Descartes' *Discourse on Method*: More Discourse?

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Why another article on Descartes' *Discourse*? Is there still that much more to be said? These were the questions we received when we informed our colleagues about our intention to write an article on Descartes' *Discourse.* What follows is a developed version of the answers we gave. First, it is rare to come across articles on Descartes' philosophy that deal in detail with his mathematics. Likewise, very rarely does one come across articles by mathematicians that deal adequately with his philosophy. We have, therefore, tried to provide a treatment that will appeal to both the mathematician and the philosopher. In an article on Descartes, this is only fitting, as he is recognized both as the father of modern philosophy and founder of analytic geometry.[1] To be sure, one hears a plethora of rhetoric today

[1] The question of whether Descartes was really the founder of analytic geometry is an interesting one and calls for some qualification. In his treatise, *In artem analyticam isagoge* (Introduction to the Analytic Art), the French mathematician, François Viète (1540-1603), launched the value of symbols by introducing vowels to denote unknowns quantities and employing consonants for constants (i.e., known quantities). This was the initial introduction of a systematic algebraic notation in Europe. Aided by Viète's insights, Pierre de Fermat (1601-1665) and René Descartes (1596-1650) managed to combine algebra and geometry in novel ways. Ever since, Descartes' *The Geometry* has often been hailed as the groundwork for analytic geometry, whereas Pierre de Fermat's work has been somewhat overlooked. Nonetheless, to trace the authenticity of the foundation of analytic geometry in Europe, one must also pay attention to Fermat. His work *Introduction to Plane and Solid Loci* was extremely important; we know that the manuscript reached Paris and was known to Descartes prior to the publication of *The Geometry*. Despite this, it never held the influence of a published work, which is one reason why Descartes efforts in the foundation of analytic geometry have usually received more attention. Although both Descartes and Fermat utilized Viète's ideas, they had different perspectives towards mathematics in general. This led to a development of different aspects within the relationship concerning equations and

on the importance of interdisciplinary approaches, but the sad truth is that such attempts are sporadic at best. This of course is indicative of a larger problem facing contemporary academia: the utter want of university discourse that easily cuts across rigid disciplinary lines. It is fine to be an expert in one's own field, but if one's scope is so myopic that it precludes intelligent and meaningful conversation with areas outside one's field, then one wonders what it is that qualifies such knowledge as *university* knowledge at all, since there is nothing *universal* about it. This article grew out of its authors' conviction that members of different departments ought to be able to produce meaningful scholarship together even if they are not experts in one another's field.

Interestingly enough, the serious academic problem of departmentalization begins with Descartes himself and his scathing critique of liberal education. This brings us to the second impetus for the present article, which is acutely related to the first: the need to stress, once again, that Descartes' attempt to free the pursuit of truth

curves. Fermat, commencing with an equation and then a curve, illustrated an equation in two variables as determining a curve. In contrast, Descartes prioritized the curve and then came up with an equation. Though their methods were dissimilar, Fermat and Descartes each played central roles in the initial development of the new subject of analytic geometry. Due to Fermat's personal lifestyle, he tended to remain in the mere shadow of Descartes, yet his calculations were extremely innovative. Mutually, they paved the way to analytical geometry and consequently both should be honored as the forefathers of analytic geometry in Europe. However, it is our contention that the original pioneers in the task of combining algebra and geometry, and the ones from whom Europe received many of its most important mathematical insights in this regard, were Ibn al-Haytham (965-1040) and Omar Khayyam (1048-1131). Though most famous for his contributions to optics and astronomy, Ibn al-Haytham's mathematical achievements in geometry and number theory are perhaps just as important. He was among the first ever to actually analyze the "methods" used by mathematicians in their efforts to solve their problems. He realized that the ancient Greek method of analysis, which was used to solve geometric problems, could also be used to solve problems in algebra. And Khayyam's *Treatise on Demonstration of Problems of Algebra* offered an inclusive classification of cubic equations with geometric solutions established by means of intersecting conic sections. Moreover, his humble acknowledgement of the contributions made by much earlier writers such as al-Mahani (c. 820-880) and al-Khazin (c. 900-971) who had translated geometric problems into algebraic equations, not only played a role in the development of his own work, but helped to construct the accurate historical record in regard to the evolution of mathematical thought.

from the shackles of probability — chains that he thought were threatening to destroy it — led ironically to the very downfall of genuine liberal education itself. It is our hope then that this brief article, in addition to providing mathematical and philosophical insight, will help to recover in some small way the "feeling" of what genuine liberal education ought to *feel* like.

The original title of at least part of what was published in 1637 under the title *Discourse on the Method of Properly Conducting One's Reason and of Seeking the Truth in the Sciences*, was *A History of My Mind.* And so it was. Descartes reflects upon the history of his own thoughts and in the second discourse recalls that momentous day of November 10th, 1619 in Germany, when as a young boy twenty-three years of age, "returning from the coronation of the Emperor to join the army"[2] he found himself "shut up in a room heated by an enclosed stove."[3] He reports three profound insights he had on that infamous day. Before we consider what these are, let us take a look at the contents of the first discourse; for there we get a glimpse of the seeds that were destined to germinate into the sweeping educational reforms of the nineteenth century.

Descartes received a traditional liberal education, but ironically enough, it was the profundity of this education that enabled him to so effectively and eloquently lay the foundation for what would ultimately be its demise. The *Discourse* is not simply a manifesto of mechanism in modern philosophy, for its literary eloquence qualifies it as a literary masterpiece. He accurately describes traditional education as "holding a conversation with the most eminent minds of the past centuries . . . in which the authors (of the great books) reveal to us only the best of their thoughts."[4] Quite the reverse, however, of expressing gratitude at being privy to such a conversation, Descartes speaks of his immense consternation. For one thing, he tells us, at the end of this long conversation all one ends up with is probability and doubt. Descartes was under the impression when he began his studies at the Jesuit College of La Flèche that he was beginning a course of

[2] Descartes, *Discourse on Method*, tr. F. E. Sutcliffe (Middlesex: Penguin Books, 1968), p. 35.

[3] *Ibid.*, p. 35.

[4] *Ibid.*, p. 30 (our emphasis in parentheses).

study at the end of which he would be able to take his place among the knowing and the wise. Once he had finished, however, he was gravely disappointed: "For I was assailed by so many doubts and errors that the only profit I appeared to have drawn from trying to become educated, was progressively to have discovered my ignorance."[5] If he had had the chance to speak with Socrates at this point, perhaps the world we now live in would be a different sort of place. Socrates would have informed him of the great benefit in knowing one's own ignorance. But Descartes was in no mood for any of the ancients, and especially not a philosopher. For philosophy in his view was especially characterized by uncertainty: "[N]ot one of its problems is not subject to disagreement, and consequently is uncertain."[6]

Authorities in mathematics are usually uncomfortable with uncertainty; mathematical geniuses often despise it.[7] The former might accurately describe Father Clavius, one of Descartes' renowned teachers in Mathematics; the latter most certainly describes Descartes himself. For as much as Descartes genuinely enjoyed his weekly forty-five minute class with Father Clavius, believing that by means of it he was finally learning something true, his teacher's proposals concerning the revision of Aristotle's hierarchical ranking of the sciences, giving mathematics the first place among the sciences owing to its exclusion of probability, could only appear ultra-conservative alongside of Descartes' own insistence that only those knowledges were true whose degree of certitude was equal to that of mathematics.[8] Probable knowledge, in Descartes' view, was no knowledge at all: "I took to be

[5] *Ibid.*, p. 29.

[6] *Ibid.*, p. 32.

[7] With the advent of "uncertainty theory" in the twentieth century, this sentence could be misleading. That is to say, we are cognizant of the fact that, today, some of the most creative achievements in mathematics come from thinkers who are not at all uncomfortable with uncertainty. Our statement ought to be read in the context of seventeenth century Europe.

[8] See E. Gilson's, *The Unity of Philosophical Experience* (Westminster: Christian Classics, 1937), pp. 129-133. For Clavius: Necessary knowledge is better than mere probability, and mathematical knowledge alone is necessary knowledge, thus, mathematical knowledge is better than all other knowledge and should be recognized as the highest science. For Descartes: True knowledge is necessary knowledge, and mathematical knowledge alone is necessary knowledge, thus mathematical knowledge is the only true knowledge and must be recognized as the only science.

tantamount to false everything which was merely probable."[9] While writing the *Discourse* many years after his graduation from La Flèche, he recalls happily the three-quarters of an hour he was able to spend with Father Clavius, though, as he tells us, he still did not know at that time the true use of mathematical reasoning: "Above all I enjoyed mathematics, because of the *certainty* and self-evidence of its reasonings, but I did not yet see its true use and, thinking that it was useful only for the mechanical arts, I was astonished that on such firm and solid foundations nothing more exalted had been built."[10]

To his great credit, Descartes wanted only certainty. He wanted desperately to overcome the skepticism of Montaigne and company, who taught that doubting was the peak of wisdom, and that genuine intellectuals were never entirely sure of their own judgments. This brand of skepticism was quite different from the "skepticism" of Socrates, who also reveled in his own ignorance, but whether in its Socratic form, or in the form of the seventeenth-century French skeptics, Descartes wanted no part of any of it. Again, he wanted only certainty, but in his great quest he failed to see that there were other kinds of certitudes besides mathematical certitude. One wonders whether he really ever appropriated Aristotle's treatment of the different kinds of certitudes. One also wonders how Descartes, had he been privy to it, would have responded to John H. Newman's *An Essay in Aid of a Grammar of Assent*, in which Newman demonstrates that we are certain of all kinds of things which we can't prove with mathematical certitude, like the certitude we have of our own death, for instance. I am certain that I am going to die, but I can never prove it.

At any rate, although Descartes did pay some tribute to the classical education he received at La Flèche, his real aim was to overcome it. He compares traditional liberal education to traveling abroad and warns of the danger in too much traveling:

> I thought I had already given enough time to languages, and even also to the reading of the Ancients, to their histories and fables. For to converse with those of other countries is almost the same as to travel. It is a good thing to know something of the customs and

[9] *Discourse on Method*, p. 32

[10] *Ibid.*, p. 31 (our emphasis in italics).

> manners of various peoples ... but when one spends too much time traveling, one becomes eventually a stranger in one's own country; and when one is too interested in what went on in past centuries, one usually remains extremely ignorant of what is happening in this century.[11]

Much is revealed in this passage from the *first discourse*. By comparing his learning of the Ancients with learning the customs and manners of foreigners while traveling, he is also telling us that the Ancients didn't really have much to offer, not at least in the way of *real* knowledge. For him, the liberal education he received from the Jesuits was simply cosmetic, precisely because it came down to nothing but probabilities. Only mathematics with Father Clavius and a few other Jesuit mathematicians had been of any real benefit, and many years later he finally realized the deeper meaning of why this was so. Not only was what he learned in mathematics certain, but it slowly dawned upon him, that this certainty could provide a firm foundation for all knowledge. Clavius had taught the young Descartes that since necessary knowledge was better than mere probability, and since mathematical knowledge alone was necessary knowledge, it followed that mathematical knowledge was better than all other knowledge and should be recognized as the highest science. Descartes was to go much further and claim that since all true knowledge was necessary knowledge, and since mathematical knowledge alone was necessary knowledge, then it must follow that mathematical knowledge was the only true knowledge and must be recognized as the *only* science. In arguing that mathematics should have pride of place among the sciences, Father Clavius, good Jesuit that he was, never claimed that the other sciences were not genuine sciences with their own valid methods and objects. Nor did he ever suggest that the traditional object of mathematics, *quantity*, ought to be replaced. But these were precisely the radical directions in which Descartes began to move. In the *second discourse*, the essence of Descartes' philosophy begins to emerge. Some historians of philosophy prefer to read the *second discourse* as three acts of a grand and cosmic-shaking philosophical drama that gave birth to modern philosophy, and in many respects,

[11] *Ibid.*, pp. 30-1.

the modern world itself.[12] From the perspectives of a mathematician and a philosopher, what follows is an attempt at an interpretation of these three acts.

The first act of the philosophical drama in the *second discourse* is a thought. At the ripe age of forty, Descartes looks back to that infamous day in 1619 when, as a young soldier in Germany, he "had complete leisure to meditate on [his] own thoughts. Among these one of the first [he] examined was that often there is less perfection in works composed of several separate pieces and made by different masters, than in those at which only one person has worked."[13] Through the brilliant skills of rhetoric, the fruit of a rich liberal education, Descartes goes on to support convincingly his claim through numerous examples drawn from a variety of subjects. It quickly becomes apparent that he himself is the *one person* and the *work* is nothing less than a new definition of knowledge. Whether in 1619 he was aware of this grandiose vocation, or whether it came to him later, is unclear. But what is clear is that sometime after 1619, Descartes began to believe that he had received a divine mandate from God himself to reconstruct the foundations of knowledge and to eliminate, once and for all, the debilitating obstacles of probability that had prevented mankind from coming into the light of certitude concerning all knowable things. In a word, he was to become the new and improved Aristotle of a new age of knowledge, a singular and exalted calling which he apparently found a firm confirmation of in his dreams that fateful night.[14]

Confident in his new role, the curtains close on act one. When they open again for act two, Descartes, the mathematician, begins to fade into the background to gradually make room for Descartes, *the* philosopher. What we read to be the introduction to act two of this philosophical drama that would change the course of thought. History, thus, strategically appears right in the middle of the *second discourse* and is worth quoting in full:

> When I was younger, I had studied a little logic in philosophy, and geometrical analysis and algebra in mathematics, three arts or

[12] *Unity of Philosophical Experience*, pp. 125-51.

[13] *Discourse*, p. 35.

[14] One wonders about the origins of these dreams? Though an interesting question, it is doubtful that anyone will ever find a satisfactory answer.

> sciences which would appear apt to contribute something towards my plan. But on examining them, I saw that, regarding logic, its syllogisms and most of its other precepts serve more to explain to others what one already knows, or even like the art of Lully, to speak without judgment of those things one does not know, than to learn anything new. And although logic indeed contains many very true and sound precepts, there are, at the same time, so many others mixed up with them, which are either harmful or superfluous, that it is almost as difficult to separate them as to extract a Diana or a Minerva from a block of unprepared marble. Then, as for the geometrical analysis of the ancients and the algebra of the moderns, besides the fact that they extend only to very abstract matters which seem to be of no practical use, the former is always so tied to the inspection of figures that it cannot exercise the understanding without greatly tiring the imagination, which, in the latter, one is so subjected to certain rules and numbers that it has become a confused and obscure art which oppresses the mind instead of being a science which cultivates it. *This was why I thought I must seek some other method which, while continuing the advantages of these three, was free from their defects.* [15]

The *method* Descartes has in mind, of course, consists in the famous four-rule method of intuition, analysis, synthesis, and deduction from which the treatise ultimately takes its name: *Discourse on Method.* To these rules we shall return momentarily, but first it is crucial to understand why Descartes was so assured that his newly found vocation to become *the* philosopher *par excellence* of a new order of knowledge was authentic. Put simply, Descartes had had so much success in solving ancient geometrical problems by substituting algebraic signs for geometrical lines, he hastily concluded that he could employ a similar method to solve all problems of knowledge. Put another way, when he discovered the seemingly unlimited possibilities for mathematical problem solving involved in eliminating shape from geometry, he was led to believe that such conversion activity had universal and philosophical possibilities and implications. The ancient geometrical problems that he solved are known as the Three and Four Line-Locus Problems of Euclidean Geometry. The three-line locus problem, for instance, may be defined as follows:

[15] *Discourse,* p. 40 (our emphasis in italics).

> Given three fixed straight lines, find the locus of a point moving so that the square of its distance to one line is in a constant ratio to the product of its distance to the other two lines.[16]

In these problems Descartes used the coordinate axes to refer to the lines and the locus involved. In his *La Geométrie* (1637) he stated: "any problem in geometry can easily be reduced to such terms that a knowledge of the lengths of certain lines is sufficient for its construction."[17] He also noted that "often it is not necessary to draw the lines on the paper, but it is sufficient to designate each by a single letter."[18] The Great Geometer, as he was known, Apollonius of Perga (262–190 BC) had long before reported in his famous book, *Conics*, that these problems had been partially solved by Euclid. In Book Three of *Conics* he claimed that his own conclusions made it possible for these problems to be solved entirely. However, until Descartes' efforts in 1637, it seems that all attempts to do so had failed. That is to say, no one had been able to determine the locus of a point relative to an arbitrary number of lines. Descartes' great success was that he solved the problems by coordinatizing the plane.[19]

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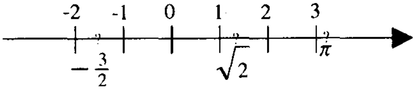
[16] Victor J. Katz, *A History of Mathematics, An Introduction* (New York: Harper Collins College Publishers, 1993), p. 121.

[17] David Eugene Smith and Marcia L. Latham, trans., *The Geometry of René Descartes* (New York: Dover, 1954), p. 2.

[18] *Ibid.*, p. 5.

[19] By "coordinatizing the plane" what is meant is the following: real numbers (*i.e.*, all possible decimals) can be represented geometrically by a horizontal line, called the real number line and denoted by R. This line establishes the most basic relation between algebra and geometry. We begin by choosing an arbitrary point O, called the origin, and assigning it the real number 0. Then, we select a line segment OA of unit length. That is, this point A appearing to the right of O on R is assigned the real number 1. Hence the positive direction of R is to the right of O and its negative direction is to the left of O. Now, we mark R off on both sides of O by unit spaced points and assign them the integers -1, ± 2, ± 3, and so on with the negative numbers to the left of zero, and the positive numbers to the right of 0, as shown in Figure 1.

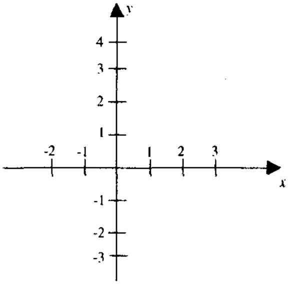
Figure 1:



Now by subdividing these unit length line segments into halves, thirds, quarters, tenths, and so on, we can locate all rational numbers (*i.e.*, all terminating decimals such as 0.5 and 0.01, and all repeating decimals such as 0.333.... and 1.666...) on R.

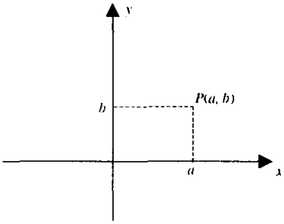
Then by geometric construction or other means, we locate all irrational numbers (*i.e.*, all non-terminating and non-repeating decimals such as $\sqrt{2} = 1.414213562....$ and À = 3. 141592653...). Thus, every point, say P, on R corresponds to a unique real number a, and conversely, each real number a corresponds to a unique point on R. The real number a is called the coordinate of P, and the real number line R is called the coordinate line. Hence establishing a one-to-one correspondence between points on the coordinate line and real numbers, denoted by $a \leftrightarrow P$. By further introducing a rectangular coordinate system into the flat and featureless plane of Euclidean geometry, we can correspond to each point in the plane a unique ordered pair of real numbers. We begin by considering a horizontal coordinate line R, called the x-axis or the axis of abscissas, and a vertical coordinate line R, called the y-axis or the axis of ordinates, that are perpendicular to one another at their origins. The plane, see Figure 2 below,

Figure 2:



is then referred to as the coordinate plane, denoted by $R \times R$ or simply R^2. Now, we agree that the positive and negative directions of the x-axis should be to the right and left of the origin, respectively. While, the positive and negative directions of the y-axis should be above and below the origin respectively. Now by projection onto these lines, as shown in Figure 3,

Figure 3:



we can correspond to every point, say P, in the plane a unique ordered pair of real numbers (a, b), and vice-versa. Hence establishing a one-to-one correspondence between points in the plane and ordered pairs of real numbers, denoted by $(a,b) \leftrightarrow P$. This correspondence establishes an extremely useful and convenient relation between algebra and Euclidean geometry. The numbers a and b are called the coordinates of P, and more specifically the coordinate a is called the abscissa of P, and the coordinate b is called the ordinate of P. The axes are called the coordinate axes, and the coordinate system is called the Cartesian coordinate system, named, of course, after Descartes. By

It is not difficult to understand why Descartes was led to believe that such conversion methods had metaphysical possibilities. He thought if the elimination of shape from geometry had borne so much fruit, perhaps the elimination of *quantity* from mathematics could bear similar fruit as well. In other words, Descartes was convinced that only the mathematical method could produce certitude, but so far mathematics was too tied to its traditional object, quantity, and therefore was prevented from having universal application. Descartes had had great success in combining algebra and geometry; his next task was to combine both sciences with logic. In effect, Descartes believed that what he had really done was to show that algebra and geometry were the same science. By combining this one science with logic, he would be creating what he would come to refer to as universal mathematics, the object of which would be, not quantity, but *order.*[20] But first, logic itself had to be purified. And thus as we approach the climax of act two, that is, the giving of the four rules of method, Descartes, the philosopher, begins to rise in stature as Descartes, the mathematician, begins to fade into the background:

> And as a multiplicity of laws often furnishes excuses for vice, so that a State is much better *ordered* when having only very few laws, they are very strictly observed, so, instead of this great number of precepts of which logic is composed, I believed I would have sufficient in the four following rules, so long as I took a firm and constant resolve never once to fail to observe them.[21]

The celebrated four rules call for some elucidation, especially the first one, commonly known as the rule of *intuition.* With the enunciation of this rule, Descartes challenges the then prevalent Aristotelian epistemology which had held that all knowledge came through the senses. The famous Aristotelian based Latin maxim *nihil*

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coordinatization of the plane, Descartes conceived the method of Analytic Geometry (also called Cartesian Geometry or Coordinate Geometry); that is, the method of relating algebra and geometry. Needless to say, this method was not only a landmark in the history of mathematics, but also in engineering and applied sciences. It easily lent itself to major advancements in these disciplines. And it is well known that it greatly enabled both Issac Newton (1642-1727) and G. W. Leibniz (1646-1716) to create the very important branch of mathematics, known as Calculus.

[21] *Discourse,* pp. 40-1.

est in intellectu quod pruis non fuerit in sensu [there is nothing in the intellect (understanding) that has not first passed through the senses] was rejected by Descartes. He argued instead that because we are often deceived by our senses, it is safer to begin the reasoning process only with those "intuitive" truths that could not be doubted.

> The first [rule] was never to accept anything as true that I did not know to be evidently so: that is to say, carefully to avoid precipitancy and prejudice, and to include in my judgements nothing more that what presented itself so *clearly* and *distinctly* to my mind that I might have no occasion to place it in doubt.[22]

Neither the method of doubt, nor the alternative epistemology to which it led, were entirely new in the history of philosophy,[23] but what was novel was the introduction of the categories of *clarity* and *distinctness* as the ultimate standards for indubitable truth. A *clear* idea for Descartes entailed all that an idea is, a *distinct* idea entailed all that it is not. Each human being, for Descartes, has certain ideas that are so clear and distinct that they cannot be doubted. And these ideas, such as the idea that a person has concerning his or her own existence, or that a *triangle has three sides* are ideas that have not come from the senses; rather, they are innate ideas. When someone knows, for instance, that *he or she exists*, he or she knows it clearly and distinctly as an operation of the pure light of the mind, not through the evidence of the senses, argues Descartes. Or *thinking*, to take yet another example, when someone knows that *they think*, they know it "intuitively" as an idea that can never be doubted. They have a clear idea with respect to all that thinking is, and a distinct idea in regard to all that thinking is not. Even if they doubt this idea, it is still an idea

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[22] *Ibid.*, p. 41 (our emphasis in italics).

[23] Plato himself of course had shunned the senses due to his epistemological doctrine of *reminiscence* wherein gaining knowledge amounted to recalling the knowledge one had had in a pre-existent and purely "spiritual " life. And with respect to the method of doubt, both Augustine's *Fallor ergo sum* [I doubt, therefore I exist] and Al-Ghazl+'s "illness" as he later described it in his autobiography written shortly before his death, anticipate, in some ways, the so-called Cartesian method. In regard to the latter especially, Al- Ghazl+'s distrust of the senses and his dissatisfaction with the various sciences precisely because they did not yield certainty, find systematic expression in his *magnus opus*, his *The Revivification of the Sciences of Religion*.

that can never be denied as a true idea since doubting is a form of thinking.

It is not within the scope of this paper to show how his four rules ultimately lead to what might be called Cartesian metaphysics, wherein his famous concept *cogito, ergo sum* [I think, therefore I am] — is raised to a supreme level as an absolute axiom to explain reality. At any rate, the latter is already well known. But what isn't as well known, and what we want to highlight, is that Descartes' desire to achieve certitude in all the sciences by accentuating what they all had in common, led inevitably to a failure to appreciate, and might we say celebrate, the extremely crucial elements of distinctness and diversity among and within the various sciences.[24] To his great credit, Descartes wanted *universal* knowledge. If he were alive today, we are convinced that he would join us in decrying the departmentalization that has all but destroyed what not that long ago could still be referred to as the "university community."[25] The point is simple: the sciences are distinct, but not separate. When either side of this truth is emphasized too much in either direction, it is our conviction that genuine progress in universal knowledge is put in jeopardy. This is based on the belief that genuine knowledge itself is, paradoxically, both diverse and unified simultaneously. Perhaps we could say that Descartes wanted only unity and certainty in all of the sciences, and either ignored, or tried to dissolve, any diversity or probability. Ironically, as we attempt to

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[24]At the risk of making a somewhat superficial observation in the Cartesian context with respect to the phenomenon of globalization, since one could reasonably argue that globalization has been going on eversince our first ancestors left Africa half a million years ago, one could say that modern globalization has its philosophical antecedents in the Cartesian method, which tries to eliminate probability by literally ignoring the essential qualities of diversity and distinctness. Concerning the question of the perennial human desire to globalize, one might speak of a good desire and a bad one. The good one is the one that seeks unity in diversity, by appreciating the otherness of the other, the bad one might be spoken of as the one that, out of pride and fear, tries to eliminate diversity by dominating and changing it. Serious works devoted to the relationship between the philosophy of mathematics and the present phenomenon of globalization are wanting. For more on globalization as a perennial phenomenon, see Ian T. Douglas' (editor) new book, *Waging Reconciliation: God's Mission in a Time of Globalization and Crisis*, (Church Publishing, Inc., 2002).

[25] For a remarkably precise statement on the breakdown of the present "university community" see the very good article by Glenn W. Olsen in the journal *Communio* "The University as Community: Community of What?" XXI/2, 1994, pp. 344-362.

now show in our exposition of what we are calling the third act in one of the most important philosophical dramas of the last thousand years, what he produced instead was less unity among the sciences and in many ways, deeper confusions.

After Descartes has presented his four rules of method, wherein it is plain to see an exact application of the principle of the formation of equations, that is, of the progress from equations of the first degree to those of a higher degree, the curtain drops and we arrive at the end of act two. When drawn again, Descartes' mathematical career has vanished forever. The rest of his life would be spent in playing out the third and final act of the drama, and one, quite frankly, that might best be described as a tragedy — for it amounted to a *promise* that he had made to himself, but one that he would never be able to keep:

> But what satisfied me the most about this method was that, through it, I was assured of using my reason in everything ... [m]oreover, I felt that, in practicing it, my mind was accustoming itself little by little to conceive its objects more clearly and distinctly, and not having subjected it to any particular matter, I *promised myself that I would apply it just as usefully to the difficulties of the other sciences as I had to those of algebra.*[26]

The only problem with applying such a method to the other sciences was that the other sciences already had their own distinct methods, which had been developed according to their own distinct objects. With respect to Physics, for instance, the proper object of which is *movement*, Descartes saw correctly that the movements of material things could be understood according to mathematical laws, but what he did not see clearly was that such understanding was only partial since the phenomenon of the movement of material things involved more than simply quantity. To be sure, Descartes had substituted the traditional object of quantity with *order* so as to make the mathematical method universal, but what this really amounted to when it came to applying the method to all the other sciences was an effort to make all the other sciences as *abstract* and *evident* as mathematics. That is to say, to make all problems similar to mathematical problems. This is aptly put by the late great historian of philosophy, Etienne Gilson,

[26] *Ibid.*, p. 43 (our emphasis in italics).

who writes in his much-celebrated book, *The Unity of Philosophical Experience*:

> The evidence of mathematics depends upon both their complete abstract generality and the specific nature of their object. Because of its complete generality, the mathematical method can be indefinitely generalized, but, if we want it to yield evidence, it cannot be indiscriminately extended to all possible objects. These logical laws of abstract order which, applied to quantity, yield the exact science called mathematics lead to nothing but *arbitrary generalizations* when they apply to objects more complex than quantity ... [t]he principle that lies at the root of Cartesian mathematicism is that, since the most *evident* of all the sciences is also the most *abstract*, it would be enough to make all the other sciences as abstract as mathematics in order to make them just as evident.[27]

In other words, Descartes failed to see that mathematics achieves certainty more readily than the other sciences because of its simplicity. The mental manipulation of abstract entities such as numbers is not nearly as complex as say the mental manipulation of the movement of material things. The mind can get a hold of numbers and dominate them through abstraction more easily than it can get a hold of matter and dominate its movements. In addition to this, the presupposition that the most evident is also the most abstract ignores what is perhaps the most essential feature of abstraction, again, put so succinctly by Gilson:

> To abstract is not primarily to leave something out, but to take something in, and this is the reason why abstractions are knowledge. Before stretching mathematical methods to non-quantitative objects, one should therefore remember that our abstract notions validly apply to what they keep of reality, not to what they leave out; next, one should make sure that the content of these non-quantitative concepts constitutes an object as completely analyzed, or analyzable, as numbers, figures or positions in space; last, but not the least, one should keep in mind that all conclusions drawn from incompletely analyzed or incompletely analyzable objects, logically correct as they may be, shall lack the specific evidence of mathematical conclusions. Everybody is free to call mathematics any logical ordering of more

[27] *Unity of Philosophical Experience*, p. 144 (our emphasis in italics).

> or less confused notions, but he will have made mathematics arbitrary in its results instead of making the results of other knowledge mathematically evident.[28]

Why, we may ask, was someone as brilliant as Descartes unable to see the very simple truth that concepts such as *movement* in physics, or *thought* in philosophy, did not constitute objects as completely analyzed, or analyzable, in the same way that numbers, figures or positions in space did? We may also ask why he failed to see that all conclusions drawn from incompletely analyzed or incompletely analyzable objects would therefore logically lack the specific evidence of mathematical conclusions? Descartes was certainly aware of the fact that neither the physicists nor the philosophers even agreed upon what the essence of matter was, let alone on the nature of its movement. Discussions concerning the primary and secondary qualities of matter abounded in traditional philosophical speculation before Descartes, a tradition that he grudgingly spent long hours studying about at La Flèche. Instead of fascinating him, though, the questioning only frustrated his craving for certainty, a craving that only the certainty of mathematics was able to satisfy. But had he been less impetuous and perhaps a bit more humble, he may have come to see that even in mathematics, there were still problems that his method could not solve. Our bringing in the virtue of humility here is not superfluous. That is to say, Descartes had companions, who were also mathematical geniuses, who were trying to make him see that his method not only would not be able to solve all possible problems in any science whatsoever, but that it would not always work even in mathematics itself. But Descartes did not listen. He had certainly spent long hours at La Flèche studying the importance of the virtues for the intellectual life. He had certainly been thoroughly exposed to the importance of the Socratic method, a method that forever praised the truth of one's own intellectual ignorance and poverty as the beginning and end of wisdom. But, again, such a method did not appeal to a mathematical genius who, at twenty-three years of age, had solved extremely difficult and ancient mathematical problems. His method, rather, was to be a universal method that would yield nothing but certainty.

[28]*Ibid.*, pp. 144-5.

As already indicated, he called this method universal mathematics and claimed that he had extracted it from algebra, geometry, and logic. It consisted entirely in the logical mental *ordering* of concepts that had to be as clear and as distinct as the ideas that came through intuition. With respect to philosophy, he tried to make the objects of philosophical knowledge more similar to those of mathematics. Thus, he not only reduced them to three, namely, God, thought, and extension, but also declared that the total substance of these philosophical objects could each be totally contained in simple intuitions. Such a declaration, of course, was meant to make these objects as simple as the notions of number and space. This was a smart move, but not a very wise one, for even number and space are not absolutely simple notions, let alone the notions of thought and God. To be sure, Descartes was aware of the teaching of the medieval theologians, who had taught that the notion of God was an absolutely simple notion, but it seems he had neglected the other side of this teaching. That is, they had taught that God was absolutely and perfectly simple in himself precisely because his knowledge of himself was utterly profound, simple, and perfect, but they also taught that, from the perspective of created beings, the concept of God was horribly complex and could not be grasped in its entirety by any created mind. This could also be said of the notion of thought, and even of the notions of space and number.

As the third act continued, the tragic nature of the philosophical drama began to emerge ever more clearly. Descartes tried desperately to keep his promise. He turned his attention not only to physics and philosophy, but also to ethics and biology. With respect to the latter, he was so confident that his method could solve any problem whatsoever that he seemed at one point to operate under the illusion that through his mathematical medicine he would be able to postpone his own death indefinitely. In this regard, the *fifth discourse* is perhaps the most tragic of all, since unlike his failures in Physics and Philosophy, Descartes was able to witness this failure for himself. That is to say, in Philosophy, Descartes was not around to witness the way in which John Locke would almost destroy the very foundations of Cartesian philosophy, and neither would he be alive to witness the way in which Newtonian physics would quickly outdate his own. But in biology, the bitter truth forced itself upon him with deadly accuracy.

In 1628, William Harvey published a book that announced the discovery of the circulation of the blood. Although Descartes agreed with Harvey in many respects, he could not see how Harvey's description of the motion of the heart was commensurate with his own mathematical medicine. Based upon the principles of his newly discovered mechanical biology, Descartes confidently presented the *correct* explanation in the *fifth discourse.* The only problem was that it was not only not correct, but it was an embarrassing spectacle. Descartes finally had to admit in a letter to Chanut in 1646 that he was failing to make any real headway in medicine that would help him to realize his goal of preserving his own life. Four years later, the third and final act came abruptly to an end: René Descartes died on February 11, 1650. He was fifty-four.

We are convinced that Descartes' attempt to unify and universalize knowledge was an admirable one, but what we plainly take issue with is the way in which he tried to do it. We are also convinced that modern academia is in dire need of some unifying profile to help people make sense of how all of the specialized knowledge "out there" is related. In Descartes' world, the universal sciences of theology and philosophy were the ones that kept all of the others together, but because of all the disagreements among the philosophers and the theologians, Descartes rejected such a classification of the sciences. In the seventeenth century, and for many years prior, to speak of Theology as the queen of the sciences and Philosophy as her handmaiden, was a very acceptable way of classifying knowledge. All the branches of knowledge served the highest branch, which had the exalted and nearly impossible task of studying the highest truth, namely God himself. Descartes rejected such a scheme since he could not see how sciences that lacked certitude could possibly be the ones that provided unity. Descartes went his own way. And people are free to determine whether his project was successful in providing unity or not. For our part, we are convinced that it was not. This is not to suggest that we in academia ought to return to the medieval classifications, but it is to suggest that a unifying science ought to unify.