SCEPTICISM AND THE SCIENCES

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The revival of ancient Greek scepticism during the Renaissance, which was to have so important an impact on 'the making of the modern mind,' and the rise of modern science, took place at almost the same time and place.. Many generalizations have been offered about the relationship between these two intellectual movements, ranging from the view the revial of scepticism and the rise of modern science are two completely separate and distinct developments, having nothing to do with each other, to the view that these two movements were practically identical ones. In this lecture I shall try to delineate what I believe was the actual historical relationship between them, and I shall attempt to trace what I feel was the crucial role played by the Renaissance and early 17th century sceptics in clarifying the aims, the limits and the methodology of modern science, as well as examining the role that some of the sceptics of the period played in combatting the new science as just another form of dogmatic thought.

Although the actual sources and beginnings of the revival of concern with Greek scepticism are a bit hazy (and becoming more so due to researches) into Spanish and Italian thought and humanistic study in the 15th century, the serious and influential sceptical movement stems, I believe, from the writings of Henricus Cornelius von Nettesheim, 1486-1535, of Michel de Montaigne, 1533-92, and of Francisco Sanches, 1552-1623. The discovery a few years ago by Professor Kristeller of Columbia of a 15th Century Latin manuscript translation of Sextus Empiricus, the most important Greek sceptical writer, in Madrid, and the very recent discovery by one of his students, Professor Charles Schmitt of UCLA, that Sextus was read in Italy as early as 1441, may lead to a reevaluation of the claims made by myself and others that modern scepticism begins in the early 16th century. However, if, for the time being, we

accept the view that Agrippa von Nettesheim was the first significant figure in development of modern scepticism, the movement starts out as an extremely anti-scientific one. Agrippa, one of the strange mad geniuses of the early 16th century, was himself an excellent medical doctor, an early advocate of the Kabhala and the Hermetic writings as the sources of true esoteric knowledge of the universe, and then the author of the polemical and sceptical work, *De Incertitudine et vanitate scientiarium declamatio invectiva...* Interpretations of the import of this work have varied considerably, in view of its extremely hostile and negative tone. Since Agrippa's major work on occult philosophy was published after it, some have doubted that the *Vanity of the Sciences* really represents his thought, and has suggested that it portrays a phase in his career when he was disillusioned with everything. Without here arguing the case, or boring anyone with details, it is my own guess that Agrippa, due to the misfortunes of his life in France, came to reject all approaches to knowledge, including his own Kabbalistic and magical theories (which are devastatingly attacked in the *Vanity of the Sciences),* and that his own explanation later on that he published the work on the occult sciences only because it was circulating so widely in corrupt manuscript texts, may be correct. Whatever the explanation for the sequence of events, Agrippa's *Vanity of the Sciences* is an extended attack on, or diatribe about, the uselessness of all forms of human intellectual activity. He inveighed against all those who made any claims to knowledge or to worthwhile skills, insisting that their activities were both futile and dangerous, and that they could never lead to the discovery of truth. The sole source of Truth, he proclaimed, was faith. The book surveys all possible science and arts, from logic, mathematics, grammar, history, metaphysics and medicine, to music, dice-playing and whoring. Although practically no theoretical arguments occur in the work, all human activities are Condemned for their failure; for producing confusions, heresies, blasphemies, etc. True knowledge, Agrippa insisted, *only* comes from, God by Revelation. Scientists, according to Agrippa, are, of all mankind, the least likely to receive God's message, because they are obstinate and persist in using their senses and their reason, instead of appealing to faith. The scientists, Agrippa claimed, had fallen into the hands of the serpent. They had refused the gifts of the

Holy Ghost, and tried to understand the universe on the basis of what the faithless philosophers had said. As a result, what the scientists offered was simply the unreliable opinions of men, rather than any true knowledge based on God's Revelation.

Agrippa's anti-intellectual attack on all the sciences hardly constituted a serious epistemological attack on the sciences, old or new. The much more important presentation of negative scepticism, in terms of systematic, philosophical argument, exploring the reasons why all human knowledge is bound to be both dubious and uncertain, was offered by the French Socrates, Montaigne. In the course of his rambling critique of various kinds of knowledge claims in the famous *Apologie de Raimond Sebond,* Montaigne attacked both those of the Scholastic and the Renaissance scientists. The Scholastics, he argued, based their scientific conclusions on information derived from man's fallacious senses, and on dubious reasonings. Employing such sources and instruments, Montaigne contended, the Scholastic scientists were only able to arrive at conclusions that were either useless, false, or highly doubtful. They concluded that Aristotle was always right. But before Aristotle other theories were found to be satisfactory. Why then should Aristotle now be accepted as the final word on scientific matters?

However, Montaigne also claimed, the 'new' scientists of the 16th century, were really no better. The occasional comments in the *Apologie* about the revolutionary developments in astronomy, mathematics and medicine, indicate that Montaigne was definitely unimpressed by the new theories that were to have so great an impact. The conversation he reports that he had with Jacques Le Pelletier about geometry shows that Montaigne had grave doubts that there was anything important or certain to be found in this area. He was impressed that even in so allegedly certain a science as geometry, demonstrations can be produced that seem to conflict with ordinary experience. His remarks about Copernicus exhibit a similar attitude. Why should we be impressed by this allegedly new theory, which is actually, based on ancient views discussed by Cicero long, long ago? Why should we now believe Copernicus? Someone in the future is liable to offer another so-called revolutionary theory that overturns both the new Copernican astronomy as well as the older Ptolemaic theories. In the realm of medi-

cal theories, Montaigne observed that Paracelsus was now maintaining that all of the doctors prior to him succeeded in killing more patients than they cured. For all that one could tell, Paracelsus may turn out to be just as bad. And the recent discoveries in America certainly indicated that much of our previous view about human nature was doubtful.

Therefore, instead of seeking for true and reliable knowledge about nature by fallible human means, Montaigne recommended that we recognize and admit our ignorance. Then, as he said over and over again in the *Apologie,* perhaps we will realize that, «Or n'y peut-il avoir des principes aux hommes, si la divinité ne les leur a revelez: de tout le demeurant, et le commencement, et le milieu, et la fin, ce n'est que songe et fumée.»

This critical and destructive attitude towards science, new and old, was reiterated by Montaigne's disciples, Father Pierre Charron, 1541-1603, and Bishop Jean-Pierre Camus, 1584-1654. Charron, in *La Sagesse,* his didactic version of Montaigne's scepticism, begins with the news that «la vraye science & le vray estude de l'homme, c'est l'homme.» The understanding of man's nature, he argued, leads in a rather startling way to knowledge of God. When man examines himself he realizes that his alleged knowledge comes from his senses and his reason. The sceptical critique of sense information shows how unreliable and dubious all such data actually is. And the sceptical problems, raised from Carneades and Sextus down to Montaigne, about discovering a satisfactory criterion of rational knowledge, indicate that we are not able to distinguish true from false conclusions. And, like Agrippa von Nettesheim, Charron contended that even the greatest rational minds have accomplished little except justifying heretical opinions or overthrowing previous ones. (In his earlier Counter-Reformation tract, *Les Trois Veritez,* he had argued that one of Calvin's main sins was rationalism, using reason as the measure of Divine Truth.) In *La Sagesse* Copernicus and Paracelsus were accused of the second sin, that of replacing previous dubious opinions with new dubious ones.

The second book of *La Sagesse* begins with Charron's *discours de la méthode,* the means for avoiding error and for discovering truth, in view of the weakness and unreliability of man's natural capacities. Charron's dicta are that we should examine all questions

freely and dispassionately; we should avoid allowing prejudice and emotion to enter into our decisions; we should develop a universality of mind, and finally, we should reject all conclusions that are dubious. The last rule, in the light of the Charronian-Montaignian sceptical critique effectively leads to the rejection of *all* opinions and conclusions. And, Charron insisted, this sceptical result «c'est la chose qui fait plus de service à la pieté religion & operation divine que toute autre qui soit.» It leads us to empty our minds of all views, and prepares our souls for God. Once we are cleansed of all dubious opinions by the Charronian method of systematic doubt, we can present ourselves as «blanc, nud & prest» before God, ready to receive the Revelation on faith alone. Ne sceptic, following this method, could be a heretic, since the only views he would hold would be those that God gave to him.

Another version of this negative view about scientific knowledge, and this sceptical-fideistic view appears in Camus's ***Essay sceptique,*** written in 1603. Camus, who became the Bishop of Bellay when he was 25, and the secretary of St. François de Sales, wrote the ***Essay*** before his ordination, when he was full of ideas from Sextus and Montaigne. He presented the sceptical case in the form of an argument setting forth the thesis-nothing can be known, then the antithesis, something can be known, and finally the synthesis, the Pyrrhonian recommendation of suspense of judgment about whether or not anything can be known.

The bulk of the work presents the thesis. All the citadels of dogmatism are attacked. Each science in turn is challenged as to whether any knowledge can be gained in that area. Among others, Camus attacked astronomy, physics, mathematics, logic, jurisprudence, astrology, political science, economics, history, grammar and music. And, like his predecessors, Camus introduced Copernicus into the sceptical discussion. For Camus, Copernicus' claim that the earth moves shows that even the most accepted first principles are denied by some people. In his massive attack, Camus indiscriminately used arguments from Sextus, anecdotes from Montaigne and comments from and about the scientists of his day.

The antithesis, that something *can* be known, constitutes a pretty tame and half-hearted attempt to argue that in spite of all the sceptical arguments, there still are some scientific truths that

no sane man doubts, such as that fire is hot, that a world exists, and that 2 + 2 = 4. The conclusion of the *Essay* is to advocate Pyrrhonian epoché, suspense of judgment about whether anything *really* can be known, since natural philosophy is only «un abysse confus, & un chaos d'embrouillemens, un labryinthe inextricable.» And throughout the work, Camus kept suggesting fideism, the acceptance of the faith based on no reasons at all, since the only truths known to man are those that it has pleased God to reveal to him; «tout le reste n'est que songe, vent, fumée, opinion.»

This anti-scientific, sceptical-fideistic attitude reached its climax in the writings of François La Mothe le Vayer, 1588-1669, the official inheritor of the keys to the sceptical kingdom, in that Mile. de Gournay, la fille d'alliance of Montaigne, made him her intellectual heir. La Mothe le Vayer, one of the early members of the *Académie francaise,* was a protégé of Richelieu, tutor of the Duc d'Anjou and counselor to Le Roi Soleil. (He is also probably the sceptic in some of Molière's plays, including the one who gets beaten in *Le Mariage forcé).* In a long series of insipid works, which rated him the title of the French Plutarch, La Mothe le Vayer set forth what he considered the New Decalogue, the views involved in the ten tropes for suspending judgment in Sextus Empiricus.

Although he was an intimite friend of several of the leaders of the Scientific Revolution, such as Gassendi, Mersenne and Hobbes, in his essay, «Discours pour montrer que les doutes de la Philosophie Sceptique sont de grand usage dans les sciences,» La Mothe le Vayer sought to show that the value of scepticism for the sciences is that it destroys them, and exposes them as vain and useless endeavours. He argued that the crucial sciences of the Dogmatists-logic, physics and ethics, are all dubious, primarily because human nature is too feeble to reach knowledge of the divine and eternal without the aid of God. Thus, unfortunately, «le desir de trop Savoir, au lieu de nous rendre plus éclairez, nous jettera dans des tenebres d'une profonde ignorance.»

Presenting a series of traditional canards about logic and logicians, La Mothe le Vayer suggested that everything in this area was dubious. Next he turned to physics, and claimed that the entire subject was open to question. The foolish physicists attempt to know everything, and do not even manage to know themselves. All

they ever accomplish, be they Democriteans, Aristotelians or of any other school (and it is interesting that modern physics is not even mentioned, though Galileo and Descartes were already famous), is to collect sets of conflicting opinions. The basic difficulty in the field, he insisted, is that the physicists is attempting to know the principles of Nature, and Nature is the free manifestation of the will of God, and is not bound by the rules of Aristotle or Euclid. It is only possible to comprehend why anything happens through knowledge of God. However, the physicists who refuse to recognize this, and who persist in employing the frail human faculties, try to impose their own rules and measures on the actions and manifestations of God. But, since God is able to do anything, there can be no necessary conditions or principles that govern His activities. Thus, there can be no necessary Knowledge or science, in the metaphysical sense. The attempt to describe the principles of Nature is actually a kind of blasphemy. It represents an attempt on the scientists 'part to restrict and limit God's freedom. God can, if He so wills, alter the secondary causal patterns in the world, and hence, He can make a discovery in physics false. Unfortunately, the physicists, like the rest of the human species, prefer «donner le tort à la Nature, & peut-estre à son autheur, que d'avouer nostre ignorance.» The scientists should realize the extent of human ignorance, should recognize that God wishes to limit our knowledge of the world, and then they should abandon scientific research, and turn to Revelation as the only guide we possess. So, according to La Mothe le Vayer, scepticism aids the sciences and the scientists, not by clarifying problems or eliminating errors, but, presumably, by eliminating any concern with scientific research, because such study is useless, hopeless, fruitless and irreligious as well.

Thus, the dominant sceptical tradition from Agrippa von Nettesheim, through Montaigne and his disciples up to La Mothe le Vayer, was extremely negative towards the development of the sciences. However, in contrast to this destructive tendency, another sceptical view emerged during the same period that was to propose a new method for the sciences in the quest for Knowledge. The theory set forth by the Spanish-Portuguese-Jewish refugee, Francisco Sanches, and developed in the 17th. century was that of joining a complete epistemological scepticism about the possibility

of gaining any genuine knowledge of reality, with an advocacy of pure empirical scientific research as the only remaining worthwhile study. Sanches was born on the Spanish-Portuguese border, raised in Bordeaux, where he studied at the Collège de Guyenne. Then he went on to medical studies at Montpellier and Italy, and became professor of philosophy and later of medicine at Toulouse. Sanches was apparently a cousin of Montaigne's, the Sancheses being intermarried with the Loppezes, Montaigne's mother's family. Although Sanches' great sceptical work, *Quod nihil scitur* was written the same year as Montaigne's *Apologie* (but published only in 1581), I can find no influence of either sceptic on the other. A few years ago, in Toulouse, where there is a large collection of materials on Sanches, I tried valiently to figure out the relationship and whether the two ever met. The large number of Sancheses married to Lopezes made the problem utterly baffling, and on that front my conclusion is that at worst they are twelfth cousins, at best, second or third. Sanches was about twenty years younger than Montaigne. As far as I could tell, when Sanches was in Bordeaux, Montaigne was not there. When Sanches was in Toulouse, Montaigne was back in Bordeaux. And, although Sanches was known in Toulouse as «le grand sceptique», and although his portrait is next to that of Raimond Sebond in the hall of honor in the medical school at Toulouse, he probably never met his more famous sceptical cousin. (Recent researches on Charron indicate that he and Sanches should have met at Montpellier in the mid 1570's.)

At any rate, Sanches' great work, *Quod nihil scitur* was the first major statement of the «Constructive» sceptic view. In it, Sanches first applied the traditional sceptical arguments to show that no knowledge,especially in Aristotle's sense, is possible. Every science Sanches pointed out, begins with definitions. But, then, what is a definition? Sanches contended it was nothing but the arbitrary and capricious assigning of names to things, telling us nothing of the nature of the object named.

Next Sanches attacked the Aristotelian notion of science as a process involving abstracting general or universal concepts from particulars. The particulars that are supposed to be explained in this manner, he insisted are clearer than the abstract ideas that are supposed to clarify them. Instead of dealing with these real

particulars, the so-called scientists waste their time discussing and arguing about all sorts of abstract concepts and fictions. Sanches said, «Do you call this science? I call it ignorance.»

Then Sanches argued that the Aristotelian method of demonstration arrived at no new information, since the premises were built up from the conclusion, and the method is such, that given the proper premises, anything can be proven. The Aristotelian method of seeking for causes is also futile, he argued, since if true knowledge of a thing involves knowing all its causes, then nothing will ever be known. One would have to know the causes of the causes of the causes, *ad infinitum*.

If the Aristotelian notion of science is inadequate, false and useless, Sanches offered instead as the scientific ideal perfect knowledge of an object, «Scientia est rei perfecta cognitio,» which would involve immediate, intuitive apprehension of all of the actual qualities of a thing, understood in and by itself. Generalizations beyond this level of certainty about particulars would only lead to confusions, chimeras, etc.

However, Sanches then pointed out, due to sceptical difficulties, even his own limited scientific ideal could not be attained. We could never know each and every object individually both because of problems about the nature of objects and because of problems about human nature. Objects unfortunately are related to one another, and hence, cannot be known separately. They are also of unlimited number, so we could never know them all. And, worst of all, they keep changing so that we cannot know *all* of their properties at any time. In addition to these difficulties, human beings only know about objects through their senses, and their senses perceive only the surface aspects of things, not their real natures. Further, from both his own medical experience and his reading of classical sceptical literature, Sanches was able to point out that human sense experience is variable and unreliable. In view of the many imperfections and limitations which God has seen fit to leave mankind with, man's senses and his other faculties and powers are forever unable to attain completely true knowledge of anything.

Thus, according to Sanches' sad sceptical analysis, it is not possible to gain any truly significant scientific knowledge. And, since, in this sense *nihil sciture,* nothing can be known, Sanches then

advocated, *per non sequitur,* that man should do what he was able to, namely to achieve limited, imperfect knowledge of some things in experience through careful collection of data and cautious judgment.

This constructive conclusion from the sceptical analysis of the possibility of genuine human Knowledge was further and more fully developed into a theory of scientific method and a 'rationale' for the 'new science' in the early 17th. Century by Father Marin Mersenne in his answer to the destructive sceptics and, Father Pierre Gassendi in his quest for a *via media* between scepticism and dogmatism.

Mersenne in 1625 published his massive (1000 page) volume, *La Verité des sciences contre les sceptiques ou pyrrhoniens,* in which he attempted to answer the sceptical arguments in new way, by arguing that even if the objections of the sceptics were irrefutable, nevertheless we could and do possess a kind of scientific knowledge that is not dubious, and which suffices for our purposes in this world. Although Mersenne was personally a close friend of some of the destructive sceptics, such as La Mothe le Vayer and Gabriel Naudé, the work begins with a denunciation of the sceptics in most extreme terms, accusing them of impious, immoral and dangerous views and intentions. Any sceptic who reads Mersenne's opus will see «qu'il yaa beaucoup de choses dans les sciences qui sont veritables, & qu'il faut quitter le Pyrrhonisme si l'on ne veut perdre le jugement & la raison.»

The work itself consists of a dialogue between a sceptic, an alchemist and a Christian philosopher (presumably Mersenne himself). The sceptic demolishes the alchemist by presenting in outline form the arguments that appear in Sextus Empiricus, Mersenne's Christian philosopher does not answer these by establishing that something can be known, nor by the method to be used by his friend, René Descartes, that of attempting to claim that there is a criterion of truth that enables us to overturn the sceptical attacks. Instead Mersenne replied by admitting that there is no answer to the sceptical arguments about the possibility of gaining real knowledge about the universe, and then saying «So what.» He insisted that it was not necessary to establish that genuine knowledge is possible, or that a completely reliable criterion of such knowledge

exists or that our faculties are reliable or accurate, or that we are not dreaming, etc., in order to show that we «know» something and that we can get along in this world. We «know» various relationships between phenomenal events; we «know» various actually indubitable truths in mathematics, and we can use this «knowledge» successfully as a guide for living, in spite of the fact that there may be no satisfactory answers to the problems raised by the sceptics. To convince anyone of his contentions, Mersenne devoted the last three-fourths of his book to exhibiting all that is actually known in mathematics and mathematical physics. This most impressive catalogue is sufficent to force the sceptic in the dialogue to admit that all of this knowledge is «*plus excellent pour renverser le Pyrrhonisme qui m'avait fait douter de toutes choses jusqu'à ce que j'ai eu le bonheur de vous rencontrer,*» even though his sceptical arguments have not been answered or disproven. Thus Mersenne contended, we may have no means of «knowing» what reality is like, or even if there is a real world. But no matter how indefensible or unjustifiable our knowledge is, we actually do have a great deal of knowledge about the phenomenal world and about mathematics, and this enables us, pragmatically to solve our problems.

In his later works, Mersenne spelled out his position plainly. In answer to the question, «Peut-on savior quelque chose de certain dans la Physique, ou dans les Mathematiques?», Mersenne insisted that the reply had to be «No». We are not able to establish that any of our information in these areas is true about reality. But, however, this does not mean that these sciences are doubtful or useless. In physics we only learn about the exterior effects of things, not about their real nature. In mathematics we only learn hypothetical truths, conditional on whether the axioms are true. But, Mersenne still insisted, just the same we do gain knowledge that cannot be doubted, in a purely psychological sense, about the relations and sequences of phenomena, that can be used for predicting the course of events. And such limited knowledge about the world of appearances suffices as our guide «jusqu'à ce qu'il plaise à Dieu de nous déliver de cette misere, & nous dessiller les yeux par le lumière qu'il reserve à ses vrays adorateurs.»

This coupling of an acceptance of a thoroughgoing epistemological scepticism with a positivistic and pragmatic interpretation

of scientific knowledge, was set forth in a less polemical and more avowedly sceptical form by Mersenne's best friend, Gassendi. In his earliest work, *Exercitationes paradoxicae adversus Aristoteleos,* after belabouring Scholasticism for all sorts of reasons, and after raising all of the traditional sceptical difficulties, Gassendi concluded with a section entitled, «Qu'il n'y a pas de Science, mais surtout pas de Science Aristotelicienne». Using arguments like those of Sextus, Montaigne, Charron and Sanches, Gassendi contended «qu'il nous est impossible de savoir, c'est-à-dire d'acquérir une connaissance certaine et évidente, et d'affirmer d'une facon infaillible et sûre qu'une chose soit par nature et en elle-même, et en vertu de causes profondes, nécessaires et infaillibles, constituée de telle manière,» and hence, in the traditional philosophical meaning of knowledge, *nihil scitur.* However, even in this first work, Gassendi began developing his view that another kind of science was possible, a science that was only probable, that dealt with experience and appearances, and whose results were confirmed by inspecting the future course of experience.

At the end of his life, in his major work, the *Syntagma philosophicum,* Gassendi developed a more involved analysis of the nature of knowledge in which he tried to establish a *via media* between dogmatism and scepticism. The type of absolute knowledge sought by the dogmatists, knowledge of things-in-themselves, cannot be found due to the difficulties raised by the sceptics. But, on the other hand, the sceptics have gone too far in denying that we can have any basis for assurance about anything, and any means of understanding the world we live in. It is obvius that something exists, and that some things can be, and are known. Even the sceptics agree that we know appearances, that we gain information through sense experiences. We are also able to draw some obvious conclusions from the data, to interpret various signs found in experience and from these reach some limited knowledge about objects beyond our experience. By careful reasoning we can correct the errors of our senses, and we can check our judgments either by verification in terms of later experience, or by the conformity of experience with the system of judgments. Gassendi then developed his atomism as such a system of judgments, which, though not constituting true knowledge, in the sense of the dogmatic philosophers, does tell us about

the causes of experience in scientific terms. Between knowledge in the dogmatist's sense, and the complete doubt of the sceptics a level of scientific knowledge exists, which Gassendi called a shadow of truth, rather than true knowledge itself. Gassendi did not try to defend his atomic theory as the *true* picture of reality, that is, as a metaphysical theory, but offered it as the best hypothesis in terms of what we «know» from sense experience.

Thus, according to both Mersenne and Gassendi, the sceptical attack on the possibility of human knowledge could not be satisfactorily answered, but it could to some extent be ignored, by recognizing that some information was, in fact, not actually open to question or doubt, and that the empirical scientific way of dealing with this information did, in fact, provide adequate means for dealing with many of man's problems. The sceptical difficulties revealed why the dogmatic philosopher was bound to fail in his quest for certainty about reality. But these difficulties did not show that man could not attain a limited certitude about the world of appearance that would be adequate for his needs. Scepticism, then, instead of culminating in the destructive anti-scientific view offered by La Mothe le Vayer, could lead to a most constructive effort to find out more and more about the world of experience, since nothing can be known about the real world.

My good friend, the Late Abbé Lenoble, insisted that Mersenne and Gassendi had actually offered a refutation of scepticism rather than a redirection of it. He compared their refutation to the answer Diogenes gave to Zeno's contention that nothing can move. Diogenes just got up and walked around. Similarly Mersenne and Gassendi just dealt with what can be known-the world of sense experience.

However, the sceptics could contend that Diogenes never actually answered Zeno's arguments. Diogenes pointed to the fact of motion, but he did not show that it could be explained or justified. In more explicit fashion, Mersenne and Gassendi accepted the arguments of the sceptics as decisive against the dogmatists, —those who sought knowledge that could not possibly be false—, but then Mersenne and Gassendi insisted that this did not cast doubt upon the knowledge that we do in fact possess, even though we cannot show that this knowledge is either certain or necessary.

If I may wander just a little further from the Renaissance, the one who most clearly illustrates this constructive outcome from the recognition of the full force of scepticism is Blaise Pascal. In his many writings on the nature of the vacuum, and the theory of atmospheric pressure, Pascal more clearly than anyone else in the 17th. century pointed out the hypothetical-probabalistic nature of scientific reasoning. He showed that no finite amount of evidence would ever demonstrate a scientific truth, although just one crucial experiment could disprove a theory, if it showed that a logical deduction from the theory was contrary to fact. The best that man could accomplish was to find the hypothesia that best fitted with the facts known at a given stage in the world's history.

In *De l'esprit géometrique et de l'art de persuader,* and the *Pensées,* all written in his last years when religion was the focus of his interests, Pascal explained why man could not gain complete knowledge by natural means. In his theory of the nature of an axiom system, Pascal pointed out the limitation of such a system was that the sceptical problem could always be raised-what evidence was there that even the clearest and most certain axioms were true? Man's rational nature would keep raising this problem, undermining each and every system, and constantly introducing insoluable doubts about the highest human rational and natural achievements. The only resolution to these doubts was the acceptance of principles known by instinct and intuition, and not by reason. «Le coeur a ses raisons que la raison ne connaît point.»

In the climatic *pensée* in both the Brunschvicg and Lafuma editions (B434-L131), on scepticism and faith, Pascal announced at the outset that even the fundamental appeal to instinct and intuition as the basis for the acceptance of first principles is open to serious sceptical questioning «puisque n'y ayant point de certitude hors la foi, si l'homme est crée par un dieu bon, par un démon méchant ou à l'aventure, il est en doute si ces principes nous sont donnés ou veritables ou faux, ou incertains selon notre origine.» Pascal then built up the tension between natural belief and scepticism, the two fighting against each other and undermining each other, so that man is left helplessly caught in their wars «la nature donc, ô homme, qui cherchez quelle est votre véritable condition par votre raison naturelle, vous confond les pyrrhonniens et les académiciens et la

raison confond les dogmatics. Que deviendrez-vous vous ne pouvez fuir une de ces sectes ni subsister dans aucune». The solution offered in the *Penséees* is «Écoutez Dieu». *In De l'esprit géometrique et de l'art de persuader,* Pascal offered a more mundane solution, that of constructive scepticism-do the best one can, given the human predicament, by following a limited, rather than ideal geometric method. Define terms until one has reached the clearest ones possible. Start with the principles that are most indubitable according to our natural beliefs. Then proceed carefully and methodically to conclusions from these definitions and principles, always realizing the conditional true value of what is thereby being demonstrated, since its certitude depends upon human natural abilities and capacities. And, in the earlier *Préface sur le traité du vide,* Pascal pointed out the situation is still worse with «toutes les matières dont la preuve consiste en expériences et non en démonstrations», since in these cases «on ne peut faire aucune assertion universelle que par la générale énumération des toutes les parties ou de tous les cas différents», and that such an enumeration is always limited by the extent and reliability of human experience.

Thus, for Pascal, the rational and natural examination of human intellectual achievements leads to the conclusion that «Le pyrrhonisme est le vrai» in an ultimate sense, until God reveals the Truth to us. However, even in man's state of misery without God, he can attain fairly certain and useful mathematical and scientific knowledge.

To conclude, thus, the Renaissance development of scepticism led to two views about the new science, one that of considering it as just one more form of dogmatic knowledge that ought to be undermined, and the other that of seeing it as the constructive outcome of the realization that in a fundamental sense, it is doubtful that man can attain knowledge of the real nature of things-the former, the tradition of Agrippa von Nettesheim, Montaigne and La Mothe Le Vayer, gradually died out as a live option as the achievements of the scientific revolution overwhelmed the 17th. century world (although Thomas Baker's *Reflections upon the Sciences,* another dirge on the uselessness, futility, and hopelessnes of attaining scientific knowledge appeared at the end of the century in 1699). The constructive or mitigated sceptical view about the new science, with

its attendent divorce of empirical science and metaphysics, was to become a commonplace by the end of the 17th. century (and again in the middle of the 20 th. century). Jesuit anti-Cartèsians, like René Ràpih, saw a type of partial scepticism as a defense of empirical science and true religion against the fanatical metaphysical-theology of Descartes. Leaders of the new Royal Society of England, like Bishop Wilkins and Joseph Glanvill, stated a kind of mitigated scepticism as the mission and interpretation of the Society's work. On their readings, Boyle, Hooke and others had shown not that any knowledge of reality could be attained, but that the achievements of their empirical researches had ended the search for ultimate truths, and had left the way open for discovering «useful knowledge» to aid man in this vale of tears. Bishop Pierre-Daniel Huet, one of the last of the great French sceptical tradition, included the Royal Society as one of those movements «qui approche fort de la Doctrine des Sceptiques.» And Pierre Bayle, by far the greatest of the 17th. century sceptics, could sum up the situation in his *Dictionnaire,* (article *Pyrrhon,* Bemarque B), by saying «Il nous doit suffire qu'on s'exerce à chercher des Hypotheses probables, & a recueillir des Experiences; et je suis fort assûré qu'il y a très-peu de bons Physiciens dans notre siècle qui ne soient convaincus que la Nature est un abime impénétrable, & que ses ressorts ne sont connus qu'a celui qui les a faits, & qui les dirige. Ainsi tous ces Philosophes sont a cet egard Academiciens & Pyrrhoniens.»

The mitigated and constructive sceptics from Sanches onward had succeeded in making scepticism not a means of destroying science, but instead a basis of the new «scientific outlook». They separated scientific research from the quest for absolute knowledge, and restricted the former to searching for relationships within observable appearances, rather than amongst unknowable realities. Constructive scepticism had separated science from metaphysics, and had clarified the role of the empirical method as the means for finding scientific truths. This success was so complete, that David Hume, in his *History of England,* written at the height of the *Enlightenment,* could summarize Newton's achievement (and he considered Newton the greatest intellect produced in those islands off the coast of Europe) as, «While Newton seemed to draw off the veil from some of the mysteries of nature, he showed at the same time the

imperfections of the mechanical philosophy; and thereby restored her (nature's) ultimate secrets to that obscurity, in which they ever did and will remain.»

To finish this story, it was the French *philosophes* (some of whom were close friends of Hume) who have confused history. It was Didérot, Voltaire, Condillac and Condorcet who thought (or rather dreamed) that Newton had found THE TRUTH, pure and simple, and they corrupted both the French and American revolutions with this view. After two centuries, we have again found mitigated scepticism as the rationale of science, and now, in spite of the Enlightenment, we are able to replace Science as Truth with science as the result of mitigated scepticism, interpreted as a system of hypotheses, justified on the basis of pragmatic results, and *finally* we can remember the message of Pascal, that absolute truth depends not on man, but on God.