

## ALEXANDER VON HUMBOLDT AND THE GEOGRAPHY OF THE UNIVERSE

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## SHORT NOTE

In 1936, the American astronomer Edwin Hubble publishes “The Realm of the Nebulae”, milestone in the history of cosmology. It is a review of an extraordinary decade of astronomical observations which led to the discovery of the galaxies and the expansion of the Universe. Together with many other astronomers, Hubble contributed to these discoveries. In “The Realm of the Nebulae” he reflects upon the birth of the expression “island universes” used to indicate the galaxies. He traces the introduction of the term back to Alexander von Humboldt: “*The multiplication of stellar systems led to the term Weltinseln (‘Island Universes’) used in von Humboldt’s Kosmos*”, presumably for the first time. In the familiar English translation, by Otte (1855), the word is translated literally as “world islands” (Vol. III, 149, 150).” von Humboldt uses this term when he refers to the Milky Way, the stellar system the Sun belongs to: “*our cosmical island forms a lens-shaped system of stars.*”<sup>1</sup> As Hubble correctly notes, the transition to the common term “island universes” is a natural step.

The short note by Hubble is just another witness of the great impact that von Humboldt’s Kosmos, had on the American astronomical community. The last remarkable example of this influence is “Cosmos”, the 1980 popular science book and television series by the astronomer Carl Sagan, which explicitly refers (even in the structure of a voyage among stars and galaxies) to von Humboldt and his final work.

In 1845, when the first volume of Kosmos was finally published, the telescopic exploration of the Universe was still taking its first steps: celestial mechanics was applied only to the Solar Systems; astronomical photography (and so the objective recording of astronomical observations) did not exist; spectroscopy - the only means to determine the material composition of heavenly bodies - was not yet applied to astronomy; the physical nature of the nebulae was unknown (were they star or gaseous systems? Internal or external to the Milky Way?).

Von Humboldt’s travel in Kosmos starts by considering the Earth in the cosmic context. In the introduction, he writes: “*The delineation of the universe does not begin with the Earth, from which a merely subjective point of view might have led us to start, but rather with the objects comprised in the regions of space.*” This was not completely new in popular scientific works. But, at that time, treatises on physical geography were generally prefaced by an astronomical introduction in which the Earth was considered solely as a part of the Solar System. Von Humboldt follows a “diametrically opposed” course, enlarging the view: “*In order adequately to*

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<sup>1</sup> All citations are from: Alexander von Humboldt, “Cosmos: A Sketch of the Physical Description of the Universe, Vol. 1”, translated by E.C. Otte, 1858, Harper & Brothers edition.

*estimate the dignity of the Cosmos, it is requisite that the sidereal portion [...] should not be made subordinate to the terrestrial. In the science of the Cosmos, according to the expression of Aristarchus of Samos, the pioneer of the Copernican system, the Sun, with its satellites, was nothing more than one of the innumerable stars by which space is occupied. The physical history of the world must, therefore, begin with the description of the heavenly bodies, and with a geographical sketch of the universe, or, I would rather say, a true 'map of the world', such as was traced by the bold hand of the elder Herschel."*

Humboldt describes indeed the first ever map of the Milky Way, obtained by William Herschel. Herschel, *"like another Columbus, penetrated into an unknown ocean, from which he beheld coasts and groups of islands, whose true position it remains for future ages to determine."*

Humboldt describes the recent observations by William and John Herschel, Lord Parson and others, and proposes an original classification of the observed heavenly bodies. Some of the terms introduced by von Humboldt are still commonly used today in the astronomical literature. We mentioned term "island universes" which is nowadays mostly used in popular science literature, but we owe von Humboldt the expression "belt of asteroids," now commonly used to indicate the family of minor bodies in the Solar System, between Mars and Jupiter.

Nevertheless, von Humboldt is not just a remarkable writer who vividly describes the astronomical knowledge and its limits. He has a deep insight about an unsolved physical problem of that time, the age of the Cosmos. He is one of the first scientists to clearly connect the vastness of the cosmos and the finite velocity of light to the age of the Universe. In 1845, there was mounting evidence that Earth was much older than what the Bible told, but there was a contradiction between the geological and astronomical estimates, the former favoring an older Earth. Von Humboldt correctly notes that *"from the knowledge that we possess of the velocity of transmission of luminous rays, that the light of remote heavenly bodies presents us with the most ancient perceptible evidence of the existence of matter."* This is a statement about the basic fact that when we look out in space we also look back in time. However, this intuition was not fully explored until 1901, when Lord Kelvin made a quantitative connection between the age of the old, distant stars and the age and extension of the observable Universe.

Finally, von Humboldt appears to be dramatically aware of the vastness of our ignorance with regards the cosmography: *"If, notwithstanding the smallness of our planet, the most considerable space and the most attentive consideration be here afforded to that which exclusively concerns it, this arises solely from the disproportion in the extent of our knowledge of that which is accessible and of that which is closed to our observation."*

It is fascinating to notice the similitude between these words and the iconic image of the Earth taken almost 150 years later by the space probe Voyager 1, when the mentioned Carl Sagan proposed to take a picture of our planet from the edges of the Solar System. The picture, the famous "Pale Blue Dot", shows a small, fragile planet in an immense cosmos yet to be explored.