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The Principled Enlightenment: Condillac, d'Alembert and Principle Minimalism

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Radical Enlightenment, Pragmatic Enlightenment, Democratic Enlightenment, Scottish Enlightenment and now Principled Enlightenment. The historiographical category of Enlightenment is so accommodating, so flexible, so adaptable that it is like a gift that keeps on giving. With no fixed chronological or geographical boundaries, with no thematic or doctrinal core, with no determinate number — is it singular or plural? — and with the intrinsic authority of being an actors' category, the Enlightenment has, is and will continue to reinvent itself, or at least scholars will continue to apply it in new and fertile ways. And this is a good thing: there is nothing inherently wrong or methodologically suspect in the fact that there are multifarious applications of this historiographical category. As long as historians apply it self-consciously and with deference to the historical record, I say, let all flowers bloom.

But was there a Principled Enlightenment? And if so, what could this be? Here is a range of questions that one might ask. In what sense was the Enlightenment a principled era? What roles do principles play in Enlightenment thought? What are the determinate principles of the Enlightenment or of particular thinkers of the Enlightenment? These are big questions, questions that require broad surveys and

comparisons and the study of a vast range of sources. Rather than attempt a comprehensive answer to even one of these questions, what I hope to do here is more modest. After presenting some evidence of the nature and importance of principles across a variety of disciplines, countries and times, I shall focus on one facet of the theory of principles as manifested in the writings of two French *philosophes*, Étienne Bonnot de Condillac and Jean Le Rond d'Alembert. I want to offer this as a case study, one that has analogues in other thinkers and in other locales, in order to argue for the broader claim that principles played a central role in Enlightenment thought; that the Enlightenment was indeed a Principled Enlightenment. So let us turn to a sampling of the evidence for the general importance of principles in the Enlightenment.

Let us start with book titles. What do these eighteenth-century English book titles have in common? George Berkeley, *A Treatise Concerning the Principles of Human Knowledge*, 1710; David Hume, *An Enquiry Concerning the Principles of Morals*, 1751; and Thomas Reid, *An Inquiry into the Human Mind on the Principles of Common Sense*, 1764. Of course, it is that they all have the term "principles" in their titles.

When we turn to ECCO we find that over 1,100 books printed in Britain in the eighteenth century have the term "principles" in their titles. Gallica lists around 580 books in French between 1700 and 1800 with the term *principe* in the title and a sampling of these suggests that the majority are relevant to the study of principles in the Enlightenment. Interestingly, there is not one book with the word "Enlightenment" in its title published in English in the period. Nor are there any in French with "siècle des lumières". This in itself is an interesting commentary on just how eighteenth-century studies is dominated by one particular historiography. For I am yet to encounter a book

about the period with the term "principles" in its title and yet books with the term "Enlightenment" continue to proliferate.

Of course, book titles, ngrams and Google searches are superficial: a handy way in to a subject but too shallow to give us a genuine understanding of the status of a concept like principles. For that we need to turn to the historical and textual record of the period. To that end, let us start with a comment on the final section (Part VII) of Adam Smith's *Theory of Moral Sentiments* of 1759. In the opening paragraph on "Of Systems of Moral Philosophy" Smith claims:

> From some one or other of those *principles* which I have been endeavouring to unfold, every system of morality that ever had any reputation in the world has, perhaps, ultimately been derived. As they are all of them, in this respect founded upon *natural principles*, they are all of them in some measure in the right. But as many of them are derived from a partial and imperfect view of nature, there are many of them too in some respects in the wrong.[1]

Smith's view is that all systems of moral philosophy are based upon principles. The means by which they are formed and the manner by which they are evaluated is in terms of their principles. Principles are at the heart of Smith's conception of moral philosophy.

Around the time that Smith was writing *The Theory of Moral Sentiments* Jean Le Rond d'Alembert was also making claims about the importance of principles. In his article on "The elements of the sciences" in the *Encyclopedia*, d'Alembert uses the term "principle" (*principe*) forty-one times. In fact, this article contains a theory of knowledge acquisition that has principles at its core. It begins with the following claim:

[1] Adam Smith, *The Theory of Moral Sentiments* (London, 1759), 413–14 (my emphasis).

> In general, we call the elements of a whole the primitive and original parts of which we suppose the whole is made up. In order to carry this notion over into the Sciences in general and to determine how we are to understand the idea of the basic elements of any particular science, let us suppose that the science in question has been treated completely in a text, so that we can have immediate and concrete access to those propositions, both general and particular, that make up that science, and that such propositions be organized in the most natural and rigorous way possible. Let us then suppose that these propositions follow coherently one from the other, so that each depends uniquely and directly upon the preceding ones, and that it does not depend upon any other *principles* than those that make up the preceding propositions. In such a case, as we have noted in the *preliminary discourse*, each proposition will be simply the translation of the first, presented differently. Everything could therefore be reduced to that first proposition, and we could regard it as the basic element of that particular science since the science would be totally subsumed in that first proposition. If each of the sciences we are concerned with shared that characteristic, the elements would be as easy to present as to learn.[2]

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[2] Denis Diderot and Jean Le Rond d'Alembert (eds.), *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers* (University of Chicago: ARTFL Encyclopédie Projet, Spring 2010 Edition [1751–72]) http://encyclopedie.uchicago.edu/. Translation from Jean Le Rond D'Alembert and Jean de La Chapelle, "Elements of the Sciences," in *The Encyclopedia of Diderot & d'Alembert Collaborative Translation Project*, trans. Lauren Yoder (Ann Arbor: Michigan Publishing, University of Michigan Library, 2011) [http://hdl.handle.net/2027/spo.did2222.0001.133], 5: 491 (my emphasis). Originally published as "Elemens des Sciences," *Encyclopédie ou*

So far this is the standard Aristotelian theory of knowledge acquisition in which a science or *scientia* is a set of propositions that are ultimately derived from a small set of principles specific to that science.[3] Thus, he says "propositions follow coherently one from the other, so that each depends uniquely and directly upon the preceding ones, and that it does not depend upon any other *principles* than those that make up the preceding propositions". However, d'Alembert then introduces a new twist, a claim that is not part of the age-old theory:

> if we were able to observe without interruption the invisible chain that links all the objects of our knowledge, the elements of all sciences could be reduced to one unique principle, whose consequences would be the elements of each particular science.[4]

The claim is that there is one unique principle (*un principe unique*) underlying all of the sciences. This is an extraordinary claim. Where does it come from and what does he think that principle might be? His allusion to the "Preliminary Discourse" of the

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Dictionnaire raisonné des sciences, des arts et des métiers (Paris, 1755), 5:491–497. For an earlier reference to principles as the elements of the sciences, see: Jean Le Rond D'Alembert, *"Preliminary Discourse" to the Encyclopedia of Diderot*, trans. and intro. by Richard N. Schwab (Chicago: University of Chicago Press, 1985 [1751]), 119.

[3] See: Peter R. Anstey, "Introduction," in Peter R. Anstey (ed.), *The Idea of Principles in Early Modern Thought: Interdisciplinary Perspectives* (New York: Routledge, 2017), 1-15.

[4] Diderot and D'Alembert, *Encyclopédie*, 5: 491. See also: D'Alembert, *"Preliminary Discourse"*, 29. D'Alembert also uses the chain metaphor in the "Preliminary Discourse". See: D'Alembert, *"Preliminary Discourse"*, 5. This also happens in his article on "Cosmology". See: Diderot and D'Alembert, *Encyclopédie*, 4: 294.

Encyclopedia in this passage suggests that we should look there. And, indeed, further elements of d'Alembert's theory of principles are found there.

> it is not at all by vague and arbitrary hypotheses that we can hope to know nature; it is by thoughtful study of phenomena, by the comparisons we make among them, by the art of reducing, as much as that may be possible, a large number of phenomena to a single one that can be regarded as their principle.[5]

We will come back to the anti-hypothetical flourish. For now, the key point is the relation between phenomena and principles. Although D'Alembert is using the term "phenomena" slightly differently to the way that Newton does, he is almost certainly expressing a Newtonian point here.[6] An example of phenomena being reducible to a principle might be the tables of planetary observations (phenomena) are reducible to the principle that planets move in elliptical orbits (Kepler's first law of planetary motions). He goes on:

> Indeed, the more one reduces the number of principles of a science, the more one gives them scope, and since the object of a science is necessarily fixed, the principles applied to that object will be so much the more fertile as they are fewer in number.[7]

Here is the link with the claim that there is one unique principle in the article on the "Elements of the Sciences". D'Alembert is committed to the view that as the number of principles of a science diminishes, so the fecundity of the remaining principles increases. Let us call this Principle Minimalism. This too is an extraordinary claim. What

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[5] D'Alembert, *"Preliminary Discourse"*, 22.

[6] See: Kirsten Walsh, "Newton's epistemic triad" (PhD dissertation: University of Otago, 2014), §4.3.

[7] D'Alembert, *"Preliminary Discourse"*, 22.

precedent is there for it and where does it come from? His next comment in the "Preliminary Discourse" provides a link to another clue:

> This reduction which, moreover, makes them easier to understand, constitutes the true "systematic spirit". One must be very careful not to mistake this for the "spirit of system", with which it does not always agree.[8]

So the reduction of principles leading to increasing fecundity is the true way to develop a system. And this approach is not to be confused with the spirit of system, which d'Alembert goes on famously to criticise later in the "Preliminary Discourse". There, the pernicious systems, according to d'Alembert, are based upon hypotheses and "frivolous conjectures" whereas a true science, such as natural philosophy (*physique*) "is ... confined solely to observations and to calculations". "Thousands of experiments prove how dangerous the use of systems is in the other sciences".[9] For the historian of early modern experimental philosophy these tropes have a familiar ring and we will return to them in due course. Meanwhile, d'Alembert's critique of the spirit of system takes us naturally to Condillac's *Treatise on Systems* of 1749, for, as he claims in the "Preliminary Discourse", "[o]ne of our best philosophers seems to have delivered the death blow to it".[10]

We turn then to Condillac's *Treatise on Systems* which supposedly dealt a deathblow to the spirit of systems. It opens with a definition of a system:

> A system is nothing other than the arrangement of different parts of an art or science in an order in which they all lend each other support and in which the

[8] D'Alembert, *"Preliminary Discourse"*, 22-3.

[9] D'Alembert, *"Preliminary Discourse"*, 95.

[10] D'Alembert, *"Preliminary Discourse"*, 94.

> last ones are explained by the first ones. Parts that explain other parts are called principles, and the fewer principles a system has the more perfect it is. It is even desirable to reduce all principles to a single one.[11]

The conception of a system and the ideal of a single principle to which all others can be reduced are virtually identical to d'Alembert's conception of a science as expressed in his article on the "Elements of the Sciences". The claim that the fewer principles the more perfect the system parallels d'Alembert's Principle Minimalism in the "Preliminary Discourse". So d'Alembert was not alone in his theory of principles and his desire for an ultimate, fecund principle.

What could be driving this? And where do these views about principles come from? The answer to these questions will take us in two different directions. On the one hand, there is the broader context of the rejection of systems over the *longue durée* which went hand-in-hand with the emergence of experimental philosophy in Britain from the 1660s. Condillac's *Treatise on Systems* and d'Alembert's enthusiastic endorsement of it should be seen as the high-water mark of this anti-system movement. And Condillac's and d'Alembert's theories of principles are best understood as a development of the new approach to knowledge acquisition that was pursued and theorised by the experimental philosophers.

On the other hand, there are the actual unique principles that Condillac and d'Alembert claim to have discovered. Their identification of these particular principles is in itself an explanation, whether justified or not, of their theory of principles and their rejection of alternative approaches to constructing systems. Thus, once both this broader

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[11] Étienne Bonnot de Condillac, *Philosophical Writings of Étienne Bonnot, Abbé de Condillac*, trans Franklin Philip (Hillsdale NJ: Lawrence Erlbaum, 1982), 1.

context is in place and their favoured unique principles are in view, we will be in a position to assess points of continuity and points of innovation in these two exemplars of the Principled Enlightenment. Let us turn then to the anti-systems movement in France.

Origins of the critique of systems

I claimed above that the context in which we must understand the anti-systems movement in France in the mid-eighteenth century is the critique of systems that had been part and parcel of the outlook of experimental philosophers since the emergence of the movement in England in the 1660s. Indeed, one of the earliest expressions of this is in Boyle's "Proëmial Essay" to his *Certain Physiological Essays* which was written circa 1657.

Boyle begins with an assessment of some of the leading natural philosophies that were of influence in his day:

> I am very sensible of my being far from having such a stock of Experiments and Observations, as I judge requisite to write Systematically; and I am apt to impute many of the Deficiencies to be met with in the Theories and Reasonings of such great Wits as *Aristotle*, *Campanella*, and some other celebrated Philosophers, chiefly to this very thing, that they have too hastily, and either upon a few Observations, or at least *without a competent number of Experiments, presum'd to establish Principles, and deliver Axioms*.[12]

[12] Robert Boyle, *The Works of Robert Boyle*, 14 vols, Michael Hunter and E. B. Davis (eds.) (London: Pickering and Chatto, 1999–2000), 2: 13 (my emphasis).

The problem with Aristotle and Campanella, for example, is that they "superstructed" their systems on principles and axioms that are based upon too slim an evidential foundation. The problem lies not in the adequacy of the ideal of a demonstrative science based upon principles and axioms, but rather in the inadequate evidential grounds for the principles and axioms themselves. Natural philosophers should:

> set themselves diligently and industriously to make Experiments and collect Observations, *without being over-forward to establish Principles and Axioms*, believing it uneasie to erect such Theories as are capable to explicate all the Phaenomena of Nature, before they have been able to take notice of the tenth part of those Phaenomena that are to be explicated.[13]

Returning to his point about quantitative evidence Boyle asserts:

> That then that I wish for, as to Systems, is this, That men in the first place would forbear to establish any Theory, till they have consulted with (though not a fully competent number of Experiments, such as may afford them all the Phaenomena to be explicated by that Theory, yet) a considerable number of Experiments in proportion to the comprehensiveness of the Theory to be erected on them.[14]

In summary then, Boyle's position is the following. First, observation and experiment have epistemic priority: one should accept only those principles and axioms in natural philosophy that are based upon sufficient observational and experimental evidence and one should avoid constructing a system without recourse to observation and experiment. Secondly, once a system is constructed, one should be prepared to revise it in the light of new experimental evidence. These two claims are the core

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[13] Boyle, *Works*, 2: 14 (my emphasis).

[14] Boyle, *Works*, 2: 14.

doctrines of experimental philosophy. They account for its emphasis on experiment and for its decrying of speculation and hypotheses, and they underwrite the pervasive criticism of systems of natural philosophy, otherwise known as speculative philosophy, in early modern British natural philosophy. Thus, we find Sir Robert Moray putting forward the following proposal about the business of the Royal Society in the early 1660s:

> This Society will not own any *Hypothesis, systeme*, or doctrine of the principles of Naturall philosophy, proposed, or maintained by any Philosopher Auncient or Moderne, nor the explication of any phaenomenon, where recourse must be had to Originall causes, … Nor dogmatically define, nor fixe *Axiomes* of Scientificall things, but will question and canvas all opinions[,] adopting nor adhering to none, till by mature debate & clear arguments, chiefly such as are deduced from legittimate *experiments*, the trueth of such positions be demonstrated invincibly.[15]

This is not the place to adduce the copious evidence for the prevalence of these views in Britain, however, an excerpt from Locke's *Some Thoughts Concerning Education* of 1693 should give the flavour of the view:[16]

> But I would not deterr any one from the study of Nature, because all the

[15] Michael Hunter, *Science and the Shape of Orthodoxy: Intellectual Change in Late-Seventeenth-Century Britain* (Woodbridge: Boydell Press, 1995), 173 (my emphasis).

[16] For further evidence, see: Peter R. Anstey, "Experimental Versus Speculative Natural Philosophy," in Peter R. Anstey and John A. Schuster (eds.), *The Science of Nature in the Seventeenth Century: Patterns of Change in Early Modern Natural Philosophy* (Dordrecht: Springer, 2005), 215–42.

> Knowledge we have, or possibly can have of it, cannot be brought into a Science. There are very many things in it, that are convenient and necessary to be known to a Gentleman: And a great many other, that will abundantly reward the Pains of the Curious with Delight and Advantage. But these, I think, are rather to be found amongst such Writers, as have imploy'd themselves in *making rational Experiments and Observations*, than in starting barely speculative Systems. Such Writings therefore, as many of Mr. *Boyle's* are, with others, that have writ of Husbandry, Planting, Gardening, and the like, may be fit for a Gentleman, when he has a little acquainted himself with some of the *Systems of the Natural Philosophy* in Fashion.[17]

One consequence of the decrying of systems and hypotheses amongst experimental philosophers was the emergence of a disregard for and, in some quarters, a contempt for metaphysics. Newton's negative attitude to the metaphysics of the schools is typical in British philosophy through to the mid-eighteenth century.[18] So, for example, just three years before the appearance of d'Alembert's "Preliminary Discourse" Hume, who was attempting to apply the method of experimental philosophy to the moral sciences, famously pleaded in the first *Enquiry*:

> If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, *Does it contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning concerning matter*

[17] John Locke, *Some Thoughts Concerning Education*, eds John W. and Jean S. Yolton (Oxford: Clarendon Press, 1989 [1693]), 248 (my alteration of emphasis).

[18] See: Dmitri Levitin, "Newton and Scholastic Philosophy," *British Journal for the History of Science* 49 (2016): 53–77.

> *of fact and existence?* No. Commit it then to the flames: For it can contain nothing but sophistry and illusion.[19]

Yet it bears pointing out that Hume is not dismissing metaphysics *tout court* here. For one of the lessons of Section One of the *Enquiry* is that we "must cultivate true metaphysics with some care, in order to destroy the false and adulterate" (Hume 2007, 8).

Now the early experimental philosophers, following Francis Bacon,[20] proposed an alternative two-step theory of knowledge acquisition which involved first, the collection and ordering of observations and experiments and only once that was near completion, second, theorising on the basis of those experimental facts. Their criticism of systems and their alternative two-step method, founded on natural history, were well known in Paris from the 1660s, not least through the efforts of Moray and of Henry Oldenburg, the indefatigable Secretary of the Royal Society.[21] Once again, space does not permit a survey of the manifestation of these methodological ideas in France, where

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[19] David Hume, (2007) *An Enquiry Concerning Human Understanding*, ed. Peter Millican (Oxford: Oxford University Press, 2007 [1748]), 120.

[20] For Bacon's criticisms of philosophical systems, see: Idols of the Theatre, *New Organon*, book I, aphorisms 61–7, Francis Bacon, *The* Instauration magna *Part II:* Novum organum *and Associated Texts*, ed. Graham Rees (Oxford: Clarendon Press, 2004), 95–109. For the two-step model, see, for example, *A Preparative to a Natural and Experimental History*, *ibid*., 455–7.

[21] See: Christiaan Huygens, *Oeuvres complètes de Christiaan Huygens*, 22 vols (The Hague: Martinus Nijhoff, 1888–1950), 4: 327, 6: 95–6 and 19: 268. For Christiaan Huygens' correspondence with Sir Robert Moray, see: Huygens, *Oeuvres*, 3: *passim*.

experimental philosophy failed to get a proper foothold until the mid-1730s.[22] Nevertheless, it is worth providing some steppingstones of the dissemination of these methodological ideas and attitudes in the period leading up to Condillac and d'Alembert.

We begin with Fontenelle, the perpetual Secretary of the Académie des Sciences, who endorses the two-step method in 1699 in the *Histoire du renouvellement de l'Académie Royale des Sciences*, as follows:

> the Academy is only at the stage of gathering an ample store of well-founded observations and facts, which will one day become the basis for a System. For systematic natural philosophy it must refrain from building its edifice until experimental natural philosophy [*Physique expérimentale*] is able to furnish it with the necessary materials.[23]

Turning from the two-step method to the critique of systems, we find a clear statement of the standard position of the experimental philosophers in the classicist, Nicolas Fréret's "Reflections on the study of ancient history":

> Philosophers understand by this word "system" an assemblage of certified facts, demonstrated truths and evident propositions, which, linked together in a natural and necessary relation, form a single body of knowledge, all parts of which

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[22] Peter R. Anstey, "D'Alembert, the 'Preliminary Discourse' and Experimental Philosophy," *Intellectual History Review* 24 (2014): 495–516.

[23] Cited from Roger Hahn *The Anatomy of a Scientific Institution: The Paris Academy of Sciences, 1666–1803* (Berkeley: University of California Press, 1971), 33 (with modifications); see Bernard Le Bovier de Fontenelle, (1708) *Histoire du Renouvellement de l'Académie Royale des Sciences* (Paris, 1708), sigs ciijr–v. See also the comments of François-Xavier Bon 1710 cited in Terrall 2014, 17.

> support one another and lend each other a reciprocal strength and clarity. Therefore the value of a system depends upon the position and strength of each one of its parts; if any one gives way, the whole edifice will soon crumble and collapse of its own weight.

Fréret's definition of "system" is fairly close to the standard theory of a *scientia* or demonstrative science and he is well attuned to the danger of the principles of such a system being undermined. He goes on:

> I do not mean in what I say here [in the previous two paragraphs] to confuse the love of system with that of philosophical spirit [*esprit philosophique*] which the exact sciences have brought to the fore in our own age. Of this there is no better evidence than the record of the two most renowned philosophical societies in Europe: the Royal Society in London and the Academy of Sciences in Paris. ... The spirit of philosophy is very different from the spirit of system; the former is as necessary as the latter is dangerous. ... True [historical] criticism is nothing other than [natural] philosophic enquiry applied to the study of facts.[24]

I want to suggest that so widespread is the new methodology of experimental philosophers that the critique of systems and the application of natural philosophical methodology to the discipline of history, are evidence that the methodological orientation of experimental philosophy preceded the processes by which French natural philosophers came explicitly to identify with the method of *physique expérimentale* and call themselves practitioners of experimental philosophy. By the mid-1730s, however,

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[24] J. G. A. Pocock, *Barbarism and Religion, Volume 1: The Enlightenments of Edward Gibbon, 1737–1764* (Cambridge: Cambridge University Press, 1999), 159–60 (modified).

all of this began to change. Take, for example, the Preface to Buffon's translation of Stephen Hales' *Vegetable Staticks*, published just four years after Fréret's "Reflexions". In it we find the following exhortation:

> let us constantly collect experiments, and flee, if it is possible, from the system-building mentality, at least until we are well informed. Someday we will be able to "... situate these materials with confidence, and even if we should not be so fortunate as to be able to build the edifice in its entirety, the materials will certainly serve us as foundation for it, and perhaps even for extending it beyond our hopes". This is the method my author [Hales] has followed. It is that of the great Newton; it is that which Verulam [Bacon], Galileo, Boyle and Stahl have recommended and embraced.[25]

All of this goes to show that Condillac's *Treatise on Systems* is hardly an innovative work in its methodological orientation: he is harping on the same themes as Boyle had done ninety years before. What *is* innovative in Condillac is not the rejection of systems, not the anti-hypotheticalism, not the opposition to abstract principles and his rejection of innate principles, but his commitment to Principle Minimalism and the fecundity of the one unique principle of the system.

Condillac's and d'Alembert's principles

In his *Essay on the Origin of Human Knowledge* published three years before the *Treatise on Systems*, Condillac claimed to have discovered the unique principle for

[25] John Lyon and Philip Sloan (eds.), *From Natural History to the History of Nature: Readings from Buffon and His Critics* (Notre Dame: University of Notre Dame Press, 1981), 38.

unlocking the origins of human knowledge. He claims as much in the Introduction to this work:

> The success of these inquiries [in the *Essay on the Origin of Human Knowledge*] depends entirely on the results of observation, and our only aim should be the discovery of a fundamental fact of experience that no one can cast doubt on and that is sufficient to explain all the rest. It ought to point clearly to the source of our understanding, to the materials from which it is formed, to the principle that activates the materials, the means we use in that process, and the manner in which we should employ them. *I believe I have found the solution to all these problems in the connection of ideas*, either with signs or among themselves. The reader may decide whether I am correct in the course of his reading of this work. It is evident that my design is to *reduce everything that pertains to the human mind to a single principle*, and that this principle shall be neither a vague proposition, nor an abstract maxim, nor a gratuitous supposition, but a firm fact of experience whose consequences will all be confirmed by new acts of experience.[26]

If we examine the underlined clauses in reverse order, we find first that Condillac's plan is to reduce everything pertaining to the human understanding to a single principle (*un seul principe*). This is entirely consonant with what he proclaims is the correct approach to system construction in the *Treatise on Systems* three years later. Second, we should note that he believes he has found that principle: it is the connection of ideas with each other and with signs, i.e. words. Third, it is important to emphasise that this principle is acquired by experience and confirmed by experience. Later he goes

[26] Etienne Bonnot de Condillac, *Essay on the Origin of Human Knowledge*, trans. Hans Aarsleff, (Cambridge: Cambridge University Press, 2001 [1746]), 5 (my emphasis).

on to contrast this with the abstract principles of metaphysicians and others that are supposedly *a priori* propositions or even innate knowledge. These latter sorts of principles are, following Locke, dismissed as dangerous foundations of knowledge and the basis of false systems.[27]

This is not the place to assess the adequacy, even the coherence, of Condillac's claims concerning his single principle of the mind. Our concern rather is merely to show that the theory of principles elaborated in the later *Treatise on Systems* was not empty methodological rhetoric, but backed up by this concrete instance in Condillac's own well-articulated theory of the origins of knowledge and the operations of the understanding.

A similar claim can be made concerning d'Alembert. For, prior to the "Preliminary Discourse" of 1751 and prior to his reading of Condillac's *Treatise on Systems*, d'Alembert himself had enunciated a new principle of mechanics in his *Treatise on Dynamics* of 1743, the eponymous D'Alembert's Principle. Indeed, the sub-title to this work ought to alert us to the nature of d'Alembert's theory of principles. The work is entitled:

> *Treatise on Dynamics in which the Laws of Equilibrium and Motion of Bodies are reduced to* the smallest possible number *and demonstrated in a new manner, and where a general Principle is given for finding the Motion of several Bodies which act on one another in any way*.[28]

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[27] See: Etienne Bonnot de Condillac, *Traité des systèmes* (The Hague, 1749), chap. VI.

[28] D'Alembert's 1743 title page reads: *Traité de dynamique, dans lequel les loix de l'equlibre & du Mouvement des Corps sont réduites au plus petit nombre possible, & démontrées d'une maniére nouvelle, & où l'on donne un Principe général pour trouver*

That general principle is, of course, D'Alembert's Principle, a principle in dynamics that was an important advance and formed the centrepiece of part two of the *Treatise on Dynamics*. As Thomas Hankins pointed out, d'Alembert went on to make rather bold claims about his principle:

> there is no problem in dynamics that cannot be resolved easily almost as a game by means of this principle.[29]

D'Alembert did, in fact, claim that his three laws of dynamics were the fewest number of laws required to solve all the problems of dynamics and, interestingly, his principle was derived from the second and third laws rather than being the fundamental principle upon which the whole of mechanics was founded. Thus, in his mind in 1743 he had a concrete instance of a science that conformed to the more abstract theory of principles elaborated in the later "Preliminary Discourse" and his article on the "Elements of the Sciences" in the *Encyclopedia*.

Moreover, all of this would have been reinforced in the minds of Condillac and d'Alembert by Maupertius' Principle of Least Action which first appeared in a paper read to the Acadèmie des Sciences in 1744, one year after the appearance of d'Alembert's *Treatise on Dynamics*. Maupertuis published it in a paper in the proceedings of the Berlin Acadèmie in 1746 and in a more elaborate form in his

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le Mouvement de plusieurs Corps qui agissent les uns sur les autres, d'une maniére quelconque. See: Jean Le Rond D'Alembert, *Traité de dynamique* (Paris, 1743) (my emphasis in translation).

[29] Quoted from: Thomas Hankins, *Jean d'Alembert: Science and Enlightenment* (Oxford: Clarendon Press, 1970), 192. See also: Diderot and D'Alembert, *Encyclopédie*, 5: 175.

Cosmologie of 1750.[30] D'Alembert gives the principle a generous endorsement in his article "Action" in the first volume of the *Encyclopedia* of 1751 which appeared with his "Preliminary Discourse".[31]

These principles of Condillac and d'Alembert, therefore, go a long way to explaining why they were both committed to one unique and explanatorily rich principle and to Principle Minimalism: the view that the fewer the principles of a science are, the more fecund they are. Yet there is a deeper and more significant explanation of their commitment to principle minimalism: namely, their conception of the science of metaphysics.

Principle Minimalism and metaphysics

Principle Minimalism was certainly legitimized by developments in natural philosophy at the hands of d'Alembert and Maupertuis. And, moreover, there is evidence of a general trend in the mid-eighteenth century in French intellectual life to appeal to ultimate or primary principles. Take, for example, Charles Batteux's *The Fine Arts Reduced to a Single Principle* (2015 [1749]), a work which argues for the primacy of the principle of the imitation of *belle nature* as an explanation of the production of works of art, and a work whose influence is found in the "Preliminary Discourse".[32] Yet

[30] See: Maupertuis 1746 [1748] and 1750. Pierre-Louis Moreau de Maupertuis, "Les loix du mouvement et du repos déduites d'un principe métaphysique," *Histoire de l'Académie Royale des Sciences et Belles Lettres*, 1746 (Berlin, 1748), 267–94; and, Pierre-Louis Moreau de Maupertuis, *Essai de cosmologie* (Berlin, 1750).

[31] Diderot and D'Alembert, *Encyclopédie*, 1: 119–20.

[32] See: D'Alembert, *"Preliminary Discourse"*, 36–9, 45, 51 and 55.

in the cases of Condillac and d'Alembert their commitment to Principle Minimalism was not simply the contingent outcome of their work in the theory of knowledge and rational mechanics, respectively. Rather it was deeply grounded in their conception of metaphysics and its relation to the sciences.

As we saw above, a corollary of the critique of speculative philosophy and its opposition to systems, was that metaphysics came in for harsh criticism in the first half of the eighteenth century. However, it should be pointed out that this admonishing of metaphysics was on the whole restricted to what Hume called abstruse and School metaphysics. It was not an outright rejection of metaphysics. It is important, therefore, not to generalise this context-specific anti-metaphysical stance to the discipline in general. A similar bivalent attitude to metaphysics prevailed in mid-eighteenth-century France.

Condillac famously distinguished two forms of metaphysics. First, there is that ambitious discipline whose practitioners aim at "solving all mysteries; nature, the essence of all beings, the most hidden causes" and so on.[33] The *Treatise on Systems* is best interpreted as a critique of and corrective to the first enterprise. For in his treatise Condillac identifies three types of principles, namely abstract maxims, suppositions or hypotheses and experimentally verified principles. The first two are associated with the speculations of metaphysicians, while the third are the sort that he endorses.[34] His submission on *Monads*,[35] for the inaugural prize competition at the Berlin Academy in

[33] Condillac, *Origin of Human Knowledge*, 3.

[34] Etienne Bonnot de Condillac, *Philosophical Writings of Etienne Bonnot, Abbé de Condillac*, trans. Franklin Philip (Hillsdale NJ: Lawrence Erlbaum, 1982), 1-3.

[35] See: Etienne Bonnot de Condillac, *Les monades*, ed. Laurence L. Bongie (Oxford: Editions Voltaire Foundation, 1980).

1746 is his attempt at the speculations of metaphysicians such as Leibniz. Secondly, there is the more modest enterprise that seeks to inquire into what is within reach of the human mind. Condillac's *Essay on the Origin of Human Knowledge* (published in the same year) is, in effect, an exercise in this second form of metaphysics, taking his inspiration from John Locke. Thus, the two different forms of metaphysics are deeply pursued in his two writings from 1746.

D'Alembert, for his part, also held a bipartite theory of the nature of metaphysics. He accorded metaphysics the premier place among the sciences in the "Preliminary Discourse". In his and Diderot's scheme for the system of knowledge, metaphysics is placed at the very top of the in the two main branches of sciences founded on the faculty of reason, namely the science of man and the science of nature.[36] This reflects the twofold nature of metaphysics as articulated in the "Preliminary Discourse" itself. First, there is particular metaphysics (*métaphysique particuliere*), which is the science of the soul. It is concerned with the origin or generation of our ideas. For d'Alembert, Locke is the recent hero of this discipline: "he reduced metaphysics to what it really ought to be: the experimental physics of the soul", and, of course, Condillac is its most able contemporary exponent.[37] Secondly, there is general metaphysics (*métaphysique générale*). In the "Preliminary Discourse" the example of general metaphysics that is discussed is the science of body taken in its general or abstract sense. It is concerned with the general qualities of body such as impenetrability, mobility and extension. D'Alembert claims that the science of nature "ought to begin with the study of these properties ... which is, properly speaking, simply the metaphysics of bodies" (*PD*, 54).[38]

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[36] D'Alembert, *"Preliminary Discourse"*, 144–5.

[37] D'Alembert, *"Preliminary Discourse"*, 84.

[38] See also: D'Alembert, *"Preliminary Discourse"*, 46.

That D'Alembert allows that the imagination has an ancillary role in metaphysics does not significantly affect these points.[39] Then, in his article entitled "Elements of the sciences" in the *Encyclopedia*, d'Alembert articulates general metaphysics more clearly:

> Metaphysics ... is nothing more than the clear and precise exposition of the general and philosophical truths on which the principles of the science were founded. The simpler the metaphysics, the easier and more widespread, the more valuable it is.[40]

In contrast to the more "rigourous" sense of the term that applies to spiritual beings such as the soul he speaks of "Metaphysics in a more general sense as that universal science which contains the principles of all the others").[41]

This distinction is maintained in his more philosophically rich treatment of metaphysics in his *Elements of Philosophy* of 1759 and the later "Eclaircissements" to the *Elements of Philosophy* that were published in 1776. In the *Elements of Philosophy* he devotes a whole chapter to metaphysics (chap. VI) and later a number of *eclaircissements*.[42] The chapter on metaphysics is part of his coverage of the sciences of man, which also includes logic and morals. Its focus, therefore, is on particular metaphysics and so he claims there "the generation of our ideas belongs to metaphysics;

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[39] D'Alembert, *"Preliminary Discourse"*, 51.

[40] Diderot and D'Alembert, *Encyclopédie*, 5: 492.

[41] Diderot and D'Alembert, *Encyclopédie*, 5: 492.

[42] See especially *eclaircissements* §I and §XV in: Jean Le Rond D'Alembert, *Essai sur les éléments de philosophie*, ed. Richard N. Schwab (Hildesheim: Olms, 1965 [1759]).

it is one of its principal objects".[43] Yet elsewhere in the book he also mentions general metaphysics. D'Alembert claims, "properly speaking, there is no science that does not have its metaphysics, if we understand by this word the general principles on which a science is founded" (*Elements*, 357). Moreover, as in the "Preliminary Discourse", he discusses general metaphysics as it pertains to the science of body, even using it in his treatment of geometry to claim that as the science of body has a general metaphysics so too does geometry.[44]

Surprisingly, this twofold conception of metaphysics in the writings of d'Alembert seems to have been overlooked in some of the recent secondary literature. Christian Leduc, for example, claims that "the sole domain to which metaphysics should limit itself, at least for Condillac and d'Alembert, is that of the analysis of the cognitive capacities of the mind".[45] Leduc's omission of d'Alembert's conception of general metaphysics enables him to pit him against Maupertuis and Euler at the Berlin Academy (and we might add, against the Secretary of the Berlin Academy Samuel

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[43] D'Alembert, *Éléments*, 124. The chapter on metaphysics is not restricted to the generation of ideas, but also covers the existence of external objects, existence of God and the nature of the soul. See: D'Alembert, *Éléments*, 31, 41 and 240 for the content of particular metaphysics and 357–8 for the claim that the term "metaphysics" properly applies to immaterial entities.

[44] D'Alembert, *Éléments*, 358.

[45] Christian Leduc, "La métaphysique de la nature à l'Académie de Berlin," *Philosophiques*, 42 (2015), 13. He also speaks of Condillac's and d'Alembert's "reduction of the field of metaphysics to psychological questions about the sources and faculties of human knowledge". See: Leduc, *"Métaphysique,"* 29.

Formey who was an even more outspoken advocate of metaphysics).[46] Yet, there is no evidence that d'Alembert took an anti-metaphysical stance against Maupertius or Euler. Instead all the textual evidence confirms that he was an advocate of a twofold conception of metaphysics from 1751 until well beyond Maupertuis' death in 1759.

A similar interpretation is found in the work of Mary Terrall. When discussing d'Alembert's reaction to the place of Maupertuis' Principle of Least Action in the latter's *Essay on Cosmology*, Terrall claims "[in his *Encyclopedia* article "Action"] d'Alembert nonchalantly read the metaphysics out of the principle of least action ... pointedly downplaying Maupertuis's insistence on the value of metaphysics for mechanics".[47] Then, in a footnote, she makes the further claim "D'Alembert's objections to metaphysics solidified with time; by the second edition of his *Traité de dynamique* (1758), he commented negatively about Maupertuis's use of metaphysics (albeit without naming him)".[48] Yet, it is not at all clear that d'Alembert is critically

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[46] Formey claims, "Metaphysics is without contradiction the mother of the other sciences, the theory which provides the most general principles, the source of the evidence and the foundation of the certitude of our knowledge". Formey goes on to differentiate this form of metaphysics from that of the Schools. See: Samuel Formey, "Preface" to *Histoire de l'Académie Royale des Sciences et Belles Lettres*, 1745 (Berlin, sigs., 1746), sigs (4r–)()(2v), (2r).

[47] Mary Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago: University of Chicago Press, 2002), 291.

[48] Terrall, *Flattened the Earth*, n67. Terrall may well be influenced by Hankins' interpretation of d'Alembert's reaction to Maupertuis' principle. Hankins claims that d'Alembert "categorically denounced the search for final causes and the physical laws derived from them," citing the relevant passage in the Preface to the second edition of

alluding to Maupertuis in the relevant passage in the second edition of the *Treatise on Dynamics*. To be sure, he warns there against dangers of reasoning from final causes, just as Maupertuis had done in his paper of 1744 where he had Leibniz and Fermat in his sights.[49] Additionally, d'Alembert criticises Descartes for deducing his erroneous collision laws from the law of conservation, just as Maupertuis had done in his 1746 paper on "The accord between different laws of nature that until now seemed incompatible".[50] Yet there are no grounds here for claiming that d'Alembert's position on final causes or on metaphysics in general differed significantly from that of Maupertuis, nor that this revision to the Preface to the *Treatise on Dynamics* is evidence of a shift against metaphysics in d'Alembert's intellectual outlook.

Thus, in his article on "Action" in the first volume of the *Encyclopedia*, d'Alembert praises Maupertuis, claiming that his works that deal with the Principle of Least Action "should focus the attention of all philosophers and we urge them to read these works and they will note that the author manages to ally the metaphysics of final

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D'Alembert's *Treatise on Dynamics* from 1759. See: Thomas Hankins, *Jean d'Alembert: Science and Enlightenment*, Oxford: Clarendon Press, 1970), 54. One scholar who has taken d'Amembert's account of metaphysics seriously is Véronique Le Ru. See: Véronique Le Ru, *Jean Le Rond d'Alembert philosophe* (Paris: Vrin, 1994), Part Two.

[49] Jean Le Rond D'Alembert, *Traité de dynamique*, 2nd edition (Paris, 1758), xxx; Maupertuis, "Accord de différentes loix," 425.

[50] D'Alembert, *Traité de dynamique*, 2nd edition, xxx; Pierre-Louis Moreau de Maupertuis, "Les loix du mouvement et du repos déduites d'un principe métaphysique," *Histoire de l'Académie Royale des Sciences et Belles Lettres*, 1746 (Berlin, 1748), 285.

causes with the fundamental truths of mechanics".[51] Then in his article on "Final Causes" in the *Encyclopédie*, fully apprised of Maupertuis' earlier criticisms of Leibniz and Fermat, d'Alembert claims "if it is dangerous to have recourse to final causes a priori in order to discover the laws of phenomena, it nonetheless has its uses".[52] Finally, the extended positive discussions of metaphysics in the *Elements of Philosophy* that were written in the very year that the second edition of the *Treatise on Dynamics* came out further undermine Terrall's "anti-metaphysical" interpretation of d'Alembert.

It is clear, therefore, that metaphysics had a central role in d'Alembert's mature conception of the nature of the sciences. In its most general form it was a kind of meta-discipline that provided the principles for all the sciences. It would only be natural, therefore, for him to commit to a form of Principle Minimalism within metaphysics itself. This is precisely what Maupertuis offered in his treatment of the Principle of Least Action in his aptly titled "The laws of motion and rest deduced from a metaphysical principle" of 1748 and his *Essay on Cosmology* of 1750. In these works the one unique principle was: "When there is a change in nature, the quantity of action necessary for this change is the smallest possible".[53] D'Alembert knew these works well and discusses Maupertuis' approach to the Principle of Least Action in the *Essay on Cosmology* in detail in his article "Cosmology" in the *Encyclopedia*. There, however, rather than committing to any determinate ultimate principle of nature, d'Alembert suggests only that "[p]erhaps (and this is possibly true) there is a general law which is and will always be unknown, one for which we only see particular consequences both

[51] Diderot and D'Alembert, *Encyclopédie*, 1: 119.

[52] Diderot and D'Alembert, *Encyclopédie*, 2: 789.

[53] Maupertuis, "Les loix du movement," 290.

obscure and limited that prohibit us from calling them general laws".[54] According to d'Alembert, our lack of epistemic access to this general law or ultimate principle results from our inability to perceive all the links in the chain of knowledge and so the ultimate principle remains an ideal for d'Alembert, one that perhaps humankind will never reach.

When it comes our prospects of discovering the principles of the individual sciences, however, d'Alembert is far more sanguine. His "Preliminary Discourse" to the *Encyclopedia* opens with an explanation the aims of the whole projected enterprise in relation to the project's title. In the second paragraph, that is, on the first page of the *Encyclopedia* itself, he writes the following:

> The work whose first volume we are presenting today has two aims. As an *Encyclopedia*, it is to set forth as well as possible the order and connection of the parts of human knowledge.

And here is the interesting claim:

> As a *Reasoned Dictionary of the Sciences, Arts, and Trades* [i.e. picking up the second part of the title of the work], it is *to contain the general principles that form the basis of each science and each art*, liberal or mechanical, and the most essential facts that make up the body and substance of each.[55]

Then in his "Advertisement" to the third volume of the *Encyclopedia* he reiterates the claim:

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[54] Diderot and D'Alembert, *Encyclopédie*, 4: 294.

[55] Diderot and D'Alembert, *Encyclopédie*, 1: I (my emphasis).

> The metaphysics of the sciences — because there is no science which has not its own metaphysics, founded on simple principles and on notions that are common to all men — will be, we hope, one of the principle merits of this volume. (*E* 3: v)

I conclude that the Enlightenment was indeed a Principled Enlightenment!

Abbreviations

E	*Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers*, eds Denis Diderot and Jean Le Rond d'Alembert, University of Chicago: ARTFL Encyclopédie Projet, Spring 2010 Edition, ed. R. Morrissey R., http://encyclopedie.uchicago.edu/. First edition 1751–72.
Elements	*Essai sur les éléments de philosophie*, ed. Richard N. Schwab, Hildesheim: Olms, 1965. [This is a compilation of *Elémens de philosophie*, Paris, 1759 and the "Eclaircissements" which were published in *Mélanges de littérature, d'histoire et de philosophie*, Amsterdam, 1767.]
PD	"Preliminary Discourse" *to the Encyclopedia of Diderot*, trans and intro by Richard N. Schwab, Chicago: University of Chicago Press, 1995. First French edition 1751.

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