

III

IRRITABILITY AND SENSIBILITY: THE FORCES OF LIFE

In his *Anatomie générale*, Bichat wrote “It is easy to see that vital properties are reduced to sensation and motion.”¹ Most physiologists and physicians in 1801 agreed with him, and by referring all living activity to an ability to sense and to move, Bichat was adopting what had become a commonplace assumption. The two properties had been studied even in the ancient world. More importantly for our purposes, they had been investigated anew in the seventeenth century, and they had received particular attention in the preceding fifty years. Bichat’s observations on animals had led him to conclude that there are, in total, five vital properties or subdivisions of sensibility and contractility.

In the mid-seventeenth century, Francis Glisson observed the reaction of fibres in response to a stimulus and made this capacity, known as irritability, the basis of his theory of bodily functions. We have already observed that sensibility preoccupied members of the Montpellier school a century later. Both Glisson and Bordeu believed that sensibility and irritability are intimately linked together in the body in such a way that the one always provides the signal which activates the other. Albrecht von Haller and Robert Whytt denied that they are tied together, claiming instead that they are distributed in various proportions in different organs and parts. That is, certain parts demonstrated considerably more sensibility to stimuli than others, which frequently behaved as though they possess more irritability or mobility. As we shall see, these differences between the various investigators had to do largely with the particular definitions they applied to the two properties. The notion of sensibility and irritability residing in the bodily parts provided Julien Offray de La Mettrie and Denis Diderot with the ingredients they needed to state a coherent materialist theory of living matter by which a soul was deemed unnecessary even to explain consciousness and rationality. The prominence of these various persons in the history of science and of medicine attests to the fact that a good deal of the progress made in physiological theory especially during the second half of the eighteenth century derived directly and indirectly from the study of sensation and motion.

To a large extent, this investigation stood apart from the mechanist-vitalist debate. The men who did the work in the eighteenth century nevertheless frequently declared their allegiance to one or other metaphysical position. Whytt, for example, was an animist though not, he insisted, a Stahlian; Haller had been a student of Boerhaave and, understandably, he considered himself to be a mechanist. The notion that sensibility and contractility exist in the bodily parts, however, was a particularly suitable one with which to defend an organicist or monist vitalism. For example, it suited Bordeu’s and Bichat’s polemical purposes admirably. Like the mechanists, the

¹ Xavier Bichat, *Anatomie générale appliquée à la physiologie et à la médecine*, 4 vols., Paris. Brosson, Gabon, 1801, vol. 1, pp. 99–101, 112–114. See also his *Recherches physiologiques sur la vie et la mort*, Paris, Brosson, Gabon, 1801, p. 130.

animists believed that the body behaves in accordance with mechanical principles but they differed over the origin or source of the body's motion. Bordeu and Bichat, on the other hand, simply denied that physical and mechanical laws had anything substantial to do with living activity. The separation of nature into organic and inorganic realms operating under two separate and distinct sets of scientific laws and principles were at the root of Bichat's vitalist theory. Like the Montpellier vitalists, he argued that organic sensibility and irritability were dominant over the universal physical properties of attraction and gravitation with which they coexisted.

Temkin has shown that such terms as "irritability", "irritable", "to irritate", and "to stimulate" occur in Galenic physiology. Galen himself wrote of a discharging mechanism in such parts as the gall bladder, stomach, intestines, urinary bladder, and uterus. Because they possess an irritable faculty, those organs are able to discharge their products without the intervention of the will or the consciousness.² William Harvey similarly used the notions of irritation and excitation in his study of the reproductive process.³ The modern concept of irritability, however, is normally traced back to *Francis Glisson* (1598–1677), who generalized it in such a way that it came to be seen as an active force, an unconscious biological property spread throughout all parts of an organism.⁴

In his *Anatomia hepatis* of 1654, Glisson considered the irritability of the gall bladder; in the *Tractatus de ventriculo et intestinis* of 1678, he treated tissue reactivity as a generalized principle, an ability of an animal fibre to contract in response to a stimulus. In the earlier work, he linked it to the discharge of bile from the liver to the gall bladder and subsequently into the digestive system. At all stages, it was said to be provoked by plenitude and its signals were mediated by the nervous fluid.⁵

In *De ventriculo et intestinis*, Glisson promoted irritability to being a property that belongs to all the organs, or more specifically, to their component fibres. He visualized these fibres as extremely thin structures which serve as the basic functional elements of the muscles, tendons, nerves, and other organs. They were supposed to be round, flexible, resistant to tearing, extensible, and, of course, irritable. More than a century later, Bichat was to assign the vital properties, including irritability, to elemental tissues, which played much the same role in the body as Glisson's fibres. Both tissues and fibres were seen to be living units that function by responding to irritation or stimuli. Glisson's language, in fact, was adopted eagerly by such as Haller and the Montpellier physicians long before Bichat's time.

² Owsei Temkin, 'The classical roots of Glisson's doctrine of irritation', *Bull. Hist. Med.*, 1964, **38**: 297–328.

³ *Ibid.* See also Walter Pagel, 'Harvey and Glisson on irritability with a note on Van Helmont', *ibid.*, 1967, **41**: 497–514.

⁴ In R. Milnes Walker, 'Francis Glisson', in Arthur Rook (editor), *Cambridge and its contribution to medicine*, London, Wellcome Institute, 1971, pp. 35–47. Though it is commonly accepted that Glisson was born in Dorset in 1597, Walker presents evidence that he was, in fact, born in Bristol in 1598 or 1599.

⁵ Glisson's notion of irritability has been discussed in many places. Among them are Charles Daremberg, 'Glisson – Théorie de l'irritabilité et de la sensibilité', *Histoire des sciences médicales*, 2 vols., Paris, Baillière, 1870, vol. 2, pp. 650–672; Eyving Bastholm, 'Francis Glisson', *The history of muscle physiology*, trans. by W. E. Calvert, Copenhagen, Munksgaard, 1950, pp. 219–225; Walter Pagel, 'The reaction to Aristotle in seventeenth-century biological thought', in E. Ashworth Underwood (editor), *Science, medicine, and history*, 2 vols., Oxford University Press, 1953, vol. 1, pp. 489–509; Walker, *op. cit.*, note 4 above, Pagel, *op. cit.*, note 3 above.

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Glisson distinguished three stages within the process of irritation. These are perception, the fibre's reception of an impulse; appetite, which awakens a desire on the part of the fibres to react; and the motion or execution of a required action. The sensation or perception of plenitude and the consequent irritation or contraction of bodily parts are, therefore, most intimately linked together.

Most bodily processes, of course, are automatic and unconscious, the brain and nervous system not being involved. Considering this unperceived local activity to be confined to the fibre, Glisson labelled it natural perception (*perceptio naturalis*), claiming that it presided over the activity of the heart, stomach, intestines, glands, and so on. He distinguished it from sensual perception (*perceptio sensitiva*), which involves the brain by way of the nerves, and from animal perception (*perceptio animalis*), which is conscious, deliberate, and under control of the will.⁶

As Pagel has shown, this *perceptio naturalis* owed much to the work of Helmont and William Harvey. To account for the development of an egg in his 1651 work *On generation*, for example, Harvey located a kind of irritability or motility in that egg itself, describing the property as “an animal virtue . . . with a principle of motion, of transformation, of rest and of conservation.” Most interestingly, he went on to say that the nature of this “virtue” is such that “if one removes all obstacles from it, it will take the form of an animal.”⁷ Far from living activity being somehow imposed upon the body as the dualists would have it, Harvey assumed an embryonic plastic force which is responsible for formation of the body and which exists prior to the conscious soul and prior to any organs; that is, it belongs in the matter itself. Indeed, it is this very immanence of living forces within matter, at least certain kinds of matter, that is the important feature for us in the systems of Helmont, Harvey, and Glisson. These forces are manifest whenever a particular organization occurs.⁸

For monists then, a basic primeval level of life in the form of natural perception divorced from all sensation may be considered to belong to matter in general.⁹ As we shall see, the basic theme of living forces being released from captivity by a particular form of organization seized the imagination of the *philosophe* Denis Diderot. In the meantime, however, as we have already seen, such views were eclipsed for some fifty years by the view that matter is inert and dependent upon external forces for its motion. Accordingly, iatromechanism and animism divorced matter from its life, thereby separating elements that many persons had hitherto considered to be indissolubly linked together in biological units.

The language of irritability of living parts was resurrected in the 1740s. Bordeu and Haller both built their physiological systems around it. Bordeu fused it on to animists' arguments against iatromechanism. It was a fruitful amalgam which gave him the means for turning his back upon the increasingly limiting dualist systems. Bordeu's work on glandular function easily owed at least as much to that of the seventeenth-

⁶ Francis Glisson, *Tractatus de ventriculo et intestinis*, London, E. F. for H. Brome, 1672, pp. 147–174.

⁷ William Harvey, *Exercitationes de generatione animalium*, London, Typis Du Gardianis, 1651, p. 77. Quoted by Jacques Roger, *Les sciences de la vie dans la pensée française du XVIII^e siècle*, Paris, Colin, 1971, p. 114.

⁸ Pagel, *op. cit.*, note 3 above; Temkin, *op. cit.*, note 2 above.

⁹ A point made by Pagel, *op. cit.*, note 5 above.

century monists as it did to Stahl and Sauvages.¹⁰ The force of sensibility, as he conceived of it, had much in common with both the *archeus*, and with Glisson's natural perception. As early as 1742, Bordeu had argued in his bachelor's thesis that there is a sensibility proper to each organ and that the soul or vital force resides in the nerves. In his doctoral thesis one year later, he speculated that the stomach contracts because its membrane possesses some critical force. Here in embryo were the major themes which evolved into his mature system of physiology.

Bordeu saw irritability and sensibility as being so closely linked as to be inseparable. In the case of salivary glands, for example, he claimed that the activities of eating and speaking provided the irritation which awakens sensibility, which in turn provokes the secretion of humour. The following quotation from the *Recherches sur le poulx* demonstrates that he conflated the two properties, insisting that nerves are essential for sensibility to exist.

Each organic part of the living body has nerves which have a *sensibility* . . . it is the necessary result of their constitution, of their position and their modification in the body or in its parts, when they are not entirely deprived of the conditions in which life can neither be demonstrated nor exist; *sensibility* is of different types, and is more or less co-mingled with *mobility* or *contractility* . . . All the ancient philosophers and physicians thought pretty much the same . . . the *strictum* of the systematists, the tonic motion, fibrillatory motion, stimulus, irritation, setting on edge of nerves, spasm, modern contractility, all this is explained by pretty much the same idea; this is by the *activity* of nerves, the scope of this *activity*, a virtue, a property, a particular disposition which Glisson called *irritability*.¹¹

Nerves transport critical signals which activate the organs and they integrate the actions of the various organs and parts. In the case of glands, for example, they signal the need for a particular humour: they accompany the arteries controlling the blood flow in the region of the gland; and they carry the irritating signal which initiates the secretory process directing glandular sphincters to accept or reject the particular parts of the blood presented to them. While nerves act as pathways for the transmission of directions it is each organ's particular indwelling sensibility that defines its nature and activity. "The eye cannot endure oil which the stomach retains easily and the latter rejects the emetic which makes practically no impression upon the eye." Each part reacts in an active manner to its own peculiar sensibility. "The eye prepares itself to receive light The ear strains itself, opens itself, finally disposes itself to receive sound waves."¹²

The best known of all work on the subject of sensibility and irritability, however, is that of *Albrecht von Haller* (1708–77). A pious and peevish man beset by self-doubts and haunted by religious insecurities, he had a special knack of making professional enemies. Born in Berne, he went to Leiden to study medicine under Boerhaave. Invited in 1736 to be Professor of Medicine at the newly founded University of Göttingen, he remained there for seventeen productive but largely unhappy years. In 1747, Haller published the first edition of his *Primae lineae physiologiae*, which has been described as Europe's first medical textbook. In 1753, much to the annoyance of Göttingen, he

¹⁰See also Elizabeth L. Haigh, 'Vitalism, the soul and sensibility; the physiology of Théophile de Bordeu', *J. Hist. Med.*, 1976, 31: 30–41.

¹¹Théophile de Bordeu, 'Recherches sur le poulx', in *Oeuvres complètes*, 2 vols., Paris, Caille et Ravier, 1818, vol. 1, pp. 420–421. Quoted by Roger, *op. cit.*, note 7 above, p. 626.

¹²Bordeu, 'Recherches anatomiques sur la position des glandes et sur leur action', in *Oeuvres complètes*, *op. cit.*, note 11 above, vol. 1, pp. 156–165.

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gave up his teaching career and medical practice to return to Berne, where he became a court bailiff and, in 1758, a director of a salt works. While a civil servant, he published an eight-volume *Elementa physiologiae*. His decision to give up medical practice in spite of his considerable reputation probably had to do with a revulsion against vivisection at a time when most of his fellow experimenters appear to have been indifferent to the bitter price exacted from animals. In any case, Haller does not seem to have found peace of mind, for he died an opium addict.¹³

Haller confused the discussion of sensibility and irritability of the bodily parts somewhat by insisting that the two terms ought to be defined differently from the way in which Glisson and Bordeu had used them. He equated sensibility with conscious feeling and irritability with observable motion. Upon examining the distribution of the properties, he found that irritability is largely a property of the muscular fibre and sensibility is basically limited to nerves. Furthermore, he observed that the more sensible organs generally possess relatively little irritability while the more irritable ones have little sensibility.

Haller also discussed an automatic and unconscious tendency to self-motion which belongs to muscle fibres. He ascribed to it properties and functions that were much like those Bordeu had assigned to sensibility. *First lines*, in which Haller first described this reactivity, opens with an important discussion of animal fibres, which Haller believed to be the structural elements of the body. “A *fibre*, in general”, he wrote, “may be considered as resembling a line made of points, having a moderate breadth; or rather as a slender cylinder.” He discerned two types of fibres. One is longitudinal and occurs in bones, tendons, ligaments, and muscles, while the other is flatter and occurs in cellular membranes and vessels.¹⁴ Boerhaave had had a similar concept of multitudinous small vessels serving as the basis of all the organs and structures,¹⁵ and it is possible that he and Haller were finally indebted to Glisson, who had discussed fibres before either of them. On the other hand, the general notion of fibres as smallest structures may equally well have been but the inevitable adaptation of the corpuscular philosophy that had emerged earlier in the physical sciences. In any case, the concept permitted Haller to adapt a modified version of Glisson’s irritability and Bordeu’s sensibility to the physiology that he inherited from Boerhaave.

On the heart’s apparently innate ability to move, Haller declared:

There resides in the heart a kind of impatience to stimulus This irritability is greater and remains longer in the heart than in any other part of the body; seeing, by stimulating it, the motion of the heart may be renewed at a time, when that of no other muscle can That motion is *peculiar to the heart itself*; coming neither from the brain, nor the soul; seeing it remains in a dead animal even when the heart is torn out of the breast; neither can it, by any act of the will, be made either quicker or slower.¹⁶

He labelled this “impatience to stimulus”, this “irritability” which derives from the fibres themselves, a *vis insita* (resident force). It is particularly abundant in the heart

¹³ An excellent and perceptive account of Haller’s theory and of its central role in the development of physiology is that of François Duchesneau, *La physiologie des lumières*, The Hague, Nijhoff, 1982, pp. 141–234. See also Lester S. King, ‘Introduction’, to Albrecht von Haller, *First lines of physiology*, trans. and ed. by William Cullen, Göttingen, Wrisber, 1786, reprinted New York and London, Johnson Reprint Corp., 1966, vol. 1, pp. xii–xxiii.

¹⁴ Haller, *op. cit.*, note 13 above, vol. 1, sect. XV, pp. 9–15.

¹⁵ King, ‘Introduction’, *op. cit.*, note 13 above, vol. 1, pp. xxiii–xxxii.

¹⁶ Haller, *op. cit.*, note 13 above, vol. 1, sect. C11, pp. 59–60. The emphasis in the passage is Haller’s own

and intestines, which are observed to contract long after they are removed from the body. It is activated by different stimuli in different parts with the result that the bladder responds to urine, the heart to blood, and so on.¹⁷ He very clearly distinguished this particular reactivity from that which derives from the will:

The heart and intestines, also the organs of generation, are governed by a *vis insita*, and by stimuli. These powers do not arise from the will; nor are they lessened or excited, or suppressed, or changed by the same. No custom no art can make these organs subject to the will, which have their motions from a *vis insita*; nor can it be brought about, that they should obey the commands of the soul, like attendants on voluntary motion. It is so certain that motion is produced by the body alone, that we cannot even suspect any motion to arise from a spiritual cause, besides that which we see is occasioned by the will, as stimulus will occasion the greatest exertions, when the mind is very unwilling.¹⁸

Haller described yet another active but automatic force which belongs to animal and vegetable fibres, including even the hair, feathers, membranes, and the cellular texture. It is a very slow “contractile power”, which resists the stretching of the fibres and restores them to their normal size when the extending power is removed. It is observed in cases of pregnancy, obesity, and so on. But they are dead forces, he said, efficacious after death and not to be confused with such living forces as the *vis insita*, sensibility, and irritability.¹⁹ His description of this force was much like that which Barthez subsequently labelled the *force de situation fixe* and described as a resistance to attempts to disrupt the organism.²⁰ Later still, Bichat stated that a slow extensibility and contractility are properties not of life but of texture.²¹

The muscular power which derives from the will or the soul alone depends upon the nerves. “For the nerve alone has feeling; this alone carries the commands of the soul; and of these commands there is neither instinct nor perception in that part, whose nerve is either tied or cut, or which has no nerve.”²² Whereas the *vis insita* remains after a nerve is cut, the willed power depends absolutely upon an intact nervous supply. This willed contractility and the nervous sensibility were the subjects of two papers which Haller read before the Royal Society of Göttingen in 1752. Entitled ‘On sensibility’ and ‘On irritability’, they contributed much to Haller’s considerable reputation. They were published in many editions, each successive edition growing longer with supplements largely added in response to various critics who took exceptions to Haller’s conclusions. Simon Tissot, a Swiss physician and a friend of Haller, published a French translation of the work in 1755. That same year, there appeared an anonymous English translation based upon Tissot’s and even using his preface.

In it, Haller made it clear at the very beginning that his concern was with conscious and observable properties:

I call that part of the body irritable which becomes shorter upon being touched; very irritable if it contracts upon a slight touch, and the contrary if by a violent touch it contracts but little. I call that a

¹⁷ *Ibid.*, vol. 1, sects. CCCCII–CCCCIII, pp. 233–234.

¹⁸ Albrecht von Haller, ‘A dissertation on the sensible and irritable parts of animals’ (London, J. Nourse, 1755), a contemporary translation from Latin with introduction by Owsei Temkin, *Bull. Hist. Med.*, 1936, 4: 651–699.

¹⁹ Haller, *op. cit.*, note 13 above, vol. 1, sects. CCCXCI–CCCXCII, pp. 226–227.

²⁰ Paul Joseph Barthez, *Nouveaux éléments de la science de l’homme*, Montpellier, J. Martel ainé, 1778, pp. 68–82.

²¹ Bichat, *op. cit.*, note 1 above, p. 130.

²² Haller, *op. cit.*, note 13 above, vol. 1, sect. CCCCIV, p. 235.

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sensible part of the body, which upon being touched transmits the impression of it to the soul; and in brutes, in whom the existence of the soul is not so clear, I call those parts sensible, the irritation of which occasions evident signs of *pain* and disquiet in the animal. On the contrary, I call that insensible, which being burnt, tore, pricked, or cut till it is destroyed, occasions no sign of pain nor convulsion, nor any sort of change in the situation of the body.²³

To determine the distribution of sensibility and irritability, Haller dissected animals of various kinds and ages. After exposing a particular part, he waited until the animal ceased to struggle and complain. To test for sensibility, he subjected the part in question to a blow, to heat, alcohol, the scalpel, acids, and so on. If the animal lost its tranquillity, began to complain, or withdrew the wounded part, Haller concluded that it had sensibility. He found that the skin is very sensitive “for in whatever manner you irritate it, the animal makes a noise, struggles, and gives all the marks of pain which it is capable of.” By the time he dissected down to the fat and cellular membrane, sensibility appeared to have vanished. Deeper still he found that muscular tissue responds to painful stimuli but only if its nerve supply is intact. Tendons are absolutely insensitive, for an animal in whom such an organ is lacerated, burned, or pricked shows no sign of pain. When it is released, provided that even a small part of the tendon remains intact, the animal walks easily apparently with no pain.

In *First lines*, Haller had asserted that nerves alone carry sensibility. He stuck to that conviction in this later work but by so doing, he was forced into certain inconsistencies. Teeth have a nerve supply and as expected, he found them to be sensitive. By the time he came to examine bones, the animal tested was in such pain that no accurate observations were possible. Though bones are made of the same basic substance as teeth, Haller argued, they must be insensible since they have no discernible nerve supply. Though other people had frequently observed that marrow is very painful, Haller thought that to be improbable “as it is of the same nature with fat, and has no nerves bestowed upon it.” When faced with the difficulty of explaining why such viscera as lungs, liver, spleen, and kidneys are sensitive though they possess no nerve supply, Haller pleaded rather weakly that “I do not allege that they are void of all sensation, but only that it is very weak in them, *viz.* such as one would expect in a part which has very few nerves bestowed on it in proportion to its bulk.”²⁴

Haller found that irritability and sensibility exist in a kind of inverse relationship in the parts. While irritability may be mediated through a nerve, there is never any motion in the nerve itself. While cutting or tying the nerve to a part destroys its sensibility, it does not affect contractility. That is, parts of the body that are normally subject to the will are largely paralysed if a nerve is cut, but they retain an ability to contract in response to direct stimulation.²⁵

²³ Haller, *op. cit.*, note 18 above, pp. 658–659.

²⁴ *Ibid.*, pp. 658–673.

²⁵ Haller found that the *sensible organs* of the body are the skin, muscles, teeth, retina, stomach and intestines, genitalia, heart, and nerves. Only a little sensibility is present in the glands and in internal viscera such as the liver, spleen, kidneys, and lungs. The *insensible organs* are fat, cellular membranes, tendons, periosteum, bones, marrow, dura mater and pia mater, omentum and pleura, blood vessels, cornea and iris, and capsulae of the joints. The *irritable organs* are the muscles (including the heart and diaphragm), stomach and intestines, caecum, glands, genitalia, bladder, and lacteals. The *non-irritable organs* are the skin, tendons, periosteum, dura mater and pia mater, mediastinum, omentum and pleura, blood vessels, pericardium, and nerves. This information and the description of the experimentation which led to the conclusions is presented in *op. cit.*, note 18 above.

This work was contemporary with Bordeu's examination of the glands. Haller attempted to discredit this system of "M. Du Bordeu, so severe a critic of the writings of others" when he had occasion to comment upon it. According to Haller, the glands in general have very little sensation for they are supplied with very few nerves. He wrote that "there are no considerable nerves besto'd upon the largest of the glands, nor the *thymus*", and "the nerves which go to the thyroid gland are a great deal smaller than those of a muscle ten times less in bulk than that gland."²⁶ I suspect that Haller was succumbing to a touch of petulance if not downright jealousy, for Bordeu's work was unquestionably impressive. Curiously enough, Boerhaave himself had remarked that glands "receive a great many Nerves, more in Proportion to their Bulk, than any other Body; and which are distributed so minutely throughout the whole Body of the Gland, that they seem to occupy every individual Point."²⁷ It may be that Haller disliked Bordeu's conclusions because they derived from a vitalist orientation. In any case, he disregarded his impeccably made observations and affirmed his own faith in the mechanist viewpoint, which held that pressure upon a gland causes it to expel its juices: saliva, for example, is squeezed out in the mouth when we are not hungry by means of the compression of the digastric muscle.²⁸

Bordeu responded, albeit mildly, to Haller's criticism in his *Recherches sur l'histoire de la médecine*. Though he remarked that Haller's theory was but one of a number on the subject of irritability, he described Haller as "one of the most distinguished medical philosophers of this century". But he pointed out that the Montpellier school had taken the irritability of the parts of the living body to be a general principle before it was studied from Haller's particular viewpoint.²⁹

Haller's most important and long-lasting argument surrounding the question of the sensible and irritable parts was with *Robert Whytt* (1714–64), who had studied medicine in London, Paris, and Leiden before receiving a medical doctorate from Rheims in 1736. In 1746, he took an appointment as professor of medical theory in his home town of Edinburgh, where he quickly developed a reputation as a major physician. He became a fellow of the Royal Society, the first physician to the king in Scotland and in 1763, president of the Royal College of Physicians of Edinburgh.

Like many of his contemporaries, Whytt was interested in the larger subject of organic motion. In 1751, he published an *Essay on the vital and other involuntary motions of animals*, a book which is judged to be his single most important work.³⁰ Whytt's ideas are particularly interesting insofar as he applied animist notions of life and matter to the study of animal activity. Though he had gone to Leiden specifically to hear Boerhaave, Whytt was not only not persuaded by mechanism but downright disdainful of anyone who was. He described the idea that an inanimate machine can

²⁶ *Ibid.*, p. 67.

²⁷ Herman Boerhaave, 'Of the different structure of the glands', *Dr. Boerhaave's academical lectures on the theory of physic, being a genuine translation of his Institutes as dictated to his students at the University of Leyden*, 6 vols., London, W. Innys, 1757–73, vol. 2, sect. 242, pp. 210–211.

²⁸ Haller, *op. cit.*, note 18 above, pp. 673–678.

²⁹ Bordeu, 'Recherches sur l'histoire de la médecine', in *Oeuvres complètes*, *op. cit.*, note 11 above, vol. 2, pp. 668–669.

³⁰ Whytt's *An essay on the vital and other involuntary motions of animals* is discussed at considerable length by Roger French in 'Involuntary motions and the reflex', *Robert Whytt, the soul, and medicine*, London, Wellcome Institute, 1969, pp. 79–92.

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produce heart movement, respiration, or intestinal motion simply by virtue of its mechanical construction as “a notion of the animal form too low and absurd to be embraced by any but the most minute philosophers!”³¹ He added that since the contraction of the heart, motion of the blood, and continuance of life in general cannot be accounted for mechanically, one must have recourse to the “energy of a living principle capable of generating motion”.³²

Whytt dismissed the monists as decisively as he had the mechanists, for he simply could not admit the possibility that animal fibres possess a power of sensation and of generating motion unless these are united by “an active PRINCIPLE, as the SUBJECT and CAUSE of these”.³³ He considered the soul to be the living and unifying principle, insisting, however, that he was not a Stahlian. He particularly objected to Stahl’s contention that the soul acts rationally when it is directing unconscious activity.³⁴ He preferred to consider it to be a sentient rather than a rational principle:

The mind . . . in producing the vital and other involuntary motions, does not act as a rational, but as a sentient principle; which, without reasoning upon the matter, is as necessarily determined by an ungrateful sensation or *stimulus* affecting the organs, to exert its power, in bringing about these motions, as is a balance.³⁵

It is curious that while Whytt rejected the notion of sentient matter, he felt comfortable in imposing a sentient principle, that is the soul, to move the inert matter. It is a good illustration of the tenacity of the mind-matter dualism so characteristic of the seventeenth century. In the *Essay*, Whytt wrote that irritability is a power of the soul, which is awakened by the sentient activity that resides in the brain and the nerves. The muscle which is about to contract “perceives the stimulus”. Thus, as with Bordeu, irritability depends upon sensibility and is its inseparable adjunct. In turn, that sensibility is a function of the central nervous system.

Haller reviewed Whytt’s *Essay*, dismissing what he called the specious Stahlian assumption that all motions proceed from the soul. Unconcerned about the distinctions separating animists, Haller continued thereafter to group Whytt with the Stahlians, apparently oblivious to any number of protests to the contrary.³⁶ Whytt, in turn, reviewed Haller’s work on sensibility and irritability in a 1755 treatise entitled *Observations on the sensibility and irritability of the parts of man and other animals*. He acknowledged in the introduction that these “new and curious experiments” must henceforth produce considerable changes in the theory and practice of medicine. He also took the opportunity to strike back at Haller’s criticism of him by caustically observing that Haller “has taken uncommon pains in making many and repeated experiments; as much to overpower the incredulous by their number as to secure himself from any chance of being deceived.” He proceeded to challenge many of

³¹ Robert Whytt, *An essay on the vital and other involuntary motions of animals*, Edinburgh, Hamilton, Balfour & Neill, 1751, p. 2.

³² *Ibid.*, pp. 270–271.

³³ *Ibid.*, pp. 241–242.

³⁴ *Ibid.*, p. 267.

³⁵ *Ibid.*, p. 289.

³⁶ French, ‘The soul in physiology’, in *op. cit.*, note 30 above, pp. 149–160. French discusses the development of the notion of the physiological role in general as well as Whytt’s particular conception of the soul’s activity.

Haller's observations and conclusions concerning the reactivity of the parts. Haller responded to these observations in the 1756 edition of *On the sensible and irritable parts of animals*, to which Whytt replied again in a 1768 edition of *Observations*.³⁷

Whytt's major criticism of Haller's experimental technique was an elementary one, for he simply pointed out that a great pain will dampen or destroy a lesser one. By the time Haller had opened an animal's thorax, he wrote, the beast was suffering excruciating pain so that the fact that it did not register additional pain when its heart was pricked or cut did not justify the conclusion that the heart is without feeling.³⁸ In general, Whytt challenged many of Haller's basic observations. He refuted Haller's claim that the periosteum and the tendons are insensitive by pointing out that arthritis is very painful. Haller replied that the seat of arthritic pain is in the skin or the subcutaneous nerves. Neither, he added, does phrenitis occur in the dura mater or pleurisy in the pleura, as is commonly assumed, for his own experiments had shown that the dura mater and the pleura are devoid of feeling. Though many physicians report that pain is experienced in the bone marrow, Haller insisted that the organ is insensitive because it is "cellular", of the same nature as fat, and with no visible nerves. When Whytt pointed out that many persons had been heard to complain that the marrow of a cut arm or leg was painful to touch, Haller replied that a single experiment was not sufficient to prove marrow sensibility.³⁹

Haller listed the cornea, kidneys, and glands among the insensitive organs. Whytt pointed out that one feels one's cornea when it is pressed, that a patient feels pain when a kidney is opened in surgery, and that a blow to the testicles or breasts produces much pain. He wrote appropriately that "One instance of this kind is more decisive . . . than twenty experiments on brutes who cannot inform us whether they feel a slight pain or none at all."⁴⁰ Thus the debate proceeded with neither man acknowledging the legitimacy of the other's observations. Whytt denied the existence of an altogether insensitive organ or tissue, pointing out that even those parts that normally seem to be so become painful if they are diseased or inflamed. Though Haller never conceded much credibility to Whytt, it was largely due to peevishness. Bichat was to take up Whytt's point by stating that a normally unconscious sensitivity becomes conscious whenever it is augmented by disease or inflammation.

However much Haller might have objected to having his notions challenged or developed by vitalists like Bordeu or Whytt, the trauma was as nothing compared to that of having them linked with the ideas of *Julien Offray de La Mettrie* (1709–51). The deeply pious Haller was appalled and offended by the work of this outspoken

³⁷ This is described in considerable detail by French, 'The controversy with Haller: sense and sensibility', *ibid.*, pp. 63–76. French also discusses it in 'Sauvages, Whytt and the motion of the heart: aspects of eighteenth-century animism', *Clio medica*, 1972, 7: 35–54. The metaphysical and theoretical differences between the two men are perceptively discussed by Duchesneau, *op. cit.*, note 13 above, pp. 171–234.

³⁸ Robert Whytt, 'Observations on the sensibility and irritability of the parts of man and other animals', in *The works of Robert Whytt*, Edinburgh, T. Becker & P. A. de Hondt, 1768, pp. 251–261.

³⁹ Haller, *op. cit.*, note 18 above, p. 667.

⁴⁰ Haller's responses to Whytt's 'Observations on sensibility and irritability' (*op. cit.*, note 38 above) are in his *Mémoires sur la nature sensible et irritable des parties du corps animal*, trans. by Simon André Tissot, 4 vols., Lausanne, Marc. Mic. Bousquet, 1756, vol. 4, pp. 102–134. In a 1768 edition of his work, Whytt responded in turn to Haller's responses and thus the argument continued. This is discussed by French in 'The controversy with Haller', *op. cit.*, note 37 above pp. 68–76.

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materialist, who was widely vilified as a libertine and an atheist. La Mettrie used basic organicist views and the notions of sensibility and irritability to develop the thesis that psychic or rational phenomena in man depend not upon an immaterial soul but upon physical factors alone. By so doing, he also denied the spiritual element of the human being.

La Mettrie was a native of Brittany.⁴¹ He attended the Paris Medical School for five years but, like many students at the time, he transferred to Rheims to get his medical doctorate at less cost. Then he went to Leiden to study with Boerhaave. He undertook to translate and to annotate the famous physician's medical work, bringing out an abridged translation of Boerhaave's *Institutiones rei medicae* shortly after Haller had completed an edition of it in 1743. To explain muscular contraction, Boerhaave had relied upon the traditional albeit clumsy notion of animal spirits flowing into the muscles. Perceiving the limitations of that theory, Haller had looked for other explanations of muscular motion, as we have seen. La Mettrie was familiar with the work of Haller and very probably with that of other contemporaries, who had examined the nature of muscular activity and of irritability.⁴² The evidence of an organic reactivity became the theoretical tool by means of which La Mettrie gave coherence to his thesis that life can exist apart from any sort of a soul or other vital principle.

In 1742, La Mettrie abandoned his family and a medical practice in his native Saint Malo to go to Paris, where he met many physicians and notable *philosophes*. While serving as an inspector of hospitals for the armies on campaign, La Mettrie composed his *Histoire naturelle de l'âme*, wherein he argued that thought, volition, and all purposive motions of the body are the products merely of the physical organization of the body, a necessary consequence of the unique arrangement of its parts. A decree of the Parlement of Paris in July 1746 acknowledged the importance of the work by condemning it to the flames. La Mettrie left a hostile France for the more liberal Holland.

The following year, his most famous work, *L'homme machine* was published. It appalled even the Dutch. The abuse heaped on La Mettrie reached hysterical proportions, forcing him to take refuge in the court of Frederick the Great in Berlin. The suave and worldly emperor's repulsion at his own pious Lutheran upbringing caused him to be tolerant of persons whom he saw to be victims of bigotry. Writing about La Mettrie, he observed that "Calvinists, Catholics and Lutherans forget . . . that co-substantiation, free will, the mass for the dead and the infallibility of the pope divide them." Like almost everything that emerged from La Mettrie's pen, *L'homme machine* delivered jibes at those persons he thought were too pompous, pious, or self-righteous. The work was pointedly antagonistic to established religion, and even atheistic in its viewpoint; it dismissed the soul as "merely a vain term about which no one has any idea",⁴³ and life after death as "a chimera based upon absurd

⁴¹ Julien Offray de La Mettrie, *L'homme machine*, edited by Aram Vartanian, Princeton University Press, 1960: La Mettrie's life and work are described by Vartanian in his 'Introduction', pp. 1–12. A brief survey of La Mettrie's biological ideas is found in Thomas S. Hall, *Ideas of life and matter*, 2 vols., University of Chicago Press, 1969, vol. 2, pp. 46–56.

⁴² Vartanian, op. cit., note 41 above, pp. 84–89, discusses La Mettrie's debt to Haller.

⁴³ *Ibid.*, p. 180.

reasoning".⁴⁴ The European scholarly world recoiled in indignation.⁴⁵

Today, the thesis of *L'homme machine* does not strike us as being any more fundamentally atheistic than that of any other physiological work described herein. The crucial point is that La Mettrie moved a logical and inevitable step beyond Bordeu, Whytt, and Haller by extrapolating organicism to its logical monist conclusion, maintaining that the rational and conscious processes are a part of the matter of the body. If all living processes derive from organization, there remains no need for an immaterial overseer. The assertion quoted above concerning the "vain term" occurred in the following context:

All the faculties of the soul depend on the proper organization of the brain and of the body so that they are visibly nothing but organization . . . the soul, therefore, is merely a vain term about which no one has any idea and for which a good intellect can only serve to name the part of us which thinks. Given the least principle of motion, animated bodies will have everything necessary for them to move, to sense, to think, to be contrite, and in a word, to conduct themselves in the physical realm and in the moral one which depends upon it.⁴⁶

La Mettrie offered a number of relevant but common observations to demonstrate the existence of a motive principle in living flesh. He remarked that all animal muscle palpitates after death; muscles separated from the body contract when they are pricked or otherwise stimulated; intestines retain their peristaltic motion for a considerable time after death or outside the body; a simple injection of warm water will reactivate the heart or muscles and so on. He was fascinated by a remarkable little creature called a polyp, which, superficially at least, resembles a plant more closely than an animal. A naturalist, Abraham Trembley, had observed that any part separated from the creature can, under certain circumstances, regenerate a complete new polyp in a few hours. It had come to be a kind of *cause célèbre* of the scientific world and its regenerative capacity lent itself to a variety of interpretations. Whytt, for example, believed that it demonstrated the presence of a ubiquitous soul in living matter, while Barthez was confirmed in his theory of the vital principle. For La Mettrie and for monists in general, the polyp's fascinating ability was powerful evidence for a motive force belonging to the parts themselves. It could not help but confirm La Mettrie in his conviction that life has nothing to do with a vital or spiritual principle.⁴⁷

If the source of intelligence and personality is but a consequence of the arrangement of the parts, it follows that the differences between man and the animals are due merely to the degree or quality of their respective organizations. It is conceivable, La Mettrie wrote, that education might be able to bridge the gap between man and the higher animals. In the *Discourse on method*, Descartes had emphasized the uniqueness of human speech, claiming that it is an ability conferred by the soul. La Mettrie, however, speculated that apes might well be capable of learning to speak.⁴⁸ Although some recent anthropologists have come to believe that such speculations may have some foundation, in the middle of the eighteenth century, the suggestion of

⁴⁴ Ibid., p. 196.

⁴⁵ Ibid., p. 95–113. Vartanian describes the reception of *L'homme machine* here.

⁴⁶ Ibid., p. 180.

⁴⁷ Ibid., pp. 180–182. See also Aram Vartanian, 'Trembley's polyp, La Mettrie, and eighteenth-century French materialism', *J. Hist. Ideas*, 1950, 11: 259–286.

⁴⁸ La Mettrie, op. cit., note 41 above, pp. 161–162.

such a possibility was deemed outrageous, which may be precisely why La Mettrie wrote it down.

La Mettrie's man-machine has often been interpreted as an extrapolation of Descartes' beast-machine. King, for example, wrote that "While Descartes had regarded animals as machines, the dualistic philosophy gave to man a soul which the animals lacked and which differentiated a human from a machine. It was only a small step, but a mightily important one, to say that the mind of man was not a separate substance."⁴⁹ Indeed, the title which La Mettrie chose for his work and much of his language in the text invites that interpretation. It may even be that the notion of the beast-machine sparked the initial idea which finally produced the work. Nevertheless, a large conceptual gulf separates the two men, for La Mettrie utterly rejected dualism. The machine he described is composed not of inert, brute matter but of material substance which is vibrantly alive and throbbing with activity. We read, for example, that "The human body is a machine which winds its own springs. It is the living image of perpetual movement."⁵⁰ And, "Let us enter into some detail concerning the innate activity of the human machine. All the vital, animal, natural and automatic notions are due to its action."⁵¹ Near the end of the work, he affirmed, "Let us conclude thus boldly that man is a machine, and that in the whole universe there is but a single substance differently modified."⁵² Therefore, though man is a machine, he is no mere mechanism. Much as La Mettrie must have been imbued by Boerhaave with the notion of mechanical laws governing an organism's behaviour, he was also much indebted to investigations of the motive principles resident in matter itself.⁵³

Though La Mettrie's aggressive atheism appalled his contemporaries, they could not help but recognize him as a prodigal intellectual relation. He maliciously pointed out the theoretical kinship that linked their work to his own. Jerome Gaub, Boerhaave's successor at the University of Leiden, is a case in point. A few months before *L'homme machine* was completed, La Mettrie had heard Gaub read a paper, *De regimine mentis*, which concerned itself with the relationship between mind and body. Proceeding from the assumption that mental phenomena are physically regulated, Gaub proposed the possibility of thus understanding and hence controlling psychic and mental phenomena. Many of his examples were then borrowed by La Mettrie, to the consequent chagrin of the good Christian, sorely tried for a long time by the apparent affinity between his notions and those of La Mettrie. In a 1763 paper, he referred to La Mettrie's presence at the talk he delivered sixteen years earlier:

I do indeed regret bitterly that a little Frenchman . . . brought forth a repulsive offspring, to wit, his mechanical man, not long after sitting before this chair and hearing me speak, and did this in such a way

⁴⁹ King, *op. cit.*, note 13 above, p. xlii.

⁵⁰ La Mettrie, *op. cit.*, note 41 above, p. 154.

⁵¹ *Ibid.*, pp. 182–183.

⁵² *Ibid.*, p. 197.

⁵³ Aram Vartanian has contributed substantially to our understanding of La Mettrie's place among eighteenth-century theorists. In his introduction to a recent critical edition of *L'homme machine* (*op. cit.*, note 41 above, p. 36), he examined La Mettrie's intellectual links with both mechanists and monists, pointing out that his theory was not rooted in any traditional notion of an externally directed machine. The irritability principle led him to a concept of the human machine as a self-sufficient dynamic system of interdependent parts. He labelled La Mettrie's viewpoint a "vitalo-mechanist orientation", for, far from being an extrapolation of the beast-machine, the man-machine's substance throbs with indwelling vitality.

that it seemed to many people that I had furnished him with, if not sparks for his flame, at least matter for embellishing his monstrosity.⁵⁴

The most famous conflict of all was with Haller. In his abridged translation of Boerhaave's *Institutes of medicine*, La Mettrie had borrowed freely from Haller's edition of the same work, but without acknowledging his debt. Haller charged him with deception in a review of his *Histoire naturelle de l'âme*. As if to compensate for his earlier neglect, the still obscure La Mettrie dedicated *L'homme machine* to Haller, prefacing the work with an effusive tribute from "your disciple and your friend". The dedication remained in the 1751 edition, in which La Mettrie also announced that Haller was his inspiration and his teacher.⁵⁵ The testy protestant was left now complaining that he wished no connexion with this "impious system which my experiments totally refute".⁵⁶ The point is, significantly enough, that his experiments by no means refuted La Mettrie, who was correct in seeing a relationship between their basic notions. It was, nevertheless, a cruel game, for the prim Haller was utterly unable to match wits with La Mettrie.

La Mettrie died at the age of fifty-two, reportedly due to an excess of a truffle pâté. His detractors interpreted his untimely end as an act of divine vengeance as if God himself had intervened to refute the materialist philosophy. Today, La Mettrie's well-placed jibes against the pompous and the pious make delightful reading. We are by now sufficiently removed from his milieu and the passions it engendered to see that he was correct to claim a relationship between his own work and that of Glisson and of many contemporaries, some of whom, like *Denis Diderot* (1713–84), even shared many of his ideas about the soul and matter, and agreed with his demonstration.

Neither a physician nor a naturalist himself, Diderot was much preoccupied with

⁵⁴ L.J. Rather, *Mind and body in eighteenth-century medicine. A study based on Jerome Gaub's De regimine mentis*, London, Wellcome Institute, 1965, pp. 115–204. Gaub's reaction to La Mettrie's work is also described by Vartanian, op. cit., note 41 above, pp. 90–92. Vartanian quotes from a letter which Gaub wrote to Charles Bonnet concerning that same 1747 lecture and La Mettrie's attendance at it. He said: "Des esprits malins en tirent des conséquences irreligieuses."

⁵⁵ La Mettrie dedicated *L'homme machine* to Haller with the following words: "C'est le plaisir que j'ai eu à composer cet ouvrage, done je veux parler; c'est moi-même, & non mon livre que je vous adresse, pour m'éclairer sur la nature de cette sublime Volupté de l'Étude. Tel est le sujet de ce Discours. Je ne serois pas le premier Écrivain qui, n'aient rien à dire, pour réparer le Stérilité de son Imagination, auroit pris un texte où il n'y en eut jamais. Dites-moi donc, Double Enfant d'Apollon, Suisse Illustre, Fracastor Moderne, vous qui savez tout à la fois connoître, mesurer la Nature, qui plus est la sentir, qui plus est encore l'exprimer; savant Médecin, encore plus grand Poëte, dites-moi par quels charmes l'Étude peut changer les Heures en moments; quelle est la Nature de ces plaisirs de l'Esprit, si différents des plaisirs vulgaires Mais la lecture de vos charmantes Poësies m'en a trop pénétré moi-même, pour que je n'essaie pas de dire ce qu'elles m'ont inspiré. L'homme, considéré dans ce point de vue, n'a rien d'étranger à mon sujet." Op. cit., note 41 above, p. 143.

⁵⁶ Haller voiced his personal objections to *L'homme machine* as follows: "The deceased M. de la Mettrie has made Irritability the basis of the system which he advanced against the spirituality of the soul; and after saying that Stahl and Boerhaave knew nothing of it, he has the modesty to assume the invention to himself, without ever having made the least experiment about it. But I am certainly informed that he learnt all he knew about it from a young Swiss with whom I am not acquainted: who never was my pupil, not is he a physician, but he has read my works, and seen some of the famous Albinus's experiments and upon these La Mettrie built his impious system, which my experiments totally refute. For if Irritability subsists in parts separate from the body and not subject to the command of the soul, if it resides every where in the muscular fibres and is independent of the nerves, which are the *satellites* of the soul, it is evident, that it has nothing in common with the soul, and it is absolutely different from it; in a word, that neither Irritability depends upon the soul, nor is the soul what we call Irritability in the body." Op. cit., note 18 above, pp. 695–696.

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scientific and technological development. Indeed, he acquired a considerable proficiency in mathematics, physics, chemistry, physiology, and a number of languages. Acutely aware of the great changes which science and the modes of thought accompanying it were producing upon the intellectual milieu of Europe, he plunged boldly and with considerable insight into the examination of many suggestive ideas and their implications. Among the questions that interested him most were those having to do with life, consciousness, and rationality.

Diderot's best-known accomplishment is the popular and vastly influential thirty-five-volume *Encyclopédie* completed in 1780, after some twenty years of toil, but in addition, he wrote extensively on a variety of subjects.⁵⁷ For our purposes, it is instructive to examine the development of Diderot's ideas about living processes. His mature theory, developed by 1769, was so provocative that he dared not publish it. By then, he had come to believe that the whole universe is composed of one single substance which possesses sensitivity. Life, he argued much like Harvey, is not the imposition of vital forces on to matter but a release of sensitivity from its material prison.

In 1746, Diderot composed *Pensées philosophiques*, a work preoccupied with nature's beauty, which he took to be a witness to divinity, but not to the malevolent Christian God whom he eschewed. His more benevolent deity was a kind of master mechanic who oversees natural phenomena including organic processes. The Parliament of Paris found the book to be unacceptable for general reading and condemned it to be burned.⁵⁸

By 1749, when his *Lettre sur les aveugles à l'usage de ceux qui voient* appeared, Diderot had effectively evolved into an atheist. Relating therein a fictitious conversation between a dying mathematician, Nicholas Saunderson, blind from birth, and a Reverend Holmes, Diderot has Holmes trying to persuade Saunderson that one can discern the existence of God in the complex mechanism of the organs, and in the beauty and order of nature generally. Saunderson protests that this need has nothing to do with a sovereignly intelligent being. "If it is a matter of astonishment for you," he asserts, "then that may possibly be because you are in the habit of treating everything that is beyond your comprehension as a miracle." Diderot would have one explain order without resorting to some notion of preliminary design. It might just as well be simply the consequence of the chance union of elements in an infinity of combinations. The viable ones have persisted while others have necessarily disappeared.⁵⁹

While serving three months in the prison of Vincennes for writing the *Lettre sur les aveugles*, Diderot annotated the first three volumes of Georges-Louis Buffon's *Histoire naturelle*. In an effort to distinguish between brute and living matter, Buffon believed that there are specifically organic molecules scattered throughout nature

⁵⁷ Diderot has been the subject of many biographical and philosophical studies. One of the most recent and most satisfying is by Arthur M. Wilson, *Diderot*, New York, Oxford University Press, 1962. A thorough analysis of the development of Diderot's thought in relation to the life sciences and of physiology is provided by Jacques Roger, 'Diderot et l'Encyclopédie', op. cit., note 7 above, pp. 585–682. A very brief survey is provided by Hall, op. cit., note 41 above, vol. 2, pp. 56–65.

⁵⁸ Denis Diderot, 'Pensées philosophiques', in *Oeuvres complètes*, 15 vol., Paris, Le Club Français du Livre, 1969, vol. 1. Roger discusses the work in op. cit., note 7 above, pp. 585–591.

⁵⁹ Diderot, 'Lettre sur les aveugles', in *Oeuvres complètes*, op. cit., note 58 above, vol. 2, p. 196. Roger discusses the book in op. cit., note 7 above, pp. 591–599.

which combine to form composite bodies. Diderot's article 'Animal' in the first volume of the *Encyclopédie* expounded upon just that theme. Buffon's work also influenced Diderot's *Pensées sur l'interprétation de la nature* of 1753, in which he speculated about the nature and origin of living species. Echoing Buffon, he wrote that "matter in general is divided into dead matter and into living matter." But that raised other questions. "How can it be", Diderot asks "that matter is not one, either all living or all dead? Is living matter always living? And is dead matter always and really dead? Does living matter ever die? Does dead matter ever begin to live? Is there any assignable difference between dead and living matter other than organization?"⁶⁰ Eventually these speculations were to terminate in a notion of unity which rejected as irrelevant the distinction between thought and matter, between life and non-life.

Not satisfied with assigning living phenomena to organization, Diderot wrote in 1759 that it is absurd to say that "particle *a* placed to the left of particle *b* has no consciousness of its existence, does not sense, is inert and dead", while if *b* is to the left of *a*, "the whole lives, knows, senses".⁶¹ By 1765, he had arrived at the breathtaking notion that sensibility is not confined to a living organism. Rather, it is a universal property of matter; an inert property in brute bodies, like movement in heavy bodies stopped by an obstacle; a property activated in the same bodies by their assimilation with a living animal substance.⁶² This theme was developed in the *Rêve de d'Alembert* of 1769, a work in which Diderot made Bordeu his mouthpiece. We have already seen that Diderot had contact with various members of the Montpellier school, from whom he commissioned many articles over the years for the *Encyclopédie*.⁶³ His use of Bordeu, therefore, is a clear assertion that his own notions about sensibility were rooted in the speculations of the Montpellier school.

D'Alembert's dream is preceded by a conversation, *L'entretien entre d'Alembert et Diderot*, in which the two men discuss the question of how apparently brute matter is transformed into that which is living and active. D'Alembert is not convinced by Diderot's theory of the universal sensibility of matter. The work opens with d'Alembert, an exponent of the traditional view of matter, admitting that if, like the dualists, one assigns an external motive force to a living body, one must admit to the existence of a spiritual being that possesses contradictory properties. "I confess to a Being who exists somewhere and yet corresponds to no point in space, a Being who, lacking extension, yet occupies space, who is essentially different from matter and yet is one with matter, who follows its motion and moves it, without himself being in motion, who acts on matter and yet is subject to all its vicissitudes." But to reject the contradictions is to move to Diderot's position, which is also fraught with problems, "for if this faculty of sensation, which you propose as a substitute, is a general and essential

⁶⁰ Diderot, 'Pensées sur l'interprétation de la nature', in *Oeuvres complètes*, op. cit., note 58 above, vol. 2, p. 770. Roger, op. cit., note 7 above, pp. 599–614. The work is also discussed in Wilson, op. cit., note 57 above, pp. 187–198.

⁶¹ Diderot, 'Lettre de 15 octobre 1759 à Sophie Volland', in *Oeuvres complètes*, op. cit., note 58 above, vol. 3, pp. 815–821. Quoted by Roger, op. cit., note 7 above, p. 617.

⁶² Diderot, 'Lettre de 10 octobre 1765 à Monsieur Duclos', in *Oeuvres complètes*, op. cit., note 58 above, vol. 5, pp. 949–952. Quoted by Roger, op. cit., note 7 above, p. 617.

⁶³ Roger discusses the influence of the Montpellier physicians in the development of Diderot's philosophy of life in *ibid.*, pp. 631–641.

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quality of matter, then a stone must be sensitive.”⁶⁴

If one acknowledges the existence of sensibility in that stone, then the process of nourishment is understood as one whereby an organism removes obstacles which mask the sensibility. It follows, therefore, that the animists, mechanists, and many vitalists had all committed the same basic error of assuming that life is imposed on to matter such that its properties supersede and dominate the inorganic ones. The truth, Diderot believed, is that life is not imposed but released. When you consume food, he wrote, “you assimilate it, you turn it into flesh, you make it animal, you give it the faculty of sensation.”⁶⁵

Agitated by their conversation, d’Alembert later sleeps uneasily. While asleep, he rambles on in a feverish vision which hovers around questions about the nature of living matter, consciousness, and sensation. Called to attend to the apparently delirious man, Bordeu establishes that d’Alembert’s pulse and respiration are normal, then settles down to assist Mlle de Lespinasse, d’Alembert’s mistress, to extract the implications that follow from the dreamer’s visions. Their part in this drama is said to have angered d’Alembert and Mlle de Lespinasse, but Bordeu’s reaction is not recorded. In any case, it is not overly difficult to imagine Bordeu expressing many of the ideas Diderot presumed to attribute to him in this work.

Diderot has Bordeu explaining growth and the attendant acquisition of sensibility as follows:

You begin as an imperceptible speck, formed from still smaller molecules scattered through the blood and lymph of your father and mother; that speck becomes a loose thread, then a bundle of threads. . . . Each of the fibres in the bundle of threads was transformed solely by nutrition and according to its confirmation, into a particular organ. . . . The bundle is a purely sensitive system. . . . This pure and simple sensitivity, this sense of touch, is differentiated through the organs that arise from each separate fibre; one fibre forming an ear, gives rise to a kind of touch that we call a noise or a sound.⁶⁶

Consciousness is merely an organizational refinement of sensitivity confined to the brain, which is the common centre of all the sensations, as sight belongs to the eye and hearing to the ear. With Bordeu’s approval, Mlle de Lespinasse draws the appropriate materialist conclusion which is that differences between human beings and animals are finally only organizational. “Where the origin or trunk is too vigorous in relation to the branches, you have poets, artists, imaginative people, cowards, fanatics, madmen. When it is too weak, you get so-called brutes and savage beasts. Where the whole system is slack and soft, without energy, you get imbeciles; where the whole system is energetic, harmonious, well-disciplined, you get sound thinkers, philosophers, sages.”⁶⁷

The visionary quality of Diderot’s views is exciting if one is pleased with the notion of a universe pulsating with ubiquitous vitality. Matter, it follows, is a panorama of apparently inert but sensitive points conglomerating to form objects some of which are living, conscious beings. Life is continuously emerging from its potential state so that soil, stone, plants, and animals form an intricate and interconnected mass of matter changing its form in such a way that neither birth nor death have any ultimate

⁶⁴ Diderot, ‘Le rêve de d’Alembert’, in *Oeuvres complètes*, op. cit., note 58 above, vol. 8, p. 55.

⁶⁵ *Ibid.*, p. 58.

⁶⁶ *Ibid.*, pp. 104–105.

⁶⁷ *Ibid.*, pp. 134–135.

meaning. As we have always known, everything returns sooner or later to the “great inert sediment” from which it emerged. The *Rêve* is a masterpiece of materialistic vitalism. If one adopts Diderot’s thesis, then it follows that the physician is not limited to studying life exclusively with the tools of physics and chemistry. But neither is he sent questing after the essence of an ephemeral and elusive soul or vital principle.

Diderot had moved an immense distance from the iatromechanists whose notions he dismissed as utter nonsense. Anyone who omits sensitivity, irritability, and spontaneity from the calculation of the motion of the sensitive, animated, organized, living beings, he wrote, does not know what he is doing. One day, he predicted, all matter will be demonstrated to have six essential properties – attraction, length, depth, breadth, impenetrability, and sensitivity. The *Éléments de physiologie* of 1776 was the last work in which Diderot addressed the questions surrounding life and consciousness. His viewpoint remained essentially that which he assigned to Bordeu in the *Rêve*.

Much like La Mettrie, Diderot recognized the life force in a skinned, headless, but still moving snake, in the quivering fragments of an eel, and in the contractions of a pricked, excised heart.⁶⁸ Bordeu had written that “the general life . . . is the sum of all the particular lives.”⁶⁹ Diderot had been much influenced by Bordeu when he commented that in the living organism, there are three distinct levels of life. These are “the life of the entire animal”, the “life of each of the organs”, and “the life of the molecule”. They are inextricably intertwined in the body which they occupy. “The heart, the lungs, the spleen . . . nearly all the parts of the animal live for some time separated from the whole. Even the head separated from the body sees, looks and sees. It is only the life of the molecule, or its sensibility which does not cease at all. It is one of its essential qualities.”⁷⁰

Diderot’s work is important because it incorporates the most progressive and innovative ideas of his time. Many works, including the *Rêve* and the *Éléments de physiologie* in which the notion of universal sensibility was explicitly expounded, were not published until 1875. Nevertheless, the new physiology upon which they were based suffused the *Encyclopédie*. It is important, finally, because it appears that until such explicit materialist notions as those of La Mettrie and Diderot were developed, there was virtually no way to avoid calling upon a spiritual, immaterial principle to play some physiological role. Sensitive matter effectively stripped the soul of any physiological functions.⁷¹

After soaring along with Diderot’s imagination it is anticlimatic to return to the somewhat more pedestrian anatomically-based speculations of Bichat. Although Bichat analysed sensibility and contractility and classified them into five distinct vital forces, he had no concept of their universality in matter. Indeed, his definition of life as “the collection of those forces which resist death” precluded such a possibility. His

⁶⁸ Diderot, ‘Éléments de physiologie’, in *Oeuvres complètes*, op. cit., note 58 above, vol. 13, pp. 661–662.

⁶⁹ Bordeu, op. cit., note 29 above, pp. 829–831.

⁷⁰ Diderot, op. cit., note 68 above, pp. 662–666.

⁷¹ *Ibid.*, pp. 67–69. An extensive discussion of the connexion between Diderot’s and La Mettrie’s notions is found in Vartanian, ‘L’homme machine since 1748’, in op. cit., note 41 above, pp. 114–136.

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five forces included the consciously perceived sensibility and contractility described by Haller and the unperceived ones which many persons assumed must occur at the level of organs or even molecules. Most important of all, he insisted that all the vital properties are fundamentally and absolutely different from physical ones.