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ASPECTS OF EIGHTEENTH - CENTURY COSMOLOGY

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We shall examine some of the historical-philosophical premises which, during the first half of the eighteenth century, formed the background for discussions on cosmology. We shall particularly dwell on Emanuel Swedenborg's cosmogonic system, profoundly influenced by the mechanistic Cartesian model. Swedenborg, who came into contact with the English Newtonian environment about 1710, attempted to mediate between vortex and universal gravitational physics. This attempt, hardly convincing with regard to the mathematical definition of phaenomena, is however particularly interesting in relation to the evolutionistic cosmologic hypotheses formulated in the eighteenth century.

Historians of science generally agree that Newton's Principia Mathematica reflect a fundamentally static image of our planetary system. In fact, they refer us to the representation of an orderly world, sustained by regular, predictable movements and similar to a large clockwork. In the "Elegantissima haecce Solis, Planetarum et Cometarum compages" which move, as Newton writes in the Scolium Generale of the Principia, in the emptiness of celestial space, we can recognize the hand of an "Entis intelligentis et potentis" presiding over the equilibrium of the universe (1).

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The image of a world-clock and of a God-wacthmaker is found, as we Know, in many authors close to Newton, such as Bentley, Clarke, Whiston, Cheyne and Derham (2), who successfully adapted it to the Newtonian gravitational model. In such a rapresentation, any prospect of developing a new world system in an evolutionistic sense evidently vanished. Newtonian celestial mechanics had in fact established the laws governing the movements of bodies in the solar system after creation with mathematical rigour and Newton himsels had clearly stated that one could not explain the primitive, regular position of the orbits of the planets and satellites around the Sun by using gravitational laws:

"Perseverabunt quidem in orbibus sui per leges gravitatis, sed regularem orbium situm primitus acquirere per leges hasce minime potuerunt." (3)

For Newton, investigating the origins and the past of the planetary order would have meant renouncing the story of Genesis and letting himself be tempted by the ambitious yet inconclusive project of "fabricare " the world "à la Descartes". The Newtonian cosmos thus has no beginning or history. One scarcely glimpses the eventuality that the system can "rejuvenate" due to the passage of a comet whose vapours could contribute "for the Refreshment and Recruit of the Sun or some of its Planets", as William Derham wrote in the Astro-Theology, referring directly to Newton (4).

Simon Schaffer (5) has rightly stressed how difficult it is for the historian to single out the numerous steps and continual integrations which led from the static cosmologic model imposed by Newtonian celestial mechanics at the beginning of the ei-

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ghteenth century to the evolutionistic model, whose birth is generally dated from the publication of Buffon's first three volumes of the Histoire Naturelle in 1749. The evolutionary hypothesis advanced by the first volume of the Histoire, dedicated to the history of the Earth, will, as we know, resound and be significantly developed in the cosmologic theories of Kant, Lambert, Laplace and Herschel.

The propositions and theorems of the Principia Mathematica surely constituted a successful alternative to Cartesian vortex physics; however, they undoubtedly left little space for those ideas of chances and transformations in natural structures which were being clearly defined in various research sectors. These perspectives were however effectively expressed in the widespread cosmogeologic literature which flourished between the end of the seventeenth and the beginning of the new century (6) (it is sufficient to recall the success of authors like Burnet, Woodward and Whiston) and in the "sparkling" prose of Fontenelle's Entretiens, which spread the image of a nature all life and movement during much of the eighteenth century (7). On the other and, Leibniz, and in this specific context we refer especially to the Protogaea, also accepted the idea of a history of nature made up of revolutions and changes (8). We must remember that these tendencies intersected and were confused with the vision of a fertile "plastic nature" animated by vital forces and spirits which the rich Neoplatonic tradition had reproposed in the Renaissance and the Cambridge school had renewed toward the end of the seventeenth century. In short, it is certainly not necessary

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to wait for the article Cosmogonie, edited by D'Alembert and published in the first volume of the Encyclopédie to understand that the cosmology of the fifth part of the Discours sur la Methode, of the Principia Philosophiae and of Le Monde had not been completely set aside during the Age of Enlightenment. In Cartesian cosmology, hinging on the mechanism of vortex of fluid material which pull planetary bodies by their continual movement, was the fantastic, seductive description of a world undergoing continual development and transformation and subject to an incessant process of destruction and reconstruction.

We do not wish to tackle the thorny problem of the role played by Cartesian mechanics in Enlightenment culture, a role diversely and authoritatively interpred in the works of Vartanian (10), Mouy (11), Aiton (12) and others. It does however seem useful to stress once more the influence, decisive in many respects, exercised by the vortex theory on modern cosmogonic hypotheses. But the search for links and eventual relationships between Descartes's "tourbillons" and modern hypotheses on the origin of the cosmos and stellar system forces us to dwell on that period in the history of science defined by Pierre Busco as "crise du problème cosmogonique" (13). This period, from the publication of Newton's Principia to the appearance of Buffon's Histoire Naturelle, coincided with the culminating moments of the affirmation and diffusion of Newton's gravitational theory in Europe. Those were the years in which the interest of the philosophers and naturalists was almost completely absorbed by discussions on the cause and nature of gravity. This debate was also fueled by tenacious resistance of the "noveaux cartésiens"; they were ready

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to pay any price on the level of physico-mathematical expedients and artifices in the vain attempt to save the vortex theory from definitive oblivion and check the success of the new physics (14), bolstered, not only in astronomy, by ever-increasing experimental confirmation and verification.

The rigour of the demonstrations and experiments and the very weight of Newton's authority, "a winner" in mathematics, mechanics and optics, seemed to have effectively succeeded in pushing cosmologic problems to the background to the point of nearly shifting them from the specific field of scientific treatment to the broader and more indefinite field of literary "otia".

One of the rare exceptions to this type of "prohibitionism" regarding cosmology is the hypothesis on the origin of the solar system formulated by Emanuel Swedenborg, who published his Opera Philosophica et Mineralia" in 1734. The first volume of this three-volume work presents the ambitious project of describing the "true system of the world" and includes an original cosmogonic model, born under the prevalent auspices of Cartesian mechanics and buried under the weight of a wearisome Latin prose. The work brought its author considerable fame as a mineralogist, as the second and third volumes are respectively a study of iron and copper; however, Swedenborg's Principia was listed in the Index Expurgatorius in 1739, the same fate awaiting the first three volumes of Buffon's Histoire Naturelle in 1751. The partially

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that, in spite of their considerable differences, a type of affinity links them in the fertile wake of materialism and Cartesian mechanics. Both are cosmogonical novels, as Buffon's work will be called in the "Journal de Savants" of 1779, and both attempt to elaborate a rational cosmology that can reconstruct, beginning from primordial chaos, the ideal genesis of a cosmos being organized and ordered only on the basis of natural laws.

In the light of these rapid considerations, perhaps it is useful to dwell on Swedenborg's cosmology; despite his fame as prevalently a mystic and visionary, acquired in part due to fulminating Kantian sarcasm (16), he began his career with a vast, varied scientific production which we are currently investigating. Swedenborg's cosmologic hypothesis is rarely mentioned by historians of science and is generally little studied and almost forgotten, like other no less significant aspects of his work as a naturalist; his cosmologic hypothesis has been paradoxically compared to that of Kant, surely the leading, most authoritative detractor of the meek, hieratic Swedish metallurgist. Swedenborg's name is indeed cited in regard to the so-called Kant-Laplace nebular hypothesis in some histories of cosmology and in studies that have numbered him, often hastily, among the "forerunners" of the modern evolutionistic model of the universe. Whishing to avoid the risks inherent in this type of historiographic perspectives, we shall not consider here the possible influences, controversial and open to different evaluations, of Swedenborg's cosmology on Kant's Naturgeschichte. However, it seemed useful to call attention to the specific context of cosmogonic hypothesis of the

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Principia Rerum Naturalium, in an attempt to give it more space than it has previously had in the panorama of natural philosophy of the first half of the eighteenth century and free it from the burden, perhaps excessive, inevitably placed on it by Swedenborg's successive life experiences.

The main lines of Swedenborg's cosmologic hypothesis, which is not motivated by "Neocartesian" vindications in regard to Newton, who Swedenborg says he fervently admires, can be rapidly summarised as follow:

1) the bodies of our planetary system originated from solar matter or chaos;

2) planetary masses gradually moved away from the Sun with a progressively slowing rotation speed until they reached their respective positions of eqilibrium within the vortex to which they belong;

3) the Milky Way is the common axis or "vinculum" of a system of Suns-stars;

4) several stellar systems exist in sidereal space.

Two different metaphysical assunptions are the foundation for this cosmologic model, which at first glance seems to have vast, varying relations, from Descartes to Buffon, Wright, Kant, Lambert and Laplace. The first assumption is that the universe in all its components is "ab infinitum productum" and therefore the long series of "finites" making up the world around us is derived from the infinite by means of a complex natural mechanism. The second establishes that nature is always similar to itself and therefore there is only a quantitative difference between small

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(microcosm) and large (macrocosm) structures. The first substantial or first finite material derives from the infinite or better from its first product or "primum ens"; this tiny particle is destined to give origin to the second finite by means of its perpetual movement describing a spatial spiral. This second finite in turn produces the third which generates the fourth and then the fifth and sixth, in a process of derivation and development of forms and movements which finally constitute the first natural elements. Swedenborg numbers among the elements the universal one filling all sidereal space, as well as the magnetic, ethereal, aerial and aqueous ones. All these elements contribute to the successive birth of the three kingdoms into which the nature of our planet is divided, formed in the course of the time through a long chain of mutations and trasformations.

The origin of the planetary system and its vortex dates back to the formation of the fourth generation of particles or "fourth finites" which, increasing in number, are welded together and finally cover the Sun's mass. The enormous solar vortex, formed from the particles of the magnetic element, is virtually empty, writes Swedenborg, in the sense that it is an "oceanus" of constantly flowing solar material completely devoid of planets, satellites and comets (18).

All the principles of things to be successively produced are latent in solar space, inside a very dense cloud in constant rotary motion which nearly forms a crust. The first stage of the evolution of matter is determined by the progressive removal and consequent thinning, due to centrifugal motion, of the solar covering or crust, which begins to split, partially due to the

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internal pressure exerted by the Sun's mass. The split, fractured crust collapses on its equatorial plane and finally surrounds the Sun, circling it like a great band or ring. In turn, due to rapid rotary motion, the ring moves progressively away from the Sun-centre, becomes thinner and finally breaks into parts which, sticking together in spheroidic masses of varying size, give rise to the planets and satellites of our system. These bodies continue to migrate towards the periphery of the vortex until they reach their respective positions of equilibrium within their various orbits. Swedenborg maintains that there are thousands of Suns-stars in the universe, of which the solar vortex, reflecting on a large scale the structures of the simplest elementary particle composed of an active nucleus and a periphery of passive or "finite" elements, is only a tiny part (19). There are in fact innumerable stellar vortexes along the axis of the Milky Way where stars appear to be particularly concentrated (20). For Swedenborg, as for Wright in 1750 (21), other stellar systems besides our galaxy exist in sidereal space, disseminated according to an order which repeats that of the smallest and simplest elementary particle expanded an infinite number of times. Swedenborg writes that the play of forces and the "gyratio spiralis" of the magnet offer us a model or representation of the whole cosmic structure on a reduced scale adequate to our senses.Each star represents an active centre determinig with its movement that of the respective vortex in which the life of planets and satellites originates and is consumed. The universe, a contiguous whole in constant movement and trasformation, is perfected by vicissitudes

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and changes through the centuries; the more modifications it undergoes, the more perfect it will be. "Sine contiguo nec foret mundus, nec ejus mechanismus" i. e., nothing can be conceived except in contiguity or connection; even the smallest movement or alteration occurring within a vortex is reflected on and perceived by the entire structure through a very long series of chain reactions.

On the basis of these necessarily rapid observations, it is impossible to fully evaluate the affinities and divergences between Swedenborg's cosmology and those elaborated after the mid-seventeenth century. It is not even possible to determine the role actually played by the cosmologic hypothesis of the Principia Rerum Naturalium immediately after their publication; from now on, however, it seems opportune to reconsider Stanley Jaki's affirmation in Planets and Planetarians that excludes the possibility that Swedenborg's cosmogonic hypothesis could have somehowe "contaminated" the French environment (23). Buffon, who shared among other things Swedenborg's interest in minerals and mining activities, was almost certainly acquainted with Principia; at American Swedenborg Printing and Publishing in New York there is a copy of Swedenborg's treatise with the French naturalist's autograph on the title-page and the date 1736. But aside from these considerations, which require more careful, closer comparison, it is sufficient here to simply note the fact before 1749 an evolutionistic or transformist cosmology presenting remarkable aspects as compared to the Cartesian one was already available. We are in fact confronted with a cosmologic model which is surely more complex and less "grossier" than the one

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offered by the mechanics of bumps, thrusts, rubbings and aggregations on which Descartes constructed his world. The pages of Swedenborg's Principia substitute the dynamic concept of matter which is force, activity and movement (derived from Leibniz-Wolff) for the Cartesian concept of matter understood as a passive, inert entity. For Swedenborg, as for Wolff, nature is a set of mutations and, as for Leibniz, natural mutations derive from an internal principles, from a force inherent in the matter itself which pushes it, almost forcing it to continually modify and transform itself.

But here Swedenborg's thought is complicated by other motifs and embraces complex metaphisical problematics which it does not seem opportune to penetrate.

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NOTES

1) Cf . Isaac Newton, Philosophiae Naturalis Principia Mathematica, in Isaaci Newtoni, Opera Quae Exstant Omnia, ed.by S. Horsley, London, J.Nichols, 1779-1785, vol.III, p.171.

2) On the subject, cfr. P.Casini, L'universo macchina, Bari, Laterza, 1969.

3) Cf . Isaac Newton, op.cit., p.171.

4) Cfr. William Derham, Astro-Theology, W.Innys, London, 1731, p.164.

5) Cf. Simon Schaffer, The Phoenix of Nature: Fire and Evolutionary Cosmology in Wrigth and Kant, "Journal for the History of Astronomy", 9,3,1978, pp.180-200.

6) Of the vast literature on the subject, we indicate only: K.B.Collier, Cosmogonies of Ours Fathers. Some Theories of the 17th and 18th Centuries, Columbia University Press, New York, 1934; M.H.Nicolson, Mountain Gloom and Mountain Glory, The Norton Library, New York, I959; Idem, The Breaking of the Circle, New York, 1965; Ch.C.Gillipsie, Genesis and Geology, Harper, New York, 1959; G.L.Davies, The Earth in Decay. A History of British Geomorphology: 1578-1878, Macdonald, London, 1968; P.Rossi, I segni del tempo: storia della Terra e storia delle nazioni, Feltrinelli, Milano, 1979; S.J.Gould, Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time, Harvard University Press, Cambridge (Mass.),1987.

7) Cf. M.T.Marcialis, Fontenelle, un filosofo mondano, Pubblicazioni dell'Istituto di Filosofia della Facoltà di Lettere e

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Filosofia dell'Università di Cagliari, Gallizzi, Sassari, 1978, cap.III, pp.224-242.

8) On the subject, cf. Giovanni Solinas, La "Protogaea" di Leibniz ai margini della rivoluzione scientifica, in Saggi sull'illuminismo, Pubblicazioni dell'Istituto di Filosofia della Facoltà di Lettere e Filosofia dell'Università di Cagliari, 1973, pp.9-69.

9) The article affirms the liberty to say: "...avec Descartes, que les planetes, et la terre en particulier, ont commencé par être des soleils qui se sout ensuit encroûtés..." and that therefore: "Il doit être permis de dire que la formation de ce Monde n'a dépendu que du mouvement et de la matiere différemment combinés...", cf. Encyclopédie, ou Dictionnaire Raisonné des Sciences des Arts et des Métiers, Paris, M.DCC.LIV, tome quatrieme, p.293.

10) Cf. A.Vartanian, Diderot et Descartes. A Study of Scientific Naturalism in the Enlightenment, Princeton University Press, Princeton, 1953.

11) P.Mouy, Le développement de la physique cartésienne 1646-1712, J.Vrin, Paris, 1934.

12) E.J.Aiton, The Vortex Theory of Planetary Motions, Macdonald, London-NewYork,1972.

13) Cf. P.Busco, Les cosmogonies modernes et la théorie de la connaissance, F.Alcan, Paris, 1924, p.49 sgg..

14) On the debate between Cartesians and Newtonians, beside the works already quoted, see: P.Brunet, L'introduction des théories de Newton en France au XVIII siècle, A.Blanchard, Paris, 1931.

15) Cf. Emanuelis Swedenborgii, Opera Philosophica et Minera-

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lia, voll.III, Dresdae et Lipsiae, 1734.

16) Cfr. I.Kant, Träume eines Geistersehers, erlautert durch Träume der Metaphysik, Konigsberg, I766, in Kant's Werke, Band II, Berlin, 1912, pp.315-368.

17) Cfr. E.Adickes, Kant als Naturforscher, Berlin, 1924, - vol.II, p.294 sgg.; G.Tonelli, Elementi metodologici e metafisici in Kant dal 1745 al 1768, Torino, 1959, p.49 sgg.; P. Casini, Newton e la coscienza europea, Il Mulino, Bologna, 1983, p.119.

18) Cf . Emanuelis Swedenborgii, op. cit., vol.I, pars I, par. X, p.119.

19) Cfr. Idem, pars III, par.IV, p.387 sgg..

20) Cfr. Idem, par.I, p.375 sgg..

21) Cfr. Thomas Wrigth of Durham, An Original Theory or New Hypothesis of the Universe, facsimile reprint with introduction by M.A.Hoskin, Macdonald, London-New York, 1971.

22) Cf . Emanuelis Swdenborgii, op. cit., vol.I, par.I, p.12.

23) Cf . Stanley L. Jaki, Planets and Planetarians: a History of Theories of the Origin of Planetary Systems, Scottish Academic Press, Edinburgh, 1978, p.79.

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