

## Spain and the Scientific Revolution: Historiographical Questions and Conjectures

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**I**N 1792, WRITING IN THE *ENCYCLOPÉDIE MÉTHODIQUE*, the French polymath Nicolas Masson de Morvilliers posed a question that, for better or for worse, framed the historiography of Spanish science for nearly two centuries. «What do we owe to Spain?» Masson asked in a voice brimming with sarcasm and contempt. «In two centuries, in four, or even in six, what has she done for Europe?»<sup>1</sup> Ostensibly, Masson's subject was not the history of science but the geography and population of Spain, themes that gave his polemic a pronounced racist character. For, according to Masson, the source of Spain's deficiency was the character of its people, who, in spite of their admirable virtues of patience and resolve, were ignorant, lazy, and superstitious. Moreover, according to Masson, Spain's futile government, bigoted clergy, and tyrannical Inquisition conspired to condemn the country to remain hopelessly backward. Particularly with regard to science, he concluded, Spain had become «the most ignorant nation in Europe». To Masson, Spain was the country that typified everything against which the philosophes were struggling.

Masson framed his question in a manner that was typical of the French Enlightenment: polemical, secular, and anticlerical, it was, fundamentally, a question about modernity. Why should the question of Spain's 'decline' have been so central to northern Europe's conception of modernity? Part of the answer lies in the fact that the history of modernity that the Enlightenment *philosophes* were writing was a kind of melodrama, with science and reason leading the way, inexorably, toward truth and utopia. A melodrama, of course, requires heroes and villains drawn in patterns of bold relief. In the history of modernity that was then being written increasingly by English, French, and German historians, Spain was the quintessentially anti-modern villain. Its supposedly inexorable 'decline' contrasted sharply with the rise of the northern European industrial powers. In the eighteenth-century melodrama of modernity, Spain was, in a sense, a necessary character.

Responses to «Masson's question» were swift and indignant. One by one, Spanish scholars, all with deeply wounded pride, responded to the insult, penning pamphlets and apologies defending Spain's honor and glory. King

<sup>1</sup> Masson de Morvilliers (1782), I, 554-68. A Spanish translation of the article may be found in Garcia Camarero and Garcia Camarero (1970), pp. 47-53. Masson's article was written for the section on «Modern Geography».

Carlos III demanded an official apology and, just to be safe, banned the importation of the *Encyclopédie* until «corrected». The Academia Española offered a prize for the «best apology or defense of the nation and its progress in the arts and sciences». The Masson *affaire* quickly spread from pamphlets to the periodical press. By the end of the decade, one could scarcely pick up a newspaper without finding a reference to Masson or to one of the «apologists» for Spain.<sup>2</sup>

Thus opened «la polémica de la ciencia española,» a polemic that, until quite recently, framed scholarship on Iberia's role in the development of modern science. For the next century-and-a-half or more, the debate over Spanish science was dominated by polarized and sterile polemics, one side condemning Spain for its backwardness and the other side patriotically defending the 'Spanish character'.<sup>3</sup> Because the Scientific Revolution occupies such a central place in the narrative of modernity, Masson's question has become, in modern historiography, a question centrally about Spain's contribution to the Scientific Revolution. The result has not been encouraging. Remarkably, as far as concerns the historiography of science outside of Spain, the situation is not very different today than it was when, in 1914, Julián Juderías coined the term «Black Legend» to describe the stereotype of early modern Spain as «Inquisitorial, ignorant, fanatical, incapable of taking a place among the cultured nations, always inclined toward violent repression, an enemy of progress and innovation».<sup>4</sup> Surveying the historiography of early modern Iberian science, Jorge Cañizares recently observed the «remarkably enduring narratives of the Spanish Black Legend ... are still with us, blinding historians every day».<sup>5</sup>

Examples are not difficult to find. Recently, the British historian Anthony Pagden asserted, «Spain never experienced a 'scientific revolution' or ... anything that could be plausibly accommodated under such a description».<sup>6</sup> Similarly, in an essay dedicated to the Scientific Revolution in Spain and Portugal, David Goodman, one of the most knowledgeable scholars of the subject, concluded, «So complete was the collapse that it is difficult to find a single Iberian contributor to the European Scientific Revolution of the seventeenth century».<sup>7</sup> According to conventional wisdom, again echoing traits of the Black Legend, the cause of Spain's comparative stagnation was religious fanaticism. Thus Allen G. Debus, one of the leading American historians of Renaissance science, recently asserted that the supposed lack of scientific innovation in early modern Spain was a result of «Philip II's effort to maintain Spain as a Roman Catholic country».<sup>8</sup>

<sup>2</sup> For an account of the Masson 'affair,' see Herr (1958), pp. 220-30

<sup>3</sup> For a history of the so-called «polémica de la ciencia española», see López Piñero (1979), pp. 15-27. The main documents related to the dispute are collected in García Camarero and García Camarero (1970). See also a recent revision of the «polémica» in Nieto-Galán (1999).

<sup>4</sup> Juderías (1977), p. 24.

<sup>5</sup> Cañizares Esguerra (2004) p. 117.

<sup>6</sup> Pagden (1988).

<sup>7</sup> Goodman (1992), p. 171.

<sup>8</sup> Debus (1998), p. 160.

Probably all would agree that it was unfortunate that so much energy should have been wasted on such a puerile question as that of Nicolas Masson. Not only has the polemic had a negative impact upon Spanish scholarship, it has also greatly inhibited our general understanding of the Scientific Revolution. Over the course of almost two centuries, the «polemic of Spanish science» divided Spanish historiography of science into two camps. The first, which we might call the nationalist tradition, was epitomized by the work of the great literary scholar Marcelino Menéndez Pelayo, who catalogued and chronicled Spanish contributions to science in a manner that can only be described as indefatigable.<sup>9</sup> On the other side, the liberal tradition of scholarship, best exemplified by the philosopher José Ortega y Gasset, appropriated the Black Legend to condemn Spanish 'anti-modernism.' Despite the eminent scientist Santiago Ramón y Cajal's insistence that «Our bad characteristics are not constitutional, but circumstantial and accidental,»<sup>10</sup> explanations of Spanish decline based on 'national character' continued to be employed by such eminent historians as Claudio Sanchez Albornoz and, more recently, Américo Castro, who pronounced that there was never any authentic scientific thought in Spain «because that was alien to the Spanish way of life.»<sup>11</sup> Pierre Chaunu best captured the meaning of the Black Legend in the Spanish consciousness when he wrote, «The Black Legend is a reflection of a reflection, an image twice distorted, the external image of Spain as Spain itself sees it.»<sup>12</sup> According to Chaunu, the real force of the legend lies not in the external image of Spain but in the negative features that the Spanish conscience discovers in its own self-image.

Meanwhile, the history of the Scientific Revolution was written in total neglect (or apparent ignorance) of Iberian developments. Indeed, the situation today is not much different than it was more than two decades ago, when José María López Piñero lamented «la escasa o nula presencia de la España de los siglos XVI y XVII en las exposiciones generales de los historiadores de la ciencia de otros países y en sus estudios acerca de la evolución de una disciplina o un tema determinados.»<sup>13</sup>

An instructive parallel may be drawn, we think, between «Masson's question» about Spain and another famous question in the historiography of science, that is, Joseph Needham's question about China. «Why did China not experience a Scientific Revolution?» Needham asked.<sup>14</sup> Nathan Sivin compares Needham's counterfactual question to the question, why did your name not appear in today's newspaper? Why, he asks, does the Scientific Revolution question assume such urgency when the latter does not? The reason seems to be that we usually assume that the Scientific Revolution

<sup>9</sup> Menéndez Pelayo (1879).

<sup>10</sup> Ramón y Cajal, in García Camarero (1970).

<sup>11</sup> In an article, «Minorías y mayorías», published in *El Nacional*, Caracas, 5 February 1953, reprinted in Castro (1973), pp. 177-185. On Castro and Sánchez Albornoz's ideas, see Glick (1992), p. 118 ff.

<sup>12</sup> Chaunu, P. (1964), p. 196.

<sup>13</sup> López Piñero (1979), p. 34.

<sup>14</sup> Needham (1969), p. 16.

is what everybody ought to have had.<sup>15</sup> In addition, the question implies the further assumption that civilizations that had the potential for a scientific revolution ought to have had the kind that took place in the West, an assumption usually linked to the belief that «European civilization was somehow in touch with reality in a way no other civilization could be».<sup>16</sup>

Nowadays, hardly anyone ever asks historical questions of the sort that Needham labored over: «why the Scientific Revolution didn't happen in location X or location Y».<sup>17</sup> Nevertheless, it seems as if Masson's question, of which Needham's was a kind of parallel version, still holds force, at least outside of Spain. How else can we explain the virtual silence of the historical community in the rest of the world on this subject?

With regard to the question of Spain's role in the development of early modern science – the problem, that is, of Spain and the Scientific Revolution – it seems that it is time to take stock. If we have been asking the wrong questions, perhaps it is time to refocus and reassess the questions that we are asking about early modern Iberian science and about Iberia's role in the Scientific Revolution. Above all, we need to pose the more fundamental question of whether or not an account of the 'Scientific Revolution' and the origins of modernity that omits Iberia can have any meaning at all. Our aim in organizing this conference was to move historiography «beyond the Black Legend,» and to do that, we must begin by asking the right questions.

At the outset, it is important to be clear about what we mean by Spain in the sixteenth and seventeenth centuries. All too often, historians confuse the monarchy as it existed under the Hapsburgs with the modern Spanish state or, even worse, mistake the peculiarities of the Castilian model for the institutional characteristics of the entire peninsula. Yet as José Antonio Maravall has pointed out, the Spanish monarchy, in the sense of a unified royal state, was largely a myth.<sup>18</sup> The reality is that the «Spanish monarchy» existed at three different levels: that of the individual peninsular kingdoms, the combination of kingdoms of Hispanic tradition, and the imperial conglomerate built up under the Spanish Crown. This reality is important to our understanding of early modern Spanish science because the three levels of political organization influenced science in different ways. For example, whereas the creation of the Protomedicato as an instrument for the control of medical practice was accomplished with few obstacles in Castile, the establishment of the institution in Aragón, Navarra, and Valencia, which had their own traditions and procedures for regulating medicine, often met with stiff resistance.<sup>19</sup> Local and regional traditions also had an impact on the universities within the various kingdoms, influencing not only the curricula but also the aspirations of professors and students.<sup>20</sup> Thus the Castilian

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<sup>15</sup> Sivin (1984)

<sup>16</sup> Sivin (1984), p. 533.

<sup>17</sup> Findlen (2005), p. 533.

<sup>18</sup> Maravall (1972).

<sup>19</sup> For example, see López Terrada (2005).

<sup>20</sup> The case of the teaching of mathematics in sixteenth-century Spain serves as an illustration: Navarro Brotóns (2006).

universities, which were at the forefront of Spanish intellectual life, directly engaged with the intellectual problems posed by the emergence of imperial Spain.<sup>21</sup> Indeed, the creation of institutions such as the Casa de Contratación and the Consejo de Indias was directly connected with imperial expansion. In constructing an interpretation of early modern Spanish science, it is perilous to ignore such regional differences.

Revolution implies change. Any serious consideration of the Scientific Revolution must therefore confront the issue of continuity versus change. The narrative of revolution has served historians of science reasonable well as a heuristic for understanding the development of early modern science; but it has had several negative consequences. As an organizational myth about the origins of modern science, it is both selective and constitutive: such a myth obliges us to tell a kind of positivistic story about the origins of science, selecting certain events and personalities and omitting others. By virtue of its universalizing claims, the myth presupposes and seeks to demonstrate historically a positivist image of science.<sup>22</sup> Moreover, the canonical narrative of the Scientific Revolution has tended to obscure the importance of local traditions. Whether or not we are to understand the history of early modern science in terms of the global framework provided by grand narrative of the Scientific Revolution, or in terms of local knowledges rooted in particular places and times and bounded by particular social contexts ought to be one of the central questions guiding our consideration of early modern science.<sup>23</sup>

The problem of local knowledge leads to a third important question, namely the problem of Spanish particularity. How, starting from a common medieval tradition, did Iberia and northern Europe take such a different paths to modernity in the sixteenth and seventeenth centuries? Recently Beatriz Helena Domingues argued that the «Iberian option» was characterized by an attempt to reconcile a new conception of the universe with Aristotelian and Scholastic natural philosophy.<sup>24</sup> Spain, more resolutely than other parts of Europe, tried to accommodate the new discoveries with Catholic doctrine. Domingues, who uses the expression «medieval modernity» to describe the particular way in which Iberia reconciled tradition with modernity, criticizes the doctrine of «national character» that has been so often used to explain Iberia's supposed anti-modernism. «The Iberian option,» she writes, «was not the result of any national character but of historical and cultural developments that can and should be elucidated».<sup>25</sup> Whether or not the modernization of the medieval tradition in Spain explains Iberia's relative isolation from the Scientific Revolution is a question that still needs further exploration.

Turning to the condition of science in medieval Iberia, we think that another problem that deserves further study is the process of what Luis García

<sup>21</sup> Kagan (1974), p. 230.

<sup>22</sup> Fuchs (1991).

<sup>23</sup> Harris (1998).

<sup>24</sup> Domingues (1996).

<sup>25</sup> Domingues (1996), p. 42. However, Domínguez herself is not completely free of the idealist tradition of Américo Castro, speaking of the «opción ibérica», as if the «Spanish» or Iberian case were the result of a conscious choice.

Ballester calls «the ebb of scholasticism» (*reflujo de escolástica*).<sup>26</sup> Scientific works that were translated into Latin in Toledo and other Hispanic centers of learning «flowed» toward northern Europe, then returned to Iberia after having become part of the canon in the northern European universities. It is still something of a puzzle why, during the fourteenth and fifteenth centuries, the creation of universities in Spain did not proceed as rapidly as in northern Europe, when by all accounts there was every reason for that to have happened. In any case, most of the scientific and medical activity in late medieval Spain took place outside of the universities, whether amongst Christians or the Jewish minority.<sup>27</sup>

By contrast, universities proliferated in sixteenth-century Spain. As a result, many of the most important intellectual developments of late-medieval scholasticism, such as nominalism, took root in Spain somewhat later than in northern Europe, and coexisted with the humanist movement without any major conflicts.<sup>28</sup> Whether or not this disjuncture accounts for the relatively more long-lasting hold of scholastic natural philosophy in Iberia is another question that needs further investigation.

Yet the supposed grip of scholasticism upon Iberian science did not, by any means, preclude the study and teaching of the new cosmology. If we have learned anything about Renaissance Aristotelianism, it is that it was a living, diverse tradition capable of accommodating many divergent positions.<sup>29</sup> This was certainly no less true in Spain than elsewhere in Europe. Indeed, as Victor Navarro has pointed out, it would be difficult to detect any significant differences between the manner in which the new cosmology was taught in the Spanish universities and that of their European counterparts.<sup>30</sup> Nor did Spain lack critics of Aristotle. Jeronimo Muñoz, a distinguished mathematician, astronomer, and geographer who taught at Valencia and Salamanca, was a fierce critic of Aristotelian cosmology. Muñoz became widely known for his precise observations and theoretical conclusions regarding the supernova of 1572, and in his *Libro del nuevo cometa* refuted the Aristotelian dogma of the incorruptibility of the heavens. Vestiges of the Black Legend continue to perpetuate the stereotype of sixteenth-century Spain as fanatical and Inquisitorial, and as an enemy of progress and innovation. Yet it is not without significance that it was the Inquisition in Rome, not Spain, that prosecuted Europe's leading Copernican, Galileo, while the major Spanish defender of the Copernican doctrine, Diego de Zúñiga, was allowed to publish his opinions freely, without threat of persecution.<sup>31</sup>

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<sup>26</sup> García Ballester (2001), pp. 115-22.

<sup>27</sup> See Beaujouan (1967).

<sup>28</sup> See Navarro (2002 and forthcoming).

<sup>29</sup> Schmitt (1983).

<sup>30</sup> Navarro Brotóns (1992), pp. 185-216. Idem (2006).

<sup>31</sup> Although Zúñiga eventually changed his mind about the Copernican theory, his decision cannot be attributed to an Inquisitorial condemnation or censure. The condemnation of Copernicus did not occur until the decree of the Roman Inquisition in 1616, in which Zúñiga's work is explicitly cited for expurgation. See Navarro Brotóns (1995). In addition, see idem (1992).

Another important question concerns the relation of science and technology to political change, particularly in relation to the origins of the modern state. As Jose María López Piñero, David Goodman, and others have pointed out (as do some of the papers in this volume) various aspects of early modern Spanish science and technology –metallurgy, cartography, artillery, fortifications, and medicine, for example– were during the reign of Philip II perceived to be closely connected with the needs of the state.<sup>32</sup> Indeed, many of Spain's most important scientific developments were encouraged by the monarchy and took place in connection with imperial designs, including overseas territorial expansion, consolidating rule over newly occupied territories, and so on. As is well known among historians of Iberian science, much of this activity took place in newly-founded institutions such as the *Casa de Contratación*, the *Consejo de Indias*, the *Academia de Matemáticas*, and the *Protomedicato Royal*. On the whole, Spanish achievements in the sixteenth century in fields such as geography, cartography, magnetism, astronomy, and natural history were notable, as many of our contributors point out. Much of that new knowledge became part of the European patrimony. Yet, at the same time, all of this seemingly pragmatically-oriented scientific and technical activity has led some historians to question whether Spain's excessively utilitarian approach to science might itself have caused Iberia's relative isolation from speculative thinking. Beyond that, did the rigorous control over scientific and technical activity imposed by the Crown as a result of its single-minded support of science and technology designed to suit state needs place limits on creative scientific thinking? Certainly such an explanation makes better sense than the kinds of racial causes attributed by the Black Legend; but are they sufficient?

Colonial science is currently a subject of great interest among historians of science, and in this area of study Spain, which possessed Europe's greatest empire and the world's first global empire, obviously occupies, or should occupy, a prominent place. Yet, as Jorge Cañizares has recently pointed out, there are huge gaps in our knowledge of the subject.<sup>33</sup> Since several of the contributors to this volume address this subject, we will not try to draw any specific conclusions here. Rather, we wish to expand a little on Cañizares's observations and to point out some possible new directions for investigation.

First of all, we think that it might be worthwhile to reconsider, and to explore more deeply, what may have been the single most important long-term consequences of the Iberian discoveries, the weakening of faith in ancient authority.<sup>34</sup> As Maravall pointed out more than forty years ago, it was in Iberia that intellectuals first developed a sense that the moderns had superseded the ancients.<sup>35</sup> Of course, this has become a standard historiographical convention and is perhaps the only concession that the dominant

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<sup>32</sup> Vicente Maroto; Esteban Piñero (1991).

<sup>33</sup> Cañizares Esguerra (2005).

<sup>34</sup> Goodman (1992), p. 168.

<sup>35</sup> Maravall (1972).

narrative of the Scientific Revolution makes to Spain. But on the whole, we think, that crucial contribution has not been taken seriously enough in scholarship. The studies of natural history and colonial science presented here will, we hope, suggest some new directions for exploring this critically important problem.

However, we think that there is much more to be done with the idea of «discovery» –this centrally Iberian contribution to the Scientific Revolution. Take, for example, the Renaissance reception of Ptolemy. Were we to judge from the attention given by historians of science, Ptolemy's influence on the Renaissance was exercised chiefly through the *Almagest*. Yet that conclusion is largely an artifact of our prioritizing of mathematics and cosmology as the drivers of the Scientific Revolution. If we look at the priorities of the time, however, a very different picture emerges. In the Renaissance, Ptolemy was seen more as a geographer than as an astronomer, and the publication of his *Geographia* far outstripped that of the *Almagest*.<sup>36</sup> This fact is rather sobering. It suggests that somehow we've gotten the whole picture of the Scientific Revolution wrong. Measured by its impact on everyday life, the discovery of the New World far surpassed the design of a new cosmos. Indeed, to most people living in the Renaissance, the real scientific revolution was not the revelation of a new arrangement of the heavens, but the discovery of new worlds on earth. Instead of trying to fit Spain into the dominant narrative, perhaps it is time to invent a new narrative.

What might such a narrative look like? First of all, it might highlight the emergence of a revolutionary new image of science and of the scientist. Cañizares suggests that early modern Spain elaborated a new model of «imperial science» in which chivalric values colored the pursuit of knowledge. That model had a striking impact on northern European natural philosophy. Indeed, as Juan Pimentel has observed, the most famous visual representation of that model of science – the frontispiece to Bacon's *New Organon*, depicting a ship sailing beyond the Pillars of Hercules, the traditional limits of knowledge – was actually borrowed from a Spanish work by Andrés García de Céspedes (see cover illustration).<sup>37</sup>

But we can go further with this line of thinking. What is in fact being elaborated here is an entirely new conception of the aims and methods of science: the idea of science as a hunt. As Paolo Rossi observed, in the early modern period, «there was continuous discussion, with an insistence that bordered on monotony, about a logic of discovery conceived as a *venatio*, a hunt –as an attempt to penetrate territories never known or explored before». <sup>38</sup> This idea carried two important implications: one was that nature was a great uncharted unknown, and that hence science had to begin anew; the other was that new methods and guides had to be found to help the

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<sup>36</sup> Bennett (1998), p. 201. The importance of the 'Ptolemaic renaissance' in geography and Spain's contribution to it had already been pointed out by López Piñero (1979), pp. 212-28. See now Navarro, Salavert (2006).

<sup>37</sup> Pimentel (2000).

<sup>38</sup> Rossi (1970), p. 42. In addition, see Cavazza (1980).



intellect weave its way through the labyrinth of experience.<sup>39</sup> Hunting was, of course, the signorial sport *par excellence*, a fact that underscores Cañizares's point about the emergence of a new model of «imperial science» influenced by chivalric values.

The idea of science as a hunt for secrets in unknown regions of nature was a theme that appears in Renaissance scientific literature with monotonous regularity. The discoveries demonstrated that ancient philosophy and science were not necessarily eternal verities. The relations of the voyagers to distant parts of the world seemed to confirm that, as Francisco López de Gómara wrote in *Historia general de las Indias* (1552), «experience is contrary to philosophy». <sup>40</sup> In the seventeenth century, the English natural philosopher Sir Thomas Browne thought that ancient philosophy and science were so fraught with error that «the America and untraveled parts of Truth» still awaited discovery.<sup>41</sup>

The New World explorer seemed to provide natural philosophers with vast hunting ground and a heroic self-image with which to explore it. Writing in the late-seventeenth century, the Italian surgeon Giuseppe Zambecari compared his physiological experiments to the explorations of the New World: «I courageously embarked upon this exactly in the same way as the discoverers of the New World, who under the mercy of fortune first entrusted themselves to the sea, without knowing (so to speak) what they were doing and where they were going». <sup>42</sup> The explorer was singled out as the model empiricist, unpretentious in his learning and skeptical of the opinions of the schoolmen. «The simple sailors of today have learned the opposite of the opinion of the philosophers by true experience,» asserted Jacques Cartier.<sup>43</sup> In the mid-seventeenth century, the English virtuoso Joseph Glanvill still envisioned the opening up of an «America of secrets and an unknown Peru of nature». As long as we stick to Aristotle, he wrote, «we are not likely to reach the Treasures on the other side of the *Atlantick*, the directing of the World the way to which, is the noble end of true Philosophy». <sup>44</sup> Like the New World, nature stood before investigators as uncharted territory.

Another point that needs much greater emphasis in our accounts of the Scientific Revolution is that, largely as a consequence of the debates coming out of the Iberian discoveries, a new conception of human nature emerged; and, as well, a new science, the science of comparative ethnology. As collectors of massive amounts of data about the people and societies of the New World, the Spaniards were among the first Europeans to face questions of ethnology, uniformity and diversity of races, and so on. As Anthony Pagden has pointed out, the result was a far-reaching change in the understanding of human societies, «a change from a description of cultures in terms of a human nature thought to be constant over time and space to a wider anthro-

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<sup>39</sup> Eamon (1994) and (2006).

<sup>40</sup> Quoted in Atkinson (1935), p. 257.

<sup>41</sup> Browne (1964), p. 5.

<sup>42</sup> Zambecari (1941), p. 313.

<sup>43</sup> Jacques Cartier, *Bref récit et succincte narration* (Paris, 1545), Atkinson (1935) p. 256.

<sup>44</sup> Glanvill, J. (1661), p. 178.

pological and historical relativism». <sup>45</sup> Of course, the growing interest in the American Indians was itself connected with Spain's imperial ambitions. Be that as it may, might the Spanish preoccupation with ethnology partially explain Spain's apparent lack of interest in the subjects that dominate the canonical narrative of the Scientific Revolution, such as astronomy and cosmology? Yet we need to ask, which of the two concerns, in the long run, was the most important – the nature of the heavens or the nature of humanity? A strong argument could be made for the latter. Indeed, might we not picture a history of the Scientific Revolution in which ethnology and anthropology, not mathematics and cosmology, took central stage? What would such a history look like? It might begin with the sentence: The Scientific Revolution began in Spain.

The problem of «decline» is the last issue that concerns us here. There is general agreement among historians that Spain experienced a decline of scientific activity in the seventeenth century. That decline is usually seen to have corresponded with a period of general economic, social, and political decline, although it must also be pointed out that the thesis of the general «decline of Spain» has been seriously challenged and is still a subject of controversy. <sup>46</sup> The thesis of decline and subsequent renewal, as it is currently understood, was first elaborated by José María López Piñero, who proposed a chronology of Iberian scientific change as taking place in three phases. The first, corresponding approximately to the first third of the seventeenth century, was a period during which scientific activity in Spain was essentially an extension of the Renaissance. The second phase, comprising the middle decades of the century, was characterized by the introduction and dissemination of «modern» elements borrowed from outside and incorporated without changing traditional doctrines. The last phase, corresponding to the last two decades of the seventeenth century, witnessed a number of authors – the so-called *novatores* – openly breaking from the traditional mold and initiating a systematic integration of the new European philosophical and scientific trends. <sup>47</sup>

One of the main problems with this thesis, in our judgment, is that it presupposes a model of scientific change based on a chronology of events that occurred in northern Europe, interpreting the «modernization of Spanish science» as a process of acculturation. Under this interpretation Spain, previously more or less isolated from European developments, overcame its backwardness only by absorbing European science. <sup>48</sup> However, the Scientific Revolution was a long process of change whose chronology is difficult to specify with much clarity. To define the Scientific Revolution as the scenario that occurred in a certain location or among a small group of leading

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<sup>45</sup> Pagden, A. (1982), p. 1.

<sup>46</sup> Kamen (1978).

<sup>47</sup> López Piñero (1965). This characterization of López Piñero's thesis is somewhat of a simplification. In recent years, López Piñero has recognized that more recent historiography has fundamentally revised this periodization.

<sup>48</sup> It should come as no surprise that the Enlightenment myth of the «decline» of Spain originated in France, and its center was Paris. Kamen (1979), p. 31.

personalities does not strike us as convincing. Moreover, if Spain experienced a decline in scientific activity in the seventeenth century, it is equally certain that it saw a revival in the eighteenth century. Indeed, all of the elements that we associate with the Scientific Revolution –Newtonian mechanics, the circulation of the blood, Lavoisier’s chemistry, the experimental study of electricity and magnetism, instrumentation, including the air pump, new scientific institutions, and so on– occurred in Spain. Thus, by the eighteenth century, Spanish scientific thought was fully within the orbit of Europe.<sup>49</sup> The question that has occupied historians of Iberian science is whether this change (whether we call it renovation or revolution) began with the Bourbon restoration as a consequence of the reformist agenda of the state or was a continuation of the scientific activity that had already begun in the seventeenth century. Scholarship of the last several decades strongly suggests that Iberian science in the eighteenth century was a continuation of a process of renovation that began in the seventeenth century, in some cases within local contexts and in other cases with the support of the centralized monarchy or, alternatively, was a combination of both.<sup>50</sup> Nevertheless, more research is needed to situate our understanding of Spanish scientific activity within current historiography in two respects: first, by taking into account not only the European context but also Spanish traditions leading back to the sixteenth century and beyond; and second, by understanding scientific change not only as an intellectual process, but also as an activity, as a search for the solution of problems, and as a continual hunt for the secrets of nature –in other words, an approach that does not privilege knowledge over practice.

We are not suggesting that we abandon the idea of the «Scientific Revolution» –at least not yet. As historians of science, we have an obligation to address the big questions about origins, identity, and meaning: that is, about the origins of science and the role of science in the identity of «the West» and in the making of the modern world.<sup>51</sup> Yet, as Betty Jo Dobbs reminded us, when we use the term «revolution» to refer to scientific thought, we are in fact using a metaphor.<sup>52</sup> She went on to write, «We are still encumbered with some of the baggage of the metaphor of revolution that obscures so much continuity in the midst of change and produces such improbable interpretations of historical actors, for in many ways we are still most intent upon explicating the changes that led to us». Clearly, we can no longer afford to repeat stories that do not make sense of the early modern world as *early*

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<sup>49</sup> On science in eighteenth-century Spain, see the synthesis by Lafuente and Peset (1988). In addition, see Sellés, Peset and Lafuente (1988); the relevant chapters by Vernet (1975); the section covering the eighteenth century in López Piñero, Navarro, and Portela (1988); Peset, coord. (2002); and volume 2 of Vernet, Pares, dirs. (2006). On the diffusion of scientific and philosophical ideas, there is some interesting information in Sánchez-Blanco Parody (1991).

<sup>50</sup> See López Piñero (1979); Navarro Brotóns (2002); López Piñero (coord.) (2002); Peset (coord) (2002); Vernet, Pares, dirs. (2007), vol. 2.

<sup>51</sup> Harris (1998), p. 138.

<sup>52</sup> Dobbs (2000), p. 33.

*modern Europeans* understood that world. That means, among other things, that we can no longer afford to leave Iberia, which loomed so large in the collective consciousness of early modern Europeans, out of the picture of the Scientific Revolution.

Masson posed his question —«What does Europe owe Spain?»— just as northern European intellectuals were crafting a new paradigm for modernity. The ‘new modernist paradigm’ that was developed in the late eighteenth century was premised on the assumption that only we, the northern Europeans, got it right. Once again, we find interesting parallels between Masson’s question and Needham’s famous query about Chinese science. For in the late eighteenth century, the Enlightenment *philosophes* traded their fascination with the Orient for an ideology of Orientalism.<sup>53</sup> During the first half of century, the image of the ‘virtuous Chinese’ reined supreme. Thus Leibniz, who carried out an extensive correspondence with Jesuit missionaries in China, had an extremely positive view of Chinese culture, and even wrote a defense of Chinese natural religion in order to show its agreement with Christian natural religion.<sup>54</sup> Yet in the last decades of the century, the northern European perspective on East Asia changed profoundly, so that in 1774, the French ethnographer Cornelius De Pauw described China as a «land of ignorant, intolerant monks and of courtiers utterly dependent on Europe» for its scientific expertise.<sup>55</sup> The reversal of China’s image in the West was complete.

The Black Legend projected upon Spain a similar kind of «Orientalism». We hope that, with these conference proceedings, we can begin to reverse that trend.

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<sup>53</sup> On the concept of Orientalism, see Said (1979).

<sup>54</sup> Leibniz, *Discours sur la théologie naturelle des Chinois* (1715); see Perkins (2004).

<sup>55</sup> *Recherches philosophique sur le Egyptiens et les Chinois*, quoted in Cañizares-Esquerria (2001), p. 34.