed to “my little daughter Elizabeth Waller,” and answered in print (*The Womans Right Proved False*) by Robert Whitehall (d. 1685), a Fellow of Merton College, Oxford. We know from the descriptions in his diary that Hooke very much enjoyed visiting with Mary More, feasting on cheesecake while the two of them discoursed in Greek of feminist theory and other recondite matters. Sometimes More and Hooke would talk of their dreams and waking visions, then turn to mulling over whatever else in the pantheon of human and natural sciences most absorbed them of a given afternoon.

Mary More’s domestic circle embraced other close friends of Hooke’s, including the naturalist and antiquarian John Aubrey (1626–1697), who recorded that he used to stay at “Mrs More’s in Hammond Alley in Bishopgate Street farthest house [opposite to] old Jailer tavern” while in London. Although now best known for his “gossipy biographies” of contemporary figures, including Hooke, Aubrey wrote several other works, among which we find a curious little book of *Miscellanies upon Various Subjects* (London, 1696), full of essays on dream consciousness and other psychic phenomena.

From Aubrey, we learn that Hooke, unlike today’s eminent drosophilists with their photographic memories, had rather a poor memory:

He is but of midling stature, something crooked, pale faced, and his face but little belowe, but his head is lardge; his eie full and popping, and not quick; a grey eie. He has a delicate head of haire, browne, and of an excellent moist curle. He is and ever was very temperate, and moderate in dyet, etc.

As he is of prodigious inventive head, so is a person of great vertue and goodnes. Now when I have sayd his inventive faculty is so great, you cannot imagine his memory to be excellent, for they are like two bucketts, as one goes up, the other goes downe. He is certainly the greatest mechanick this day in the world. His head lies much more to Geometry then to Arithmetique.... In fine (which crownes all) he is a person of great suavity and goodnesse.⁸

Certainly, Hooke was always himself on the lookout for artificial memory enhancers. His diary entry for 11 September 1677 reads in part:

... At Garaways. Mr. Melancholy told me that a freind of his had been recoverd of a bad memory and severall other distempers by carrying a small box full of very fine filings of the best refined silver and now and then licking of it with his finger and swallowing it. It seems very probable that this may be a very efficacious medicine, as is steel ☉ and the other medicines and mineralls, of this query further. At Cole harbor...⁹

Four years earlier, in a diary entry for 4 September 1673, Hooke had documented his ongoing inquiry into related mechanisms of human consciousness:

At Mr. Lems. Springs coffee house. at Dr. Wrens examind some accounts, Auditor Philips there. stayd there till 11. at Guildhall for the bakers, gott their businesse determined by court of Aldermen. Dind with Lord Mayor. Controuler, Sir Th. Bloodworth and Bakers company dind there. Wharfingers about keys, summond in. some bound over to pull downe. Garways home—found out that there was something in my head that shutt or opend as soon as ever I fell a Sleep. Dreamt severall things which came to passe the Day following.¹⁰

Since this is precisely the sort of thing he would later discuss with Mary More, it's clear that the mysteries of human mental processes were popular themata for the more sociable science practiced in the early days of the Royal Society. Such talk transferred easily from the drawing-room, to the coffeehouse, to the laboratory and lecture hall. We find it, for example, recorded in the Royal Society's Journals for 13 February 1667/8:

Mr. HOOKE related, that Sir WILLIAM STRODE had assured him, that he knew a man, who had a hole in his skull, through which it was seen, that his brain grew turgid at the full and flaccid at the new moon. He was desired to bring the account of this in writing from Sir WILLIAM STRODE.¹¹

The Society's Journals are full of such phenomenological observation.



While Hooke's lecture on memory built on shared sources and traditions, it also deviated from these. Now, as then, there has been a tendency to stress the lecture's novel "mechanical" aspects. In this vein, B. R. Singer applauds Hooke's hypothesis as an "important early contribution to an explanation of the mechanisms of memory, association and time perception" which "has not been given the attention it merits."¹²

Yet, in the same article where Singer celebrates Hooke's explication of "the mechanism of memory" (128), he also states that Hooke's memory is "an organ

for apprehending time” (117).

Given our own tendency to stereotype 17th-century intellectuals and ideas as either mechanist or vitalist, what are we to make of Hooke’s hybrid mechanical-organical hypothesis of memory?

I would argue that we begin by recognizing that such philosophical hybridism is a venerable tradition within eurowestern science.

Going back to the 13th century, there was the Dominican friar, Albertus Magnus (1206?–1280 CE), patron saint of students of the natural sciences (canonized and so designated in the 1930s–1940s). Albertus was an Aristotelian, an empiricist, and something of a mystic. He was widely known by the monikers *Big Boots* and *doctor universalis* because of his extensive perambulations across Europe, during which he acquired vast knowledge of the natural world. To Albertus, the common sense, imagination, opinion, phantasy, and memory were all *organs* of apprehension.

Returning to the 17th century, we find that to Thomas Hobbes—often reviled for his materialism and mechanical reasoning—emotions (“the passions”), memory, and imagination were all organic functions of the mind.¹³

And to Robert Hooke—history’s archetypal mechanist—the “Memory is organical.”

In fact, throughout the 17th century, Francis Bacon’s “Mechanicall Motions” were still indistinguishable from the chemical and physical processes of living organisms and cells. For Hooke and most others, “mechanical action” was still conceptualized in terms of agency and craft (as in the “mechanical arts”). And a “mechanical explanation” didn’t de-vitalize an organism, so much as make its functioning intelligible to human beings. To provide “a mechanical and sensible Figure and Picture,” as Hooke attempts in his lecture on memory, was to communicate his own sense of wonder at nature’s intelligent design. As always, there were those who worried that such a focus on How questions—on explicating “the mechanism of memory”—would undermine orthodox religious answers to the all-important Why questions. But even such Hooke antagonists as the Cambridge Platonist, Henry More (1614–1687), were drawn to mechanical explanation of perceptual processes (in More’s case, turning to explanation by way of “the *Hylarchick Spirit*”).

Three centuries later, scientists continue to debate the usefulness of intelligible explanation with their critics. In a proleptic turn, the neurobiologist, Semir Zeki, concluded his book *Inner Vision: An Exploration of Art and the Brain* with the hope that

... no one will think that knowledge of what happens in the brain when we look at works of art will demystify and etiolate art, thus reducing it to a formula and degrading the aesthetic experience. The brain is a beautiful organ, whose functioning and formidable feats are undoubtedly the greatest achievements of the slow process of evolution. Knowledge of its operations and of its products ... merely enhances the sense of wonder and beauty, because we then begin to admire not only the product but also the organ that is able to produce it.¹⁴



Hooke opens his lecture on memory with the Aristotelian maxim, *Nihil est in Intellectu, quod non suit prius in Sensu* (“there is nothing in the intellect, but what was first in the sense”). Hooke would cite this maxim of Aristotle’s again in his important “Discourse concerning *Telescopes* and *Microscopes*,” a paper delivered before the Royal Society in February 1692, in which he argued for the “further improvement and use” of scientific instruments (technologies that make the insensible—hence, inconceivable and unimaginable—sensible).

This was good Hobbesian doctrine, as well. Hobbes defined imagination as “being only of those things, which have been formerly perceived by Sense, either all at once, or by parts at severall times.”¹⁵ Or to put it more poetically, as did Margaret Cavendish in lines 11–13 of “The Elyzium,” printed in her *Poems and Fancies* (1653, 1664, 1668):

Where *Memory*, the *Ferriman*, doth bring
New company, which through the *Senses* swim.
The *Boat Imagination*’s always full

And not just imagination, but all intellect too, Hobbes believed, originates with motion from material bodies. It is our physiopsychological response to phenomenal experience—which Hobbes models complexly as a reciprocal activity of mind, of motion to and within the head, heart, etc.—that produces the subjective effects we know as perceptions, conceptions, and emotions.

This theatre of mental activity—our sense of inner reality—Hobbes calls *memory*. Simply put, to Hobbes, memory constitutes the entire field of our accumulated experience. All learning is but a remembrance of things past. And so it is, writes Hobbes, that

The Ancients therefore fabled not absurdly in making memory the Mother of the Muses. For memory is the World (though not really, yet so as in a looking glass)....¹⁶

In his lecture of memory, Hooke adopts Hobbes’s motionism, and with it, his conceptualization of memory as an agential power of mind.¹⁷ This deviates somewhat from more popular strains of Renaissance psychology, such as we find in Huarte’s work on physiology and psychology, *Examen de ingenios*. According to Huarte, who cited Aristotle and Galen as his authorities, memory is not in itself a creative agency but a passive “store-house and receiuing place” which “minis-treth matter and figures to” the understanding and the imagination. Huarte, like so many before and after him, carefully distinguished between two mental states: one embodied by the *imaginative-practical* mind, and the other, by the *rationalistic-theoretic* mind. When Aubrey metaphorically described Hooke’s inventive genius and flagging memory as see-sawing “bucketts,” he neatly evoked this neoclassical

distinction, along with its related questions of harmonious balance—all of which were integrally bound to the humanist *ethos* and its epistemology.¹⁸



Hooke's own lecture on memory emphasizes the temporal element in perceptual categorization, even intimating that primary consciousness and higher-order consciousness co-exist and have different relations to time. Given Hooke's background and scientific interests, the focus on spatiotemporal location is hardly surprising. Time and timekeeping were a lifelong obsession. Hooke constructed his first working timekeeper, a wooden clock, before age 13. During his tenure with the Royal Society he developed a staggering variety of pocket watches, pendulum clocks (including a seconds pendulum, circular pendulums, and an elaborate weather clock), clepsydras, a sand/water timepiece, a magnetic watch, sun-dials, star-dials, a seconds telescope, a decorative circular hour-glass, and more. In addition, both Hooke and the Royal Society had a vested interest in mensuration of all kinds, and were engaged in numerous projects for developing a new standard of measure, by which they hoped to improve contemporary navigation, cartography, astronomy, and earth science.

But there was probably a psychological imperative, too. "I believe he was deeply disturbed by the question of time," writes Ellen Tan Drake.¹⁹ And I agree with her.

There are many kinds of time, of course. During the progress of his career, Hooke probably thought about most of them, from everyday time, to historical time, to deep time, to standard time. One thing he didn't seem to grasp was sociocultural time, or what Bakhtin would call the "chronotope."²⁰ While Hooke was always mindful of the organism, developing interactively within a cultural and natural environment, there is no sense in his extant work and writing of any thought of the human being's conscious or unconscious entanglement in cultural values. Hooke was not self-critical in this way. The collective (or social) dimension of memory simply didn't interest him.

This is not to say that Hooke was untouched by his age's concern over artificial memory (e.g., verbal and visual records, and in our own case, digital and other technologically-mediated memories). Despite his involvement in multiple priority disputes, and his genuine concern for reputation and recognition from peers, Hooke did not seek immortality—to stand outside of time—by way of his scientific work. While others such as Francis Bacon and Margaret Cavendish busied themselves constructing ideality—creating an heroic self for after ages to admire—Hooke trusted to the Royal Society's Register books, and to time itself, assuming that these would vindicate him and his work.

“Time has discover’d that those were but groundless Hypotheses,” he was known to state, on more than one occasion.

“*Vindica me Deus*,” he once wrote bitterly in his diary.²¹

And so history has.

But while a hypothesis liberated from its chronotope might well be proven in another, the man who had held it and argued it passionately was, in most cases, easily forgotten. Had Hooke been more attentive to the rhetorical nuances of artificial memory, he, too, might have lived “as Nature doth, in all Ages, and in every Brain.”²²

Bacon had explained the process quite well in his *Of the Advancement of Learning*, and in doing so, described a certain tension in visual representation between the artificial image and the living original that was often remarked on:

We see then how far the monuments of wit and learning are more durable than the monuments of power or of the hands. For have not the verses of Homer continued twenty-five hundred years, or more, without the loss of a syllable or letter; during which time infinite palaces, temples, castles, cities, have been decayed and demolished? It is not possible to have the true pictures or statues of Cyrus, Alexander, Caesar, no nor the kings or great personages of much later years; for the originals cannot last, and the copies cannot but leese of the life and truth. But the images of men’s wits and knowledges remain in books, exempted from the wrong of time and capable of perpetual renovation. Neither are they fitly to be called images, because they generate still, and cast their seeds in the minds of others, provoking and causing infinite actions and opinions in succeeding ages. So that if the invention of the ship was thought so noble, which carrieth riches and commodities from place to place, and consociateth the most remote regions in participation of their fruits, how much more are letters to be magnified, which as ships pass through the vast seas of time, and make ages so distant to participate of the wisdom, illuminations, and inventions, the one of the other?²³



In lieu of dwelling on collective memory and social psychology, Hooke looked inward, to the mental images that constituted individual memory. Although Hooke makes allowance for auditory and gustatory memory, it is the “little Images” somehow encoded in visual memory that most concerned him, as these were widely held to be the building blocks of imagination and intellect.

As J. J. Macintosh has noted, Hooke’s “detailed mechanical model” relied “on a visual theory which had long since been rejected”: species.²⁴ For centuries, it was believed that species were the source of perception—an emission or emanation from outward things, forming the direct object of cognition for the various senses or for the understanding. Species were the *form* that was transmitted from

an object to the percipient's sense organs, and thence, to the brain.

But it was the more crude notions of species transmission, and not species the concept, that had been rejected by the time of Hooke's lecture on memory. The Chambers/Rees *Cyclopædia: or, an Universal Dictionary of Arts and Sciences* (1st ed. 1728) includes a long entry on species, defined as "a perception of the soul" communicated by way of the sense organ (eye, ear, etc.). Such occult communications were the stuff of literature and art well into the 18th century. In the early 1640s, William Cavendish addressed Donne-like metaphysical erotica to the young Margaret Lucas in which he referred to "Speties"; and Margaret responded in kind, all part of the rituals of courtship:

My lord,

As grace draws the sole of life so natuer, the pencell of god, has drawn your wit to the birth, as may be seene by your verses, though the subget is to mene for your mues. The medeum and species of my sight and understaning are flated [i.e., dulled or enfeebled] to all things in respeck of what comes from you...²⁵

Roger Bacon (1219?–1292 CE), the Franciscan monk sometimes dubbed "the English Galileo," whose long list of inventions includes everything from the telescope to a flying machine, gives a typically complex list of synonyms for species: *lumen, idolum, phantasma, simulacrum, forma, intentio, similitudo, umbra, virtus, impressio, and passio*.²⁶ In its crudest interpretation, visual species meant a "little image" of something as cast upon or reflected from a surface. But the theories of sense impression associated with visual species were not always so passively photographic, as Friar Bacon's list of synonyms amply attests.

In her printed debates with some of the biggest names in natural philosophy at the time—Hobbes, Descartes, the van Helmonts (father, Joan Baptista, and son, Francis Mercury), Henry More, William Harvey, Galileo, Walter Charleton, Robert Boyle—Margaret Cavendish had argued that "all Perception is not Impression and Reaction, like as a Seal is printed on Wax."²⁷ Neither Hobbes nor Hooke ever maintained that it was. Scholastic models of the passive reception and retention of visual impressions within some kind of mental storehouse had not survived the optical researches of those like Kepler, who knew that even the received retinal image was not some kind of straightforward, undeformed translation of visible species (for one thing, the received image was inverted, just like with the camera obscura).

When Hobbes and Hooke discoursed of sense impressions received into memory, they weren't thinking of the visual memory as a passive record, akin to an ordinary photographic plate, but of the organic transformations of motion into subjective effects—an autopoietic process every bit as agential as Cavendish's "figurative motions."



Hooke's emphasis on the anatomy or physiology of memory led him to some rather startling claims.

His novel modeling of "the Repository of Ideas" must have, in part, been formulated in response to an earlier challenge of Boyle's:

... the way, whereby the Rational Soul can exercise any power over the humane body, and the way, whereby the Understanding and the Will act upon one another, have not yet been intelligibly explain'd by any. And the like I may say about the Phænomena of the Memory.... for t'is a thing much more fit to be admired, than easie to be conceived, how in so narrow a compass, as part of a Human Brain there should be so many distinct Cells or Impressions as are requisite....²⁸

Hooke's calculation, a year later, of the number of ideas encoded in memory over an average lifetime is an argumentative technique reminiscent of John Wilkins' mathematical digression on Noah's Ark in *An Essay towards a Real Character, and a Philosophical Language* (London, 1668). Presumably, both men felt that such detailed calculation was a persuasive tool with audiences.²⁹

In Hooke's Repository, "spatial location" accounts for the pastness and recollection of ideas (Macintosh 348), and this may well have been suggested not only by classical models of *ars memoria*, but also by Hooke's extensive architectural work following the Great Fire of London in 1666, as well as by Hooke's long experience as "Keeper of the Repository" for the Royal Society, a role to which he had been assigned in October 1663. In his capacity as Keeper, Hooke was responsible for "the well-ordering, preserving, and increasing the stock of the Society's repository." A committee was even appointed and ordered to meet regularly to discuss with Hooke related topics in information design and librarianship. By the time Hooke delivered his lecture on memory in June 1682, he had had "Repository of Ideas" designs on the mind for over 20 years.



But what does the mechanism of individual human memory have to do with light? Why would Hooke close his series of Lectures of Light with a discourse on time, soul, and memory?

J. J. Macintosh has argued that Hooke's lecture on memory was "the final move in the process of making the explanation of light in terms of touch an interior one." (328) I think this is right, although not perhaps the entire story. Nonetheless, Hooke is to be applauded for this "final move." It was a sophisticated manoeuvre, both rhetorically and metaphysically.

According to inherited tradition, memory, and everything else having to do with what we now call mind, was "a power of the Soule." Hooke retained this

conceptualization, describing, for example, attention as an “action of the soul”:

I do suppose that what we call Attention is nothing else but the Action of the Soul in forming certain Ideas, which for the present I will call little Images, which bear the Stamp, Seal or Mould according to which the Soul formed it in the Center of the Repository.

As Waller remarks in his summation, Hooke’s soul is “a Spiritual, Immaterial and Self moving Principle ... that ... both acts and is re-acted upon by Body.” In fact, the Hookeian soul is inextricably bound to the *anima mundi* (what the Jungians call “the principle of All-Being,” or the cosmic soul).

Hooke doesn’t use the phrase *anima mundi* in his June 1682 lecture on memory, preferring instead the vernacular “Soul of the World.” But he opened his course of Lectures of Light in 1680 with specific reference to the *anima mundi*:

... This being that we call light, sure if any thing may be call’d the *Anima Mundi*: Its action being so near of Kin to that of a Spirit, the whole Mass being in an instant acted by it, and made sensible as I may so speak, of what is done in any one Point: So that light may be said to be *tota in toto & tota in qualibet parte*, possibly with some kind of Plausibleness.³⁰

The *anima mundi* topos then replays in the series’ concluding June 1682 lecture when Hooke describes light as “the most spiritual Action of all we are sensible of in the World,” and describes “the Radiation of the Sun” and its optical communications as “a Representation of the Soul of the World.”

Once again, we’ve come full circle.

Hooke had first publicly raised the vitalist principle, *anima mundi*, in 1678 in his printed discourse, *Lectures and collections made by Robert Hooke, Secretary of the Royal Society. Cometa.... Microscopium* In the *Cometa* section of this text, he described magnetism as a more spiritual principle, even, than light or sound:

Now this magnetical virtue, (which may be called one emanation of the *Anima mundi*, as gravity may be called another) being diffused through every part of it, and seeming to be, as it were *Tota in toto & tota in qualibet parte*, and to be more spiritual, and to act more according to Magical and Mystical Laws than Light, Sound, or the like, it giving to every magnetical body, and every piece of it, though infinitely divided, the same proprieties it hath it self; This magnetical virtue, I say, having such a relation, and being forced thus to vary, ‘tis very probable that the internal parts to which it hath a respect, have a variation likewise; and consequently, that these internal parts which are supposed generally very dense, compact, and very closely and solidly united, may be notwithstanding more loose, and ununited, and movable from certain causes.” (sig. C2^r)

And there is a typically cryptic diary entry early the next year (19 March 1678/9) wherein Hooke records a follow-on conversation concerning the *anima mundi* at Jonathans, the famous coffeehouse in Change Alley (and a favorite haunt of the stock-jobbers):

... at City Committee about Mrs. Marshall. With Controuler. DH. at Jonathans with Sir J. Hoskins. Spake about Long Concave, Gothick build. *Anima mundi*.³¹

But scientific theories of the *anima mundi* had been circulating long before this. Joseph Glanvill (1636–1680), an Anglican clergyman elected F.R.S. 14 December 1664, was a polemicist for the Royal Society, and connected to both the Cavendish and Conway family circles. A full decade before Hooke’s first official publication on the subject, Glanvill disputed with Margaret Cavendish about the *anima mundi*. Glanvill’s real-life philosophical letters to Cavendish date from 1667, the same year as her visit to the Royal Society,³² and three years after her publication of the fanciful *Philosophical Letters* in 1664. But Glanvill tells her that he has been studying her works (no doubt, some of the lavish presentation copies gifted to Oxford colleges, from 1655 on) for at least three years before initiating a correspondence with her.

Selected letters from Glanvill to Cavendish were published posthumously by her husband in a memorial volume, *Letters and Poems in Honour of the Incomparable Princess, Margaret, Dutchess of Newcastle* (London, 1676). The few Glanvill letters included in this text hint at an intellectual exchange that was respectful, but vigorous. On one occasion, Glanvill acknowledges that “though I must crave your Pardon for dissenting from your Grace’s Opinion in some things, I admire the quickness and vigor of your Conceptions, in all.” (*Letters and Poems* 98) In another letter, dated 13 October (no year), Glanvill responds to Cavendish’s “so ingenious a Discourse,” an earlier letter in which she had apparently argued for a synthesis of materialism/vitalism:

I am not so fond a mechanist, as to suppose all the *Phænomena* of the World to be raised meerly by those Laws; but most of them perhaps by a Principal that is vital; And the *Anima Mundi* I take to be a very likely, and convenient *Hypothesis*. Of this I am ready to give your Grace an account, that you shall be pleased to permit it.
(*Letters and Poems* 102)

Unfortunately, the rest of their exchange on this matter never made it into publication. Glanvill did keep an ms. book of their correspondence, titled *Letters and Poems written and sent to Margaret, Duchess of Newcastle*. At one point, the ms. book was listed among the titles in Ashmole’s library. But it has since been lost to us. No mention of it occurs in the *Ashmolean Catalogue*.



With Cavendish’s critique of Hookeian-style mechanical explanation, we cycle back ourselves to the difficult question of 17th-century dualism.

J. J. Macintosh has already probed this issue with his detailed look at “Perception and Imagination in Descartes, Boyle and Hooke.” Therein, it is Macintosh’s contention that despite the difference in their dates—Boyle was 23, and Hooke 15,

when Descartes died—Descartes', Boyle's, and Hooke's preference for "mechanical explanations" caused ongoing problems for each when it came to the topic of *perception* (then an umbrella term which subsumed sensation, memory, and imagination). In short, Macintosh holds that no 17th-century natural philosopher was able to resolve the contradictions of the culture's spiritual dualism.

Pointing out that Descartes' own thinking on the subject of consciousness is often misrepresented by critics—"many philosophers being content to restrict themselves ... to the *Meditations* and the prefatory *Discourse on Method*" (329, 350)—Macintosh turns to Descartes' scientific writings, which were closely studied by other natural philosophers, and far more influential than the *Meditations*, throughout the early-modern period. Surprisingly, on the subject of perception, "Descartes seems to be almost a reluctant Cartesian. When we read his *scientific* writings, the incorporeal soul is not stressed, and Descartes happily speaks of physical, or of corporeal, *ideas* in discussing sensation, memory and imagination." (327)

Boyle's views on perception "closely" followed those of Descartes, claims Macintosh. Boyle adopted "Cartesian examples and Cartesian conclusions, while stressing our total ignorance of the supposedly incorporeal soul." (328) In fact, Boyle allows for intellectual operations that are *not* corporeal, and remain suitably mysterious to us, such as his statement that "in extasies, the mind does (at least sometimes) act without turning herself to corporeal phantasms" (Boyle, qtd. Macintosh 343). For both Boyle and Descartes, the imagination—which is always a visual imagination, and functions by forming clear and distinct images of things—is epistemologically limited. For example, both theorists stress that the (visual) imagination is incapable of conceiving God, a chiliagon, a myriagon, or even the true magnitude of the sun.³³

As for Hooke, Macintosh contends that Hooke's June 1682 hypothesis was able to explain "mechanically" that which in Descartes remained an unresolved dualism: "for Descartes, corporeal memory was made to depend on incorporeal memory, a paradigm case of explaining the dimly perceived in terms of the completely obscure" (346). Both Descartes and Boyle "want to explain all the *animal* functions mechanically, while offering non-mechanical (non-)explanations for the rest" (333), leaving Macintosh to puzzle over "how strangely *uninterested* in dualism these two dualists were." (328) Hooke, argues Macintosh, "goes farther than either in offering mechanical models for perception and shows with extreme clarity how uneasily an immaterial scanning device [i.e., the soul] fits such models." (328)

In the end, Macintosh deems all three models unsatisfactory, and finds audience acceptance of their contradictions "indicative of the strength of the seventeenth-century commitment to dualism." (328)



Three-plus centuries later, 17th-century contradictions have yet to be resolved. We still have no satisfactory model for describing the full range of human consciousness, especially what's now known as "higher-order consciousness."

For some, such as the eminent drosophilist and genetic behaviorist, Jeff Hall, there is nothing spiritual outside the mechanism: "every aspect of mind and brain is ultimately metabolism," he tells Jonathan Weiner in *Time, Love, Memory* (161). Hall, who sequenced drosophila's *period* or clock gene in the late 1980s, is impatient with those who feel that

Once you know something about it, it's not behavior. It remains behavior [only] as long as it sits at the level of mystery and miracle.

"It is now time for us to accept that behavior is as much a part of the material world as the stars above us and atoms inside us," he tells Weiner in exasperation (162).

Hall and his colleagues are still hunting after the mechanism of memory, "the trick" that allows us to catch something from our experience in a mesh of nerves and hold it there, in some cases, for the remainder of our lives. "Somehow the memories are written in atoms, and somehow we keep the memories even though we lose the atoms." (Weiner 131) Scientists have taken to calling the elusive physical change in the brain that actually encodes memory, the *engram*.

Today's search into the mechanism of the engram has some commonalities with 17th-century motionalist theories. The motionalists (including Hobbes, Cavendish, and Hooke) also fastened on those mysterious mechanical or "corporeal figurative motions" that somehow create consciousness—memory, judgment, imagination—in what Margaret Cavendish called "the whirlpit of the brain." And they early on asserted our own post-modern belief that perceptions, conceptions, and emotions are emergent properties of the neural processes in our brains.

Margaret Cavendish, in fact, took this even further with her modeling of a "triumvirate of matter" that distributed consciousness (in varying degrees) throughout the material universe, thus extending the principles of perception and conception ("Sense and Reason, Life and Knowledge") to inorganic as well as organic bodies. Her modeling of what Hooke called "the Opinion of *Intelligent Matter*" was not entirely new, although, as one might expect, the duchess put her own unique stamp on it. In part, Cavendish was reacting to contemporary Cartesians who pushed a centralized model of consciousness (with the pineal gland functioning as central processing unit), thus restricting somatic knowing to the human head and heart.³⁴ Leonardo da Vinci had earlier summed up the long-standing debate between the two camps, himself siding with those who hypothesized a *communis sensus*:

The soul apparently resides in the seat of the judgment, and the judgment apparently resides in the place where all the senses meet, which is called the common sense; and it is not all of it in the whole body as many have believed, but it is all in this part; for if it were all in the whole, and all in every part, it would not have been necessary for the instruments of the senses to come together in concourse to

one particular spot; rather would it have sufficed for the eye to register its function of perception on its surface, and not to transmit the images of the things seen to the sense by way of the optic nerves; because the soul—for the reason already given—would comprehend them upon the surface of the eye. (from *The Notebooks of Leonardo da Vinci*; qtd. Macintosh 333n9)

Hooke would similarly dismiss a theory of consciousness intermingled with the *entire* body in his lecture, “A Discourse of the Nature of Comets,” delivered before the Royal Society a few months after his June 1682 lecture on memory (Waller dates it “soon after Michaelmas 1682”). In the course of describing “the most remarkable Proprieties of Gravity” and popular theories regarding “what may be the Cause thereof,” Hooke flatly stated:

I believe I shall not need to say much against the Opinion of *Intelligent Matter*, which supposes every part of Matter to act understandingly; for that being supposed, all Philosophy is vain, and there needs no farther Inquiry into Nature. (*The Posthumous Works of Robert Hooke*, ed. Waller, 183)

Nonetheless, Hooke’s theory of organic “adapted Matter” (as in his description of the organ of memory) allowed for a kind of somatic intelligence not entirely restricted to head and heart. While not quite the same thing as current folk belief in “the wisdom of the body,” Hooke’s model would still have accommodated modern conceptions of, e.g., the “Little Brain” in our bellies. It is even in accord with Galen Cranz’s conception of “sensual rationality.”³⁵



There is commonality, too, in what’s missing from early-modern monist memory paradigms and those of post-modern genetic behaviorists who restrict themselves to a genes-eye view of the cosmos: the chronotope. I am hardly alone in making this observation,³⁶ but I would like here to revive its 17th-century history a little. As William Cavendish, then Marquis of Newcastle, advised his prince in a Machiavellian-style handbook,

So powerfull sire Is Custome, it is converted into nature, & is Nature, & In the bloud...³⁷

Newcastle would have been perfectly at home with the new cultural biology, and our post-modern ideas concerning the strong influence of culture and social context on perception.

Hobbes, Cavendish and Hooke all modeled what Sunny Auyang (*Mind in Everyday Life and Cognitive Science*) refers to as the “open mind emerging from the self-organization of infrastructures.” That is to say, all three saw the human mind as “emergent” via an infinitely various and individual complex of physical, bio-

logical, and social interactions. Although they didn't express it in modern terms, all three theorized what some now call "mind in experience."

The importance of *experience* in early-modern psychology and philosophy cannot be overstated. Experience was a core concept for neoclassicism and humanism. It was a defining term in the notion of Triadic Time that stood for wisdom (*phronesis*). It was a defining term in the closely related early-modern ideal of prudence (*prudentia*). Experience was the authorizing force of early-modern art, science, and action, especially on the public stage. It was commonly held that an imaginative use of the materials of experience set a "good Wit," good poetry, and good drama apart from bad. In short, everything that was admirable in the humanist *ethos* was held to emerge through one's breadth and depth of experience.

Hobbes was expressing a Græco-Roman rhetorical ideal when he so defined the wo/man of action in *Leviathan*:

When the thoughts of a man, that has a designe in hand, running over a multitude of things, observes how they conduce to that designe; or what designe they may conduce unto; if his observations be such as are not easie, or usuall, This wit of his is called PRUDENCE: and dependeth on much Experience, and Memory of the like things, and their consequences heretofore. In which there is not so much difference of Men, as there is in their Fancies and Judgements.... (qtd. Thorpe 100)

Margaret Cavendish similarly held that

Nature is but rude in the minds of Men, and so in other Creatures, untill Community and Art have civilized them, and Experience and Learning have perfected them.³⁸

The only problem with this, as Cavendish well knew, was that experience and learning were not evenly distributed in early-modern societies. Socio-economic inequalities could severely limit the sort of experiences available to the individual. In Cavendish's case, both gender and class set her at odds with a humanist *ethos* grounded in breadth and depth of experience. Where Hooke had been prompted to important new discoveries concerning "seed of moss" and the mysteries of spontaneous generation by his observation in 1667 that "vast quantities" of moss were "to be found every where dispersed among the Ruines left by that Fire"—an observation dependent on his intimate knowledge of London streets and architecture, before and after the conflagration—Cavendish was never at liberty to roam the city like this, even after the Restoration.³⁹

To increase her store of life experience, Cavendish took on the memories of others. Always apologizing to scholarly audiences for "my little Experience, and want of Learning,"⁴⁰ Cavendish explained how her culture had gendered *prudentia*:

... we are kept like birds in cages to hop up and down in our houses, not suffered to fly abroad to see the several changes of fortune, and the various humours, ordained and created by nature; thus wanting the experiences of nature, we must needs want the understanding and knowledge and so consequently prudence, and

invention of men: thus by an opinion, which I hope is but an erroneous one in men, we are shut out of all power, and Authority by reason we are never employed either in civil nor marshall affaires, our counsels are despised, and laught at, the best of our actions are troden down with scorn, by the over-weaning conceit men have of themselves and through a despisement of us.⁴¹

“Wanting the experiences of nature” herself, Cavendish turned to male family members and friends, especially her husband:

I have learned more of the world from my Lords discourse, since I have been his wife, then I am confident I should have done all my life, should I have lived to an old age; and though I am not so apt a Scholar as to improve much in wit, yet I am so industrious a Scholar to remember whatsoever he hath said, and discoursed to me ... it is my Lords discourse that gets me understanding, and makes such impressions in my memory, as nothing but death can rub it out.... (*Worlds Olio*, sig. E4^r)

Unlike Hooke, Cavendish had a prodigious “*Art of Memory*,” which she used for stockpiling the experiences and observations of those men-of-the-world with whom she interacted. In the “*Epistle to my Braine*” published in her *Philosophicall Fancies* (London, 1653), she muses about her sudden writer’s block:

I wonder, *Braine*, thou art so dull, when there
Was not a day, but *Wit* past, through the yeare.
For seven yeares ‘tis, since I have married bin;
Which time, my *Braine* might be a *Magazine*,
To store up wise discourse, naturally sent,
In fluent words, which free, and easie went.
If thou art not with *Wit* inrich’d thereby,
Then useless is the *Art of Memory*.

Typically, it is her vicarious memory that begets fancy and judgment:

... if they [“my husband, or brothers”] should tell me of all the parts of an Animal body, and how they are formed and composed, I conceive it as perfectly to my understanding as if I had seen it dissected although I never did and therefore may be deceived in my understanding, for truly I have gathered more by piece-meals, then from a full relation, or a methodical education for knowledge; but my fancy will build thereupon, and make discourse therefrom, and so of every thing they discourse of ... from a bare relation, I can conceive to my thinking every particular part, and passage, as if I were a witness thereof, or an actor therein; but many things, although I should never have heard of any such thing, yet my natural reason will guide and discover to me, the right and the truth.

For put the case I see a watch, or any other invention, and none should tell me how it was made, yet my natural reason would conceive how it was made, so in natural things my natural reason will conceive them without being any wayes instructed; and so working a brain I have that many times on small objects or subjects will raise up many several phancies, and opinions therein, from which my discourse betwixt reason and those opinions will be produced; but the truth is, I have more materials to build with, then ground to build on, whereby they become useless ... but as yet my head is fully populated with divers opinions, and so many phancies are therein, as sometimes they lie like a swarm of bees in a round heap, and some-

times they flie abroad to gather honey from the swett flowry rhetorick of my Lords discourse, and wax from his wise judgement which they work into a comb making chapters therein.⁴²

Renaissance reformulations of the classical *ars memoria* have long been linked to the growth of science. And this linkage is fruitfully complicated, I think, by introducing women's art of memory as part of the overall climate of opinion in which the new science developed. How Cavendish's own art of memory influenced her natural philosophy and theories of consciousness is an intriguing question. We know, for instance, that while she had an excellent vicarious, aural memory, she had a less perfect verbal memory. In her autobiography, she states that whenever she tries to quote from her own texts, as is often expected in conversation, she botches it, "disfiguring ... my works, by pulling out a piece here, and a piece there, according as my memory could catch hold," with the unhappy result that she usually "bores" her audience.⁴³ Although not herself schooled in Renaissance rhetorical-encyclopaedist enterprises, Cavendish shared with other women of the age an alternative art of memory tied to women's social roles, not book-learning. In fact, Cavendish felt that book-learning "oppresseth" memory and destroyed individual identity, rendering the scholar covert in "the multitude of Opinions" she studies: "great scholars are Metamorphos'd or transmigrated into as many several shapes, as they read Authors" (*The Worlds Olio* 5). Clearly, Cavendish didn't have the photographic memory of an Alfred Sturtevant, or some of the others among our better-known drosophilists (see note 8).

Cavendish's description of how she is in her own way "so industrious a Scholar" that "my Lords discourse ... makes such impressions in my memory, as nothing but death can rub it out" replays in descriptions of the exact female memories of Amerindian women in the English colonies. Benjamin Franklin recorded that

The business of the women is to take exact notice of what passes, imprint it in their memories, for they have no writing, and communicate it to their children. They are the records of the council, and they preserve tradition of the stipulations in treaties a hundred years back, which when we compare them with our writings, we always find exact.⁴⁴

There are still no intimations in Franklin's language of the modern derogation of memory as passive recording. But by the time we reach the 20th century, women's art of memory has become mechanical in the modern sense—i.e., stripped of agency. The first "computers" in university labs in the 1940s were women, who, as described by one company employee in 1942, could "perform the routine machine operations with great speed, but who need not have much logical insight into what the result should be or how they should check, etc."⁴⁵



The matter of agency weighs heavily on post-modern social activists of all stripes, including feminists concerned with race and gender inequality within the workplace and larger society, which extends now into cyberspace. Calls to reconceptualize the (feminized) body as the *subject* of perception, and not just its object, are a staple of the feminist canon, and all too often, anachronistically applied to the 17th century. I hope I have shown by now that post-modern feminist inquiry into how “perception is structured by the body as a whole rather than an abstracted perceptual organ” is not truly the “exciting new area of philosophical discussion” we are so often presented with. It has a history.⁴⁶

In closing, I wish to turn to the work of the ecofeminist philosopher, Wendy Lee-Lampshire, who raises the latest re-discovered issue within neuroscience: *eliminativism*. Lee-Lampshire is especially worried about how the new eliminativism endangers feminist (and other standpoint) theories by writing subjectivity out of the mind-brain equation once and for all:

... a far more serious threat from a quarter seemingly remote to feminist theory and politics: the eliminativist trend in contemporary philosophy of mind-brain. According to eliminativists such as Paul Churchland, Patricia Smith-Churchland, and Steven Stich, recent advances in genetics, neurophysiology, and evolutionary theory may well be antiquating the use of such so-called psychology terms as *mind, self, intention, subject, autonomy, and I*, by showing how these terms have no physical analogues. In short, since words like *mind* do not name anything, we have no justification for their continued use in the explanation of behavior; a naturalistically conceived world fully explicable in terms of physical laws has no room for occult objects like “minds.” Eliminativists predict that just as the term *phlogiston* was replaced by *oxygen*, so the terms we use to describe mental events will inevitably be replaced by terms that more accurately describe physical processes; in effect, anatomy will replace autonomy just as surely as the discovery of the earth’s rotation around the sun displaced human beings from the universe’s conceptual center to the sun’s anonymous periphery.⁴⁷

Lee-Lampshire’s solution to this impending feminist crisis looks, once again, to the fly—or rather, to Wittgenstein’s description of a “wriggling fly” in his *Philosophical Investigations*. Lee-Lampshire argues that Wittgenstein’s “wriggling fly” is given a new kind of psychosexual complexity through his compassionate dialogue with it.

The fly *wiggles*. Its behavior exhibits some unspecified minimum of behavioral indeterminacy, and this is enough like those things that we say “have” mental states to attribute pain to it. (416)

Thus modeling “another kind of naturalism,” Wittgenstein uses psychological terms as “*descriptive heuristics* for the complex system-concept relationship expressed in something’s behavior.” (415) In similar manner, argues Lee-Lampshire, feminists should re-think the feminist lexicon. Instead of using core feminist terms (mother, dyke, virgin, body, whore, blood, marginality, woman, emancipation) to name occult entities (essences, the nature of women’s experience, or “a globally conceived subordination under patriarchy”), feminists should begin

using them as *metaphors* for the complex bio-psycho-social and historical positions that women actually occupy. Hence, the goal of the new feminist lexicon “is not only to reconceptualize subjecthood” such that it no longer assumes some form of introspective transcendence, rooted in mind-body dualism, “but also to reconceptualize a naturalist alternative of ‘subject’ able to account for women’s historiographical absence.” (414)

A tall order, indeed.

Lee-Lampshire takes this one step further in uniting Wittgensteinian strategy with Donna Haraway’s theory of cyborg subjectivity (or standpoint), which treats self and other, whether an it/her/him, as subjects.⁴⁸ Both strategies, she maintains, insist that we exercise ecological conscience as subjectivities: in exposing the lack of any essence underlying subjecthood, we are forced to be “responsible for our conceptions” and “to take responsibility for differences among feminists.” (422)

Moreover, it enjoins us to face squarely what we share in common with animals, machines, and men, namely, the complex positions that we are as evolved, inculturated, and physical things. For difference is the product of this commonality. This recognition is fundamentally political as well as ethical in that, as Wittgenstein points out, however we conceive a being affects our view of it as slave or citizen, resource or user. (422)

Sounds a bit like 17th-century mechanism, to me.





NOTES

1. Royal Society Journal Book entry for 3 May 1682. Rpt. in R. T. Gunther, ed., *Early Science in Oxford* (1930; London, 1968), vol. VII, 594–5.
2. Royal Society Journal Book entry for 17 May 1682. In Gunther VII, 596.
3. Royal Society Journal Book entry for 21 June 1682. In Gunther VII, 598.
4. Evelyn diary entry for 20 June 1682. In E. S. De Beer, ed., *The Diary of John Evelyn*, London: Oxford University Press, 1959, p. 726.
5. Royal Society Journal Book entry for 28 June 1682. In Gunther VII, 598–9.
6. Partly because so much has been made of the antipathy between Hobbes and Boyle, there has been insufficient attention paid to Hobbesian influences on the Royal Society, Hooke in particular. An endnote is hardly the place to begin to make this case, but the fact that it needs to be made at all should be acknowledged before any free-associating of the sort I'm about to do, especially concerning Hobbesian “empirical-rationalist” methodology.
With this caveat in mind, I would substantiate my claim here with a quote from Hobbes's *The Elements of Philosophy*, which I believe holds for Hooke's psychological inquiries as well: “The principles, therefore, upon which the following discourse depends, are not such as we ourselves make and pronounce in general terms, as definitions; but such, as being placed in the things themselves by the Author of Nature, are by us observed in them; and we make use of them in single and particular, not universal propositions.” Qtd. in Clarence De Witt Thorpe, *The Aesthetic Theory of Thomas Hobbes, with Special Reference to His Contribution to the Psychological Approach in English Literary Criticism* (1940; New York: Russell & Russell, 1964), 85.
Thorpe's book on Hobbes is excellent, and deserves to be better known than it presently is. I am indebted to Thorpe's scrupulous scholarship for a number of things, including my understanding of Hobbesian psychology, its rhetorical origins, and its subsequent web of influences.
7. The surname “More” dates from Mary's second marriage, sometime prior to 1674.
Mary More has been closely studied by Margaret J. M. Ezell, who reprints *The Woman's Right* in Appendix II of *The Patriarch's Wife: Literary Evidence and the History of the Family* (Chapel Hill: University of North Carolina Press, 1987), 191–203. Further information on Mary More's domestic circle can be found in Margaret J. M. Ezell, “Richard Waller, S.R.S.: ‘In the Pursuit of Nature,’” *Notes and Records of the Royal Society* 38 (1984): 215–33.
8. “*Brief Lives*,” *Chiefly of Contemporaries, Set Down by John Aubrey, Between the Years 1669 & 1696; Ed. from the Author's Mss. by Andrew Clark...* (Oxford: Clarendon Press, 1898), 1:411. Aubrey's biography of Hooke was written ca. 1680.

Aubrey's remark about resting at Mrs. More's is also from this text, 1:44.

Jonathan Weiner, in his study of "science at the fringe" as practiced in the Fly Rooms associated with Seymour Benzer and his students, remarks that our modern drosophilists "had bottomless memories themselves. They needed them for their work." Thus, "Ron Konopka was born with a photographic memory. Jeff Hall carried in his head thousands of references to papers in genetics, and often he could remember not only the authors of a paper and the genealogies of the flies but also the year, volume, and page numbers. Sturtevant used to read the *Encyclopædia Britannica* for pleasure in the evenings, and in his later years he had a hard time finding an article that he had not already read and committed to memory." In *Time, Love, Memory: A Great Biologist and His Quest for the Origins of Behavior* (New York Knopf, 1999), 131–2.

While there is no explicit mention of *Drosophila* in Hooke's June 1682 lecture on time and memory, Hooke's understanding of the relativity of "perceivable moments" in time and of our differing molecular clocks owes much to his lifelong fascination with that "beautifull creature," the fly. In one of his Lectures of Light, delivered a month earlier in May 1682, Hooke explicitly compared human and Dipteran life cycles: "I do not at all doubt but that the sensible Moments of Creatures are somewhat proportion'd to their Bulk, and that the less a Creature is, the shorter are its sensible Moments; and that a Creature that is a hundred times less than a Man, may distinguish a hundred Moments in the time that a Man distinguishes one. For when I hear a Fly moving his Wings to and fro so many times, with such a Swiftnesse as to make a Sound, I cannot but imagine, that that Fly must be sensible of and distinguish at least 3 Moments in the time that it makes one of those Strokes with his Wings, for that it is able to regulate and guide it self by the Motion of them. And the like may be said for the quick Motions of other lesser Creatures. So that many of those Creatures that seem to be very short lived in respect of Man, may yet rationally enough be supposed to have lived, and been sensible of and distinguished as many Moments of time as a Man; because within that space of time it has lived, it has had as many distinct Moments of time, and has had as many distinct Differences of Moments, as a Man hath in the Age he lives. But this only by the by." (*The Posthumous Works of Robert Hooke*, ed. Waller, 134)

9. Hooke diary entry for 11 Sept. 1677. In *The Diary of Robert Hooke, 1672–1680*, eds. Henry W. Robinson and Walter Adams (1935; rpt. London: Wykeham Publications, 1968), 311–2.

The graphical shorthand here used by Hooke is representative of his evolving style as a diarist. In his diary mss., Hooke uses an array of abbreviations (e.g., "DH" for "Dined home") and icons to name everything from the planets, and assorted chemical compounds and elements, to his sexual orgasms. For this particular entry, ☿ is the conventional symbol for mercury,

and ☉, the symbol for gold.

10. Hooke diary entry for 4 September 1673. In Robinson & Adams, 59.
11. Royal Society Journal Book entry for 13 February 1667/8. In Gunther VI, 326.
12. B. R. Singer, "Robert Hooke on Memory, Association and Perception," *Notes and Records of the Royal Society* 31 (1976), 115.

Singer attributes such neglect to Hooke's imperfect communication of his ideas. Although Hooke "suggests a material basis for memory" (127) and constructs a model of memory remarkable for its "incredible ingenuity" (126), any true "account of the possible origin and background of Hooke's ideas" and "inventiveness" is far from cut-and-dried: in the end, "One must agree with his friend Aubrey who wrote of Hooke on another matter: 'I wish he had writt plainer, and afforded a little more paper.'" (128)

13. Thorpe nicely explains Hobbes's hybrid psychology: "The problem of volitional versus mechanical activity appears less difficult as we study closely all that Hobbes has to say on the matter. For, in spite of his consistently maintained theory that all the materials of knowledge originate in sense perception, motion from without impinging on the peculiar structure which is man's nervous system, it turns out that he is far from conceiving of the mind as a merely passive and helpless mechanism acting in response to external stimulus. In sum, considering all his qualifications and the implications of these qualifications, Hobbes's whole theory is less mechanical than it first appears. Thus, as we have seen, there is always in the perceiving act an 'outward pressure' from the mind to meet the motion from without. Moreover, even elementary perception is impossible without memory of some previous sense impression with which to compare the incoming impression; and all ideas of objects in more complex perception, as of a man or of a square, are made up of a composite of ideas held in the memory and re-presented on the occasion of the fresh external stimulus to form a synthetic whole. It is true that Hobbes fails to show how the first perception would be produced; but he is tacitly admitting powers of mind which function in perception to aid in the conversion of motion into idea. In other words, perception is not a mere imprint of image upon the nervous system as of a seal on wax, but, as is the case in the theory of the Stoics and of Telesio and Campanella, it is an *effect* to which the mind itself contributes something. This conception appears in its most significant form ... in the attribution to the fancy and the judgment of special capacities to link together, at the moment of perception, ideas that are like and discriminate between those that are unlike." (*The Aesthetic Theory of Thomas Hobbes* 113-4)
14. Semir Zeki, *Inner Vision: An Exploration of Art and the Brain* (New York: Oxford University Press, 1999), 219.

Susan Wells, in her book *Sweet Reason: Rhetoric and the Discourses of Modernity* (Chicago: University of Chicago Press, 1996), has an interesting assessment of Stephen Hawking's work, which promises to collapse this

tension between How and Why questions. Marveling at how Hawking has turned “scientific self-reflection back to ultimate issues” in his *A Brief History of Time: From the Big Bang to Black Holes* (New York: Bantam, 1988), Wells quotes Hawking: “if there really is a complete unified theory ... it should in time be understandable in broad principle by everyone, not just a few scientists. Then we shall all, philosophers, scientists, and just ordinary people, be able to take part in the discussion of the question of why it is that we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason—for then we would know the mind of God.” (Hawking 12, 175)

Comments Wells: “In this projected future for scientific communication, the differentiation of the discourses dissolves, modernity unravels, and everyone speaks a common language. Just as the cosmological story unrolls time backward, cosmological talk simplifies and broadens itself, figuring its own transparency as divine. The observer extends metaphorically outside time, so that, in Hawking’s account, to know the full range of temporality is to know ‘why’ observers and objects exist, to take up the position traditionally ascribed to God. We have moved from Darwin’s omniscient narrator of details to a sublime, temporally dislocated spectator.” (Wells 87)

15. Hobbes is here differentiating between acts of simple and compound imagination: “Much memory, or memory of many things, is called *Experience*. Again, Imagination being only of those things, which have been formerly perceived by Sense, either all at once, or by parts at severall times; The former (which is the imagining of the whole object, as it was presented to the sense) is *simple Imagination*; as when one imagineth a man, or horse, which he hath seen before. The other is *Compounded*; as when from the sight of a man at one time, and of a horse at another, we conceive in our mind a Centaure. So when a man compoundeth the image of his own person with the image of the actions of an other man; as when a man imagins himself a *Hercules* or an *Alexander* (which happeneth often to them that are much taken with reading of Romants) it is a compound imagination, and properly but a Fiction of the mind.” (*Leviathan*, I, ii; qtd. in Thorpe, 82–3)
16. Hobbes, *The Answer to Davenant*; qtd. in Thorpe 108.
17. Frithiof Brandt coined the term “motionalist” in his study of Hobbes, *Thomas Hobbes’ Mechanical Conception of Nature* (Copenhagen and London, 1928): “... if we were to give a general estimate of Hobbes, it is not difficult to see that the whole of his philosophy is built upon the foundation of one single, quite simple idea, the idea of motion.... So when Hobbes has been and is still called a materialist, this is in a certain sense misleading. The concept of matter plays an exceedingly small part and has a constant tendency to disappear. Hobbes should be more correctly called a motionalist, if we may be permitted to coin such a word. He is the philosopher of motion as Descartes is the philosopher of extension.” (379)

18. Juan de Dios Huarte, *Examen de ingenios. The Examination of Men's Wits ...*, translated out of the Spanish tongue by M. Camillo Camilli, Englished out of his Italian by R. C. Esquire (London: Printed by Adam Islip for Richard Watkins, 1594), 60–1.

The English translator of Huarte's text, R. C., is identified by Thorpe as Richard Carew (*The Aesthetic Theory of Thomas Hobbes* 42n57). Second, third and fourth editions of Carew's popular translation appeared in 1596, 1604, and 1616.

The old humanist (and Hobbesian) distinction between imagination and understanding (ratiocination) as different mental states is not completely lost to us. Stephen Hawking, for instance, poses it anew as a complexity-versus-speed problem (not only for the human brain, but for electronic circuits, too): "Ultimately, however, increases in the size of the human brain through genetic engineering will come up against the problem that the body's chemical messengers responsible for our mental activity are relatively slow-moving. This means that further increases in the complexity of the human brain will be at the expense of speed. We can be quick-witted or very intelligent, but not both...." In *The Universe in a Nutshell* (New York: Bantam Books, 2001), 167–8.

19. Ellen Tan Drake, *Restless Genius: Robert Hooke and His Earthly Thoughts* (New York: Oxford University Press, 1996), 101.
20. Mikhail M. Bakhtin, *The Dialogic Imagination: Four Essays*, ed. Michael Holquist, trans. Caryl Emerson and Michael Holquist (1981; rpt. Austin: University of Texas Press, 1990).

Bakhtin's chronotope is a specific "time-space" that articulates human values.

Bakhtin, a literary critic, was primarily concerned with the intrinsic connectedness of temporal and spatial relationships as artistically expressed in literature. Of note, Bakhtin conceives the chronotope, or fourth dimension of space, as "a unity without a merging" (97). "In the literary artistic chronotope, spatial and temporal indicators are fused into one carefully thought-out, concrete whole. Time, as it were, thickens, takes on flesh, becomes artistically visible; likewise, space becomes charged and responsive to the movements of time, plot and history." (84)

21. The first quotation is from Hooke's "Lectures concerning navigation and astronomy," delivered before the Royal Society ca. year-end 1684 (*The Posthumous Works of Robert Hooke*, ed. Waller, 481).

The second is from a Hooke diary entry for 2 June 1676. Hooke had just been to see a performance of Thomas Shadwell's play, *The Virtuoso: A Comedy, Acted at the Duke's Theatre* (also printed in 1676). Shadwell, another Hobbesian, was a member of the Cavendish circle, and dedicated his theatrical satire of the new science—Hooke in particular—to his patron, William Cavendish, duke of Newcastle. Hooke attended the play on a Friday, and

it must have been difficult for him to sit through the performance: “With Godfrey and Tompion at Play. Met Oliver there. Damned Doggs. *Vindica me Deus*. People almost pointed.” (*The Diary of Robert Hooke*, ed. Robinson and Adams, 235)

22. Margaret Cavendish, *CCXI Sociable Letters* (London, 1664), 178.

I have written elsewhere about the Baconian roots of Margaret Cavendish’s quest for fame and influence: “I am restless to Live, as Nature doth, in all Ages, and in every Brain.” In this, Cavendish emulated Francis Bacon as well as nature; his works, she wrote admiringly, “have been very Propagating and Manuring other mens Brains” (*CCXI Sociable Letters* 146). A brilliant rhetorician, Cavendish was quite astute in her manipulations of artificial memory, making sure to distribute lavish presentation copies of her folios to important public and private libraries. Her voluminous publication record makes “the thrice Noble, Illustrious, and most Excellent Princess, the Duchess of Newcastle” (as stated on several title pages) more accessible to after ages than other women of science in the period. But our received portrait of Margaret Cavendish as an unconventional thinker, ostracized by the literati, and left to contemplate the epitomes of the universe alone in her closet, is still an ideal concept of character constructed by its author-creator, not to be confused with the real-life human being.

Bacon’s own rhetorical self-fashioning has recently been the subject of a book by Lisa Jardine and Alan Stewart, *Hostage to Fortune: The Troubled Life of Francis Bacon* (New York: Hill & Wang, 1998). Their conclusion: “At the end of his life, Bacon himself imagined that with the help of those closest to him he could draw a veil over the frequently unsavoury career through which he had struggled in the full glare of court and parliamentary scrutiny, under two difficult monarchs. He believed that he could reinvent himself for future generations as the contemplative sage he might have been, leaving his works as his lasting legacy. He was entirely mistaken. The scandals could not be laid to rest. And the efforts his friends made to erase past dishonour as he had instructed muddied the waters of the ‘Life’ still further. Even without wife and children, he had left too many hostages to fortune.” (524)

23. Francis Bacon, *Of the Advancement of Learning* I, viii; qtd. in Thorpe, *The Aesthetic Theory of Thomas Hobbes* 76–77n159.

A more poetic expression of the tension is found in Shakespeare’s *Venus and Adonis*, lines 289–300:

Look, when a painter would surpass the life requirements
In limning out a well-proportioned steed,
His art with nature’s workmanship at strife,
As if the dead the living should exceed.

Colin Eisler traces Shakespeare’s inspiration for these lines to the vivid equine word portrait of *doctor universalis*, Albertus Magnus. The great naturalist’s compelling description of an ideally beautiful horse was thought to

have also inspired Leonardo da Vinci's visual studies of the horse. See Eisler, *Dürer's Animals* (Washington: Smithsonian Institution Press, 1991), 8.

24. J. J. Macintosh, "Perception and Imagination in Descartes, Boyle and Hooke," *Canadian Journal of Philosophy* 13.3 (Sept. 1983), 350.
25. Letter from Margaret Lucas to William Cavendish; rpt. in *The Phanseys of William Cavendish, Marquis of Newcastle, Addressed to Margaret Lucas, and Her Letters in Reply*, ed. Douglas Grant (London: The Nonesuch Press, 1956), Letter 8, p. 105.

In her published work, the married Margaret Lucas Cavendish would evoke the species metaphor, without using the word:

What Creature else, but *Man*, has such piercing Eyes,

That mingles Souls, and in fast Friendship tyes? (*Poems, or Several Fancies in Verse: With the Animal Parliament in Prose.... The Third Edition* [London, 1668], 134)

and poetically re-work such *topoi* in some quite incredible prose about lovers' stellification.

26. Macintosh, "Perception and Imagination in Descartes, Boyle and Hooke," 330n5.
27. Margaret Cavendish, *Philosophical Letters: Or, Modest Reflections upon Some Opinions in Natural Philosophy, Maintained by Several Famous and Learned Authors of this Age, Expressed by way of Letters* (London, 1664), 174.
28. Robert Boyle, *Advices in Judging of Things said to Transcend Reason*, pub. 1681; qtd. in Macintosh, "Perception and Imagination in Descartes, Boyle and Hooke," 348.
29. Wilkins was responding to "some Atheistical scoffers" who had questioned "the truth and authority of Scripture, particularly as to the description which is given by *Moses*, concerning *Noah's Ark*, *Gen.* 6. 15. where the dimensions of it are set down to be three hundred cubits in length, fifty in breadth, and thirty in height, which being compared with the things it was to contain, it seemed to them upon a general view, (and they confidently affirmed accordingly) that it was utterly impossible for this Ark to hold so vast a multitude of Animals, with a whole years provision of food for each of them." (*An Essay towards a Real Character, and a Philosophical Language* 162)

Wilkins sets out to prove that Noah's Ark did in fact have "sufficient capacity for the containing all those things to which they are assigned" (163). Working from his own tabular calculation of beasts and provisions (e.g., "According to this computation, five *Sheep* must be allotted to be devoured for food each day of the year, which amounts in the whole to 1825...."

[165]), Wilkins affords to each species "such fair Stalls or Cabins as may be abundantly sufficient for them in any kind of posture, either standing, or lying, or turning themselves, as likewise to receive all the dung that should proceed from them for a whole year" (166), then provides two diagrams of the multi-storied, cellular Ark, showing the placement of all species and

provisions within it.

It's one of the more remarkable pieces of information design I've seen.

30. Hooke, Lecture 1 of "Lectures of Light"; in *The Posthumous Works of Robert Hooke*, ed. Waller, 79. The lecture was "read about the beginning of 1680," according to Waller.

The Latin *tota in toto & tota in qualibet parte* translates roughly as "the whole is in the whole & the whole is in every part."

31. Hooke diary entry for 19 March 1678/9. In Robinson & Adams, 404.

The sun's "way of Communication," as discussed in Hooke's June 1682 lecture on memory, and Hooke's modeling there of the reciprocal influence between bodies—both linked with his theories of the *anima mundi*—are in fact present in Hooke's very first published work, *An Attempt for the explication of the phaenomena, observable in an experiment published by the honourable Robert Boyle, esq.; in the XXXV, experiment of his epistolical discourse touching the aire. In confirmation of a former conjecture made by R. Hooke* (London, 1661).

In the epistle dedicatory, addressed to Robert Boyle, Hooke writes: "Sir, The honour you were pleased to do me, in putting me upon this enquiry, did not a little animate and encourage me to persevere in what I had begun with so happy an Omen. My good Success therefore herein, if any, is wholly to be ascribed to your self; as being the first Excitor and chief Abettor of it. And therefore I hope that may be my excuse, for craving You so great a Patron thereunto, in that I could not have entitiled it to any other without a manifest Injury to Your Honour; whose Gracious countenancing of it, justly requires my utmost Gratitude. I must therefore with the *Persian* offer to you, as he to the Sun, what he believes himself to have received from it..." (sigs. A2^{r-v}). It was a dignified statement of reciprocity in the relations with a patron.

Cf. this statement in the June 1682 lecture on memory: "And hence the Bodies so placed, as they have each of them peculiar Properties, Shapes and Motions of their own, so have they also particular Influences, Radiations, Excitations and Regulations communicated to them from the Sun, which gives them not only their regulated Motions and Positions, but also a kind of new Being or Activity, by which they become visible and sensible to the rest of the World, which would otherwise be dark and insensible, and vagrant here and there uncertainly in the *Expansum* of the Universe. So that the Soul forms to it self a Microcosm, or Picture of the Macrocosm, in which it radiates, and is insensible of every thing contain'd therein, in the same manner as the Sun in the Macrocosm."

32. The famous visit was on 30 May 1667. As usual, Hooke was tasked with preparing the scientific show, at which he was to demonstrate his very latest experiments with magnetism, first conducted the beginning of May, "which seemed to show how the loadstone conforms itself to the earth."

As recorded in the Royal Society Journal Book, entry for 23 May 1667:

“The experiments appointed for the entertainment of the DUCHESS OF NEWCASTLE WERE: 1. Those of colours. 2. The mixing of cold liquors, which upon their infusion grew hot. 3. The swimming of bodies in the midst of water. 4. The dissolving of meat in the oil of vitriol. 5. The weighing of air in a receiver, by means of the rarefying engine. 6. The marbles exactly flattened. 7. Some magnetical experiments, and in particular that of a terrella driving away the steel-dust at its poles. 8. A good microscope. These experiments Mr. BOYLE and Mr. HOOKE were desired to provide and take care of.” In Gunther VI, 305.

The magnetical experiments, and Hooke’s “new notions concerning the loadstone” and its motions, clearly had a reciprocal influence on the duchess, who was running some experiments of her own with “the filings of the loadstone” prior to her death in December 1673. On 13 August 1672, Mark Anthony Benoist (tutor to Newcastle’s sons) wrote to William Cavendish from London, confirming that “I have received my Lady Duchess’s letter, with the filings of the loadstone, which I intend to show to several persons, to have their opinions whether it be right or no.” Qtd. in Douglas Grant, *Margaret the First: A Biography of Margaret Cavendish, Duchess of Newcastle, 1623–1673* (London: Rupert Hart-Davis, 1957), 236.

33. To explain “the way in which God understands all things in a single mental act, or the way in which his decrees are identical with himself,” Descartes invokes a confusing triple distinction: understanding vs. conception vs. imagination. Hence, there can be divine “things which we *understand*,” although we “do not *conceive* of them,” nor can we imagine them (Descartes, qtd. Macintosh 337). This kind of mystical knowing (understanding) is similar, Descartes argues, to that which we use to interpret optical illusions. For instance, when confronted with a chiliagon (a plane figure with a 1000 angles), we are able to intuit “the whole figure” (pattern and parts) quite “clearly” even as “we are not able to imagine it as a whole at the same time; which proves that the two powers of understanding and imagining differ, not so much in respect of more and less, but as two wholly diverse modes of operation.” (Descartes, qtd. Macintosh 337)

Boyle is somewhat clearer: “... some assistance may be borrowed from what we may observe in that other faculty of the mind, which is most of kin to the Intellect, I mean the *Imagination*: For when, for instance, I think of a Triangle or a Square, I find in my fancy an intuitive *Idea* (if I may so call it) of those figures[.] that is a Picture clear and distinct, as if a figure of three sides or four equal sides, and Angles were placed before my eyes.”

He continues: “But if I would fancy a *myriagon*, or a figure consisting of ten thousand equal sides, my Imagination is overpowered with so great a multitude of them, and frames but a confused *Idea* of a *Polygon* with a great many sides: For if (to speak suitably to what the excellent *Des Cartes* has well observed in the like case) a man should endeavour to frame *Ideas* of a

Myriagon or a *Chiliagon*, they would be both so confused, that his Imagination would not be able clearly to discriminate them, though the one has ten times as many sides as the other.” (Boyle, *A Discourse of Things Above Reason*; qtd. Macintosh 342)

Macintosh inserts an illustration of the Fraser spiral to elucidate the point. “We can all discover that this figure contains concentric circles, for example by tracing them with a finger or a pencil, but it is not the case that we can all see them as such, for even when we *know* the spiral is an illusion, we continue to see it, and not a set of concentric circles.” (Macintosh 336–7)

34. Cavendish’s theories are too complex to adequately describe in a note, but it should be pointed out that the sort of pluri-consciousness she describes is not without its dualisms, hierarchies, and contradictions (e.g., her theories of “double perception,” “double knowledg,” “Divided and Composed Perceptions,” and dual souls—a natural rational soul, which is material, and the supernatural divine soul, which is immaterial).

To Cavendish, “particular figures have variety of knowledges, according to the difference and variety of their corporeal figurative motions.” (*Observations upon Experimental Philosophy* 227) Because of their particular figures, neither the human heel nor the lodestone have “Poetical Imaginations” or “Philosophical Contemplation.” The unique configuration of matter suited to embodying human understanding (which Cavendish associates broadly with linguistic reasoning, judgment, thought, ratiocination, opinion, wit, discourse, and the arts & sciences) is restricted to the most rarified parts—the human brain. However, “though other Creatures have not the Speech, nor Mathematical rules and demonstrations, with other Arts and Sciences, as Men; yet may their perceptions and observations be as wise as Men’s, and they may have as much intelligence and commerce betwixt each other, after their own manner and way, as men have after theirs” (*Philosophical Letters: Or, Modest Reflections upon Some Opinions in Natural Philosophy, Maintained by Several Famous and Learned Authors of this Age, Expressed by way of Letters* 114). Hence, “Why may not *Vegetables* have *Light, Sound, Taste, Touch*, as well as *Animals*, if the same *kinde* of *motion* moves the same *kinde* of *matter* in them? For who *knows*, but the *Sap* in *Vegetables* may be of the same *substance*, and *degree* of the *Brain*: And why may not all the *senses* be *inherent* in a *figure*, if the same *Motion* moves the same *matter* within the *figure*, as such *motion* without the *figure*?” (*The Philosophical and Physical Opinions* 23)

35. The Little Brain names the enteric nervous system that scientists have located in the wall of the esophagus, stomach, small intestine, and colon. The Little Brain is an active intelligence, and does not just passively take instruction from the three-pound Big Brain in our heads, as was supposed both by Telesio and Campanella in their speculations on sea-sickness and the associative processes involved in memory (specifically, how thoughts or the image of a voyage on the sea may produce nausea). Not only is the Little

Brain within the human gastrointestinal tract capable of distinguishing among kinds (e.g., steak vs. steamed vegetables), it continually adapts itself in order to process each kind. This means it has an active memory (e.g., of smells and tastes that have upset our digestive tracts in the past). Further, we've learned that the Little Brain in our stomachs can integrate personal preferences and aversions with seemingly unrelated information from other gut activities, sometimes creating "food allergies." It even remembers negative experiences that are non-food-related. If, at some point in the past, a person's Big Brain has responded nervously to violence in movies and signalled the belly brain to release chemicals that cause stomach cramping, from then on, the mere suggestion of violence in a movie can cause stomach cramping without requiring any new signals from the Big Brain in the head. So our little belly brain turns out to be a rather important—and independent-minded—player in determining what we know of the world and how we (re)act in it.

Galen Cranz describes "sensual rationality" in her book, *The Chair: Rethinking Culture, Body, and Design* (New York and London: W. W. Norton, 1998): "Body-conscious design is synonymous with sensuous rationality. Reason and sensation, cognition and perception, are often set up as opposites, but an underlying theme of this book is that it is reasonable to honor both: our sensual wisdom. On its own, rationality runs amok. Freud worried that modern man had become a prosthesis god—powerful, mechanized, and artificial through the use of painful, ill-fitting prosthetic devices, such as buildings and chairs. I assume that we can improve the environment through reason informed by our senses." (152) I recommend Cranz's book to any of those who, like me, sit immobilized for protracted periods in front of computer screens.

36. Groups such as Science for the People were levelling such criticisms back in the 1970s, if not earlier. The most recent book from this camp is probably *Alas, Poor Darwin: Arguments Against Evolutionary Psychology*, ed. Hilary and Steven Rose (New York: Harmony Books, 2000). But there is a growing flood of titles, from scientists and critics alike, newly interested in what's been called "the culture factor," and in research that crosses the nature/nurture divide. A recent title from Steven R. Quartz and Terrence J. Sejnowski, *Liars, Lovers, and Heroes: What the New Brain Science Reveals About How We Become Who We Are* (William Morrow, 2002) offers the most up-to-date survey of the new "cultural biology."
37. William Cavendish, *Advice to Charles II*, transcribed and introduced by Thomas P. Slaughter, in *Ideology and Politics on the Eve of Restoration: Newcastle's Advice to Charles II* (Philadelphia: The American Philosophical Society, 1984), 70. Newcastle's tract has been variously dated to 1660–1, 1658–9, and 1651–3.
38. Margaret Cavendish, *The Worlds Olio* (London: Printed for J. Martin and J. Allestrye, 1655), 161.

The theme replays throughout her works. E.g., “... that which makes a good *Poet*, is that which makes a good Privie Councillor, which is, observation, and experience, got by time and company.” (*The Worlds Olio* 5)

It surfaces again in the character of the prudent peasant-scientist given in her 1662 text, *Orations of Divers Sorts, Accommodated to Divers Places*: “... there should be Natural Teachers and Informers for the Profitable Increase for Men, such as have not only Experience by Practice, and Judgement by Observation, but have both Learning and Conceptions of Natural Philosophy, as to Learn and Search into the Causes and Effects of Natures Works, and to Know and Observe the Influences of the Heavens on Earth, and on the Diverse and Sundry Creatures In and On the Earth; also the Sympathies and Antipathies of the several Creatures to Each other, as also the Natures and Proprieties of every Kind and Sort of Creature; so shall we know how to Increase our Breed of Animals, and our Stores of Vegetables, and to find out the Minerals for our Use; for as Learning without Practice is of No Effect, so Practice without Knowledge is of Small Profit ... when Practice and Wit are joyned together, they beget Wisdome and Wealth, the One being Adorned with Gold, the Other Inthroned with Fame, for Emperours have Ascended from the Plough, and Kings from the Sheep-coats, Converting their Plough-sherds to Thrones, their Sickles to Crowns, and their Sheep-hooks to Scepters. Thus Clowns, Boors, or Peasants by Name, are become Princes in Power, and Princes in Power are become Beasts by Name and Nature, witness *Nebuchadnezzar*.” (*Orations* 245–6)

Despite the persuasiveness of the oratory here, Cavendish’s ideal scientific character was not the prudent husbandman, but the poet-scientist, who has a “Sun-like Mind” which “conceives several Causes and Effects, and creates several Fancies; and as the Sun shews the World, and the World of Creatures, so the Mind finds and shews the Truth of Things.” (*CCXI Sociable Letters* 23) Cf. Hooke’s use of the solar analogue in his June 1682 lecture on memory.

39. Robert Hooke, “An Observation about the Seed of Moss,” in *Lampas: Or, Descriptions of Some Mechanical Improvements of Lamps & Waterpoises. Together with Some Other Physical and Mechanical Discoveries. Made by Robert Hooke, Fellow of the Royal Society* (London: Printed for John Martyn, Printer to the Royal Society, at the Bell in St. Pauls Church-yard, 1677).

Hooke here refers to the Great Fire of London, which broke out on 2 September 1666; within four days, the greater part of the City within the walls had been destroyed.

I should add that there were social, as well as natural, stimuli for Hooke’s renewed intellectual interest in the propagation of moss seed, among them, Cavendish herself. Hooke first published on the topic in April 1665 (Observ. XXI, “Of Moss, and several other small vegetative Substances,” in *Micrographia: Or Some Physiological Descriptions of Minute Bodies Made by Magnify-*

ing Glasses with Observations and Inquiries Thereupon), but his microscopical investigation of moss seeds dates from 1663. In 1666, Margaret Cavendish published her *Observations upon Experimental Philosophy. To which is added The Description of a New Blazing World*, in which she challenged Hooke to prove his earlier “wild Fancy” concerning seed propagation: “I believe that Natural Creatures are more numerous and variously produced by dissolution of Particulars by the way of Metamorphosing, then by a continued propagation of their own Species by the way of translation of Parts; and that Nature hath many more ways of Productions, then by Seeds or seminal Principles, even in Vegetables: witness the Generation of Production of Moss, and the like Vegetables that grow on Stones, Walls, dead Animals skulls, tops of Houses, &c. So that he who doth confine Nature but to one way of Acting or Moving, had better to deprive her of all Motion; for Nature being Infinite, has also Infinite ways of Acting in her Particulars. Some are of opinion, that the Seed of Moss being exceeding small and leight, is taken up, and carried to and fro in the air into every place, and by the falling drops of rain, is wash’d down out of it, and so dispersed into all places, and there takes only root and propagates where it finds a convenient soil for it to thrive in: But this is only a wild Fancy, and has no ground; and no Experimental Writer shall ever perswade me, that by his Dioptrical glasses he has made any such Experiment: wherefore I insist upon sense and reason, which inform me of the various Productions of Nature, which cannot be reduced to one principal kind, but are more numerous then Man’s particular and finite Reason can conceive.” (39)

When Cavendish visited the Royal Society on 23 May 1667 (see note 32), Hooke may well have included his popular “seed of moss” demonstration among the microscopical experiments shown the duchess (I know I would have!), although there is no evidence of this. Unfortunately, by the time Hooke had his dioptrical proof in hand, and published it in the small discourse added at the end of his *Lampas*, Cavendish had been dead almost four years.

40. Margaret Cavendish, *Grounds of Natural Philosophy: Divided into Thirteen Parts, with an Appendix Containing Five Parts. The Second Edition, much altered from the First, which went under the Name of “Philosophical and Physical Opinions”* (London: A. Maxwell, 1668), 180. The full sentence reads: “I hope my Readers will not find fault with my Endeavour, though they may find fault with my little Experience, and want of Learning.”

41. Margaret Cavendish, prefatory epistle “To the Two Universities,” in *The Philosophical and Physical Opinions* (London: J. Martin and J. Allestrye, 1655).

The whole is an eloquent plea to have her works taken seriously by academics, not just “for the good encouragement of our sex” in developing wisdom and prudence, but for women’s emotional well-being, too (“lest in time we should grow irrational as idiots, by the dejectednesse of our spirits,

- through the careless neglects, and despisements of the masculine sex to the effeminate, thinking it impossible we should have either learning or understanding, wit or judgement, as if we had not rationally souls as well as men”).
42. Margaret Cavendish, “To the Reader,” in *The Philosophical and Physical Opinions* (London: J. Martin and J. Allestrye, 1655).
43. Margaret Cavendish, “A True Relation of my Birth, Breeding, and Life.” In *Natures Pictures drawn by Fancies Pencil to the Life. Written by the thrice Noble, Illustrious, and Excellent Princess, the Lady Marchioness of Newcastle. In this volume there are several feigned Stories of Natural Descriptions, as Comical, Tragical, and Tragi-Comical, Poetical, Romancical, Philosophical, and Historical, both in Prose and Verse, some all Verse, some all Prose, some mixt, partly Prose, and partly Verse. Also, there are some Morals, and some Dialogues; but they are as the Advantage Loaves of Bread to a Bakers dozen; and a true Story at the latter end, wherein there is no Feignings.* London: J. Martin and J. Allestrye, 1656.

There are numerous accounts from the early-modern period describing women’s excellent aural memories. For example, Elizabeth Joceline (1592–1622) was knowledgeable “in Languages, Historie, and some Arts” and able “upon the first rehearsall to repeate above forty lines in English or Latine: a gift the more happy by her imployment of it in carrying away an entire sermon, so that she could (almost following the steps of the words, or phrase) write it down in her chamber.” This account of Joceline’s art of memory is from “The Approbation,” a biographical piece prefaced to some of the editions (1624, 1625, 1632, 1635, 1684) of Joceline’s extremely popular *The Mothers Legacie to Her Unborn Child*, and signed by Thomas Goad. Qtd. in Valerie Wayne, “Advice for women from mothers and patriarchs,” in *Women and Literature in Britain 1500–1700*, ed. Helen Wilcox (Cambridge and New York: Cambridge University Press, 1996), 64.

And Aubrey describes the “excellent memory” of the celebrated poet, Katherine Philips (1632-1664), also known to contemporaries as *The Matchless Orinda*: “She was very religiously devoted when she was young; prayed by herself an hower together, and tooke sermons *verbatim* when she was but 10 yeares old.... She was when a Child much against the Bishops, and prayd to God to take them to him, but afterwards was reconciled to them. Prayed aloud, as the hypocriticall fashion then was, and was overheard.”

Aubrey continues with his account, citing yet another source (her cousin) for his information about Philips: “From her cosen Blacket, who lived with her from her swadling cloutes to eight, and taught her to read:—She informs me viz.—when a child she was mighty apt to learne, and she assures me that she had read the Bible thorough before she was full four yeares old; she could have sayd I know not how many places of Scripture and chapters. She was a frequent hearer of sermons; had an excellent memory and could have brought away a sermon in her memory. Very good-natured; not at all high-minded; pretty fatt; not tall; reddish faced.” (Aubrey, *Brief Lives*, ed.

Clark, ii:153 and ii:154)

44. Benjamin Franklin's bagatelle, "Remarks Concerning the Savages of North America" (1777–1785); qtd. in Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill and London: University of North Carolina Press, 1989), 109.
45. From a 1942 letter written by an employee of the Curtis Aircraft Company. Qtd. in Paul E. Ceruzzi, "When Computers Were Human," *Annals of the History of Computing* 13.3 (Sept. 1991): 237–44.
46. The possibilities of a vital materialist philosophy have still not been exhausted.

I like to think that the legacies of Hobbes and Cavendish and Hooke live on in the secular, interactionist models of mind and agency I associate with the work of Steven Rose, Gerald Edelman, Joel Kovel, and others.

I have already posted extensively to the list about Steven Rose's *Lifelines: Biology Beyond Determinism* (Oxford and New York: Oxford University Press, 1998), so I shall here limit myself simply to citing it once again, without further description.

Gerald Edelman is a neuroscientist whose book *Bright Air, Brilliant Fire: On the Matter of the Mind* has been nicely excerpted by James McConkey in his anthology, *The Anatomy of Memory* (New York and Oxford: Oxford University Press, 1996), 47–54. Edelman still calls for a truly materialist account of how mind emerges in the world, coupled with a theory of action based on the notion of human freedom (the latter, as he so rightly points out, being just what was missing from Enlightenment-era mechanistic accounts). And Edelman asks all the right questions, I think, about how we refashion a materialist alternative: "How would humankind be affected by beliefs in a brain-based view of how we perceive and are made aware? What would be the result of accepting the ideas that each individual's 'spirit' [soul] is truly embodied; that it is precious because it is mortal and unpredictable in its creativity; that we must take a skeptical view of how much we can know; that understanding the psychic development of the young is crucial; that imagination and tolerance are linked; that we are at least all brothers and sisters at the level of evolutionary values; that while moral problems are universal, individual instances are necessarily solved, if at all, only by taking local history into account? Can a persuasive morality be established under mortal conditions? This is one of the largest challenges of our time." (53–4)

Joel Kovel, author of *The Enemy of Nature: The End of Capitalism or the End of the World* (Zed Books, 2002), was recently involved in a "Symposium" on John Bellamy Foster's book, *Marx's Ecology: Materialism and Nature*, which ran within the pages of the journal, *Capitalism, Nature, Socialism* (March and June 2001 issues). In general, CNS symposiasts were critical of Foster's "failed promise" of articulating an "ecological marxism." Yes, Foster adequately defended Marx "against the charge of Prometheanism, among

other misreadings,” but he did so by holding to “a linear, monolithic view of history” and promoting an inexcusably “teleological” style of history of science (i.e., still touting “the inexorable advance of science, whose pinnacle is the achievement of dialectical materialism embodied in Marx”).

Kovel’s own critique of Foster’s book re-introduces 17th-century mysticism to Marxist history of science and to the new “red-green” political movement now gathering momentum on the left. In his June 2001 *CNS* essay, “A Materialism Worthy of Nature,” Kovel writes passionately about the Renaissance mystic, Jakob Böhme (1575–1624), and Böhme’s mystical insights into the vital spirit, or “Qual.” Concludes Kovel: “Böhme’s God is not some daddy in the sky, but the very unfolding of universal formativity. His genius was to realize that God itself had to come into being—formativity is itself formed from within nature. Böhme’s God does not create heaven and earth, It (though called ‘He’) is itself created from non-being—the ‘Un-ground’—in a process that bears an uncanny resemblance to the Big Bang of current cosmological theory.” But Böhme’s mystical “visions into the basic structure of matter and the cosmos ... had to remain merely spiritual and theosophic until the science of the 20th century could pose the questions anew.” “Being ‘theosophic,’ Böhme’s language was turned to speaking of nature as a manifestation of God.... [T]his was not an idealist replacement of nature, rather, an intuitive and symbolic way of describing the awesomeness of nature that could stand in, so to speak, until the physics of general relativity and quantum mechanics could catch up to it.” Similarly, in speaking of Marx’s own spiritual awareness, Kovel claims that spirituality is in keeping with—not at odds with—atheism and science: “This is no contradiction, as there is nothing that says that spirituality need include a belief in a personal god, nor, certainly, the historically constructed gods of patriarchal religions.” “How can this be? Because it is possible to obtain a true *insight* into nature, and hence construct one leg of a vital materialist philosophy, through reflection on lived experience—experience, that is, of an embodied and conscious creature whose being participates in the universe. Needless to say, insight of this sort in no way substitutes for the hard, patient verification of nature-in-itself that can be shared, transmitted and developed through the community of science. To put it metaphorically, a person does not walk on one leg. But an in-sight can orient others—as Marx saw something in Böhme’s notion of ‘Qual’ that corresponded to and helped organize his incipient notion of a historical materialism grounded in struggle, sensuous practice and consciousness, by orienting it with an equivalently vital materialism of nature.” (79–81)

47. Wendy Lee-Lampshire, “Women-Animals-Machines: A Grammar for a Wittgensteinian Ecofeminism,” in *Ecofeminism: Women, Culture, Nature*, ed. Karen J. Warren (Bloomington: Indiana University Press, 1997), 413.

48. See Donna Haraway, “Manifesto for Cyborgs: Science, Technology, and

Socialist Feminism in the 1980s,” *Socialist Review* 80 (1985): 65–108. Rpt. as chapter 8, “A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century,” in *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991).

Haraway has been criticized as “a kind of po-mo anti-McKibben who revels in culture’s swallowing of Nature. Like the gender benders whose antic assaults on ‘masculine’ and ‘feminine’ proceed from the faith that they’re only social constructs, Haraway throws away quite a lot of baby with bath water that might prove needed after all.” This is from Eric Zencey, in his book review of *Nature: Western Attitudes Since Ancient Times*, by Peter Coates (*Los Angeles Times Book Review*, 8 November 1998).

A more sensitive critique of Haraway’s canonical essay comes from Russell Janzen in his essay, “Reconsidering the Politics of Nature: Henri Lefebvre and *The Production of Space*” (*Capitalism, Nature, Socialism*, 13.2, June 2002, 96–149). Janzen argues that both Haraway’s “cyborg” and Bruno Latour’s “hybrid” figures are inadequate for constructing a new politics of nature because, while they “serve as points of entry into complex networks of natural-social processes” and “themselves deconstruct or problematize the possibility of such singular totalities as nature or society,” they ultimately “describe networks along the flat plain of a two-dimensional cartography that is difficult to correlate with the complex physical and social topographies of everyday experience: there is no way explicitly to articulate the relative weight or scale at which different processes are implicated in cyborg subjectivity or hybrid quasi-objectivity.” (98–99)





C O L O P H O N

I have here reproduced the full text of Hooke's June 1682 lecture on memory, as first printed in Richard Waller's 1705 edition of Hooke's *Posthumous Works*, pages 138–148 (full title: *The posthumous works of Robert Hooke containing his Cutlerian lectures, and other discourses, read at the meetings of the illustrious Royal Society. Illustrated with sculptures. To these discourses is prefixt the author's life, giving an account of his studies and employments: with an enumeration of the many experiments, instruments, contrivances and inventions, by him made and produc'd as curator of experiments to the Royal Society. Publish'd by Richard Waller*).

The introductory comments (in italic type) and marginalia (also in italic type) are Waller's own.

As one might expect, given their friendship and shared intimacies, Waller proved a thoughtful and dedicated editor, carefully assembling the *Posthumous Works* from Hooke's papers, subsequent to his death in 1703. Waller obviously intended the *Posthumous Works of Robert Hooke* as a memorial to the man and his work.

In his role as editor, Waller decided that he would first concentrate on the

... Lectures, made and read by him at several distant times upon different Subjects, which the Reader is here presented with as the Author left them; for I was unwilling to Model or Methodize them a new, by reducing the Subjects and Discourses of many Lectures into one continu'd Discourse, as his method has been in the Treatises formerly Publish'd by him in Quarto; much less have I ventur'd upon any Epitome, Abridgments too often distorting and curtailing the Author's true Sense, and disguising it so, that his own Sentiments are hard to be distinguish'd and always dubious, which Errors I have desir'd as much as possible to shun. I am sensible, by publishing his Discourses thus at large, some Recapitulations have been unavoidable, especially in Discourses of this Nature, which it is possible may disgust some nice Criticks; nevertheless I hope the Canded Reader will not find these Repetitions so many or large, as to be dissatisfy'd thereat, most, if not all of them, containing some new Matter added to what was said before.

The Subjects here handled are some of the most difficult in Natural Philosophy, and the Discourses were all well accepted and approv'd of when read before com-

petent Judges of the ROYAL SOCIETY, at their usual Meetings....

Waller's memorializing of Hooke was further complicated by the fact that, at the time of publication, Isaac Newton was President of the Royal Society, and Waller, its Secretary. Waller diplomatically dedicated his volume of Hooke's *Posthumous Works* to the "Royal Society of London for the Improving of Natural Knowledge" and its august President, who by then bore an implacable hatred for Hooke.

From the beginning, Waller had planned to follow this up with a second volume, but died before he could complete anything more. It's impossible to know now what he would have included from Hooke's papers in a follow-on volume, but we find a hint in Hooke's Diary mss., where Waller appended a handwritten memorandum of his own:

... that great genius Dr. Hook ... who was as I could prove were it a proper time the first Inventor or if you please first Hinder of those things about which Magni Nominis Heroes have contested for the Priority.

Unfortunately, Waller knew nothing about the Diary mss. until 1708, three years after publication of the *Posthumous Works*.

With the following transcription, I have retained, as well as I can, Waller's original formatting and layout. But there is no way modern computerized typesetting can duplicate early-modern print, other than photographically.

The amount of text early-modern printers could squeeze into a 31-pica-wide column, without sacrificing legibility, still impresses me, while it eludes even the superior text-handling capabilities of Adobe InDesign. Given this, and the smaller page size of modern documents (Waller's 1705 book was a full-sized folio), I can't begin to match Waller's layout page for page, and so have left off page numbers from the header following the first page of the printed lecture, p. 138.

I have silently corrected a few obvious printers' errors:

✻ "where all things are are ordered"

✻ "it be become more faint and weak"

✻ "extavagant"

but left other possible idiomatic spellings

✻ "Archiectonical"

✻ "the *Supollex* of the Soul"

✻ "sense of the Reniteny of Bodies"

as is. To quote a worthy predecessor, far more experienced than I in the transcription of obscure 17th-century texts:

As usual I reproduce the original with all fidelity and carefulness.

(Alexander B. Grosart, in *The poems of Mildmay, 2d Earl of Westmoreland*, Blackburn, Eng., 1879)

A Note on Reading Early-Modern Text

Those of you unaccustomed to reading early-modern print may balk at some of the typographic conventions. Most peculiar to modern readers is the use of an old-style, lower-case s. This letter resembles the lower-case f, only with a shortened crossbar—as in

Repository (modern: Repository)

Diftance (modern: Distance)

supposed (modern: *supposed*)

possibly (modern: *possibly*).

The old-style lower-case f is used everywhere except at the end of a word—as in

Muficalnefs (modern: Musicalness)

fharpnefs (modern: sharpness)

Seafons (modern: *Seasons*).

Most ligatures will be familiar enough not to cause problems—as in

refpe& (modern: respect).

But ligatures formed with the old-style f can be hard on modern eyes—as in

moft flourifh'd (modern: most flourish'd)

miftakes (modern: mistakes)

Diftin&ions (modern: Distinctions).

Differences in orthography can cause problems as well, especially when combined with the old-style f—as in

fhews (modern: *shows*)

fhews (modern: shows).

Early-modern print also used different reader cues than we do today. Typically, there is a heavy use of italics in text. And continuity from page to page is maintained by printing at the bottom right of every page the first word/letter to appear at the start of the next page (one early-modern print convention that might well be worth bringing back).



S E C T . V I I .

The CONTENTS.

BEfore I give the Contents of this Section, I think it may be convenient, in order to the better understanding of what follows, to premise, That our Author having thus far prosecuted his Inquiries into the Nature of Light, What it is in the Luminous Body, to wit, a certain Vibrative Motion of its Parts, of a determinate Velocity. 2dly, What the Medium is, how it is acted upon by Light, and how Light is thereby propagated, with all the necessary Qualifications of this Medium. 3dly, What this Action is on the Eye, and how the Powers of Light are exerted upon the sensible Part thereof, to cause Vision: Instead of proceeding farther in the Method he had proposed to himself, of explicating how the Rays or Pulses of Light from the Luminous Bodies are Reflected, Refracted or Inflected, by a successive Refraction, bending the Ray into a Curve; which several Subjects I suppose he design'd to treat of, though I do not find he ever did (except of Inflection, of which see Micrography, p. 217.) being diverted by other intervening Subjects, which carried his Thoughts other Ways: And indeed the Field of Nature is so large, and so plentifully adorn'd with tempting Curiosities, that it is a Restraint upon the Collector, not to leave one before it is thoroughly examined, to reach at another. I say, when our Author had treated on these Heads so far, he leaves this Subject, I must confess, in some sense imperfect; and taking occasion from his having mention'd Time and a Human Moment, he wrote the following Discourse, wherein,

- I. The Author attempts to shew how we come by the Notion of Time, tho' the Impressions on the Senses are all momentary. The Communis Sensus not sufficient for this purpose, therefore there
is

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is a necessity of supposing some other Organ. This he conceives to be what we call Memory, and then he proceeds to give an Hypothesis to explain Memory, and how it is performed: That Memory is organical: That the Soul, tho an Incorporeal Being, yet in performing its Actions makes use of Corporeal Organs: That Memory is the Repository of Ideas form'd by the Senses, or rather by the Soul it self. 2. The Action of the Soul in ordering and storing up Ideas, is call'd Attention. The Author's Notion what it is: That the Place of the Repository is somewhere in the Brain, whose Substance is the Material out of which Ideas are formed, the Chain of which is coyled up in the Repository, the Soul being at the Center where the present Idea is made, which is the present Moment; and hence comes the Notion of Time and Duration, and is apprehended as a Quantity. 3. A Mechanical Representation supposed for the better Understanding the several Operations of the Soul, viz. Apprehending, Remembring and Reasoning. That there may be some certain Point in the Brain, where the Soul has its chief Residence, and there receives its Informations, and gives its Orders. This Repository is furnished with adapted Matter for the Uses of the Soul: Five sorts of Matter for the Impressions of the Five Senses: That for Sight explain'd by the Bononian Phosphorus: That for Sound by the Vases in antient Theaters and Unison-tuned Strings. Smelling, Tasting and Feeling also after the same manner are explained. 4. Out of this adapted Matter the Ideas formed are material and bulky, of determinate Figures, Sizes and Motions. That the Soul forms one Idea each Moment, which Moments differ in duration in different Men. A Computation of the number of Ideas that may be form'd in a Man's Life. That the Number will not be found to be an Objection against this Hypothesis. That Attention is the Action of the Soul in forming Ideas, and what they are. That they continually protrude each other from the Center. That the Soul by its Radiation and the Reaction of the Ideas, becomes sensible of them, and so of Time. How it is sensible of many concomitant Ideas. How some Thoughts lost may be recovered. That this Radiation and Re-action weakens in

a

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a duplicate proportion to the distance of Time. That the Soul may exert its Power on any particular Idea according to its own Will. That there is a continual Radiation of the Soul in the Repository of Ideas, and is in some sense reacted upon by them; whence comes what we call a bringing to remembrance. 5. The Action of the Soul called Thinking, is a more particular Radiation thereof to this or that part of the Repository. Thinking is partly Memory, and partly an Operation of the Soul in forming new Ideas. Reason a more compleat Action of the Soul from comparing Ideas. As the Repository is better stored, so the Soul acts better. The Soul a self-moving Principle and Primum Movers. The Soul compared to the Sun in the Great World. If the Sun had Understanding, it would be sensible of the Resistance its Rays meet with. This explain'd by Hearing and Seeing. A double instance from the Sun on Bodies and their Motions. Tho' we cannot conceive how the Soul, being spiritual and incorporeal, acts upon Ideas that are corporeal, or can be acted upon by them; yet we are assured such Effects are performed. That the Soul is not confin'd to act only upon these Ideas, but may extend its Power to every part of the Body, and possibly to some considerable Distance from the Body.
R. W.

*How we come
by the Notion
of Time.*

BEfore I come to the discussing of the particular Matters treated of the last Section, I would a little further consider what I have been discoursing of, *viz.* Time: And here, since it is a general Maxim in the Schools, that *Nihil est in Intellectu, quod non suit prius in Sensu*, I would query by what Sense it is we come to be informed of Time; for all the Information we have from the Senses are momentary, and only last during the Impressions made by the Object. There is therefore yet wanting a Sense to apprehend Time; for such a Notion we have: And yet no one of our Senses, nor all together, can furnish us with it, and yet we conceive of it as a Quantity. For this therefore, since we cannot find any external or outward Sense, we must seek within, and we shall

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shall find there is somewhat like that which is called *Communis Sensus*, which is receptive of all the outward Impressions of the other Senses. But still this is insufficient to afford us the Notion or Knowledge of Time; for the Impressions on that can be no other than the Impressions from the other Senses, conveyed by the *Media* of the sensory Nerves, which must be also momentary, as well as the first Impressions, and consequently do not yet sufficiently inform us of the Notion of Time. Considering this, I say, we shall find a Necessity of supposing some other Organ to apprehend the Impression that is made by Time. And this I conceive to be no other than that which we generally call Memory, which Memory I suppose to be as much an Organ, as the Eye, Ear or Nose, and to have its Situation somewhere near the Place where the Nerves from the other Senses concur and meet.

Now that it is really Organical, I argue from this, that it may be both improved and impaired, it may be destroyed and exalted to a great Perfection. It is at some times sensible, and at other times wholly insensible, as particularly in Sleep: And whenever 'tis so, we have no Sense of Time, but we pass over all that Space of Time, as if it had not been, and we only come to understand it by other Circumstances. Besides, we have often known that the Memory has been quite destroyed by a Fall, or great Blow upon the Head, by a Fever, or other great Sickness; nay often by Excess of Drinking, all which affect not the Soul: And in probability, this might be caused by some Wound, Hurt, Bruise, or some other Distemper of that Part, which we conceive to be the Organ of Memory; which makes it an unfit Organ for the Soul to make use of for that effect; and consequently the Soul can no more remember without the Organ of Memory, than it can see without the Organ of Sight, the Eye, or hear without an Ear. For the Soul, or first Principle of Life, tho' it be an Incorporeal Being, yet in performing its Actions, makes use of Corporeal Organs, and without them cannot effect what it wills.

Memory then I conceive to be nothing else but a Repository of Ideas formed partly by the Senses, but chiefly by the Soul it self: I say,

*Memory
Organical.*

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say, partly by the Senses because they are as it were the Collectors or Carriers of the Impressions made by Objects from without, delivering them to the Repository or Storehouse where they are to be used. Which Impressions being actual Motions, as I have plainly proved in the Explication of the Organ of the Eye, and the Operation of Light, those Motions conveyed to this Repository become Powers sufficient to effect such Formations of Ideas as the Soul does guide and direct them in: For I conceive no Idea can be really formed or stored up in this Repository, without the Directive and Architectonical Power of the Soul; and the Actions or Impressions cease and fail without the concurrent Act of the Soul, which regulates and disposes of such Powers.

2. This Action of the Soul is that which is commonly called *Attention*, by which what is meant no one does further or more intelligibly explain, than only by giving the same Notion by some other ways of Expression, which, it may be are as little intelligible. My Notion of it is this, that the Soul in the Action of Attention does really form some material Part of the Repository into such a Shape, and gives it some such a Motion as is from the Senses conveyed thither; which being so formed and qualified, is inserted into and inclosed in the common Repository, and there for a certain time preserved and retained, and so becomes an Organ, upon which the Soul working, finds the Ideas of past Actions, as if the Action were present.

*The Author's
Notion
concerning
Ideas.*

This Repository I conceive to be seated in the Brain, and the Substance thereof I conceive to be the Material out of which these Ideas are formed, and where they are also preserved when formed, being disposed in some regular Order; which Order I conceive to be principally that according to which they are formed, that being first in order that is first formed, and that next which is next, and so continually by Succession, from the time of our Birth to the time of our Death. So that there is as it were 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; and the other End is always at
the

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the Center, being the last Idea formed, which is always the Moment present when considered: And therefore according as there are a greater number of these Ideas between the present Sensation or Thought in the Center, and any other, the more is the Soul apprehensive of the Time interposed.

These are the *Supollex* of the Soul, and these are the Instruments it makes use of in the apprehending of things or Actions past; and by these it becomes sensible of all that it really knows, and according to the Perfection or Imperfection, the Multitude or Paucity, the Regularity or Irregularity of the Order and Disposition of these Ideas in the Repository or Memory, the Aptitude or Ineptitude of the Substance for Formation, Radiation, Disposition, &c. so is the Soul the better enabled, First, to form new Ideas aright, or rightly to apprehend the thing to be known. Secondly to apprehend the Order according to which they have been formed, and are ranged; that is, to know the time, or, to speak in the common Phrase, to remember what is past; as if it were present, and how long it is since it was done, by the number of Ideas between. The Soul therefore understands Time, or becomes sensible of Time, only by the help of the Organ of the Memory, which Organ is this Repository of Ideas, and by means of the Order, Situation and Distance of the said Ideas, from the Center, or one among another, so it becomes sensible of Time: And Time, as understood by Man, is nothing else but the Length of the Chain of these Ideas, between any two that are at any time apprehended together: And according to the Number of the Links in this Chain, so is the Impression made to the Soul that apprehends it, of a longer or shorter time interposed; and the Notion of Time is the Apprehension of the Distance of Ideas from the Center or present Moment. And so Time comes to be apprehended as a Quantity, and so falls under the Consideration of Geometry and Mensuration.

3. Now because nothing is so well understood or apprehended, as when it is represented under some sensible Form, I would, to make my Notion the more conceivable, make a mechanical and sensible

*A sensible
Representation
of the Matter.*

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fenfible Figure and PiCture thereof, and from that fhew how I conceive all the ACTIONS and Operations of the Soul as Apprehending, Remembring and Reasoning are performed.

I fuppose then that there may be a certain Place or Point fomewhere in the Brain of a Man, where the Soul may have its principal and chief Seat.

I will not now enter upon Arguments or Reasonings from Experiments or Observations, to determine the precise Place, though concerning the definitive Pofition thereof, I have much that I may at another time produce: But I will only fuppose at present, that there may be fome fuch Place whereinto all the Impreffions made from the Senfes upon adapted Matter may be deliver'd; which Impreffions, as I have elfewhere explain'd, are no other but actual Locomotions given to the Parts of Matter or Bodies fo or fo moved.

I fuppose then this Repository to be furnished with variety of Matter adapted for the ufes to which the Soul applies them, which I call the Elements out of which Ideas are made; among which Variety there are principally five forts fitted and adapted to receive the Impreffions from the five Senfes; that is, one peculiar Kind for the Impreffions of Sight, which is of fuch a Quality, Form, Make, Bulk, or other Conftitution, as makes it Receptive and Retentive of the Impreffions of Light and Colours, which none of the other Bodies are capable of. Which may a little be explain'd by the Matter of the Phosphoros made of the *Bononian* Stone, or that found out by *Baldwinus* made of Chalk and Niter; which Matters are fo made and adapted by the Chymical Preparations of them by the force of Fire and Mixtures made in their Proceffes, that they, fo foon as expofed to the Impreffions of Light, receive and retain thofe Impreffions, though for no long time, yet enough to fhew us a Specimen of a certain Qualification not to be found in moft other Bodies, which may yet poffibly be done much more powerfully and effectually by the Chymiftry of Nature in the Digestions and Preparations made in the wonderful Elaboratory of the Animal Body; where all things are ordered and adapted by the
the

Lectures of Light.

the All wise Creator, for the Work to be done: So that nothing can be imagined wanting or redundant to perform what is by his Intention design'd to be done.

Another sort of Matter I suppose to be that which is fitted to receive the Impressions of Sound, somewhat like those Bells or Vases which *Vitruvius* mentions to be placed in the antient Theaters, which did receive and return the Sound more vigorous and strong; or like the Unison-toned Strings, Bells or Glasses, which receive Impressions from Sounds without, and retain that Impression for some time, answering the Tone by the same Tone of their own. And though in these Examples (which I am fain to bring for Explication only) there seems wanting the great Requisite of a Power to retain for a long while those Impressions which are so given, they all of them losing them in a very short time; yet, as I shall by and by shew, they do and will each of them retain their several Impressions long enough to make them sufficient for producing the same Reactions whenever they are again acted upon. And such an Impression I shall prove is again given both by the Soul and by succeeding similar Sensations: For having Potentiality of receiving, and being excited by such Impressions, they do again renew their former Impression, and afresh shew their Power, in the same manner as the Musical String or Bell, or the well prepared *Bononian* or *Baldwin* Phosphorus do each shew their Natures, when the one is struck or agitated by Motion, and the other acted upon by Light.

The like appropriated Materials I suppose also for the Impressions of the other Three Senses, *viz.* Smelling, Tasting, Feeling; each of which are qualified to receive and retain the Impressions from the other Senses. As for instance the Smell being caused by a subtil and curious Exhalation from the odoriferous Body imbibed by the Air, the Olfactory Nerves are prepared with an ærial Body fit to dissolve or imbibe that Substance in the same manner as the Air does from the odoriferous Body; which ærial Body, by means of the Olfactory Nerve, having an immediate Intercourse and Passage to the Brain, does immediately convey it thither:

And

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And according to the nature of this ærial or spirituous Substance with which the Olfactory Nerve is furnished, so does it dissolve or imbibe this or that Exhalation out of the Air. Whence I conceive that it is of distinct Natures in every Species of Animals, and thence that every one of them have distinct Sensations of the same *Effluvia*, and that which is congruous and agreeing to one, is of a contrary nature to another; and thence what is grateful to one is odious to another. And again, what is sensible to one sort of Creature, who has an ærial Substance fitted to dissolve and imbibe such or such a Steam, is wholly insensible to another that wants that ærial Substance, and is furnished with one of a differing Nature. Which I conceive to be the reason, why Dogs and other Creatures have so strong a Faculty of smelling the Scent of Animals, or the Flesh of them, which are very hardly discoverable to a Man. On the other side, in probability Man is sensible of many things, as the Smell of Flowers, Herbs and Fruits, which possibly a Dog does very little, if at all scent.

The like may be said of the Taste, which I conceive lies only in the Nature of the watery Liquor conveyed by the Nerves of Taste to the Tongue, according to the Nature of which for dissolving this or that Substance of the Bodies touching it, is the Impression of Taste conveyed to the Brain. And so we may see a clear Reason why one Taste may be tasted by one, which is not by another, and why one Taste is pleasant to one Creature which is not so to another, and how a Body becomes gustable or tasteless, and how that which is tasteless in it self may be made tastable, and why that which is tastable may be made tasteless. Of both which kinds I could give hundreds of Instances which would much confirm this my Theory, and shew what Improvements of this kind could be made. The like, I conceive, is to be said of an adapted Matter for receiving and retaining the Impressions of Feeling, somewhat after the nature of the warming Stone, and several other such Substances, which do imbibe those Impressions more readily, and retain them for a longer time. Now I do suppose, that the Repository is continually supplied with a sufficient quantity of those

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those kinds of Substances, with which the Sense does continually form Ideas, and dispose of them into the Repository of Memory, and that without those Materials, and the concurrent Impressions of the Senses, it cannot form them: For otherwise a blind Man would have Ideas of Colours, which yet he has not, and a sick Man would have a true Idea of Tastes, which yet he has not.

But to return to the consideration of the Place or Repository where these Ideas are form'd and retain'd.

4. I suppose there may be about this place, which I will henceforward call the Center, a certain Sphere of Capacity fill'd with adapted Matter, for the Formation, Reception, and containing of all the Ideas which shall be emitted from the said Center. 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 no 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.

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I will suppose further, that the Soul may every moment, partly by its own immediate Power, and partly by the help of the Impressions produced by the Senses, form one of these Ideas, and insert it into the Repository. Which Moments in some Men may be more, in some may be less, within the same compass of time, according to the Activity of the Soul it self, and according to the Aptitude or Unfitness of the Matter to be wrought upon. So that in some there may be Four of them formed in a second Minute of Time, in others possibly not One in two Seconds of Time: And according to the Perfection and Aptness of the Matter to be formed, and the Activity of the Soul in performing its Effects, so are there more of these Ideas formed within the same Space of time. So that a Man of an ordinary Constitution of Soul and Body, that is, one of a middle Degree between the more active and quick, and one of the more slow and dull, may within the
compass

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compass of his Life, supposing he should live to a hundred Years of Age (which yet not one of a hundred thousand thousand does arrive to) form within that compass of time, and store up in his Repository, a thousand Millions of distinct Ideas; all which may have followed each other in a continued Series, beginning with the time of the first Advertency of the Child, and continuing to the time of the actual Separation of the Soul and Body at Death, Which I thus compute: A hundred Years contain 36525 Days, and 36525 Days contain 876600 Hours, and 876600 Hours contain 3155760000 Seconds. Now one with another, when the Soul is intent and acting, there may be 3600 formed within the compass of an Hour, and so one in a Second of Time. So that if the Soul could through the whole Course of 100 Years be continually so intent, and so acting and forming these Ideas, and inserting them into this Repository or Organ of Memory, there might be there reposed 3155760000 Ideas. But by reason of Sleep interposed, one third Part of the Number will be taken off, the Soul then for the most part ceasing to form Ideas, or when it does, they are only imperfect and lost. So that there will remain but 2103840000, or to take a round Sum, but 21 hundred Millions. Now if we examine this remaining two thirds of Time or Moments, and therein consider what part of the time remaining is lost in Infancy, Old Age, Sickness and Inadvertency, we may well reckon that two thirds of these remaining Moments are lost, and no Ideas at all formed in them; and so instead of 21 hundred, there will remain but the number of 7 hundred Millions. And if we again consider how small a part of these are industriously and carefully stored up, we may very well agree, that not above a seventh Part of these are stored up: And so one hundred Millions may be a sufficient Number to be supposed for all the Ideas that may have been treasured up in the Organ of Memory through the whole Course of a Man's Life, though of a hundred Years continuance; and consequently one Year with another may be supposed to add to this Store about one Million of Ideas. But if we consider how much this will amount to for every Day, we shall

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shall find that yet the Number is very much too big, and must be yet very much diminished: For when we consider that this will still make 2738 Ideas for every Day of the hundred Years; and if a Man considers with himself how many he conceives he may have added to his Store in one Month next last past, I am apt to think he will conclude, that one with another, it will be enough to allow one Tenth of that Number for the Number of Ideas that have obtained a Place in this Repository, the Organ of Memory. So that if a Man allows but two or three hundred a Day, nay, but one hundred for every Day he hath lived, since he was born to his present Moment, he will find that Number large enough to contain all the Ideas he has really stored up in the Organ of his Memory. As supposing a Man of fifty Years of Age, who according to that compute must have lived 18262 Days; and consequently if you reckon but a hundred for each Day, must have 1826200. It will be very hard, I conceive, for a Man of that Age perfectly to remember so many distinct things, though yet I will not say it is impossible. But supposing he could by recollecting remember 100 Millions, and consequently must have as many distinct Ideas, I see no Reason why all these may not actually be contained within the Sphere of the Activity of the Soul acting in the Center. For if we consider in how small a bulk of Body there may be as many distinct living Creatures as here are supposed Ideas, and every of these Creatures perfectly formed and endued with all its Vegetative and Animal Functions, and with sufficient room also left for it to move it self to and fro among and between all the rest, so as to pass by every one and touch none, we shall not need to fear any Impossibility to find out room in the Brain where this Sphere may be placed, and yet find room enough for all other Uses, of which we may afterwards assign some very necessary.

But to return to the Description of this Organ. I do suppose that what we call Attention is nothing else but the Action of the Soul in forming certain Ideas, which for the present I will call little Images, which bear the Stamp, Seal or Mould according to which the Soul formed it in the Center of the Repository.

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I suppose further, that these are continually formed by the Soul in the Center, and the present always protrudes those that were formed before it further into the Repository. So that the greater the number of Ideas are that have succeeded any ones Formation, the greater is the Space of Time of which we have a Sense: and the Ideas become further and further removed from the Center and more and more new-form'd Ideas interpose themselves between the Center and the said Ideas placed in Orbs at a greater distance, by the intrusion of fresh Ideas between the Center and them.

I suppose further, that all these Ideas, though they may for a long time retain the Forms and Motions impress'd on them by the Senses, and by the Action of the Soul; yet notwithstanding they being material, and so subject to change, I conceive, that as the Motions may in time decay, so the Form may (by shifting and changing place in the Repository or Organ of Memory, and being protruded farther and farther from the Center or Seat of the Soul, and crowded into Orbs, though further off, yet closer and closer stuffed and crowded together) be in time alter'd, and sometimes quite lost.

I suppose further, that the Soul being seated in this Center, and there acting, as I said, by the help of the Information and Impressions of the Senses, and forming continually new Ideas, and so protruding them onwards, and filling the Sphere of the Repository fuller and fuller from the Center, increasing outwards. I suppose, I say, that this Soul by its Radiation does actually apprehend, or as it were feel, or is sensible of any Idea that remains treasured up within this Repository: And this it becomes sensible of, partly from its own Power of Radiation, and partly from the Re-action of the Ideas. It becomes, I say, sensible of them, wherever placed within the Repository; partly by its own Radiation, by which it acts upon the fluid Spirits incompassing it, propagating from it self every way *in Orbem*, a Radiation like the Sun, by which, as by a Stick, it becomes sensible of all those Ideas that are yet unwaisted within the Repository, feeling as it were their Form,
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their Resistance, and their Re-action to its Radiations: Partly, I say, only by their lying in the way of the Radiation, and partly also by their re-acting and repercussing a Radiation back upon the Soul. By the Distance of it from this Center the Soul becomes sensible in some measure of the time in which the Idea was made, and how long since it was inserted, there being so many Orbs of later or more inner Ideas formed and lying between them, which have been since inserted.

By this means it becomes sensible of many Ideas that accompanied that Idea, when made, many of them having kept the same Order in which they were made; though oftentimes other Ideas, not formed immediately before or after intrude and thrust in themselves between, out of the order they did really succeed in, so as often to interrupt and break the Chain or Order of Insertion.

I conceive further, that besides the natural Decay there may be of the Form and impressed Motion of the Ideas, there may be also an Impediment to this Radiation of the Soul, by the Interposition of other Ideas between the Center and the Idea sought, much after the manner as the Earth interposing between the Moon and the Sun, hinders the Sun from radiating upon the Moon. And in such case the Idea may sometimes be thought to be lost, which yet may afterwards be found again when the Obstacle is removed.

Again, as in the Radiation of the Sun, which is as it were a Representation of the Soul of the World; the Radiation of the Soul is more powerful upon Ideas at a nearer than at a further Distance; and their Reaction is also more powerful back again, and that in a duplicate proportion to their Distance reciprocal, much the same with that of Light, which is the most spiritual Action of all we are sensible of in the World. And thence it is, that the Memory of things long since done is for the most part very faint, unless in some cases, where the Impressions made upon those Ideas were at first very powerful, or often recalled, which may be laid to be a new forming of them.

I suppose further, that though by means of the continual Radiation of the Soul into this Repository or Organ of Memory, it has
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at all times sense of all the Ideas that are there reposed, yet that Sense is but imperfect and confused by reason of the Multitude; yet can it readily exert its Power more particularly and strongly to this or that Idea, according to the Determination of its Will. And whensoever it is upon the Action of Thinking, that is, of fixing or darting its Radiation more powerfully upon this or that Idea placed in the Repository, it does according to the Power of its Radiation receive a more sensible Impression or Repercussion from those Ideas upon which it radiates, and thereby it does not only apprehend their Qualifications more distinctly, but also it does as it were renew or refresh the former Impressions, and add to them a further degree of Perfection. And so though they are in a Place farther distant from its Center, and by the length of time or the number of Ideas that have been since inserted, and so lie in the way of Communication, it become more faint and weak in the retaining the first Impression, and consequently in its re-acting Power; yet by this second Action or Radiation of the Soul upon it, its Form and Qualifications are renewed and perfected, and for the future it becomes more powerful than the rest of those at the same or lesser Distances, that have not been by such second Radiations so renewed and invigorated; and besides every such Action of the Soul does create and form a new Idea at the Center, which has Impressions that are the Result of those renewed Actions: And this having somewhat the like Figure and Motions or Qualifications, it has a Sympathetick Agreement with the other; and the Impressions from the one do more readily make the Impressions from the other more sensible, in the same manner as a Musical String being moved, does make another String that is unison or harmonious with it, move also, and so together make the Sound the louder, or the Impression the stronger.

Next, as I suppose there is a continual Radiation of the Soul into the whole Repository of Ideas, so I do conceive likewise that every Idea so placed being so qualified as above, by particular Impressions of Motions, which continue for a long time so to move, as they were at first impregnated, does from such its Power
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so retained, radiate a Motion of its own, which may in some manner also act upon the Soul, so as to excite it to Attention; and by this means also whenever any Idea is created and impregnated with Motions or Qualifications similar to those of other Ideas placed at some distance in the Repository, the concurrent Impressions or Re-actions of those similar Ideas upon the Soul at that time do make the fainter to be the more notable, and so excite the Soul to Attention or Radiation that way also; and by that means it has an Excitement to be more sensible of the other also at that moment: And this I take to be that Impression which we are sensible of, when we say, This brings to my Mind, or This puts me in mind, or this makes me remember, &c.

5. I do further conceive, that that Action of the Soul which we call Thinking, is a more particular Radiation of the Soul to this or that part of the Repository, or on this or that Idea placed in it, and at the same time forming new Ideas in the Center of the Repository; which Action of the Soul in framing new Ideas at the Center, is continued almost every moment: And though it doth not every moment make a distinct Idea, yet may it be perfecting of one, and giving new Impressions every moment: And thence I conceive the Body of one Idea (for as I before mention'd, I suppose them to be really corporeal and material) may have many and various Impressions and Motions annexed to it, possibly of 100, nay of 1000 Moments, whence that Idea may be supposed to be more compleat and perfect in it self: And when it again comes to be acted upon by the Radiation of the Soul, all the Impressions or Qualifications thereof become of Power to affect the Soul with those Impressions which it had formerly received from the Soul.

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So that Thinking is partly Memory, and partly an Operation of the Soul in forming new Ideas.

Another and more compleat Action of the Soul, is the forming new Ideas from the comparing the Re-actions from several Ideas placed here and there in the Repository, and its being sensible of the Harmony or Discord of them one with another, which
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does produce an Idea wherein all those various Respects are in some means united and impressed upon one and the same Idea. This is an Idea of greater Perfection, and according to the Attention of the Soul in being sensible of more and more variety of former Ideas, and the Regularity and Order of its proceeding in that Action, and the more steady and distinct manner in the Course and Progress of it, so is the Idea more compleat, as well as more compounded: And this I conceive to be that Action of the Soul which is commonly called Reasoning; and the Conclusion is the new Impression made upon the Idea informing from the comparison of other Ideas which may be contain'd in the *major* and *minor* Propositions.

Now according as the Repository is stored with more and more Ideas, so has the Soul a greater variety to range and expatiate into, whether these Ideas are only the first and more simple, such as are the Results from the Impressions of the Senses; or the more compounded, such as are made by the Result of comparing several together: And therefore accordingly the Ideas that are made from fewer and more simple Ideas, are less compounded Ideas; and those which are made from a greater number, and those more compounded Ideas, are yet more and more compounded, and more and more accomplish'd and perfect. This will give some Reason why the younger and first Results of the Actions of the Soul in forming Ideas, are more simple and less perfect, and from whence the Results of the Actions of the Soul in the elder Years, become the more compounded and perfect.

The Soul a self-moving Principle.

The Soul then is the *Primum movens*, the self-moving Principle, which has in it self a Power of radiating every way *in Orbem* from its Center of being every instant and for ever, and so is always by means of that Radiation every where as it were actually present, in every point of the Sphere of its Radiation though yet it may be supposed to be more immediately and powerfully present in the Center of its Being. It is not, I conceive, possible to be truly understood or described, but only by Similitude; and the best Similitude for that purpose I conceive, is the Sun in the great
World

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World.

Now if we consider the Sun in the Great World, we shall find it first a Being which has in it self a Power of radiating or dispersing Light into the Whole of Nature, and (consequently by this its Influence) of being as it were every where present, and of being sensible of all those other Bodies that are placed any where throughout the whole *Expansum*: For as it doth by its Radiation influence and affect every Point of the Universe, so must there be a kind of reflex Influence upon it self from every such Point: For as any one, and every one Ray it sends forth, does meet with and affect any Body in its way, so consequently must that End of the Ray that touches the Sun, have a greater or less Resistance to be moved forwards; and consequently if there were Understanding in the Sun it self, it must be sensible that this or that Ray does somewhere in its Progress receive such or such an Impediment to its Propagation or moving forwards that way. And be not only sensible, that somewhere that Ray meets with an Impediment, but it may be sensible also at what distance that Impediment or Re-action is given to its Progress: For supposing the Resistance or Re-action of all those impeding Objects, where-ever placed, to be in themselves equal, the Impediment or Resistance to that End of the Ray that is moved by the Sun, must receive a Resistance proportion'd to the nearness of the impeding or re-acting Object; and consequently the Impediment made thereby upon the End of the Ray protruded by the Sun, must be reciprocally proportionate to the Distances of the impeding Object; and consequently by the proportion'd Resistance or Re-action of the Objects, there is a manifest Distinction at that End of the Ray that touches the Sun, of the Distance of the Object touched by it. Next by the number of the Rays that receive Impediment from that Object, there is a manifest Distinction of the bigness of that Object; for if the Angle of the Cone of Rays that receive Resistance from any Object, be actually made and has its Being at the Sun, and that the Distance of that Resistance be likewise distinguishable at the Apex of it at the Sun, then is there a Manifestation or Indication

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at the Superficies of the Sun (by means of this Radiation) both of the Distance of the affected or affecting Object, and of the Angle or Magnitude of it at that distance, and not only of the Magnitude and Distance, but of the differing nature of the Resistance or Re-action of the Object of such a bulk and such a distance, by the consecution of momentary Impressions. This I could plainly demonstrate by a Similitude drawn from the Action made upon the Organ of Hearing, from which the Ear is not only inabled to judge of the Magnitude and Distance of the Sound, but of the Flatness and sharpness, the Musicalness and not Musicalness by the like Distinctions in it.

But it may be much better explain'd by the Eye, wherein we find, that though there be no Radiation immediately emitted by the Eye, which would make the Reactions to the Center the stronger; yet is the Eye able by the reflected Reactions only of Objects that are acted directly upon by the Sun, to discover the Figure, Colour, Magnitude, Distance, &c. of all Objects from which there can come to it self that free Radiation; So that the Soul in the Center of the Repository, is sensible of all the Ideas placed in it, as the Eye is sensible of all things that are placed before it.

Next, if we consider the Sun in the Great World, we shall find it to be placed in the Center of a Space, all which Space and all Bodies placed within that Space, it does more particularly influence by an attractive Power of drawing all bulky Bodies to it, or of commanding all the Motions of them; and consequently may have sense of the Renitency of Bodies, as well as of the Motions and Distances of each of them. So that all Bodies, more especially within the Sphere of its Activity, do receive a double influence from it; first of being radiated, inlightned and vivified; and secondly of being regulated and govern'd in their Motions by it. And hence the Bodies so placed, as they have each of them peculiar Properties, Shapes and Motions of their own, so have they also particular Influences, Radiations, Excitations and Regulations communicated to them from the Sun, which gives them

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them not only their regulated Motions and Positions, but also a kind of new Being or Activity, by which they become visible and sensible to the rest of the World, which would otherwise be dark and insensible, and vagrant here and there uncertainly in the *Expansum* of the Universe. So that the Soul forms to it self a Microcosm, or Picture of the Macrocosm, in which it radiates, and is sensible of every thing contain'd therein, in the same manner as the Sun in the Macrocosm.

Somewhat of this kind is the Influence of the Soul upon the Ideas placed within the Sphere of its Radiation: And though I cannot conceive how the Soul, which is incorporeal, should move and act upon the Ideas which are corporeal, or how those on the other side should by their Proprieties, Qualifications and Motions, re-act upon and influence the Soul; yet I am assured, that such Effects are performed both by the one and the other Beings; and without them, neither the Sensation, Cognition, Remembring, nor Ratiocination, could be performed; all which are plainly the Results of the conjunct Influences of the Soul, and the Ideas or Bodies placed within the Repository or Sphere of its Activity.

Now though by what I have been saying, I have endeavour'd to shew that the Soul has by its Radiation a more than ordinary and commanding Power over all the Ideas placed within the Repository; yet I would not be understood so to limit its Sphere of Radiation, as not to suppose that it may have a much bigger Sphere of influencing Power, and thereby may extend it, not only to all and every Point of the Body inlivened and preserved by it; but possibly it may extend even out of the Body, and that to some considerable Distance, and thereby not only influence other Bodies, but be influenc'd by them also. And upon this account I could produce a Multitude of Observations and Reasons, to prove not only the Possibility, but the Probability, nay almost Certainty of such an Influence, and this from the sensibleness of others Ideas, *Lupus in Fabula, Fascination, &c.* of which possibly some other time.

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Here our Author leaves off, nor as I can find, ever reassumed this Subject; and though possibly some Persons may imagine that the foregoing Explication of these abstruse Actings of the Soul is too mechanical, and tends to the making the Soul a material Being, yet I hope the candid Reader, perusing it without prejudice, will not find the least Cause for such an Imputation, it being throughout the whole Discourse asserted and shewn to be a Spiritual, Immaterial and Self moving Principle; and it is granted by all Men, that it both acts and is re-acted upon by Body, only our Author supposes the Pictures conserving the Ideas to be material, which I hope cannot justly give offence: Howsoever, as I have said in the Preface, I hold my self not in the least obliged to defend or maintain any of his Opinions or Discourses, but fairly present them to the Ingenious as he left them. The next that follows is a Discourse of Comets wrote about Michælmas in the Year 1682, containing a Physical Hypothesis and Explication of them, from Observations made of one that appeared in August 1680, and on that very unusual one appearing in December the same Year, and the beginning of the next Year, and on the following in August 1682. Wherein, after an Introduction, and setting down several Opinions of Authors that have wrote of Comets, he gives us his own Observations, Hypothesis and Explication. R. W.

FINIS.

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