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## Religious Beliefs, Philosophy and Scientific Theory in the Origin of Spanish Geomorphology, 17th-18th Centuries

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RELIGIOUS BELIEFS, PHILOSOPHY AND SCIENTIFIC THEORY  
IN THE ORIGIN OF SPANISH GEOMORPHOLOGY,  
17th-18th CENTURIES

At the end of the 17th century, Europeans accepted the Biblical tale of the Creation of the Earth, which implied admitting that the Earth had an origin and would also have an end; according to the most common calculations, some 6,000 years would have elapsed since the moment of Creation. A century later, scientists already had accepted the ideas of evolution and change and had considerably extended the age of our planet. The triumph of these ideas entailed a long fight against profound religious beliefs, and contributed to the questioning of the whole intellectual universe of the Europeans. It did not involve only a discussion in which scientific reasons flourished, based on the observation of the terrestrial surface. Rather, arguments of a theological and erudite nature were used; at first, to an overwhelming extent. This was the logical result in an intellectual environment so profoundly saturated with religious beliefs, which, besides, appraised humanistic criticism of historical-philological nature.

It can be said that, in general, theological arguments were in opposition to accepting the idea of change and evolution, in the same way as they confronted the idea of the original chaos and an eternal world. But it is also certain that the efforts, realized since the 17th century, of rationally interpreting the Biblical tale, and the discussions which they in turn produced, contributed to the acceptance and diffusion of new ideas. In this regard, the theme of the relation between theology and natural sciences will be undertaken in the present work. The analysis of ideas of certain Spanish writers of the 17th century and of the first half of the 18th century will allow us to demonstrate how important were the discussions in regard to the theme of the Creation and universal Flood, thus opening a path that leads to the acceptance of the idea of change on the terrestrial surface.

## THEOLOGY AND NATURAL SCIENCE

During the Modern Age, the system of religious beliefs continued to exert a powerful influence on the vision of the world and the interpretation of nature, even if two worlds, that of faith and that of science, were slowly separated, which could not be done without great difficulty. In addition, it produced such profound fissures in the consciences of many scientists that insurmountable obstacles appeared obstructing the integration of observation data into the accepted system of beliefs.

In a manner similar to what has been put forth since the time of Max Weber concerning the problem of the influence of Protestant ethics on economic activity, one can also state the problem of the possible influence of religious ideas on scientific activity. In fact, ideas concerning the Creation, the world as the contemplation of a divine plan, providence, or the consequences of the original sin also affected the way in which the scientist looked at nature and interpreted the data observed in it. The study of the assumptions of Calvinist and Lutheran theology has already allowed certain authors to demonstrate the close relation between religion and natural sciences in the 16th and 17th centuries (Buetner, 1977; Huebner, 1980). Their results are less valid for Catholic countries. Here, in spite of the apparent theological uniformity, there existed important differences between well-differentiated trends of thought. Those of religious orders, for example, could support contradictory positions. It is worth remembering that the Augustines, Franciscans and Capuchins elaborated the theology based on Saint Augustine, and, consequently, on the Platonic root; while on the other hand, the Dominicans have been shaping their theology with Aristotelian concepts since the 13th century. In principle, among the former, a greater emphasis was laid on the act of the Creation as the contemplation of Divine will; whereas the latter, paid great attention to the function of the world in virtue of natural laws.

Since the 16th century, the Jesuits have sometimes maintained positions eclectic and moderately open to new philosophical trends, such as Cartesianism.

Catholic philosophers and scientists who were incorporated into the Platonic tradition could easily identify—as they have since the 12th century—the Demiurge of Timeo with God as Creator, who gives form to the world in accordance with an established plan. Greater difficulties were encountered from Aristotelian tradition, since the Christian concept of the created world hindered accepting the idea of the eternity of the world. That demanded many equilibria and intellectual matices.

According to Christianity, the Earth had been created by God and would be destroyed before the Final Judgement. Time was lineal and progressive since the creation until the coming of Christ to redeem mankind. However, nature was essentially static and unchanging, as instructed in the Bible. During the Modern Age all this began to be questioned upon discovering

that the Earth had a history—not only that which was narrated in the Scriptures, but also the one revealed in the traces of fossils and the disposition of stratum. But between one history and the other, that of the Biblical tale and that of natural history, no disagreement could exist. Because of this, the essential effort of many scientists during that period was directed at interpreting the Scriptures rationally, in a manner that would make it possible to integrate the conclusions obtained, beginning with the observation of nature. Not all the scientists, however, saw the necessity of this rationalization. For some it seemed extremely dangerous to adhere to an allegorical interpretation of the Biblical tale, also because it might presuppose a threat to the science as independent from the scope of faith.

#### THE CREATION OF THE WORLD AND THE PROBLEM OF CHANGE ON EARTH

For the Spaniards of the Renaissance and the 17th century, the world had been created by God as a dwelling-place for man, and all was arranged for the conservation of mankind. This represented, therefore, an anthropocentric and theological vision in which the existence of the earth was conceived only in relation to the existence of man. The history of the world was narrated in the Scriptures and it was to the Scriptures that it had to be necessarily referred.

The traditional thesis of the Creation of the world in seven days was still widely spread in the 18th century, not only through religious books, but also thanks to renowned works addressing this problem. An example, for instance, is *Filosofia Racional, Natural y Moral* (1736) by presbyter Juan Bautista Berni, professor of Philosophy at the University of Valencia (Spain), a person linked to the Novator Movement of Valencia. In any case, it is certain that in this instance the author accepts the possibility of asking questions about the manner in which God had carried out the Creation. Berni writes: “since no man was witness to the sight of the Creation of the Universe, the most that one can do in this matter is guess, because God did not reveal it”.

This sentence shows that even while accepting in its essence the Biblical tale, it was possible to rise above it to diverse speculations. The denial of the original chaos and the postulate that God did not act in vain nor had the necessity to change His plans, led to the acceptance of the fact that the earth had been formed only for one time, with all the attributes necessary for its functioning and for the life of man. In any case, in spite of the declaration of principles concerning the immutability of the Earth, the description of the first periods after the Creation, and in particular the interpretation of the Great Flood, could have placed some writers in positions that implied in some way the acceptance of change on the terrestrial surface.

In the 17th century, some Spaniards dared to make an important step in the interpretation of the Biblical tale by defending different configurations of the earth before and after the Great Flood. The arguments for this were not of a scientific nature, but rather derived from an interpretation of the Scriptures. This is the case with the historian and scholar Jose Antonio Gonzalez de Salas, who was connected with the neo-stoical circles of Madrid in the middle of the 17th century. In a study carried out on the occasion of the translation into Castilian of *Geografia* by Pomponio Mela (1644), Gonzalez de Salas emphasized a text of Esdras (4.3), in which it is said that the seas which existed before the beginning of the Creation would recede on the third day to one-seventh part of the Universe, leaving uncovered the other six parts. This text openly contradicts the thesis of Aristotle, who admitted that the area covered with water was ten times greater than that of the land. The discovery of America weakened the theory of Aristotle, but at any rate, the proportion, between the lands already known and the extension of the oceans was far from that noted in the text of Esdras. The need to accept as certainty that passage of the Scriptures had unexpected consequences.

As a matter of fact, there were only two solutions. Either that there existed more lands which had emerged from water than those that were known, or that the configuration of the lands and seas had experienced changes. The first path led to assuming the existence of a large continent in a part of the Universe not yet known; that is, in the Southern Hemisphere. The second path called for the re-interpretation of the history of the Earth, accepting the existence of important changes on its surface. This is the path that the Spanish scholar followed, and that led him to propose his thesis about the difference of the Earth before and after the Great Flood.

The cause of that difference would have been rooted in the indignation of God with regard to the sins committed by man and His desire to carry out an exemplary punishment that would strike not only mankind but also Earth itself. Thus, the land that emerged after the Great Flood would be totally new since, in the words of Saint Auguste, "the ancient world of the Creation would come to an end with the Great Flood".

Gonzalez de Salas tried to reconstruct the geography of the land inhabited by Adam, based on the data given in Genesis, and from its analysis he made a final judgement of the difference between that land and that which emerged after the Great Flood. He concluded that "a parcel of continuous land was what is now our sea", and he also considered that "land which today is a continent, was sea in the past and it was land that today is covered with the sea". He speculated at the same time about the possible mechanism of the inundation and receding of the seas. Finally, in view of certain arguments that the sea invades some lands and abandons others,

Gonzalez de Salas felt obligated to argue about the normal character of this phenomenon, supporting it with the testimony from the classics.

The opinions of Gonzalez de Salas were audacious in Spain of his epoch, even though his work seems authorized by the respective religious and civil censorship, among which was the censorship of his friend, the writer Francisco de Quevedo. But his theses were immediately argued and rejected by various authors, who accused them of being barely faithful to the Biblical tale. In fact, the ideas that he defended opened a path towards the theses of a "Second Creation", which ten years later was defended with great commotion by the Frenchman Lapeyrere. But the interpretation most adaptable to the Bible that the others pretended to have could also signify a rational discussion that would equally lead to unexpected results.

This is the case with one of the most violent opponents of the theses of Gonzalez de Salas, the eminent historian and jurist, Antonio de Leon Pinelo. In his work, *Paraiso de Nuevo Mundo* (circa 1655), Leon Pinelo undertook the theme of the possible localization of a terrestrial paradise, defending his location in South America. In this work, Leon Pinelo was obliged to deal with the Great Flood, whose existence permitted the understanding of a series of changes that occurred suddenly on the earth. It was the Great Flood, as a matter of fact, that inundated the whole American Continent and allowed Noah and his family to leave by sailing towards the Old Continent. Leon Pinelo held the opinion that in spite of its magnitude, the Great Flood did not change the face of the earth, since he believed that God needed to punish only men and not the earth. Thus, he goes against the idea of punishment of the world, and, in turn, against the idea of decadence, as he writes: "the same force existed before and after the Great Flood". His acceptance of the profound stability of the Universe brought him to reject the possibility of important changes on the surface, even though he admits to the erosive force of the sea and atmospheric agents. He claims that the land and sea maintain a permanent equilibrium and what is removed from one part is later restored in another.

The testimony accumulated in ancient times and then brought to view by Renaissance men of learning gave information that could not be disavowed about the topographical modifications experienced in some lands; particularly, changes in coastlines, variations in the courses of rivers, and effects of volcanic eruptions. In Spain, such testimonies were brandished by certain authors during the 17th century to demonstrate the existence of erosive processes. This led Jose Vicente del Olmo in his book, *Nueva Description del Orbe de la Tierra* (1681), to affirm that "with time, the mountains will be ruined, as experienced in the foundations of many ancient buildings". In any case, in spite of this process of wearing away, the earth maintains its essential topography, since the mountains can grow "from the perpetuations and everlasting exhalations and vapors that are sublimated from its interior parts

and mixed with many earthy portions". From this, it can be clearly seen that the decrease in the surface of the mountains "gradually repairs itself in the interior part due to the continuous elevation of vapors and exhalations that surge over and sublime it".

From another perspective, the discussions about the populating of America and the arrival of animal and vegetable species to that continent—a problem already lucidly raised by Father Jose Acosta in 1690—also necessitated the consideration of the possible earlier union of the Old and New Continents and their later separation as a consequence of earthquakes. (Concerning ideas about causes of earthquakes in 18th-century Spain, see Capel : 1980).

#### POLEMICS ABOUT THE DECADENCE OF THE WORLD

The awareness of the importance of erosive processes and the existence of changes on the terrestrial surface immediately raised, as we have seen, the question of the possible decadence of the earth. The controversy concerning this problem multiple links and derivations, and is, for example, closely related to the polemics concerning the possible existence of giants and long-living men in ancient times. The Bible, the classic fables, the legends of various primitive peoples (among them the Aztecs), and the finds of gigantic bones, supported this belief that was still strong at the beginning of the 18th century. But the theme of giants, equal to that of long-living men led—sooner or later—to a logical conclusion that there existed changes in the world and that this coincided with decadence. This conclusion was already put forth by the authors of Renaissance treatises, and the cosmographer Pedro de Medina affirmed in 1548 that "the lesser vital force of contemporary men was due to the fact that the heavens and the elements do not have effect on the earth with that same power and strength that they had before to nurture things at perfection".

At the end of the 17th century, the problem continued to be raised and a Capuchin, Brother Antonio de Fuentelapena, alluded to it in his work, *El Ente Dilucidado* (1676). He opposed the thesis of decadence with philosophical arguments, and defended the view that human stature and the duration of life "has always been the same"; at the same time he considered as false the idea that "the world is being deteriorated little by little; while even though it is certain that the world is approaching its end, it will not approach it by diminution little by little, nor will it end by curtailment, rather the earth will be nurtured and preserved so completely and vigorously until the final day when, scorched in flames, it will be entirely consumed".

In a similar manner he opposed the so-called disappearance of animal or vegetable species from the time of antiquity, with arguments that were at the same time theological and scholarly, and defended the concept of a stable and balanced nature. Naturally, as the testimony of the Scriptures with respect to the existence of giants was undeniable, there remained

open only one path to Fuentelapena and to those who argued like him, namely to accept the existence of giants in his epoch. Confusing information that they had about Patagonian giants could nurture the said belief.

A much similar opinion to that of Fuentelapena was also maintained years later by the Benedictine Jeronimo Feijoo, a fundamental figure of the Spanish Enlightenment, due to his efforts to culturally modernize the country. In *Teatro Critico Universal* (1726–1739), dealing with the theme of old age of the world, Feijoo gives repetitious proof of an optimism that much resembles Leibnizianism. He opposed the idea of eternity as much as that of decadence, and, logically, also opposed whatever change that could assume the loss or diminution of the earth, since that would presuppose that the plan of Creation was not perfect. Because of this, he finally rejected the idea of the loss or disappearance of animal or vegetable species, with what were at the same time theological and scholarly arguments. Feijoo seemed an optimistic radical and thought that, contrary to what others pretended, “nature becomes more vigorous each day and the world, more finely adorned”. According to him, there is a perfect equilibrium and stability on Earth, Disappearance of the species does not exist, nor can there be creation of other species. His arguments in this sense are supported by the idea that all living beings are produced starting with a seed. By this, “it must consequently be said that today any new species cannot result in the vegetable kingdom; so that the seed from which whatever other plant is formed, necessarily came from another plant of the same species”.

He firmly maintained this concept of the world as a body in equilibrium, and the same idea seems reflected in his more diverse themes. For example, with reference to the fundamental stability of the coastline, according to him what the sea erodes in one part is restored later at other points. From all this, Feijoo deduces that there exists a principle of equilibrium in nature, smoothly directed in the background by Divine Providence: “The proposed observations”—he writes—“persuade me that Very Wise Creator, who made everything with a number, weight, and measurement, fabricated this machine of the Orb, balancing the opposing forces that take part in it, in such a way that they reciprocally yield and surpass one over the other, so that in this way the world conserves that number of centuries that Providence has established”.

Towards the end of his life, the commotion produced by the earthquake of 1755 made him uneasy about the possible ruin and decadence of the earth, as he writes: “if the earthquakes of this century and the past exceed in their duration as they have done in the past, I do not know if we can fear that the Globe will wear away more and more each day, and consequently, the ruins will be made greater each day until they reach a prodigious calamity”. (Concerning this question, see Capel, 1980, pp. 46–47.)

The fact that Feijoo was a Benedictine gave his point of view some natural support, like the Benedictine Sarmiento; and likewise there were



natural-born enemies—the members of other religious orders. Thus, his theses were refuted by Franciscan Torrubia, who, while opposing Feijoo, defended, though without great conviction, the contemporary existence of giants. And, above all, the Franciscan Soto y Marne, who in his final confrontation of Feijoonian ideas defended the thesis of the decadence of the world.

In spite of these reputations, it can be said in general that the overall opinion of Spanish authors was contrary to the idea of the decadence of the world. In this sense, all the opinions that imply the ruin of the earth are explicitly opposed. Thus, the thesis of Thomas Burnet was attacked frontally and rejected, for example, in what was written by Doctor Andreas Piquer of Valencia in his book, *Física Moderna, Racional y Experimental* (1745).

#### THE GREAT FLOOD AND THE PETRIFICATIONS

The controversy about the possible decadence of the earth was also related in the 17th and 18th centuries to the scientific discussions about the Great Flood and the petrifications.

Among those who undertook this last question, we again encounter Feijoo, who violently opposed the consideration of petrified bodies as products of chance because of the problems that, according to him, such opinion raises above all in common sense. But also from philosophical-theological point of view he thinks that “who would believe that this regular configuration, faithfully observed in thousands of stones, was by accident, so well disposed he is to agree with Epicurus in that all the bodies of the Universe are effects of the fortuitous simultaneous happenings of the stars”.

But to deny chance necessitated a rational explanation of the phenomenon, above all when the news of frequent findings was reported. To this, Feijoo also dedicated himself, since he did not doubt the relation petrifications of shells had with the Flood. At the same time he interpreted the discovery of petrification of vertebrate animals in relation to various factors; for example, by attributing the bones found in Conclud (Teruel, Spain) to the remains of a battle of the Roman epoch.

Feijoo utilized the concepts of Tournefort to explain the mechanism of petrification. He also raised the problem of factors that explain the distribution of fossils on the terrestrial surface. Two problems, in particular, attracted his attention. One was the existence of stones with the traces of fish found on continental land, situated in great distance from the sea. The other was the finding of stones with markings of animals or tropical plants in regions with a cool or cold climate. Trying to find an answer to those two questions, he had to accept the existence of important changes on the terrestrial surface as well as modifications in climate in the course of centuries.

He explained in two ways the finding of petrified fish in the interior of continents. The first, which explicitly utilizes the ideas of Beglivo y litton de

Tournefort, shows the result of the formation of islands by the growth of rocks and their later union with the continent. The second uses elements that can be derived from Steno, since he accepts the idea that masses of land fell into subterranean cavities full of water; the shock of this collapse would then be able to give the waters such an impulse "that they would climb with the fish to the altitudes of the rest of the mountains that were left standing".

Because of the discovery of vegetable fossils that do not correspond to the climate of the place, various problems were raised. Feijoo accepts the existence of a single universal inundation, that of the Great Flood, and as this lasted 40 days, he considers that in that period, large organic displacements could not be carried from India to Europe, as was for example claimed by the botanist Jussieu (1718 and 1721); in any case, the remains would have been destroyed during this great journey. His opinion is more like the following: "Before that time in which large stones were configured, they were nurtured in the same places or countries where the stones were found". To prove that this is possible he carries out a scholarly discussion about changes in the habitat of some species since ancient times, from which one can deduce that "many types that today are reputed to be foreign in respect to various lands, were at one time a production of themselves"; this naturally implies accepting climatic change and the migration of species from one part of the globe to another. By supporting his argument with the ideas of Kircher about the existence of caverns of fire in the interior of the Earth (pyrophyllacia), he could then explain these climatic changes: the extinction of a subterraneous fire would be able to provoke cooling of the region situated above it.

The arguments of Feijoo about the origin of petrifications are relatively exceptional in the Spain of his epoch, in that they represent the effort to find diverse explanations. The most general opinion related these phenomena to the Great Flood, which in due course led to arguing about the natural mechanisms that could have given origin to this inundation, or if these were not accepted, about the miraculous character of the Flood.

Among those who considered petrified shells and fish as relics of the Great Flood, we find Doctor Andreas Piquer (1745), cited before. The sailor, Antonio de Ulloa, also alluded to this interpretation when he explained the unpetrified marine shells he found in terrestrial deposits during his trip to Peru to measure the degree of the meridian: he wrote about it in his book, *Relacion Historica del viaje a la America Meridional* (1748). Later, Ulloa also found petrifications in Huancavelica. The find had great importance because while testifying against the thesis of the pre-adamites and libertines, it seemed to demonstrate in irrefutable form the universality of the Great Flood. But the most important work published in Spain on this problem was *Aparato para la Historia Natural de Espana* (1754) by the Franciscan, Jose Torrubia.

Torrubia was an experimental scientist and self-proclaimed follower of

Bacon and the inductive method. In his missionary trips to the Philippines and Mexico, he carried out numerous observations, aided by a microscope that he always had with him. He considered the experiment as the ultimate and surest guide, and declared his confidence in the uniform character of nature and in the possibility of making inferences based on the observation of nature.

Because of his scientific training, Torrubia had no difficulty in identifying and classifying the finds he made in 1750 in the sierra of Teruel near Molina de Aragon, while he investigated the remains of sea animals. He also argued the problem of their presence in the mountains of Teruel, frontally opposing the opinions of Feijoo, and attributing, instead, their conveyance to the Great Flood. Torrubia felt obliged to demonstrate the existence of the Great Flood, going against the opinion of the libertines. For him, the Great Flood was a miraculous act that corresponded to the will of God. This did not impede him from dedicating himself to explaining certain natural aspects of the event by means of an operation that consisted in scientifically "explaining" all that interested him and eluding or considering as miraculous all that could raise unsolvable problems from the point of view of faith. For example, by going against the theses of Burnet, Woodward and Whiston—whom he surely knew through Buffon—he considered that the Great Flood was truly supernatural and prodigious. His whole reasoning shows a constant vacillation of the dogmas of faith and his tendency to scientific and experimental reasoning. This resulted in numerous contradictions, for despite his categorical declaration of the Great Flood as a miraculous event, it allowed him to force himself, at one time or another, to reason "as a physicist", even if he only directed his attention towards certain secondary aspects of science. As a result, his opinion is that the Great Flood was supernatural but that while studying it one can apply physical arguments in one's reasoning. Thus in this sense he opposed Buffon, who pretended to determine the limits of the realm of faith and science and rejected the rational interpretation of the Biblical narration concerning this phenomenon.

In his effort to reconcile theology with physics, Torrubia acted, without doubt, in good faith. But it is also certain that his option was a closed and unproductive one. By declining to separate carefully the field of faith and the field of science, and by mixing one with the other in a confused form, he accepted the condition of the natural or the supernatural without any previously specified criterion, only in relation to a greater or a lesser difficulty of scientific interpretation of the Biblical text. What was at stake was very important. It was nothing less than the possibility of a free reflection about the earth, independent of the tale of Genesis. In the circumstances of the epoch, this could only result from a careful distinction between the level of faith and the level of science, which Buffon attempted to make, or rather from the consideration of the Biblical text as a metaphorical narration that

had to be interpreted. The ambiguous attitude adopted by Torrubia for religious reasons made the road toward a true scientific interpretation of the history of the earth difficult for this otherwise good scientist.

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