INTRODUCTION

The final chapter of Locke's *Essay concerning Human Understanding* sketches a threefold division of the sciences which is meant to include 'All that can fall within the compass of human understanding' (4. 21. 1). The list of possible objects of the understanding is given as

> *first*, the nature of things, as they are in themselves, their relations, and their manner of operation; or, *secondly*, that which man himself ought to do, as a rational and voluntary agent, for the attainment of any end, especially happiness; or, *thirdly*, the ways and means whereby the knowledge of both the one and the other of these is attained and communicated.

Natural philosophy or the science of nature, *ethics*, and *logic* or *semiotics* are the names of the sciences which deal with these different matters. Divisions of science, maps of knowledge, were common in the early part of the century;[1] it was a time for surveying the fields of knowledge and for finding ways of improving the methods for extending human knowledge. The euphoria caused by developments in science as well as by the gradual realisation that scholastic methods and concepts were useless for advancing knowledge, led to an optimism which saw human knowledge expanding indefinitely. It was discovered that the ancients could be discarded, that knowledge could be extended by reliance upon human reason and experience; this is evident, as R. F. Jones has shown, in the tracts and pamphlets of some of the Elizabethan writers.[2] Bacon crystallised the growing faith and sketched a long-term programme. Other writers began to see the need to turn inwards, to examine the human understanding in order to discover how it works, what it might accomplish. There were various anticipators of this aspect of Locke's *Essay* in England. Read

[1] Of particular interest for a study of Locke is the brief division given by P. Nicole in essays which Locke translated: 'Knowledge is either of words, or of things, or of actions' (*Discourses, Translated from Nicole's Essays* by John Locke, edited by Thomas Hancock, 1828).

[2] *Ancients and Moderns; A Study of the Rise of the Scientific Movement in Seventeenth-Century England*, 2nd edition (1961).

from the beginning onwards—as one normally reads books—it is not always easy to discern any general pattern or programme at work in or behind his *Essay*. Even the last chapter appears tacked on, seems not to differ from any number of other chapters throughout that prolix work. Locke appears to wander somewhat aimlessly from topic to topic, dropping one theme here, picking it up later, mixing several questions together, adding bits and pieces as he thought of them. To be sure, the general epistemic claim is clear enough: no innate ideas or principles, all ideas to be derived from experience, knowledge to be a perception of the relation of those ideas. That final chapter of the *Essay*, however, enables us to place this epistemic programme in the wider, more general and more typical seventeenth-century concern with the classification of types of knowledge, kinds of subject-matter. The prolixity and disorganisation is still there, but with the aid of that simple classification we can begin to see a more ambitious plan working in Locke's mind. The totality of Locke's writings might be placed within this division, though he was not so systematic as to allocate different books to each of the sciences. Not much would be gained by classifying the Locke corpus in this way, but an understanding of his work can greatly profit from an examination of what Locke has said about or under this threefold division. In particular, his relations with the physical science of his day can be clearly seen.

Locke's treatment of the three sciences is not uniform. Natural philosophy consumes most of his attention in the *Essay*. What he says under that head, together with most of what he says about signs, constitutes a philosophy or epistemology of physical science. There is precious little anywhere in Locke's works of ethics, though when he discusses how to teach virtue to children in the *Education* and when he writes in a normative way in *Two Treatises* and occasionally in *The Reasonableness of Christianity*, we can reconstruct something of the ethical doctrine he accepted and shared with his contemporaries. The bulk of his remarks on ethics in the *Essay* is what would be termed 'meta-ethical' today: remarks about the role of moral concepts and principles in action, the motives that move a man to act, what an action is and how actions are possible, agency and the person. A careful look at

these meta-ethical concepts in Locke is rewarding, primarily for an appreciation of his theory of action, which anticipates a number of points made by recent writers on action. I do extract some of the principles of action to which Locke appeals, but my main concern under the science of ethics is with his meta-ethical remarks.

One of the more interesting features of Locke on action is his notion that action-concepts are not primarily factual. They are what he calls 'mixed modes', they define and constitute what can be done. Natural philosophy or the science of nature is restricted almost entirely to factual or observational matters. Theory of action exposes general and conceptual connexions, science of nature uncovers contingent and particular truths. Demonstration is possible in the former, experiment and observation relevant in the latter. Locke's remarks on demonstration contain an attack on the logical formalism of his day (maxims and the syllogism) and a recommendation for an informal logic of concepts and a lay-out of argument similar in theme and attitude to that suggested by Stephen Toulmin in *Uses of Argument*. Appreciating the exact nature of the logic Locke was recommending helps to dissipate the misunderstanding of Locke's suggestion about a demonstrative morality: it was demonstrative without being deductive. Once the meta-ethical concepts have been clarified, disputes in ethics or politics have primarily to do with questions of conceptual connexions. Locke's discussion of property is an interesting example of conceptual clarification.

It is more difficult to fit Locke into a context on the theory of action than it is on the other two divisions of science. There were, of course, disputes over free will (Hobbes, Bramhall); Hobbes at least had a concept of the person. Sir Matthew Hale anticipates some of the points about action made by Locke. Moral principles were cited frequently in support of political and religious doctrines. But while the terminology and method of the way of ideas was used by many predecessors and contemporaries of Locke, and while his moral philosophy is quite traditional in content, it is not readily apparent that his analysis of action and agency was a consolidation of concepts already in use. It may be that Locke was at his most original in the science of action.

In explicating Locke's remarks on the science of nature, it is

useful and necessary to place the *Essay* in the historical setting of the Royal Society and its general programme. The aims of that group were varied, both in general philosophy and in methods, but one predominant aim was to enlarge the observational knowledge of nature by compiling natural histories of phenomena. Not less important, even perhaps of greater importance for some (e.g. Boyle), was the desire to show that their method and their discoveries were not antithetical to religion. Boyle's *Some Considerations Touching the Usefulness of Experimental Natural Philosophy* (1663) is mainly concerned to vindicate science from this charge. The Royal Society ran into difficulties from the start of its incorporation on this score. The fact that Locke was a member of that society and was clearly associated with the new way of doing science undoubtedly contributed to the quick reaction to the *Essay* by the defenders of traditional religion. As I have shown in *John Locke and the Way of Ideas*, the doctrines of that work provided sufficient grounds for concern by Locke's contemporaries for the fate of a number of traditional theological and moral doctrines. I think it is also clear that his association with the Royal Society made it easy for his name and his doctrines to become caught up in the suspicion many people had towards that society.

Put in this context, we are able to see Locke's first division of the sciences as his account of the epistemology of the physical sciences. Thomas Sprat's *History of the Royal Society* (1667) attempted to defend and to explain the aim and methods of that group. Glanvill's *Plus Ultra* (1668) and *Scepsis Scientifica* (1665), like his earlier *The Vanity of Dogmatizing* (1661), were written also in defence of the Royal Society. There were other praises and justifications of the aims of the society, some brief, others longer. The Preface of Robert Hooke's *Micrographia* (1665) is especially important (as is the body of that work). Henry Power's *Experimental Philosophy* (1664) also contains accounts of the experimental method and the long-range goals and hopes of the society. Locke did not need to justify that method, but he did explicitly address himself to the task of explicating that method in philosophic terms. He wanted to show how the way of ideas could formulate and provide for the kind of observational knowledge of nature that his experimental friends were compiling. The plain, historical

method of the *Essay* is a clear reference to the natural histories of phenomena made by Boyle, Power, Hooke, Sydenham; it was also a method which Locke attempted to apply in his study of the development of knowledge and awareness, a natural history of the understanding. The '*Origin and Variety of Forms*' in nature had been, Dr Basil Kennet wrote in 1705, '*well trac'd and pursu'd through all its intricate Mazes, by the Excellent* Mr. Boyle, *and other Experimenters, as Naturalists, and by* Mr. Lock *as a metaphysician*'.[1]

My examination of Locke's science of nature is not meant to be an historical study. I want to give a careful and precise exposition of some of Locke's doctrines, staying as close to the text as possible. Some indication of his many similarities with Boyle on the nature of body, with Hooke on the nature and improvement of the understanding, some references to statements of the method of the Royal Society by its members, help to shed light on what Locke was saying about the science of nature. I have tried not to let these references interfere with the forward progress of the exposition. Neither have I wanted to enter into polemics, since what we need is a much more detailed presentation of Locke's doctrines than is usually to be found. Occasionally, however, criticism or comment is necessary of some writing which is particularly important or misleading.

One recent book about which I must comment, here and in later chapters, is M. Mandelbaum's *Philosophy, Science, and Sense Perception* (1964). His chapter on Locke is an important study of Locke and science, being one of the very few such discussions, the only sustained and detailed one.[2] The importance of Mandel-

[1] In the 'Preface of the Publisher' in *The Whole Critical Works of Monsieur Rapin* (London, 1706). The Preface is dated 1705 but unsigned, though Kennet is said by all sources to be the editor and translator. This remark was quoted in 1718 in John Pointer's *Miscellanea* and again in 1750 in *Parentialia or Memoirs of the Family of the Wrens*.

[2] Fulton H. Anderson's 'The Influence of Contemporary Science on Locke's Methods and Results' is much too schematic to be useful, though it was a much earlier recognition of some of the points Mandelbaum makes in his chapter. One suspects that Anderson had much more detailed material among his papers when he died in 1968. James Axtell has also put Locke in the scientific context: see his *The Educational Writings of John Locke* (1968), chapter 4 and 'Locke, Newton, and the Two Cultures', in *John Locke: Problems and Perspectives* (1969). R. Harré's *Matter and Method* (1964) is also an important study of the corpuscular theory of matter in the seventeenth century. His analysis of Locke's use of this theory and his understanding of the primary and secondary quality distinction in Locke are

baum's chapter lies in its placing Locke within the scientific tradition, his clear recognition that Locke was defending much of Boyle's general account of body and 'the method of work of the virtuosi of the Royal Society' (p. 49; cf. 50, 51, 58). Locke's theory of knowledge must be examined in the context of the new science, at least initially, not in that of the philosophical debates that arose later. But Mandelbaum's account undervalues the importance and the influence on Locke of the method of making natural histories. His account of Locke and science is mainly concerned with the corpuscular hypothesis. I think Mandelbaum over-estimates the role and use of that hypothesis among seventeenth-century scientists, though I do not suppose any of them would have rejected that hypothesis. What is the case is that much of the work conducted by the members of the Royal Society (certainly in its early years) was not concerned to support or even to employ that hypothesis. That Locke accepted it and used it is beyond doubt. It was, however, the emphasis upon compiling natural histories of bodies, which was the chief aspect of the Royal Society's programme that attracted Locke, and from which we need to understand his science of nature.

In the minds of seventeenth-century writers on science, there was a distinction between the mechanical and the experimental philosophies. The latter was the method for getting data, compiling histories of phenomena. Historians of science, certainly philosophers of science who look at this period, tend to seize upon the corpuscular philosophy as the main ingredient in physical science at this time. It is of course dangerous to generalise about the aims and methods of the scientists of the seventeenth century, since they were not a homogeneous group, not even as members of the Royal Society. Moreover, the actual practices of scientists do not always coincide with their own statements of their methods. Nevertheless, there is a vast literature in the seventeenth century

accurate. But like Mandelbaum, Harré does not mention the natural history side to the science of that period, nor does he show Locke's interest in that method. It is an over-estimation to say 'Locke set himself the task of developing in a coherent, systematic and rational way what he took to be the fundamental tenets of the corpuscularian philosophy' (p. 93). R. M. Yost's 'Locke's Rejection of Hypotheses about Sub-Microscopic Events' (*Journal of the History of Ideas*, XII, 1951) is also a useful discussion, especially in showing how Locke accepted the corpuscular hypothesis but took the making of natural histories as the method to science.

about science, written by medical men, chemists, microscopists, and learned laymen. There is in this material (large in bulk, published from early in the century right through the period when Locke was writing his *Essay*) a consistent and oft-repeated attitude towards science; there are also firm statements about the aims and methods of the sciences. Judged in terms of the statements made by these writers, the corpuscular hypothesis was not the main feature of scientific thought and practice. Anyone who wants to see the documentation for this claim need only read R. F. Jones's excellent study.[1] The longer way to an appreciation of the Bacon-inspired stress upon experiment, observation and natural histories is to read the pamphlets mentioned and discussed by Jones. Those quickly and easily confirm Jones's account.

In seventeenth-century opinion the one factor more responsible than anything else for fallacious reasoning was the lack of sufficient data. Thus the need of heaping up experiments and observations, stressed by Bacon years before, was declared again and again. Experimental philosophy remains a thing distinct from the mechanical, and Bacon, who was the chief sponsor of the former, far outweighs in importance Descartes, who lent his great influence to the latter (Jones, p. 169).[2]

The more fundamental philosophy—mechanical or experimental—was without a doubt the experimental. 'The mechanical philosophy was considered by the scientists a *hypothesis*, the truth of which was gradually being revealed to their eyes through experimental verification, but experiment and observation as the proper method for the discovery of natural truths represented a faith,

[1] R. F. Jones, *op. cit.*

[2] R. M. Blake has shown that even in Descartes there is recognition of and stress upon the need for histories of phenomena. See his 'The Role of Experience in Descartes' Theory of Method', in W. H. Madden's *Theories of Scientific Method* (1960), pp. 75–104. Cf. A. C. Crombie, 'Some Aspects of Descartes's Attitude to Hypotheses and Experiments', *Collection des Travaux de l'Académie Internationale d'Histoire des Sciences*, XI (1960), 192–201. Jones's study was generally well received by historians of science, though some feel that he has made too sharp a distinction between the use of hypotheses and the gathering of data, too much difference between Bacon and Descartes and the influence each had in the century. Others quite rightly point out that Bacon's programme did not just call for the making of natural histories: hypotheses were important too. The attempt to characterise the attitudes to science and the programme of scientific investigation at this time is perilous but necessary if we are to understand Locke's analysis of the science of nature. By the end of chapter 3 I hope to have balanced any excesses that may appear in these introductory statements.

to doubt which was heresy, and which was common ground for all members of the Royal Society' (Jones, p. 185). To reject the mechanical hypothesis was possible. It was unthinkable that one could reject the experimental method. To reject the latter would mean going back to the older methods of quoting authority, book learning, deducing from axioms. We need not go over the ground on this matter so ably covered by Jones, but it is useful for the purposes of this study of Locke (Jones does not fit Locke into his survey) to sample here some of the writers on science and its philosophy whom Locke either knew personally or whose books were in his library. Others are referred to in the chapters that follow.

Robert Hooke is of particular interest, since he was both a scientist at the centre of the Royal Society activity and an acquaintance of Locke. Hooke's *Micrographia* has, as I point out in chapter 2, a number of attitudes and phrases similar to those Locke employs. Another work of Hooke's, probably written around 1666, is of even greater significance in its anticipation of Locke's general approach to the human understanding.[1] The aim of science is, Hooke says, to 'find out the true Nature and Properties of Bodies; what the inward Texture and Constitution of them is, and what the Internal Motion, Powers, and Energies are' (p. 3). The ancients did not make 'subtile Examination of Natural Bodies by Direction, Experiments, or Mechanical Tryals'; they made the evidence fit their hypotheses and theories, rather than the other way about (pp. 3, 4). Hooke's ultimate aim in this tract was to build as complete a history of all phenomena, natural and artificial, as was possible, so that eventually we might extract from those histories (by a 'philosophical algebra') general principles. But the application of the algebra was a long way off. The first step for improving our knowledge of phenomena was 'an Examination of the Constitution and Powers of the Soul, or an attempt of Disclosing the Soul to its self, being an Endeavour of Discovering the Perfections and Imperfections of Humane Nature, and finding out ways and means for the attaining of the one, and of

[1] 'The Present State of Natural Philosophy', in *Posthumous Works* (1705). For a discussion of this work and of the programme for a 'philosophical algebra', suggested but not developed by Hooke, see Mary B. Hesse, 'Hooke's Philosophical Algebra', *Isis*, LVII (1966), 67–83.

helping the other' (p. 7). The next step is to find a way to use the 'Means and Assistance of Humane Nature for collecting the Phenomena of Nature, and for compiling of a Philosophical History, Consisting of an exact Description of all sorts of Natural and Artificial Operations' (pp. 7–8). The third step is to find a 'Method of describing, registring, and ranging these particulars so collected, as that they may become the most adopted Materials for the raising of axioms and the Perfecting of Natural Philosophy' (p. 8). The order in these steps for improving our knowledge is important.

Medical doctors were also praising the method of experiment and observation as a way of breaking out of the older methods: it would, W. Simpson said,[1] 'worm out the *Galenical* Method' (preface). All former opinions are now being put to the test of 'matter of Fact, in *Experiments*; and what is found consonant to *Truth*, made forth by collateral *Observations*, is approved, the rest...is rejected'. Simpson gives expression to the general philosophy of physical science, what he calls 'an *Hypothesis* of experimental Philosophy' (p. 214). We must, he says, lay aside our books in order 'to lay a groundwork for a more facile, unprejudiced understanding of things'. Simpson recommends making up a book of experiments, taken from other books—a *Clavis Philosophica*—and then establishing a laboratory so that these experiments can be repeated and new ones undertaken. Jonathan Goddard also urged the chemist and physician to use only the method of experiment and observation.[2] Maynwaring generalised the method: 'Solid knowledge in Natural Philosophy, is the most necessary qualification, preparatory to make a good *Physician*: now this *Philosophy* must be experimental, solid, and certain: the *notional Theorems* in philosophy, the world hath too long insisted on, and spent much time to little purpose, in vain *ratiocination*, *speculative conjectures*, and *verbal probation*.'[3]

Sir Matthew Hale (in a book not in Locke's library) spoke of the 'want of a clear, and sensible, and experimented Observation' of things, and says that because of this 'our positions and con-

[1] *Hydrologia Chymica* (1669).
[2] A *Discourse Setting Forth the Unhappy Conditions of the Practice of Physick* (1670).
[3] *Praxis Medicorum Antiqua et Nova* (1671).

clusions touching their Causes, Effects, Order and Methods of their procedure are but fictions and imaginations, accomodated to our Inventions rather than to the things themselves'.[1] These stresses upon experiment and observation were of course not confined to England. The Italian Accademia del Cimento presented to the Royal Society in 1667 some of its experimental findings. This report was translated and published in 1684. The report says that it is not a perfect experimental history, but only a beginning. The authors comment that, if a few speculations are present here and there, they belong to individual members and do not represent the society. Their '*sole Design is to make* Experiments, *and Relate them*'.[2] The faith in experience, trial and observation is expressed throughout. Similarly, the French translation of Swammerdam's work, *Histoire Générale des Insectes,* 1682 (also in Locke's library), repeatedly emphasised experience and careful observation and description, in contrast to the older methods of authority, the truth of experience instead of 'sa raison trompeuse' (p. 45). We should attach ourselves to convincing experiences rather than following the proud reasoning of our minds and the prejudices of our imaginations (pp. 19, 27–8, 30–1, 33–40, 138, 169).

These are only a sample of the attitudes that can be found over and over in the scientific literature at the time Locke was writing his *Essay*. These attitudes are found in scientists of all sorts (not just in medical writings), as well as in writings about knowledge in general. If we shift our attention from the background assumption of corpuscularianism to the interest in the production of natural histories of phenomena (viewed with ordinary eyes and with instruments), we shall see the relation between Locke's epistemology and his account of the science of nature. His epistemology, the main facet of the science of signs, may have been handcuffed by the concept of certainty; it was not controlled by a notion that all knowledge is deductive. The idea-signs in terms of which our knowledge of body is couched are derived from the things themselves, from the objects of observation. Mandelbaum finds a continuity between Locke's account of

[1] *The Primitive Origination of Mankind* (1677), p. 8.
[2] *Essayes of Natural Experiments Made in the Accademia del Cimento* (1684). Locke had in his library a copy of the original Italian edition, published in 1667.