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Ideas in the Brain: The Localization of Memory Traces in the Eighteenth Century

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PLATO SUGGESTS IN THE *Theaetetus* that we imagine a piece of wax in our soul, a gift from the goddess of Memory. We are able to remember things when our perceptions or thoughts imprint a trace upon this piece of wax, in the same manner as a seal is stamped on wax. Plato uses this metaphor to explain the errors which arise when we mistake something for something else: we connect the perception of an object with the trace belonging to another. The metaphor can also be used in explaining differences in people's mnemonic capacities: rapid learning and forgetting correspond to soft wax, impure wax results in muddled traces, etc.¹ If we locate the traces in the brain instead of in the soul, Plato's metaphor gains consistency and turns into a testable hypothesis. This move was already made by Quintilian.²

So, the metaphor of memory as traces in the brain is evidently not a modern invention. This is easy to understand. To frame the hypothesis one needs only to reflect on how we use objects outside our brains for mnemonic purposes. We conserve ideas by tracing or printing letters and words on paper. We are also able to conserve images in drawings, paintings and prints. What could be more natural than to think of memory as the formation of traces in the brain? The development of even better information storage techniques in the form of pictures, symbols, and signs provides the metaphor extra plausibility. Plato's seal allows us to imagine the imprint of a person's likeness, but modern techniques of information storage and retrieval make it even easier to imagine memory in general as the formation of material traces.

Explaining memory in terms of material traces could, of course, be taken

¹ Plato, *Theaetetus*, 191c–195a.

² Cited in Michèle Aquien, *Dictionnaire de rhétorique* (n.p.: Livre de Poche, 1996), entry Mémoire.

to mean that the formation of material traces in the brain is merely a necessary condition of memory. But one could also take a more reductionistic stance which *identifies* memory with the formation of material traces. Furthermore, one could identify specific mental items (sensations, ideas, memories) with specific physiological events or anatomical entities in the brain. This seems especially plausible if we imagine that the traces in the brain are as discrete and separate as ideas or memories are in our minds. Since the traces we form or print on paper consist of discrete letters and words, the thought that the traces in the brain are equally discrete and separate comes easily. Plato, in fact, made separateness a condition for the memory to work properly: it is not easy to read signs printed on one another.³ Of course, no traces are actually visible in the brain. But they are easy to imagine, as it is to imagine explanations of psychological phenomena, such as association, based on these traces.

At the end of the seventeenth century, explanations of mental phenomena referring to material traces in the brain were used by writers, from Platonists to materialists, who supported widely different theories about the nature of the human mind.⁴ In fact, as I will show later in this paper, the question of the possible identity of mental entities, like ideas or sensations, with material entities or traces in the brain is relatively independent of the question of the existence of an immaterial soul. Or rather, if there is a systematic connection between the answers proposed to these two questions in the eighteenth century, it is not the connection one would expect. Nowadays we often tend to think of a prototypical materialist as someone who makes radical reductionistic claims about the identity of mental phenomena with brain states. We also tend to think of the eighteenth-century French materialists as "mechanistic."⁵ In view of this reputation, it may come as a surprise to find that some eighteenth-century materialists, notably Denis Diderot, were in fact consistent anti-reductionists and opposed to mechanical or mechanistic explanations of the mental.⁶ In fact, the epithet "mechanistic" is misleading even when applied to the philosopher who is traditionally presented as the paradigmatic example of a "mechanistic materialist," Julien Offray de La Mettrie, the author of *L'homme*

³ *Theaetetus*, 195a.

⁴ Heikki Kirkinen, *Les origines de la conception moderne de l'homme machine* (Annales Academiae Scientiarum Fennica, series B, vol 122, Helsinki 1960), passim.

⁵ For the historical sources as well as a criticism of this view, see Timo Kaitaro, "The eighteenth century French materialists and 'mechanistic materialism,'" in J. Alavuotunki, A. Leikola, J. Manninen and A. L. Räisänen, eds., *Aufklärung und Französische Revolution II* (Publications of the Department of History, University of Oulu, no. 3, 1987), 66–83; or Kaitaro, *Diderot's Holism: Philosophical Anti-reductionism and Its Medical Background* (Frankfurt am Main: Peter Lang, 1997), 12 and 239.

⁶ See Kaitaro, *Diderot's Holism*.

machine.⁷ Perhaps it is equally surprising to discover that some of the dualists were quite keen on identifying mental phenomena with specific material entities or events in the brain.

In this paper I will examine some, mainly French, eighteenth-century discussions related to the localization of traces. The focus will be on the different models proposed for their localization, the evidence or reasons put forward to defend or deny their localization, and the relationship of this theme to wider philosophical positions (mainly materialism and dualism). I will begin with theories defending the doctrine of localizable traces in the brain. I call the proponents of these theories localizationists and their critics anti-localizationist, though I am well aware that in this context these terms have a meaning which is distinct from the sense they have in the history of scientific neuropsychology proper. In contrast to the neuropsychologists of the nineteenth century, who assigned specific areas in the brain for different kinds of traces, the eighteenth-century authors were concerned with the abstract possibility of localizable traces in the brain.

1. THE LOCALIZATIONISTS

1.1. *Association and the Contiguity of Traces*

When Hume wrote his *Treatise of Human Nature* (1739), the idea of traces in the brain was already a commonplace. In introducing his principles of association, *resemblance*, *contiguity* and *causation*, Hume does not inquire into their physiological causes. However, he later observes that it would have been easy “to have made an imaginary dissection of the brain, and have shown why upon our conception of any idea the animal spirits run into all the contiguous traces, and rouse up the other ideas, that are related to it.” Though Hume, as a consistent empiricist, wants to avoid such hypotheses, he has recourse to one when he explains mistakes in reasoning and sophisms in philosophy by the hypothesis of the animal spirits falling into contiguous traces instead of the proper ones. Hume’s reluctance to use this kind of explanation is expressed in his formulation:

But though I have neglected any advantage, which I might have drawn from this topic in explaining the relations of ideas, *I am afraid* I must here have recourse to it, in order to account for the mistakes that arise from these relations. (emphasis added)⁸

Hume’s circumspection is justified: explaining the association of ideas by contiguous traces is not only going beyond experience, but a pseudo-explanation as

⁷Ann Thomson, “L’homme machine, mythe ou métaphore?” *Dix-Huitième siècle* 20 (1988): 368–376.

⁸David Hume, *A Treatise of Human Nature*, L. A. Selby-Bigge, ed. (Oxford: Oxford University Press, 1928), Bk. I, Part II, Sect. V, 60–61.

well. The explanation actually presupposes what it should explain. One should also be able to explain—without referring to psychological association—why the traces corresponding to the ideas related to each other by association happen to be contiguous.

Despite its vacuousness this explanation was popular in the eighteenth century. Its popularity is understandable. It solves the problem raised by Descartes' explanation of association. Descartes had explained association by the claim that the routes by which the animal spirits pass and which have been opened earlier together tend to open simultaneously when a part of them is opened.⁹ Descartes does not, however, provide any explanation why this would happen. That the traces are considered contiguous permits one to imagine a quasi-mechanical explanation for this fact.

This conjecture, that the traces of ideas which are related by association are contiguous, was already presented in the seventeenth century. The Cartesian Louis de La Forge cites Chanet's *Traité de l'esprit de l'homme et ses fonctions*¹⁰ which explains that letters and words make us think about the object to which they refer, because the "species" that they send to sense organs and those of the objects themselves encounter one another in the same part of the brain. La Forge notes, however, that this could only explain what happens when we speak about (sensible) bodies, but the explanation would not work in the cases where we talk about God, the angels, or our thoughts, i.e., things for which no sensible species exist. The second point that La Forge makes concerns the supposition that the image or species that is received by the ear when a person's name is pronounced ends up in the same place as the image coming from the eyes in seeing him. According to La Forge this is unlikely, since the nerves serving these two senses have different origins. In addition, he notes that it would be difficult to conceive how two or more figures could subsist in the same part (*particule*) of the brain. Third, La Forge considers that when we read a book it can make us conceive objects we have never seen or heard of before: nature should have put the corresponding species beforehand into the same part of the brain as the species of the words and letters.¹¹

La Forge's criticisms are pertinent. His first objection could, however, be dealt with by adopting materialism and an empiricist theory of knowledge: if the terms for which no corresponding sense-impressions exist are meaningless, as Hume had claimed, there is no need to explain how their meaning

⁹René Descartes, *Oeuvres complètes*, 12 vols., Charles Adam and Paul Tannery, eds. (Paris 1897–1913), vol. XI, 178–179; *Oeuvres philosophiques*, 3 vols., Ferdinand Alquié, ed. (Paris: Garnier, 1963, 1967 and 1973), vol. I, 452–453.

¹⁰Printed in Paris 1649 by Augustin Courbé.

¹¹Louis de La Forge, *Traité de l'esprit de l'homme* (1665) in *Oeuvres complètes* (Paris: Presses Universitaires de France, 1974), 169–170.

arises. The empiricist theory in its Lockean form, which refers to complex ideas as arising from the conjunction of simple ideas, would also take care of the third objection. The second objection is the hardest to overcome.

1.2. *Sense Modalities and the Localization of Traces*

There is, however, one case in which the similarity of ideas could plausibly be correlated with the contiguous localization of traces. In his first philosophical work *Histoire naturelle de l'âme* (1745), also known as *Traité de l'âme*, as it was titled in his *Oeuvres philosophiques* (1750), La Mettrie presents a theory which is vulnerable to the criticism presented by La Forge. But he also mentions a case—that of sensory modalities—where the contiguity of traces could be reasonably explained by anatomical considerations. This explanation actually refers to the separate origin of the sensory nerves, a fact which La Forge used in his objection. La Mettrie, who as a materialist is not vulnerable to the two other objections made by La Forge, suggests, like Hume, that the corporeal impressions in the brain corresponding to ideas which are connected are often contiguous. This explains, according to La Mettrie, why the soul cannot discover one trace or idea without remembering others that have usually accompanied it.¹²

La Mettrie draws attention to the fact that one word can help us to remember a verse we have forgotten. According to him, this shows that ideas have “separate territories, but with some order.”¹³ The phenomena of memory can be explained mechanistically because the traces of ideas that follow each other mentally in association are anatomically contiguous. The beginning of the verse, a sound in the ears, communicates its impression to the part of the brain which is “analogous” to the one where the first vestige of what one is searching for, that is, the trace or memory of the following verses, is found. La Mettrie notes that in order for this mechanism to work, it is necessary that new ideas are regularly taken to the same place where similar ideas have been earlier engraved. La Mettrie adds that his theory can also be proven by the fact that certain pathologies of the brain can cause a loss of one sense without affecting others. La Mettrie mentions a case of blindness due to a commotion of the brain as well as a case of a complete loss of memory.¹⁴

If one compares La Mettrie's explanation of association with Descartes' explanation, one notes that La Mettrie moves a step towards explaining what Descartes could not explain: the fact that the traces of objects or of properties

¹²J. O. de La Mettrie, *Histoire naturelle de l'âme*, or *Traité de l'âme* (“La Haye: Jean Neaulme,” 1745/1750), chap. X, § x.

¹³“Les idées ont des territoires séparés, mais avec quelque ordre.” Loc. cit.

¹⁴It is difficult to see how the latter example would support La Mettrie's idea of the localization of traces, but evidently he wanted to present it as evidence of the fact that memory depends on traces in the brain which can be destroyed by organic pathology.

presented earlier together tend to get “associated” (and in the corresponding order as their ideas are associated in the mind). He explains this by the contiguity of the traces. The problem with his explanation, however, is that in doing this he has to invoke another inexplicable fact. His explanation supposes, as he himself acknowledges, that new ideas are regularly taken to the same place where similar ideas have earlier been engraved. He has not actually provided a satisfactory general solution to La Forge’s second objection. But, in so far as the similarity of ideas refers to the identity of sensory modality, La Mettrie’s model works, precisely for reasons put forward in La Forge’s objection. In developing his argument, La Mettrie sketches a theory that was to prove useful in the nineteenth century. Instead of the centralistic seat-of-the-soul model he presents a regional localization of traces according to a functional division: that of the sensory modalities.¹⁵

When La Mettrie poses the question concerning the seat of the soul, he locates it in the origin of the nerves at the beginning of the medulla.¹⁶ But, since he has already observed that there is no common gathering point for the nerves,¹⁷ he adds that this seat of the soul is more extended than one generally supposes. He goes on to draw some consequences from this extension:

Si le siège de l’âme a une certaine étendue, si elle sent en divers lieux du cerveau, ou ce qui revient au même, si elle a véritablement différentes sièges, il faut nécessairement qu’elle ne soit pas elle-même inétendue, comme le prétend Descartes.¹⁸

The fact that the soul is extended is used as a materialistic argument against Descartes’ dualism. La Mettrie also refers to the possibility that the soul may actually have not one but many seats. He writes that considering all that has been said concerning the diverse origin of the nerves and the diverse seats of the soul, there might be some truth in all these opposing opinions. Since the maladies of the brain suppress one sense rather than another, depending on the part they affect, the different localizations might all be equally true. The soul might be actually spread out in the whole of the brain:

¹⁵ Cf. the strategies combining functional localization with the localization of memory traces in the nineteenth century, for example, the localization of traces related to different linguistic functions by Broca and the other eighteenth-century localizationists. Charcot uses the term “partial memories” for such memory centres involved in different linguistic and motor functions. See, for example, I. Rosenfield, *Invention de la mémoire: Le cerveau, nouvelles données* (Paris: Eshel, 1989); H. Hécaen and J. Dubois, *La naissance de la neuropsychologie du langage 1825–1865* (Paris: Flammarion, 1969); and J. Gasser, *Aux origines du cerveau moderne: Localisations, langage et mémoire dans l’œuvre de Charcot* (Paris: Fayard, 1995).

¹⁶ *Op. cit.*, chap. X, § vii.

¹⁷ *Ibid.*, chap. IX.

¹⁸ *Ibid.*, chap. X, § viii.

Nous pourrions donc appliquer à toute la moelle du cerveau, ce que Virgile dit de tout le corps, où il prétend avec les Stoïciens que l'âme est répandue. En effet où est votre âme, lorsque votre odorat lui communique des odeurs qui lui plaisent, ou la chagrinent, si ce n'est dans ces couches d'où les nerfs olfactifs tirent leur origine? Où est-elle, lorsqu'elle aperçoit avec plaisir un beau ciel, une belle perspective, si ce n'est pas dans les couches optiques? Pour entendre, il faut qu'elle soit placée à la naissance du nerf auditif, etc.¹⁹

Thus La Mettrie concludes that the soul is actually located in diverse parts of the brain, corresponding to the different pathways through which sensations enter. La Mettrie claims that this does not involve supposing a plurality of souls, only that the soul is extended.²⁰

This localization, which refers to functional differentiation instead of the similarities and associations of ideas, is more plausible than the theory which takes for granted the correspondence between associative "mental contiguity" and anatomical contiguity. Generalized, La Mettrie's idea parallels Charcot's "partial memories" which correspond to different functions each having their own localization.²¹ However, La Mettrie lacks a coherent view of what functions other than sensation might be localized. Partly this is due to the sensualism that he defends in *Histoire naturelle de l'âme*: if all other mental functions can be reduced to sensation, there is nothing else to localize.²²

When La Mettrie talks about the seat of the soul, this should, however, be taken with a grain of salt. In the Cartesian scheme the seat of the soul refers to the place where the immaterial soul interacts with the body. When a materialist has recourse to the term he obviously uses it in a different sense, or merely as a rhetorical device in the deconstruction of the idea of an immaterial and unextended soul. La Mettrie's own doctrine of the soul in the *Histoire naturelle de l'âme* is a curious mixture of Aristotelian and scholastic terminology of substantial forms, vegetative and sensitive souls and the like, and of more or less mechanistic Cartesian-like physiological explanations of mental functions. All of this La Mettrie later gave up in *L'homme machine* (1747), which does not contain detailed mechanistic explanations of mental phenomena.²³ That La Mettrie no longer discusses the problem of the seat of the soul in his mature

¹⁹ Ibid.

²⁰ "... une seule suffit sans doute avec l'étendue de ce siège que nous avons été forcés par l'expérience de lui accorder." Ibid.

²¹ See note 15 above.

²² In his *L'homme machine* (1747), where the sensualistic elements are not so dominant, La Mettrie does not discuss the question of the localization of mental functions.

²³ *L'homme machine* contains a critical remark on the "author of the *Histoire de l'âme*" (the book was published under a pseudonym), who is blamed for having recourse to the "ancient and unintelligible doctrine of substantial forms." La Mettrie's *L'Homme Machine*, Aram Vartanian, ed. (Princeton: Princeton University Press, 1960), 189.

work can be taken as evidence for the interpretation which sees his extension of the seat of the soul to the brain as a whole as a rhetorical move towards getting rid of the whole notion of the seat of the soul—and consequently of the immaterial soul for whom this seat was reserved. The relationship of La Mettrie's mature materialism to reductionistic mechanism on the one hand, and to his own early materialism in the *Histoire naturelle de l'âme* on the other, is quite complex and cannot be addressed here in full.²⁴ What is significant in terms of the conclusions of this paper is that in developing a consistent materialist doctrine La Mettrie seems eventually to give up both mechanistic explanations and attempts at localization.²⁵

1.3. *The Ultralocalizationist Theory: Ideas and Fibers*

During the eighteenth century some writers presented much more radically localizationist theories than the one sketched by La Mettrie. A theory according to which each simple idea is produced by the oscillation of one determinate fiber, and compound ideas by the contemporaneous vibrations of several fibers, is mentioned and attributed to Dr. Jean Astruc in Chambers' *Cyclopaedia* (1728).²⁶ The article "Cerveau" in Diderot's and d'Alembert's *Encyclopédie* reproduces the passage, but the article observes that such ideas have so little evidence for them that it is not worth stopping to examine them.²⁷ François-Joseph Collet defended this idea in a thesis at the Medical School of Paris in 1763. According to Collet each idea has its own fiber. Following Astruc's theory, which correlates the properties of judgements with physiological events, Collet even divided these fibers into two classes: the fibers corresponding to subjects and those corresponding to attributes.²⁸

This idea was also taken up by Charles Bonnet, who discusses the phenomena of memory and its physiological correlates in his *Essai analytique sur les facultés de l'âme* (1760). In fact, Bonnet subscribes to the localization of the seat-of-the-soul type. He locates this seat at the point where all the nerves are

²⁴ These questions have been adequately and intelligently addressed in Ann Thomson's article already cited (see note 7).

²⁵ According to Ann Thomson's excellent analysis, what is left of mechanism in *L'homme machine* is not a "man-machine thesis" but a metaphor (*Art. cit.*).

²⁶ Cited in John Yolton, *Locke and French Materialism* (Oxford: Clarendon Press, 1991), 107.

²⁷ "Mais toutes ces choses sont si peu démontrées, qu'il paroît inutile de s'y arreter . . ." *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers* 17 vols, Denis Diderot and Jean Le Rond D'Alembert, eds. (Paris: Briasson, David, Le Breton & Durand, 1751–1765), vol. II, 863b. (The article is signed by Tarin.)

²⁸ Yolton, *op. cit.*, 106–109. According to Astruc, a judgment is affirmative when the number of vibrations of the fiber that gives the idea of the subject is equal with that of the fiber which produces the idea of the attribute. Correspondingly, if the vibrations are unequal, the judgment is negative (*ibid.*).

gathered together.²⁹ But in addition to this, Bonnet presents a theory localizing specific memory traces, which is similar to the one presented by Astruc and Collet. Bonnet has no doubts about the fact that memory is a corporeal function, because the causes which affect memory and which result in its weakening, destruction, or fortification, concern only the body. He refers to medical evidence, maladies and accidents affecting memory.³⁰ “It is not the soul that conserves, it is the body,” he claims.³¹

First Bonnet discusses the possibility that reminiscence is based on the conservation in the brain of the mechanical energy of the movements which give rise to ideas. Bonnet discards this explanation because such movements are bound to be too short-lived to serve as basis for memory.³² Instead he proposes that memory depends on the disposition of the sensory fibers to repeat the movements caused by objects.³³ This disposition is based on changes in the original molecules of which it consists, or changes in their respective positions.³⁴ The transmission of the sensations might be effected either by vibrations or by the movements of fluids. Bonnet leaves the question of the details of the mechanisms open.³⁵ To explain how the mechanism might work in the case that the impulses are transmitted by fluids, Bonnet observes that though animal spirits are incapable of conserving impressions, their action can be modified by the solid parts.³⁶

After Bonnet has discarded the possibility that the diversity of sensations might result from the diversity of the movements of the same fiber,³⁷ Bonnet subscribes to a theory according to which each sense has appropriate fibers for the different kinds of sensations that the sense can excite in the soul.³⁸ Bonnet seems to forget the possibility that the sensations might be discriminated by the patterns of sensations, by “figures” transmitted by many fibers, as Descartes had claimed.³⁹ This neglect is probably due to his analytic method, which always

²⁹ *Essai analytique*, §§ 27–30. Bonnet observes, however, that it is in fact inappropriate to talk about the location, the seat of the soul, since properly speaking only bodies are located. Thus, one should rather speak of the place where the soul is present in the brain (*ibid.*, § 27).

³⁰ *Ibid.*, § 57.

³¹ “Ce n’est pas l’Ame qui conserve, c’est le corps.” *Ibid.* §. 95.

³² *Ibid.*, § 55.

³³ *Ibid.*, § 58.

³⁴ *Ibid.*, § 66.

³⁵ *Ibid.*, § 31.

³⁶ *Ibid.*, § 68.

³⁷ *Ibid.*, § 77ff.

³⁸ *Ibid.*, § 85.

³⁹ Timo Kaitaro, “La recherche du siège de l’âme: Descartes, La Peyronie et la neuropsychologie moderne,” *Actes du congrès L’esprit cartésien* (Paris, August 30–September 3, 1996), forthcoming, or “Descartes’ Dualism and the Localization of Mental Functions,” in Tuomo Aho and Mikko Yrjönsuuri, eds., *Norms and Modes of Thinking in Descartes* (forthcoming in the series *Acta Philosophica Fennica*).

looks for simple elements. The fibers are in a sense the simple elements of the organs.⁴⁰ In Bonnet's system they correspond neatly to the Lockean or Condillacian simple ideas: the analysis of sensations and that of the body end up in corresponding elements.

Bonnet explains associations between sensations and between sensations and the signs of language by the communication of fibers, which can either be immediate or mediated by other bodies.⁴¹ His explanation does not thus require that the traces are actually contiguous. However, he connects this communication with the localization of the seat of the soul by reasoning that the different fibers must communicate in the seat of the soul, since all kinds of sensations are able to recall one another.⁴² Fibers which have been simultaneously affected (*ébranlées*) acquire a tendency to affect one another reciprocally.⁴³ In addition, the brain has a tendency to form a habit of reproducing perceptions in the same *order* in which they have constantly succeeded each other.⁴⁴ Bonnet's explanation for the latter fact is not, however, entirely convincing. From the reasonably plausible claim that the movements of the fibers dispose them to the same movements, he reasons that the repetition of these movements in the same order disposes the fibers to execute the movements in this order.⁴⁵ He attempts to provide a quasi-physical explanation of this mechanism, the details of which need not concern us here.⁴⁶ But the important point, as far as localization is concerned, is that Bonnet's explanation is based on the interactions of the fibers. It does not require that the fibers are contiguous. Bonnet's localization is limited to the two extremes: the seat of the soul and particular ideas.

Bonnet's mechanistic theory may sound materialistic and reductionistic, but, in fact, he was a dualist. This kind of ultralocalizationist theory was often combined with dualism. For example, Astruc was an occasionalist.⁴⁷ The reasons for this seeming paradox are revealed in Astruc's criticism of materialism in his *Dissertation sur l'immaterialité et immortalité de l'âme* (1755). Starting from the premises that sensation, ideas, judgements and volitions are indivisible, he reasons that thoughts cannot be produced mechanically by matter, by a machine formed of parts.⁴⁸ He also claims that the advocates of a material think-

⁴⁰ *Essai analytique*, § 96. Later Bonnet even analyzed the fiber into elements, thus considering it to be actually complex and not simple (see below).

⁴¹ *Ibid.*, §§ 601 & 789ff.

⁴² *Ibid.*, § 795.

⁴³ *Ibid.*, § 641.

⁴⁴ *Ibid.*, § 624.

⁴⁵ *Ibid.*, § 629.

⁴⁶ *Ibid.*, §§ 641–649.

⁴⁷ See Yolton, *op. cit.*, 63.

⁴⁸ [Jean Astruc] *Dissertation sur l'immaterialité et immortalité de l'âme* (Paris: La Veuve Cavalier & fils, 1755), 10–16.

ing substance are either forced to admit the absurd divisibility of ideas, or that sensations, ideas, affirmations, or volitions of the soul are associated with (*portent sur*) only one part of matter.⁴⁹ In so far as materialism involves an attempt to explain the mental as the result of the complex organization and structure of material entities, the latter strategy (of attributing mental properties to simple parts of matter) is not a very satisfactory strategy from the materialist point of view. It would give parts of matter inexplicable spiritual properties, without the possibility of a mechanistic or functional explanation in terms of the complex organization of material entities.⁵⁰ Thus it is not so surprising that ultralocalizationist theories are basically dualistic. For a dualist there is no reason to doubt that the laws of the mind-body union instituted by God could not correlate specific mental phenomena with the movements of simple fibers. But for a materialist it is much easier to imagine mental phenomena could be produced by a complex material organization rather than by a simple fiber. Of course there is the possibility of regarding the latter as examples of the former: fibers might actually be complex organs.

1.4. *Fibers as Organs*

In the short *Analyse abrégée* of his *Essai analytique* contained in his *Palingénésie* (1769), Bonnet notes that he has considered each fiber a small organ with its proper function, like a small machine, whose functioning results from its “primordial structure” which, in its turn, depends on the “nature and arrangement of [its] elements.”⁵¹ Though he refuses to consider these elements as simple bodies, he takes them to be the constituent parts of a small organ, comparable to the different pieces of a small machine. This internal constitution causes the fiber to receive, transmit, and reproduce the impression of the object to which it is appropriate. Just as the structures of the eye and the ear makes the former react to light and the latter to sound, the different fibers involved in vision react to rays of light of different color, because of the differences (in their internal structure) which correspond to the variations in the rays of light.⁵² In the *Essai* Bonnet writes that each fiber is a small machine destined to produce a certain movement. The capacity of the machine to execute this movement depends on

⁴⁹Ibid., 14–15.

⁵⁰In fact, Diderot tended to think that some kind of primitive sensibility is a fundamental property of matter, but he combined this idea with an emphasis on organization, which transforms the passive and merely potential sensibility into an active sensibility of the kind encountered in living organisms. Thus the universal and primitive sensibility of matter is different from the developed sensibility of the whole organism. See Kaitaro, *Diderot's Holism*, 103–106.

⁵¹“J’ai jugé que l’effet de la Fiber doit résulter essentiellement de sa Structure primordiale, & celle-ci de la nature et de l’arrangement des *Elémens*.” Bonnet, *Palingénésie philosophique*, 2 vols (Geneva: Chez Claude Philibert et Barthelemei Chirol, 1769), vol. I, 18.

⁵²Ibid., 18–19.

its internal structure (*constitution*) which distinguishes it from all other similar machines.⁵³ Thus nature has varied the structure of the sensible fibers so that they correspond to the prodigious variety of sensations which we experience.⁵⁴ No wonder Bonnet was a preformationist: for someone living before Darwin, it would be hard to imagine how such correspondence could be the result of anything short of divine providence.

Bonnet thus gives a quasi-mechanistic explanation of the correspondence between sensations and fibers. Curiously, instead of considering that the function of each fiber is determined by its functional role in the context of a larger structure, he wants to explain their specific function, in a quite reductionistic and mechanistic way, by their own internal structure. Thus they are treated analogously to organs each having a specific function. Since these small organs correspond to the simple ideas of sensationalist psychology, psychological phenomena can always, after proper analysis, be correlated with their anatomical and physiological counterparts. What is localized is not so much psychological functions but mental elements: sensations and ideas. From this stance, one could probably not go further in localizing the mental. In the question concerning the union of the soul and the body, Bonnet claims to support—not as a fact but as something plausible—the hypothesis of physical influence, that is interactionism.⁵⁵ Perhaps his “naturalistic” and mechanistic explanation of the correspondence of sensations and bodily changes enables him to reject the otherwise tempting solution of occasionalism. In fact, his hypothesis of the fibers as small machines seems to be able to transform the localization of traces into a version of functional localization (the function of the fiber is treated analogously to that of an organ of sense).

2. THE ANTI-LOCALIZATIONISTS

2.1. Antoine La Camus' Anti-Localizationist Functionalism

The author of the *Médecine de l'esprit* (1753), physician Antoine Le Camus, who according to his own remarks could also be described as an occasionalist,⁵⁶ observes that one might object to the possibility that the movement of animal spirits or vibrations of fibers produce ideas. Le Camus replies to this objection by comparing the brain to a watch. The property of telling the time is not to be found in the different parts of the watch. The watch's ability to mark the hours results from “the arrangement, the correspondence, and the unanimous action” of its parts. Likewise, though the fibers of the brain do not have ideas by

⁵³ *Essai analytique*, § 616.

⁵⁴ *Palingénésie*, 24.

⁵⁵ *Palingénésie*, 11.

⁵⁶ See, Le Camus, *Médecine de l'esprit*, 2 vols. (Paris: Ganeau, 1753), vol. I, 49 and 176–177.

themselves, ideas result from “the combination of their size, their length, their dryness, their humidity, their tension, their movement.”⁵⁷ However, Le Camus seems not to notice that what he is presenting is basically a materialist thesis. Or then he was merely masking his real materialistic opinions under the pretence of occasionalism.⁵⁸ His watch-argument was certainly a common materialist device used to defend the view that the mental can be produced by organized matter.⁵⁹

Le Camus’ “functionalism,” that is, his functional account of the mental, does not require localization.⁶⁰ In fact, Le Camus provides criticism of localizationist theories, both of the seat-of-the-soul type (and its variants) and of the theories concerned with local mnemonic traces in the brain. Le Camus presents a review of contemporary theories of the mechanism of memory. The first theory which Le Camus discards is the theory according to which each object we know leaves a portrait engraved in our brain. The portraits are then stored in the brain like a pile of prints (*chez les imagers*). But this is ridiculous, exclaims Le Camus, considering the confusion which would result in the brain of anyone who would receive and store daily the portraits of everything he encounters.⁶¹

The second system Le Camus discards is the theory based on the supposition that objects open up passages in the cervical substance by means of the animal spirits; each time the animal spirits pass again through these channels and reopen these passages, the mind apperceives the object by means of which they were opened in the first place. Le Camus says that this supposition is as false as the first one: if it would be true our brain would end up being a sieve.

⁵⁷ Ibid., 174–175.

⁵⁸ What makes the latter hypothesis plausible is the author’s obvious familiarity with the clandestine materialistic tradition and his possible involvement in the production of clandestine works (a hypothesis argued for by Olivier Bloch in a communication at the *Séminaire sur la littérature philosophique clandestine*; see the abstract published in *La lettre clandestine*, no. 3, 7–8). In fact, the passage quoted above is part of the evidence for this theory: Le Camus had obviously quoted the passage verbatim from a text by Abraham Gaultier which circulated in the form of a clandestine manuscript and which was eventually printed clandestinely in a collection of philosophical texts. For details and references, see Kaitaro, *Diderot’s Holism*, 93–95.

⁵⁹ For some examples, see Kaitaro, *Diderot’s Holism*, 93–95.

⁶⁰ Here I am using the term functional in the sense Aram Vartanian uses it in describing the conception of the soul of eighteenth-century authors who compared the relationship of the soul to the organism with the relationship of the function of a machine to the machine (Aram Vartanian, “Quelques réflexions sur le concept de l’âme dans la littérature clandestine,” in Olivier Bloch ed., *Le Matérialisme du XVIII^e siècle et la littérature clandestine* (Paris: J. Vrin, 1982), 149–163. In contrast to Vartanian, I do not, however, wish to assimilate this conception of the soul, which is compatible with functionalism as well as reductionism, with mechanism. Since one should be careful in identifying this kind of functionalism with functionalism in the sense of the term as used in the modern philosophy of mind (see note 94 below), I prefer the term “functional” or use quotation marks when I use the term “functionalistic” in this less technical sense.

⁶¹ Le Camus, *op. cit.*, 90–91.

Le Camus presents also some more serious and philosophically perspicacious criticisms. He asks what would direct the animal spirits to one channel rather than another. The channels would obviously penetrate one another. Thus the theory would require some kind of *maréchal de logis* which would attend to all the impressions of objects and which would guide the spirits and distribute them to the “quarters where they should dig a particular route.”⁶²

The third theory Le Camus rejects is the theory presented by Daniel Duncan, but which, as Le Camus notes, is originally taken from Thomas Willis. This theory localizes the functions of sensation, imagination and memory in different parts of the brain. Memory is attributed to the cerebral cortex or the “grey matter” (*substance cendrée*). Le Camus criticizes this theory on the same grounds as other “fictions” which imagine that “personified operations of our soul play their role in particular theatres.”⁶³ In the same way he discards Descartes’ theory of the pineal gland, and the other proposed localizations of the seat of the soul.⁶⁴ Le Camus also adds that though he explains all “animal” functions by mechanisms which are executed in the brain, it does not follow that he would establish the seat of the soul in the brain.⁶⁵ He also notes cryptically that there are strong reasons to doubt that the soul could exist in the body.⁶⁶ Written by someone who says that ideas result from combined action of the fibers of the brain and who explains animal functions by the mechanisms in the brain, this incidentally provides reasons to suspect that he actually means that the whole hypothesis of a soul is useless.

Concerning the localization of memory, Le Camus also presents a theory which he considers more plausible than the others and which, he claims, is adopted by “practically all modern physiologists.” This is the theory of folds, a theory which takes the Cartesian metaphor of folds quite literally. According to this theory memory is based on the folds (*plis et replis*) of the small membranes of the brain. However, Le Camus discards this theory on the same grounds as the first one. Only confusion would result from such a mess of folds, whereas our ideas evoke each other *avec justesse et précision*.⁶⁷

Thus the problem with the theories based on the existence of discrete “traces” or “images” that Le Camus criticizes is basically that they fail to account for the order involved in the storage of information. They would either

⁶² “Quel est Le Maréchal de Logis, qui attentif à toutes les impressions des objets, guidera les esprits. & leur attribuera les quartiers où ils doivent se creuser une route particulière?” *Ibid.*, 91.

⁶³ “. . . c’étoit une pure fiction dans laquelle, pour ainsi dire, les opérations de notre ame personnifiées jouoient leur rôle sur des théâtres particulières.” *Ibid.*, 92–93.

⁶⁴ *Ibid.*, 63–65 and 175–176.

⁶⁵ *Ibid.*, 175.

⁶⁶ *Ibid.*, 176.

⁶⁷ *Ibid.*, 94–96.

result in confusion or would require some kind of a homunculus (the *Maréchale de logis*) guiding the process. After his destructive criticisms, Le Camus presents his own “sentiment” on the mechanism of memory.

2.2. *Dissociation Without Localized Cerebral Traces*

Without going into the details of Le Camus’ theory let us note that his explanation of what he calls “sensible memory” (*mémoire sensible*) is similar to Descartes’ account of bodily habits.⁶⁸ This kind of memory enables us to remember something “without the participation of the soul.”⁶⁹ And, like Descartes, Le Camus presents the example of a musician: a violinist who is asked to play a tune which he does not remember exactly, takes the violin and his fingers find the tune for him.⁷⁰ This kind of memory is based on the facility of the animal spirits to flow promptly into the small muscles involved in these well-learned and precise movements.⁷¹ This kind of mechanical memory can be described as the formation of “a habit in the members and in the sense organs.”⁷² It is thus not actually localized in the brain, though there is another kind of organic localization involved: different habits are connected with certain organs instead of others. According to Le Camus, all organs have a mechanical memory of their own.⁷³

At this point Le Camus makes interesting remarks on a phenomenon which in modern neuropsychology is called dissociation. He writes that all organic habits can subsist or perish independently of one another. He cites a case published in the *Journal de Médecine* (in April 1686) of a man who was, after he had recovered from a general paralysis involving all members, left with only his tongue “without movement” and who had not lost any other habits, but for whom it was impossible to write anything but his own name, and this only as a signature.⁷⁴

The other varieties of memory that Le Camus describes involve the interaction of the body and soul. They involve reflection and reasoning.⁷⁵ Le Camus also points out that “reflective memory” which recognized objects either as merely seen or situates them in relation to other events, requires self-

⁶⁸ Kaitaro, “La recherche du siège de l’âme” or “Descartes’ Dualism and the Localizations of Mental Functions.”

⁶⁹ “. . . sans, pour ainsi dire, la participation de notre âme.” *Médecine de l’esprit*, 98.

⁷⁰ *Ibid.*, 98.

⁷¹ *Ibid.*, 99–100.

⁷² “Nous observons donc ici que ce que l’on appelle habitude dans les membres & dans les organes du sens n’est autre chose qu’une Mémoire mécanique.” *Ibid.*, 100.

⁷³ *Ibid.*, 100.

⁷⁴ *Ibid.*, 100–101. Incidentally, this is obviously a slightly inaccurately described and interpreted case of Broca’s aphasia.

⁷⁵ *Ibid.*, 101ff.

consciousness, a consciousness of a temporally continuous self.⁷⁶ Without this consciousness of a continuous self every instant would seem to be the first of our existence, and this would reduce all faculties of the understanding to a first perception.⁷⁷

Le Camus considers that his system follows nature (*est pris dans la nature*) and avoids confusion (cf. the theories he refutes). And it does not postulate any nonexistent entities in the brain.⁷⁸

2.3. *The Migratory Soul of a Materialist*

Diderot agrees with La Mettrie in varying the localization of the soul with the function involved on the one hand, and he follows Le Camus in hinting at the eventual impossibility of localizing the seat of the soul on the other. Since Diderot identified the soul or the mind with the unity of the body, it is natural that he should be sceptical about attempts to find the seat of the soul. In the article "Ame" in the *Encyclopédie* he examines the different hypotheses that have been put forth concerning the subject. According to Descartes, the pineal gland is the seat of the soul. This, Diderot argues, is refuted by the discovery of people whose pineal gland is missing or atrophied but who despite this have retained their senses and reason. He gives credit to the hypothesis of La Peyronie, who thought that the soul is situated in the corpus callosum, as being the only one that has not yet been refuted by experiments. Diderot is, however, afraid that such experiments will be made, leaving the physiologists again in the difficult predicament of not knowing where to locate the soul.⁷⁹ So, the materialist seems to suspect that in the theatre of mental operations the seats might all end up being sold out and the soul would be left standing outside, useless.

In the novel *Les bijoux indiscrets* (1748) one of Diderot's characters presents a curious hypothesis of the migratory character of the soul. Instead of confining the soul in one place, usually in the head, Mirzosa thinks that the soul should be localized in different places in different people and in different ages depending on which part of the body assumes the controlling role. In childhood, when one is more concerned with moving than with thinking, the soul is in the

⁷⁶ "Cette réflexion vient de la conscience que nous avons de l'existence antérieure d'un être qui est le même nous." Ibid., 105.

⁷⁷ Ibid., 105.

⁷⁸ Ibid., 106.

⁷⁹ In fact, A. C. Lorry's experiments in 1760 seemed to refute La Peyronie's results and suggest that the seat of the soul is in the medulla oblongata. At least this was the conclusion that Charles Bonnet drew from Lorry's experiments (Raymond Savioz, *La philosophie de Charles Bonnet* [Paris: Vrin, 1948], 32). What Lorry had actually discovered was the respiratory center (For details, see Edwin Clarke & L. S. Jacyna, *Nineteenth-Century Origins of Neuroscientific Concepts* [Los Angeles: University of California Press, 1987], 217).

feet. From thence it later migrates into the head, though as Mirzosa remarks, there are many people whose soul visits the head like one visits a summer cottage—merely as a temporary habitation. The body is then compared to a great palace, where the soul is able to move from one apartment to another. So talkative people have their soul in their tongue, dancers in their feet, etc.⁸⁰ Though *Les bijoux indiscrets* was not meant as a piece of serious writing, Mirzosa's hypothesis is characteristic of Diderot's thinking. The same theme is developed in the *Lettre sur les aveugles* (1749), in which Diderot speculates that a blind and deaf man, if he were to develop into a philosopher like Descartes, would have his soul in his fingertips, because it is from these that he receives his principal sensations and knowledge. He also says that he would not be surprised if a congenitally blind and deaf man would after profound meditation feel fatigue in his fingers instead of his head. Diderot notes that a philosopher might object to this by pointing out that the nerves are the causes of sensation, and that they all have their starting point in the brain. He says that this argument would not be enough to convince the blind and deaf philosopher that his soul is not in his fingertips.⁸¹ The phenomenological fact that the sensations are situated in the fingertips is in no way affected by such anatomical considerations.

It is, however, not merely a phenomenological point Diderot is making. For the materialist does not need a place in which the interaction of the body and soul takes place. Diderot seems to challenge the whole notion of a single seat of the soul. And in fact his active and nomadic soul is in no need of a seat. Like La Mettrie, he claims that its specific locus changes according to the function involved. But unlike La Mettrie and like Le Camus, he refuses to limit the ground given for mental activities to a single organ and sees them instead as being the result of the workings of the body as a whole.

3. CONCLUSIONS: THE MODELS OF LOCALIZATION IN THE MIDDLE OF THE EIGHTEENTH CENTURY

In the middle of the eighteenth century one can discern two different models for the localization of mental functions. The first model is the centralistic seat-of-the-soul model, which is usually associated with Cartesian dualist metaphysics. This model places the locus of intellectual functions at the point where all the nerves originate and where all sensory information is gathered. This model seems to be already on the wane in the period we are dealing with. There is a growing interest in localizing more and more specific functions or

⁸⁰ Diderot, *Oeuvres romanesques*, Henri Benac, ed. (Paris: Garnier, 1962), 102–109.

⁸¹ Diderot, *Oeuvres complètes*, 20 vols., J. Assézat and M. Tourneux, eds. (Paris: Garnier, 1875–1879), vol. I, 292–293.

parts of the soul. On the other hand, there is a tendency to give up localization altogether.

The model which gradually replaces the traditional seat-of-the-soul model is that based on the existence of mnemonic traces. Traces can be used not only in explaining the physiology of memory in general but also in localizing different "ideas" in various parts of the brain. The "ultralocalizationist" version of the theory associates each idea with a specific fiber (Astruc, Collet, Bonnet). An interesting feature of the fiber model is that memory does not actually concern the simple ideas which correspond to fibers.⁸² Memory consists in the connections between ideas/fibers. In this respect the theory resembles the associationist model of contiguous traces, though the idea of contiguity of traces is replaced by connections. This latter aspect is in fact an improvement: in giving up the contiguity model, one gets rid of La Forge's second objection. But, of course, some kind of *maréchal de logis* seems to be necessary for the traces model in order to prevent the confusion of associations.

In La Mettrie's case we can see the emergence of the notion of localizing mnemonic traces generically, according to a functional division. It seems that the function of sensation provides the most natural basis for localization. This holds for the theory localizing ideas (since according to sensationalists like Bonnet ideas originate in sensations) and for the theory localizing ideas generically, in which case one can localize different sensory functions in different places. In the latter case one can refer to the memory traces model or one can adapt the seat-of-the-soul model by decentralizing it, but without giving up the idea of the gathering point of nerves (La Mettrie provides examples of both strategies).

Not only is the seat-of-the-soul model associated with dualistic metaphysics, there is also a corresponding tendency in materialist writers to be sceptical of this model (La Mettrie, Diderot). This is especially evident in Diderot's article "Ame" in the *Encyclopédie*, where the argument refers to the difficulties in localizing the soul. According to the strategy common in the *Encyclopédie* the reader is discreetly invited to draw the conclusion that perhaps the difficulties of the physiologists in finding the seat of the soul are due to the fact that there is no ghost in the machine in need of a seat. And, in fact, for Diderot, no machine either.⁸³

On the other hand, the ultralocalizationist theory, by being more plausible in the framework of occasionalist dualism, was more or less incompatible with

⁸² Bonnet distinguishes "reminiscence" (*réminiscence*), the experience of familiarity that is involved when we experience the same sensation again, from memory proper. The latter (*rappel*) is essentially a connection between ideas (*liaison des idées*). See Savioz, *op. cit.*, 168–169 and 174.

⁸³ See Kaitaro, *Diderot's Holism*.

materialism. The difficulty of explaining the correspondence between ideas and fibers was, as we have seen, surmounted by Bonnet, only to be replaced by a mechanistic account which required a divine artisan no less than the system of occasional causes.

The connection between a functional account of mental phenomena with materialism on the one hand, and the idea of localized traces and dualism on the other, is also revealed in Descartes' physiology of memory, where the traces corresponding to the functions which did not require the participation of the soul were material, but not necessarily discretely and punctually localized, whereas when the soul was involved there were specific figures localized in the pineal gland corresponding to ideas.⁸⁴ Some later materialists such as Diderot discarded the Cartesian mechanistic account of the animal organism, but stuck to the idea that mental phenomena result from the activities of complex material organisms. It is thus revelatory that Diderot's treatment of memory in the *Éléments de physiologie* does not mention specific traces at all. Nor does he refer to the physiological explanations of mnemonic phenomena which have recourse to such traces. Diderot, however, makes use of the Platonic metaphor of wax in a more general way and suggests that we regard the substance of the brain as "sensible and living wax." Here the wax is, however, no longer a passive recipient of impressions. In order to escape the dualistic presuppositions of the metaphor, Diderot attributes vital properties to the wax by giving it life and sentience. Diderot is thus conscious of the limits and of the dualistic implications of the metaphor. The distinction between signs and their reader necessarily collapses here:

Voilà le livre. Mais où est le lecteur? Le lecteur est le livre même.⁸⁵

Seeing the brain as a book full of signs is not very helpful when one should explain the workings of the psychological subject, the reader. Multiplying signs in the brain can only end up in the regression of homunculi or in an immaterial interpreter of these signs. When functional localization later came to be associated with the localization of mnemonic traces in the latter half of the nineteenth century, we can see the paradoxical situation where an essentially materialistic theory is supporting itself with an idea which can reasonably be claimed to be essentially dualistic.⁸⁶

The relationship of the dualists to the reduction of the mental to the physiological was complex. On the one hand, the supposedly simple and unex-

⁸⁴Kaitaro, "La recherche du siège de l'âme" or "Descartes' Dualism and the Localizations of Mental Functions."

⁸⁵Diderot, *Éléments de physiologie*, Jean Mayer, ed. (Paris: Librairie Marcel Didier, 1964), 243.

⁸⁶See Kaitaro, "La Recherche du siège de l'âme" or "Descartes' Dualism and the Localizations of Mental Functions."

tended nature of the soul was used by the eighteenth-century dualists as an argument against the possibility of reducing the mental to the physiological.⁸⁷ On the other hand, the separateness of the soul seemed to act as an “alibi” for the dualists’ often completely mechanistic physiological speculations on the physiological correlates of mental phenomena. Charles Bonnet’s mechanistic physiology and psychology were far more reductionistic than the respective doctrines of materialists like La Mettrie and Diderot, who tended to think more in terms of emergent properties.⁸⁸ In fact, the separate localization of the immaterial soul served the interests of the reduction of the mental. One could correlate sensation, memory and other mental phenomena with physiological mechanisms like a materialist. And when one was suspected of being a materialist, one could always refer to the seat of the soul and point out that the immaterial soul is actually not concerned in the explanations concerning bodily mechanisms. The physiological project of the dualists was thus intrinsically ambiguous, since it simultaneously insisted on separating *and* identifying the physiological and the mental. In comparison with the materialist, one had the advantage of avoiding the trickiest problems related to the reduction of the mental to the physical, for instance, that of the unity of consciousness. Of course one had the problem of the interaction of two completely different substances to account for. But here one could always refer to the universal laws of the mind-body union instituted by the Almighty, which unfortunately are incomprehensible for our limited understanding.⁸⁹

The materialists did not have the advantage of an immaterial soul to account for the unity of mental life. Diderot solved the problem by giving up physiological mechanism and by espousing the biological holism of the Montpellierian vitalists.⁹⁰ This materialism resulted in a biological and functional account of mental phenomena: the mental was a function of the biological organism as a whole. Though the mental could not be separated from the body, it was not reducible to the mechanisms of the body considered as a physical entity—as merely inanimate matter in motion.

On the whole it seems that in eighteenth-century France the doctrine of the localization of the mental, especially in its most radical form, was associated with dualism. In contrast, scepticism concerning doctrines that localized men-

⁸⁷ Kaitaro, *Diderot's Holism*, 90–96. For the same arguments in the nineteenth century, see Clarke and Jacyna, *op. cit.*, 275–285. Ben Lazare Mijuskovic discusses the history and the various uses of the “simplicity argument” in a larger context in *The Achilles of Rationalist Arguments* (The Hague: Martinus Nijhoff, 1974).

⁸⁸ Bonnet’s mechanistic explanations tended, on the other hand, to arouse suspicions that he was a materialist. See Savioz, *op. cit.*, 37, 133 and 226.

⁸⁹ See for example Bonnet, cited in Savioz, *op. cit.*, 141.

⁹⁰ Kaitaro, *Diderot's Holism*.

tal phenomena in specific parts of the brain was often voiced by materialists.⁹¹ The use of specific reductionistic or mechanistic explanations of mental functions seems also to be more common among dualists. The latter were also keen on making bold hypotheses concerning the correlation of mental phenomena with specific physiological events.⁹² These reductionistic features make the theories of these dualists more than occasionally resemble doctrines that are now called "reductive materialism" or "identity theory."⁹³ On the other hand the doctrines of anti-reductionist materialists like Diderot fit quite well the description of property dualism.⁹⁴

For the eighteenth century writers the preference of one theory or another concerning the localization of mental functions or mnemonic traces was determined by the larger context of philosophical views and solutions. The writers examined here, especially La Forge, Le Camus, and Diderot, quite perspicaciously referred to specific philosophical problems involved in the theories based on the idea of traces. What is also interesting is the fact that most of

⁹¹ Le Camus seems to be an exception, but as we have seen there are some reasons to doubt the sincerity of his occasionalism. That Le Camus' opinions concerning the possibility of localization of the mental are similar to those of the "functionalist" or anti-reductionist materialists discussed here, could, of course, be taken as providing an additional reason to doubt the sincerity of his occasionalism. His idea that the mental is the result of the combination and arrangement of physiological phenomena certainly sounds materialistic.

⁹² We have already mentioned that Astruc identified properties of judgements with physiological events in the brain. Bonnet identified the pleasurable and painfulness of sensations with the quantity of the agitation of nervous fibers (*Essai*, chap. X, § 122).

⁹³ On reductive materialism or identity theory, see Paul Churchland, *Matter and Consciousness* (Cambridge: Bradford/MIT Press, 1984), 26–35.

⁹⁴ For Diderot's dualism, see Kaitaro, *Diderot's Holism*, 243–248. For the definition of property dualism, see Churchland, *op. cit.*, 10–12. It is sometimes difficult to make the distinctions between property dualism, functionalism and reductionism in the case of philosophers who did not themselves use or discuss such distinctions. For instance, as we have already mentioned, some eighteenth-century materialists used arguments which compared mental properties with the capacity of a watch to measure time. One could well ask: does this imply functionalism, or mechanistic reductionism? In so far as the comparison does not present claims about the identity of the predicates attributed to the watch as an instrument of measuring time with its physical properties, it is quite neutral in relation to the reductionism-functionalism distinction. It merely denies that functional properties require an immaterial soul for their explanation. It can also be taken to refer to the fact that it is possible to describe material entities using different levels of description, which need not be reducible to each other. On the other hand, it is difficult to apply the distinction between property dualism and functionalism to eighteenth-century philosophers; we can hardly expect them to be conscious of all the distinctions (for example, type/type vs. token/token identities) involved in theories developed much later. Though Diderot considered some mental and vital properties to be irreducible and took a stand against reductionism, he might not have had anything to say against functionalism in the modern sense of the term—but this is, of course, mere speculation (on modern functionalism, see Churchland, *op. cit.*, 36–42). Jean Deprun has suggested the term "functional dualism" in order to describe Diderot's position. Deprun, "L'anthropologie de Diderot: Monisme métaphysique et dualisme fonctionnel," in Alfredo Manga, ed., *Diderot; Il politico, il filosofo, lo scrittore* (Milan: Franco Angeli, 1986), 115–122.

these authors referred to medico-pathological evidence in dealing with the question. The mind-brain problem and that of the localization of mental functions was in a growing measure also seen as an empirical and scientific question instead of being merely an affair of philosophical speculation.⁹⁵

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⁹⁵ Of course, references to medico-pathological evidence were not completely absent from earlier discussions on the subject. For example, a text from the fourteenth century, Crathorn's *Quaestiones in primum librum Sententiarum* (c. 1330), refers to such evidence in connection with the traditional medieval theory which localized the mental faculties of imagination, reasoning and memory in the cerebral ventricles (Crathorn, *Quaestionem zum ersten Sentenzenbuch* [Münster: Aschendorff, 1988], 157–158). I am indebted to Professor Simo Knuutila for pointing out this interesting reference. The first person to collect case studies and make experiments in a systematic way in order to localize mental functions, or, as it happens, to localize the seat of the soul was probably the French surgeon La Peyronie (1678–1747). See Kaitaro, "La Peyronie and the Experimental Search for the Seat of the Soul: Neuropsychological Methodology in the Eighteenth Century," *Cortex* 32 (1996): 557–564.