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due to worries about lack of an epistemological criterion for religious beliefs that BOYLE and LOCKE and the Latitudinarians had earlier stressed the need for *objective* criteria provided by reason, shared experience, and testimony. Thus Henry MORE, in *Enthusiasmus Triumphatus* (1656), provided what he saw as a natural history of enthusiasm in which he painted it as a disease of the IMAGINATION with physiological causes, or induced by intense silent meditation. (His own acceptance of SPIRITUALISM seems to have escaped similar treatment.) John Locke, in his *The Reasonableness of Christianity* (1695), was another firm opponent of enthusiasm. His general concern was that it was extravagant and unbounded, and gave an insufficient role to reason. He held moreover that any doctrinal authority not delivered by reason must derive from written Scripture attesting miracles, not from supposedly private revelations in personal experience.

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Keith E. Yandell

See also Anglicanism; Epistemology; Latitudinarianism; Religion, Philosophy of

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EPISTEMOLOGY

One or both of two instincts drive philosophical enquiry: wonder and control. We have a deep wonder in the world, its structure and origin and in ourselves and our place in the world. We also possess a general desire for control and, as Schopenhauer pointed out, understanding can be partly a vicarious mastery over the world. We share these instincts with other ANIMALS. Psychologists have found that monkeys confined to a room without a view will perform tasks in order to obtain a look through an opened window, or to be able simply to manipulate objects. Sometimes, as reflected in Francis BACON's aphorism 'knowledge is power', the two are intimately related. But wonder and its satisfaction is its own delight and some delightful knowledge is of no other practical use. Unlike the mystic, who is content to savour mystery, the philosopher wishes to solve it, revelling in the expectation of even deeper problems within the cracked shell of the first problem. The mystic monkey would stay in the room simply savouring the question 'what is outside?', whereas the monkey philosopher would jump through hoops to open the window.

The fundamental questions of epistemology concern the source, the nature, the scope and limits of knowledge. Often neglected in current commentaries is another, perhaps more fundamental, problem: how do we advance the growth of knowledge? How to advance the growth of knowledge is the question that can be discerned as a background goal of most thinkers who have addressed these issues, from Plato to DESCARTES, Leibniz, KANT, Duhem and Poincaré; and in the case of the British philosophers, from Francis Bacon, HOBBES and LOCKE, to HUME, RUSSELL, WHITEHEAD and POPPER. (BERKELEY is an exception, as he feared the advance of SCIENCE.) Most philosophers, including British philosophers, have assumed that it is necessary to answer the problem what is knowledge first in order to solve the problem of how to advance or promote it. However, it may be that knowing how knowledge grows will tell us both what knowledge is and how to accelerate that growth. Clearly, it is only the growth of knowledge that can satisfy both our wonder in the world and give us greater control. Most thinkers, including most British epistemologists, assume that we acquire common-sense knowledge and scientific knowledge without a settled view of what knowledge is, just as we know how to walk, ride a bike and use language without a settled view of the knowledge that those skills involve. It is supposed that tacit knowledge (stressed by the British chemist and philosopher, POLANYI) or knowing *how* as opposed to knowing *that* (stressed by the British philosopher, RYLE) can exist and grow even in the absence of answers to the epistemological questions.

Of all the fundamental questions about knowledge, it is, however, questions about the *nature* of knowledge that have exercised most thinkers most of the time, centring on the problem of what distinguishes knowl-

edge from merely true belief. Understanding this problem forms an important background to understanding the intellectual history of epistemology. Plato's *Meno* has an important discussion in which Socrates is trying to answer this question. We are asked to imagine that we wish to get to a city and that in walking along a road we come to a fork. We have no map. Suppose we take the left fork because we merely believe that that is the way and it happens to be true that the city lies along the left path. Our merely true belief has helped us to our goal. However, is this knowledge? Socrates asks us, would we have acted any differently if we had had knowledge? The suggestion is that we would not have: true opinion is as good a guide as knowledge. Socrates proceeds, however, to suggest that knowledge is still a greater prize because, having found the reason for holding the belief, the belief is more stable, less easily forgotten. Specifically, beliefs supported by good reasons are more valuable and enduring than those that are not. Up until recently, Socrates's emphasis on reasoned belief dominated thinking on knowledge, with almost every thinker conceiving knowledge as justified true belief. The main distinctions between various thinkers and schools of thought in epistemology thus emerged in terms of disagreements over the nature of the justifications for our claims to knowledge.

It is fashionable in some circles to scorn philosophy, especially epistemology, as irrelevant to humankind's practical affairs. However, the dominant view that a society has of knowledge makes a fundamental difference to its ETHICS, LAW and the conduct of science. Prior to the ENLIGHTENMENT, European thought had sunk into an obsequious epistemology which held that the sources of knowledge are in tradition, and especially the tradition of respect for Aristotle and the medieval schoolmen. An exciting aspect of the history of British epistemology is that it took part in an intellectual revolution against this stultifying authoritarianism, replacing it with the liberating idea that, with the right method, any individual can explore the world and promote the growth of knowledge. Any individual can do this because the source of knowledge and TRUTH lies within his own powers either of careful observation (as with Francis Bacon) or of his intellect, for example, the PERCEPTION of clear and distinct ideas (as with Descartes). At this point, both branches of thought shared the idea that truth is manifest if one only looks properly. Another aspect to the rise of British epistemology is its interplay with science. Science, through the genius and intellectual bravery of Galileo and NEWTON, became an inspiration for epistemologists, and we can also see the influence of philosophy on science.

Kant highlights the main differences between epistemologists in a way that nicely sets the frame of debate in epistemology in Britain from its inception. Kant distinguishes between the rationalists and the empiricists. Rationalists are those who think our knowledge is wholly or largely justified and obtained from our reason, considered independently of experience; empiricists are those who place a greater emphasis on our experience as the source and justification of our knowledge. Awed by the then undoubted and seemingly irrefutable insights of Euclid's *Elements* and the unrefuted explanatory success of Newton's scientific theory of the world, with its conception of absolute SPACE AND TIME, Kant argued that the human mind brings to experience fundamental assumptions about the structure of the world thus in some sense reconciling the two. We cannot have experiences that are not shaped by our conceptions of space and time and causality. In characterizing his empiricist predecessors, Kant was thinking of the British empiricists, Bacon, Hobbes, Locke, Berkeley and Hume. Kant famously claimed that the latter had woken him from his 'dogmatic slumbers'. British epistemology largely continued on the empiricist path started by Francis Bacon.

Early epistemologists in Britain, such as Robert GROSSETESTE and Roger BACON, were concerned with either applying theological thought to the issue of our knowledge of the world or reconciling these theological positions with Aristotelian thought, imported via Arab commentators such as Avicenna and Averroes. They were interested in experiments, but did not develop much of a methodology. Roger Bacon did raise one of the fundamental problems of perceptual knowledge: if things are distant from us, how can we be aware of them? And WILLIAM OF OCKHAM, though a naïve realist, is famous for the principle of 'Ockham's razor', the injunction to be economical in one's theories.

Liberation of British epistemology from the theological imperative did not occur until the early seventeenth century with Francis Bacon's *Novum Organum* (1620). Epistemology had been dominated by Aristotle's method of deriving truth about nature by inference from purportedly self-evident axioms (for example, that objects in motion need a continuing push to stay in motion, or that all objects will fall to earth). Bacon questioned the self-evidence of these axioms, advocating instead the method of INDUCTION for the discovery of laws of nature. His idea was to proceed from particular direct observations of nature to axioms of intermediate generality and thence to theories of most generality. Bacon assumed that nature is an open book, as opposed to one only understandable by the mystic or initiated or other elect few. However, before engaging in induction, the inquirer must free his mind from certain false notions or tendencies that distort the otherwise manifest truth. These are called 'Idols' and are of four kinds: 'Idols of the Tribe' (perceptual illusions), 'Idols of the Den' (personal biases), 'Idols of the Marketplace' (linguistic

confusions) and 'Idols of the Theatre' (dogmatic philosophical systems). Bacon believed that it is indeed possible to rid the mind of all presumptions and presuppositions, and in this state to read the book of nature, which is manifest for all those with unprejudiced minds. The collection of repeated observations and experimental results (both verifications and falsifications) would enable one to induce with certainty laws of higher and higher generality, culminating in statements of the laws of nature. The soundness of Bacon's approach has been called into question both for the insuperable logical difficulties of inferring the general from the particular, and for the psychological and logical impossibilities of removing all preconceptions from our observations. For example, even framing what to observe involves a selection from the uncountable observable aspects of the world. Bacon's quest for a method of ascending from particulars to laws of higher and higher level was to be taken up later by WHEWELL, who makes a similar point. Bacon's real importance lies, however, in championing the scientific approach, with its emphasis on reproducible empirical observation and test, which any individual can in principle perform. In doing this he indirectly challenged the then greatest impediments to the liberation of science: the authority of Aristotle, the authoritarian tradition of the medieval schools and the OCCULTISM of his day.

Thomas Hobbes, influenced by Francis Bacon (to whom he was secretary) and his friendship and correspondence with Galileo and debates with Descartes, kept this empiricist approach alive and applied it to other realms, including PSYCHOLOGY and political theory. He was also concerned to throw off the manipulations and deceptions of MYSTICISM and superstition (e.g. concerning ghosts), and to reject subservience to the tradition of the medieval schoolmen. In the *Leviathan* (1650) he argued that all these aberrations could be tamed by science, systematic observation and experiment. Like Bacon, Hobbes argued that if one avoided certain errors, which he listed, one could not fall into absurdity. Even tradition could be critically analysed and, in the case of the state, justified. Hobbes argued that all our ideas are derived from the senses; there is nothing in the mind that was not first in the senses. Strange ideas, such as of a centaur or a unicorn, are derived by the combination of components derived from the senses. Hobbes also argued that this process of knowledge acquisition could be explained as the action of mechanical principles, on a model he took from Galileo. Hobbes's universe was a materialistic and deterministic one. It had no room for spirits and other substances and entities that lay outside the grasp of science. Hobbes was a brilliant thinker (Leibniz, rationalist philosopher and co-inventor of the Calculus, said that Hobbes had to be considered on all important issues) and upholder of the empiricist approach. His main contribution to epistemology was the suggestion that with sufficient investigation one would be able to understand human knowledge in naturalistic terms in the same way that Galileo had understood the behaviour of colliding bodies. This was a rudimentary forerunner of many later naturalistic theories of psychology (including J. WATSON's and B.F. Skinner's behaviourism) and also naturalistic theories of knowledge (including Quine's philosophical materialistic BEHAVIOURISM).

John Locke, intellectual friend of the outstanding scientists Newton and Leibniz and Robert BOYLE, further elaborated the British empiricist approach to knowledge. In his best-known work on philosophy, *An Essay concerning Human Understanding* (1690), Locke was concerned to specify the limits of human knowledge with the goal of focusing human exploration on the questions humans could answer, and to establish the circumstances under which one could have various degrees of support for one's beliefs. He is well known for his attack on innate ideas and his counter-thesis that the human mind begins life as a *tabula rasa* on which experience writes. Like Hobbes, Locke believed that all our ideas are derived from our experience. But Locke distinguishes between experience from sensations and experience of our own mental operations upon the material provided by sensation, which he calls 'reflection'. One would never know the taste of pineapple or the sensation of red if one were never to taste pineapple or see red; it is not possible that one could imagine a new simple idea, for example, a new taste or a new colour. One problem with Locke's account is that he seems to assume that the mind, though it has no particular innate ideas, does have innate capacities. Ideas are constructed from simple ideas of sensation and reflection according to three processes: combination, the PERCEPTION of relations between ideas and ABSTRACTION. These methods lend themselves to a description in terms of inherited algorithms, and algorithms can be redescribed as highly compressed information, which takes us back to something highly reminiscent of ideas. More specifically, modern psychology has undermined Locke's implicit use of the notion of a general intelligence (operating via association). The modularity of mind hypothesis (Jerry Fodor, 1983) asserts that our minds have very specifically adapted methods or algorithms for solving problems in specific domains. Hobbes and Locke would, however, have found the computational view of a knowledge using organism congenial. As Steven Pinker points out, the principles of association and contiguity are not alternatives to a computational view; they comprise a crude version of one.

Locke argued that there is a fundamental distinction between two classes of qualities. Secondary qualities – such as the blueness of the sky, the pinkness of one's skin, the taste of pineapple – that do not belong to the objects

themselves, but only arise through our perceiving the relevant objects. In this insight he was preceded by Hobbes. Contrasted with this is the class of primary qualities – such as extension, location, mass, weight, composition – that can be measured and classified independently of whether they are perceived, and are the proper concern of science. Some commentators have taken this distinction as a damaging incoherence in Locke's account, for if all knowledge is derived from the senses, how does one decide that the primary qualities are not systematically deceptive? One can hardly consult sensation to justify this decision, as that would be circular. Locke's answer would be that perhaps we do not know these things with certainty, but our opinion is sufficient because God is our ultimate assurance that we will not stray too far from the truth, and that secondary qualities are reliable indicators of the corresponding powers in bodies.

Locke's emphasis on experience as the sole source of all ideas opened up the possibility of questioning the existence of matter, and it was Bishop George Berkeley who championed this position, known as 'subjective IDEALISM'. Berkeley is an interesting aberration in British epistemology. For, like Bacon and Hobbes and Locke, he saw the power of science and even made significant contributions himself (he wrote on optics and also prompted a better formulation of the calculus). But he also thought that his British predecessor's infatuation with the MATERIALISM and determinism of science might undermine faith in God. If matter were shown to be eternal with no beginning, then what use was there for a creator? Locke, indeed, though wishing to uphold a Christian view of the person with an independent, immaterial soul, confessed he had no answer to the contrary position that a person's soul was just a dependent property of matter.

Berkeley argued in *A Treatise concerning Human Knowledge* (1710) that we perceive ordinary objects like mountains, rivers, houses and people. However, since we only perceive ideas, it follows that these ordinary objects are ideas. The only exceptions are people, who were conceived to be spirits. What coherence, stability and independent reality these clusters of ideas have is maintained by God's mind, indeed it is God who continuously intervenes to put the world of ideas into people's minds. The mountains and rivers continue to be when unobserved by people because they continue to exist in the mind of God.

Berkeley is important in articulating the first statement of an extreme idealism: to be is to be perceived. Moreover, in his attack on the existence of corpuscles or insensible particles (the theory of atoms), he propounded the first version of what came to be called instrumentalism in the PHILOSOPHY OF SCIENCE. In his pamphlet *De Motu* (1721), he argued that just because the notion of corpuscles is useful for calculating and predicting the behaviour of matter, it does not follow that corpuscles must be posited as real objects; one can simply retain them as useful instruments of science. Berkeley influenced some important scientists, such as Ernst Mach, and through him, Einstein. For example, Mach embraced the idea that all knowledge was the economical conceptual organization of sense-data, and thus opposed Newton's absolute space and paved the way for Einstein's relativistic account of space.

The smoldering SCEPTICISM lurking in Locke's epistemology that Berkeley exploited in developing his idealism is more deeply explored by David Hume, probably the most outstanding empiricist philosopher. Hume starts by noting that most of us take for granted that the past will be a reliable guide to the future. For example, if a flame is always followed by heat in the past, we infer that future flames will also be followed by heat. This is the principle of induction. More generally, a background belief in the uniformity of nature allows us to infer the unknown or unobserved from the observed; to infer one part of the world from another part. We observe a match being struck and we infer (predict) a flame. But how can we justify this inference? In particular, can we do it by assuming that the world is uniform? This is the problem of induction. Hume says there are only two possible types of justification, demonstrative and probable, both of which fail. The *demonstrative* approach claims that as a matter of logical necessity, the future is like the past. But this fails because we can imagine a world of chaos, or one similar to this one right up to this point after which it becomes completely different. The alternative, *probable*, approach is to argue that past pasts have been similar to past futures and that therefore the future will probably resemble the current past. But this involves another appeal to the principle of induction and so is circular. Looked at in its most general form, the probabilistic reasoning yields a figure of zero. For example, if we take the statement that all flames are followed by heat, the probability of some unexamined arbitrary flame being followed by heat is zero, because we have to divide the number of possible cases, which is infinite, by the number of observed cases, which is finite. One can see that the same point applies to the general principle itself, for there are an infinite number of possible ways that the world could be uniform and non-uniform.

Hume did not supply an answer apart from the consolation that, at the end of the day, after our philosophical reveries, we are, nevertheless, governed by an instinct to reason according to induction. It is a sign of Hume's honesty that he did not pretend to have an answer to the logical problem; it was a sign of his greatness that he set out most clearly the problem of knowledge that was to dominate the discussion to the present day.

William Whewell was an extraordinary polymath in whom philosophy and science fed upon one another to yield a fundamental advance in understanding the progress of science, i.e. the growth of knowledge. He was one of the most influential intellectuals of the nineteenth century, both in philosophy and science. He made contributions in mathematics and geology, and he was a founding member and an early president of the British Association for the Advancement of Science, a fellow of the ROYAL SOCIETY, president of the Geological Society, and longtime Master of Trinity College, Cambridge. He invented the term 'scientist'. He reacted against what he saw as an overemphasis on uninterpreted observation and, while placing weight on empirical experiment also wished to bring broadly Kantian influences to bear. He thought Bacon was correct to place weight on observation, but Whewell recognized that the construction of hypotheses was necessary for any serious experiments or even observations. Our observations are theory-laden. In other words, Bacon's admonition to observe nature carefully and without prejudice was inadequate. In his book *The History of the Inductive Sciences, from the Earliest to the Present Time* (1837), Whewell sets out the steps leading from particular observations to laws of higher and higher generality. He also argues from many examples from the history of science, that 'invention, sagacity, ingenuity' are needed at each step in the generation of testable hypotheses.

Bacon and John Stuart MILL had said that the inductive method involves more than a simple enumeration of instances. But it was Whewell who made this clear, and in a way that called into question the former empiricist presumption of the manifest nature of evidence. Mill, in *A System of Logic, Ratiocinative and Inductive: Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation* (1843), had supplied certain methods of inferring theories from the instances. But Whewell pointed out, contra Bacon and Mill, that one cannot have the instances without some admixture of theory (or as he put it 'conception'). A mental element (above simple observation) was added by the very act by which the instances are combined. Whewell stressed that discoveries are often made not by new observations but by applying the appropriate conception to the facts. For example, the points of orbit of Mars were known before Kepler by Tycho Brahe, but it was Kepler who supplied the idea that they conformed to an ellipse. It is arguable that Whewell's work provided ammunition for, though did not presage, the approach of Karl Popper in the early twentieth century. Whewell did not, however, countenance pure guesswork, which is permitted within Popper's conjecture and refutation approach; his method is still inductivist even though it starts from (theoretically) 'colligated' facts, whereas Popper's method may start from a bold or wild conjecture with little or no connection with observations.

Epistemologists had long envied what was seen as the ideal powerful axiomatic approach of mathematics. Descartes was enchanted by Euclid's *Elements*, by its successful derivation of the whole of geometry from a few indubitable axioms and definitions, and he wanted to do the same for the whole of knowledge, or at least for all its methods. One can also see this attitude in Hobbes, though in Locke there is a greater concern with degrees of support for belief. The next great development in British epistemology came with A.N. Whitehead and Bertrand Russell, in a bringing together of philosophy and mathematics. They were very much aware of their debt to the EMPIRICISM of Hume. In his book *History of Western Philosophy*, Russell said that modern analytical empiricism differs from that of Locke, Berkeley and Hume mainly in the use of mathematics and powerful logical techniques. The axiomatic approach to all problems in science and mathematics still had its enchantment, and Russell and Whitehead, in their epochal *Principia Mathematica* (1910, 1912, 1913), sought to derive the whole of mathematics from LOGIC, and thus justify mathematical knowledge.

Russell was vexed by the gap that Hume had shown between our experience and our claims to scientific knowledge of the world. In analysing this problem, Russell distinguished between knowledge by acquaintance and knowledge by description. By 'acquaintance' is meant direct awareness without any inference or knowledge; knowledge by description concerns by contrast propositions such as that the sun's heat is caused by nuclear fusion or that the North Pole is cold (when one has not been there). In empirical matters, the former – knowledge by acquaintance – is primary and justifies the latter. Russell was of the opinion that our assumption that we know of objects like mountains, rocks and buildings should be accepted, but that we only ever have knowledge by acquaintance of sense-data. He suggested that we conceive everyday objects as being logical constructions out of sense-data. Therefore Russell, as seen in his 1918/19 *Lectures on the Philosophy of Logical Atomism* (pp. 178 and 281), thought that he may have bridged Hume's gap by suggesting that logical atoms are neither mental nor physical by themselves and only become mental or physical by the way they are combined into complexes. WITTGENSTEIN, who had helped Russell to develop logical ATOMISM, later abandoned the approach because some good candidates for atoms, such as something's being red and something's being green, are incompatible (and therefore not logically independent after all).

Russell's use of mathematics and logic to solve philosophical problems inspired many developments, especially the emergence of logical POSITIVISM, Wittgenstein's philosophy and linguistic philosophy in general. Logical positivism was a doctrine centred around the Austrian

intellectual group, the Vienna Circle. Their main goal had been to distinguish scientific knowledge from what they regarded as a pretence to knowledge, METAPHYSICS, by which they meant such areas as astrology, myth, AESTHETICS, ethics and also systems such as HEGEL's. The idea behind this approach was that only science had brought about definite increases in knowledge, so that science should be taken as a paradigm. Accordingly, they looked for a principle that would guide in the proper formulation of our knowledge claims, but the principle they chose entailed that everything but science, logic and mathematics was meaningless.

A.J. AYER was the vigorous British representative of logical positivism, reinvigorating the philosophical scene in London with his enthusiasm for public debate. In Ayer's chief work, *Language, Truth and Logic* (1936), he advocated the so-called verificationist principle of MEANING. He argued that our knowledge consists of either empirical facts (e.g. 'Water boils at 100 degrees centigrade at sea level') or logical truths (tautologies, such as 'A green circle is green'). The verificationist principle prescribed that a statement is meaningful if and only if it has a method by which it can be verified, or else is a tautology. Moreover, its meaning as such is captured precisely by the conditions of its verification (in the case of empirical statements, it is an observation; in the case of logical truths, it is a truth table or other proof). Ayer defined knowledge as 'justified true belief', like his empiricist heroes, but unpacked the notion of justification in terms of verification. The verification principle soon came under attack for it was, as his critics pointed out, neither a tautology nor an empirically verifiable statement, and so ought – on its own terms – to be counted as meaningless. And as Karl Popper pointed out, the principle rejects, unintentionally, other statements which are the very prize of science, namely, laws of nature. It does so because a law of nature (e.g. 'Water boils at 100 degrees centigrade at sea level') is a universal statement, it covers the whole of space and time. It speaks not just of the observed cases, nor even of just the observable cases, but of all water at every point in space and time, past and future and all the possible portions of water that were never, nor ever will be realized. The deepest wound inflicted on logical positivism was by the work of the mathematician, Kurt Godël, who showed that in any consistent system that could formulate arithmetic, there must always be true but unprovable (and therefore unverifiable) statements. Since scientific theories use arithmetic, it follows that there must be unverifiable but true statements within their range of implications.

With the rise of linguistic philosophy, British epistemology entered a torpid state, for linguistic philosophy became obsessed with intricate analysis of the conceptual structures behind ordinary language (as advocated by Gilbert Ryle and Peter STRAWSON) and categorizing nice distinctions of usage (as brilliantly executed by J.L. AUSTIN). Early influences on its development were Wittgenstein's precept that there are no real philosophical problems, only confusions of language use, and his doctrine that the meaning of a word is its often multifarious though overlapping uses. For this school of thought, questions concerning how we can know the world or promote the growth of knowledge or, for example, how quantum theory affects our ability to know the world at the subatomic level are, in a sense, silly, since they just follow from a confusion of words. This fashion in philosophy, which dominated both Cambridge and Oxford during the 1950s, is partly responsible for the common misconception of philosophy as a clever but useless play with words. During this phase, British epistemology could hardly have been less influenced by science and was indifferent to the logical analysis of the methods of science and to promoting the growth of knowledge. It may have reflected the growing over-specialization within British academia. It was in stark contrast to what was happening in the United States, where there was still an excitement about scientific knowledge and an assumption that philosophy and science could learn from one another.

There were, however, notable exceptions to this dominant view. The polymaths Michael Polanyi and Karl Popper stand out as two, very different, major opponents of logical positivism and linguistic philosophy. Both of these men were enchanted by the potential of science and the quest to understand the world, which they thought of as fundamentally interdisciplinary: as Popper put it, 'there are no subject matters, only problems and our desire to solve them'. Michael Polanyi in *Personal Knowledge* (1958) expounded the theory that all knowledge has both articulate and tacit components. Our articulated knowledge consists of the books, maps and other physical encodings or formulations that we produce. Tacit knowledge consists of a much larger world of knowledge that cannot ever be fully expressed and that forms a necessary basis for the existence of articulated knowledge. Polanyi also stressed that even our theories and other articulate knowledge contains tacit knowledge, in the sense that we never quite fully understand what we say, because what we say is replete with unforeseeable repercussions and implications. Our usage can be informed by our pioneering and fumbling attempts to apply our language to hitherto uncharted areas and problems, for example the speculative, and at first rejected, extension of mathematical operations to produce new kinds of number – negative, irrational, imaginary and transfinite. Polanyi thus argued contra Wittgenstein and linguistic philosophy, that our language is a tool for expanding knowledge and although it can be misused, its usage can be radically

manipulated for the purpose of the growth of knowledge. Polanyi's epistemology is important, not only for its own sake, but also because it led to new ways of interpreting the behaviour and functioning of society and the economy. Polanyi applied his insights on the nature of knowledge to the analysis of the market versus communism, contributing fundamental arguments against the possibility of society-wide planning (see Polanyi's concepts of spontaneous order and polycentricity in *The Logic of Liberty*). It is ironic that the early Wittgenstein (of *The Tractatus*) had stressed that what really mattered in life was precisely that which could not be said. On the other hand, the logical positivists had embraced the opposite presupposition that all that was really important in life could be said. The other key opponent of linguistic philosophy, Karl Popper, expressed similar points about the unfathomable nature of our knowledge based on mere logical analysis of the informative content of our objective theories.

Michael OAKESHOTT also stressed that much knowledge is inexpressible. We do not so much know reality but live it by entering into the special human practices of history, politics, science, morality and poetry, and these practices cannot be reduced to explicit formulations or analysed by external standards. Oakeshott's position contrasts dramatically with Popper's, however, in that the latter held that all practices (traditions) – and especially science – can be critically analysed by external standards of truth and logic.

Justificationism, which characterizes most views in the history of epistemology, whether rationalist or empiricist, asserts that one ought to accept a position if and only if one can justify it. Karl Popper attacked justificationism, pointing out that justification faces a trilemma of dogmatism, circularity or infinite regress. In justifying a position one appeals to assumptions in an argument. One is immediately faced by the question, how are these assumptions justified? Fries had pointed out that raw experience cannot serve as an assumption, for one needs statements in an argument. One must therefore either adduce another argument for these assumptions and become locked into an infinite regress or circularity, or stop rational discussion and posit the assumptions as ultimate, non-discussable axioms, that is, adopt a dogmatic stance. (Oakeshott's special practices might be counted as dogmatic stopping points.) Popper's general escape route is to advocate that truth (or closeness to the truth) be adopted as the goal of enquiry, not justification.

Popper, in *The Logic of Scientific Discovery* (1934), was impressed by the fact that Newton's theory of universal gravitation, successful, unrefuted and justified by many observations for 200 years, had been exploded by observations inspired by Einstein's theory, a theory that had no confirmations to its name. And Euclidean geometry (assumed by Newton's theory), successful for thousands of years, with millions of confirmations to its name, was also refuted by the same observations and replaced by a new unconfirmed system. If any theories satisfied Francis Bacon's and Mill's requirements for valid induction or the positivist's conditions of verification, the old ones did; yet they turned out to be wrong. Popper's solution was inspired by Kant's view (and echoes of Whewell) that we impose our ideas on the world: we have freely to create our theories independently of experience. Kant was right that many of our important ideas do not derive from sensation. But, Popper insists, instead of being justified by an aprioristic intuition, they remain conjectures, liable to fall with recalcitrant counter-observations.

Popper advocated a methodological approach to the study of knowledge, focusing on the growth of scientific knowledge, seen as common sense knowledge writ large. Distinguishing between what science does and what it ought to do to advance knowledge, Popper proposed that scientists ought to proceed by making testable bold conjectures followed by unrelenting attempts to refute them by experiment. Hopefully, this would lead us towards the theories that are nearest to the truth (those with high verisimilitude). Unlike positivists such as Ayer, Popper acknowledged that much of our knowledge comes from myth and metaphysics, but unlike, for example, Oakeshott, he held that in order to promote the growth of knowledge one has to formulate these ideas in statements whose logical consequences can be checked against observation reports. The statement 'gold is instantly soluble in hydrochloric acid' is scientific – though false – because it can be checked against observation. On the other hand, the statement 'there is a herb that when consumed makes the person invincible' is unscientific – though, taken by itself, possibly true – because one cannot exhaustively check all possible herbs. The refutability of our hypotheses gives us two things: greater control over error and more informative theories, since, as Popper showed, the more testable a theory is the greater that theory's information content. By contrast, irrefutable theories have less information content and, if false, are like useless programs without an uninstall option. Popper's method thus satisfies our two great motivations: curiosity and control.

Others, such as Francis Bacon, Whewell and John Stuart Mill, had pointed to the importance of eliminating false theories by experiment; Popper was the first to argue that the critical elimination of theories is not only necessary, but sufficient. Justification of theories by observation and experiment was not only futile but unnecessary. Popper's approach broke decisively with the long tradition of defining knowledge as justified, true belief; for Popper, knowledge might better be said to be unjustified, untrue, unbelief. Why? 'Unjustified' because,

following Hume, Popper argued that induction, even probabilistic induction, is invalid, pointing out (following Fries) that there is a logical gap between experience and the statements required in our scientific reasoning, and that therefore raw experience (Russell's 'knowledge by acquaintance') could not serve as a source of justification by inference. 'Untrue' because our scientific knowledge is a collection of theories, most of which are close to the truth – hopefully – but nonetheless not wholly, and thus not strictly, true. Even Einstein expected his theory to have deficiencies. 'Unbelief' because scientific knowledge is embodied in physical things like books and hard drives, and these actually have emergent properties beyond their creators' psychologies. The corpus of scientific knowledge in the libraries of the world simply cannot be embraced by human beliefs and would still exist even if a virus were to wipe out humanity. Popper brings us back to that suggestion in the *Meno* that truth, or rather closeness to the truth, might be adequate as the goal of science, justification being in any case a wild goose chase. Critical British developers of Popper's work are W.W. Bartley (*The Retreat to Commitment*), David Miller (*Critical Rationalism: A Restatement and Defense*) and Ray Scott Percival (*Openness to Argument*). Key British critics are Colin Howson and Peter Urbach (*Scientific Reasoning: A Bayesian Approach*.)

Because of the greater movement of people, it is now difficult to discern a distinctly British epistemology. Perhaps, and this goes for all philosophers, the difference today is one not of content but of attitude. Those brought up in Britain still have the penchant for a healthy vigorous debate, something that is often lacking in, for example, the United States, where a tendency towards excessive politeness is evident. There are many creative thinkers among British epistemologists – too many to mention all. Key British figures in recent years have been Michael DUMMETT, John MCDOWELL, Colin McGinn, Susan Haack, Simon BLACKBURN. All except Dummett have represented anti-sceptical stances. Dummett is one of the few philosophers to survive the massive attack on verificationism. He argues that the meanings of sentences cannot be associated with truth-conditions, but only with assertability conditions. (As a consequence, the law of the excluded middle fails in some domains, such as our knowledge of the past and of other minds.) McDowell (1986), inspired by Wittgenstein, has argued against the Cartesian view of mind that, as he says, detaches it from the external world and thus leads to an intolerable scepticism. He substitutes an externalist view to rescue realism, in which putative thoughts are not genuine thoughts if their objects do not exist. McGinn has explored the possibility that some of the deepest problems lie outside our cognitive abilities. With subtlety Susan Haack has explored the possibility of combining foundationalist and coherentist views of justifying our knowledge.

Lastly, it is worth noting that epistemology, as with all philosophy, has become a rich ground of multidisciplinary thought with many writers outside the corridors of philosophy departments making important and stimulating contributions. Of particular note are the British scientists John D. Barrow (*The Anthropic Principle*, 1986), and David Deutsch (*The Fabric of Reality*, 1997). British epistemology has never been healthier.

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See also Ancient Philosophy; Common Sense Philosophy; Free Will; God, Concepts of; Innate Knowledge; Linguistics; Mathematics, Philosophy of; Natural Law; Naturalism; Ordinary Language Philosophy; Scientific; Scholasticism

EQUALITY

Things that are not identical are never absolutely equal. Nonetheless, descriptions of the human condition often emphasize fundamental similarities, or equivalences, between individuals. The seventeenth-century thinker Thomas HOBBES, for example, used the term 'equality' to refer in *Leviathan* to similarity in the abilities of men, all things considered, to survive. Similarities such as these have been taken to have normative import, or to suggest ideals of equality.

Ideals of *formal* equality, typically invoked to condemn legal privileges or discrimination on grounds of factors such as class, colour or sex, require that people are treated alike unless there are good reasons for treating them otherwise. Ideals of *substantive* equality, on the other hand, require that people are treated in such ways as to achieve equality among them according to some specific independent metric (of wealth, or of opportunity, for example).

John LOCKE's seventeenth-century POLITICAL PHILOSOPHY helps demonstrate that formal equality and substantial inequalities can sometimes overlap. In *Two Treatises of Government*, Locke claimed that God created all men with equal RIGHTS to life, LIBERTY and estates (property), but that equal property rights could be enjoyed unequally. Significant inequality in the enjoyment of such rights would be justified if some individuals had mixed the labour of their employees with natural resources, and the employees had agreed to relinquish the fruits of labour for rewards. Also in the seventeenth century formal equality, as absence of privilege, featured in the ideas of the Levellers' thinker John LILBURNE. For the Diggers, meanwhile, Gerrard WINSTANLEY argued for more substantial equality. Judging that unequal power derived from wealth results in oppression, Winstanley argued that equality means equality of goods, or equal access to the use of the earth and its fruits. No longer forced to surrender the products of their work in return for a meagre wage, labourers would thus no longer be oppressed.

In the late eighteenth century Mary WOLLSTONECRAFT argued that women and men should have equal rights in fields such as education, politics and the LAW. However, she advocated neither social equality nor equal opportunities to benefit from rights. In the nineteenth century John Stuart MILL offered a classic argument for equality of opportunity in *Principles of Political Economy*. Favouring limited inheritance taxation, he influenced many liberals. Mill's argument in *The Subjection of Women* for 'perfect equality' (p. 471) between the sexes was also, essentially, an argument for equality of opportunity. The idea of equality of opportunity has some associations with the idea of formal equality. Mill and his fellow liberals did