COSMOS

From Goya to de Chirico, from Friedrich to Kiefer
Art in Pursuit of the Infinite

edited by
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The New Astronomy and the Expanding Cosmos
The View From France at the End of the Nineteenth Century

The revolution in astronomy that occurred in the last four decades of the nineteenth century reverberated in the development of French modernism. Impressionism’s concern for the natural properties of light and changes in color effected by weather and the hour of day evolved at a time when the emerging science of solar physics was bringing the investigation of energy and light to bear upon solar-terrestrial relationships, and meteorology, armed with recent inventions, was progressing in the understanding of atmospheric conditions in the context of cosmic dynamics. At the turn of the century, Symbolists with mystic tendencies speculated about the possibility of spiritual life on other planets, following the lead of imaginative astronomers who used scientific advances to support the claim of infinite possibilities for an afterlife on other orbs. Whether attention was focussed on the earth or the stars, on this life or the hereafter, it seemed that lasting truths dissolved and the earth shrank before the immaterial forces of the cosmos.

Until the mid-nineteenth century, Newtonian principles of a clockwork universe had guided French astronomers, who devoted themselves largely to observing the position and motion of heavenly bodies - charting their orbits, masses and distances. Laplace’s work in the late eighteenth and early nineteenth centuries, including his widely read Exposition du système du monde (1796) and the authoritative Mécanique céleste (1799-1825), provided a convincing model of a stable, self-regulating solar system where even unique events like comets could be predicted accurately. Celestial mechanics upheld the idea of order in the universe and the notion that cosmic beginnings happened only once; following some mysterious original moment, planets and their satellites were set in motion in a timeless, unchangeable pattern; planets revolved in a given course for all eternity, and stars were set immobile in their place. The revolutionary “new astronomy” that revealed an infinitely vast, dynamic and sometimes unpredictable universe began to coalesce around 1860 and eventually replaced positional cosmology.

Several new interpretive tools were necessary to transform the way man would see the cosmos at the end of the nineteenth century. One was the “big telescope.” With improvements to the telescope, celestial phenomena could be examined in greater detail, and many new heavenly bodies were identified. The most powerful telescope in France in 1876 was that made by Martin and Gautier for the Paris Observatory. The observer reached the eyepiece at the top by way of a spiral staircase mounted on a circular track. By 1880, the telescope of the Nice Observatory had surpassed it with the largest refractor lens then in existence.

As the nineteenth century drew to a close, stars seemed to multiply by the dozen. New minor planets were also discovered in rapid succession. In 1845, only four had been observed. By 1870, this number had grown to a hundred and ten; in 1885, two hundred and fifty, and by 1891, three hundred and twenty were documented. Beginning in 1873, Paul and Prosper Henry charted new stellar maps at the Paris Observatory. Their work was revolutionized in the eighties by applying the newly invented process of gelatin silver dry emulsion photography in their work. They discovered that besides aiding in documenting stars, this type of photographic plate revealed celestial objects not previously observed by astronomers. The Henry brothers then headed an international photography project to produce a definitive Carte du Ciel, or Map of the Heavens.

Perhaps the most important new tool in the study of the solar system was spectral analysis, first used in 1859. Spectroscopy breaks down the light from a celestial body into a series of coloured bands that reveal the elements it is composed of. Information thus gathered regarding physical structure and chemical substance may also be used to deduce temperature and age. By 1886, the astronomer Pietro Secchi had begun to classify stars according to spectra. The real possibility of analyzing the evolution of a star over time was introduced into the new field of astrophysics. The heavens were no longer thought of as eternal but as constituted of celestial bodies that were born, grew older and died in the ongoing drama of the cosmos.

Spectroscopy also revolutionized the study of the sun and led to the birth of solar physics, one of the most important subfields within the new astronomy. Eclipse studies, which facilitated the observation of solar activity, gave additional impetus to identifying the nature of the sun’s energy sources, surface and corona. The sun was now understood to be an ever-transforming ball surrounded by a boiling atmosphere of hydrogen. Red prominences that projected from this surface were recognized as occasional extensions, akin to huge flames, from a lower layer around the sun called the chromosphere.

New models of the sun made use not only of spectroscopy but of thermodynamics, a branch of science concerned with the conservation of energy and its loss, or entropy. In 1865, the French astronomer Faye proposed the model of a sun made up of many stars. Matter in space had collapsed and given rise through the conservation of energy - to hot, rotating stellar masses. With contraction and cooling, molecules and particles coalesced on the surface to form a photosphere. Over a period of many years, hot gaseous masses would rise to the sun’s surface from deep within. Faye’s central ideas - that the sun was an ordinary star; that it originated in the gravitational collapse of matter; that the heat so engendered put it into a gaseous state; that the photosphere was a condensation surface - were all to remain central to twentieth-century theorizing. Secchi summarized his ideas on the sun several years later in the trailblaz-
Telescope of the Paris Observatory illustrated in the magazine La Nature, 1876

Imaginary cosmologies


The dissemination of science to the general public was high on the Republican agenda. Guillemin’s Instruction républicaine (1871) emphasized the importance of scientific education, and science officially became part of school curricula under laws instituted by Paul Bert in 1881. This led to an explosion in the vulgarization of science, and many new books on astronomy, both didactic and fictional, were published in the last decades of the century. The popular dissemination of science, regarded as key to regeneration of the country, ensured a broad-based knowledge about astronomy.

The Sun, Exposé of the Principal Modern Discoveries about the Structure of This Star, Its Influence in the Universe and Its Relation with Other Celestial Bodies (1870). This book, which contained new information on the surface movement of the sun, its radiation and the gases that rise from the surface, was widely consulted in France. One of the early offshoots of solar physics was the exploration of solar-terrestrial relationships. First, terrestrial magnetic variations were correlated with sunspots, which led to a detailed examination of the links between solar changes and the earth’s weather.

Astronomers in search of better perspectives on celestial phenomena frequently relied on balloon ascensions. These scientists often doubled as meteorologists, using new equipment to learn more about the earth’s atmosphere and pondering from aloft the effects of the sun and other celestial bodies on the surface of the planet. Hot air balloons also functioned as public spectacles, drawing attention to the scientific investigations associated with them.

It is perhaps no coincidence that the style of the sun-loving French Impressionists, which evolved in the 1860s, is characterized by vibrant, dematerialized surfaces and a fascination with atmospheric conditions. The first Impressionist exhibition was held in 1874 in the studio of the photographer Nadar, who was also known as a balloonist and amateur meteorologist. The Post-Impressionist Seurat advanced Impressionist interests with his “colour-light” formula, and Van Gogh found one of his most powerful symbols in the radiating solar disk of his Sower (1888).

Awareness of the advances in astrophysics from the 1860s on would also have been available through scientific popularizers like Amédée Guillemin. By the time the fifth edition of his Ciel (1864) was published in 1877, it had undergone considerable revision, due to “changes in the subject matter [of astronomy] itself ... the knowledge bestowed upon it by science, which had expanded and been in some respects transformed by ten years of new observations.” This revised and amplified edition and the many new publications on astronomy to follow, such as Zurcher’s Monde sidéral. Description des phénomènes célestes (1878), Camille Flammarion’s Astronomie sidéral (1878) and his widely read Astronomie populaire (1879), reflect not only the accumulating results of the ongoing revolution in the new astronomy, but the financial support given by the newly established anticlerical, pro-science Third Republic after 1874.

France’s defeat in the Franco-Prussian War in 1871 had brought science’s role in the life and survival of the nation to centre stage. While France had enjoyed a period of growth in the sciences in the 1860s, there were many who felt that the nation’s hope of regeneration lay in increased funding and support for the sciences, and “the integration of science into culture.” Astronomy was one of the fields that benefited from this commitment, and France assumed a leading role.
In 1876, the French government established a new observatory at Meudon, headed by Jules Janssen, who would devote the greater part of his work to solar physics. One of the most famous projects at Meudon was his atlas of solar photographs. Composed of exposures made between 1876 and 1903, it summarized the history of the sun’s surface during these years. Also in 1876, the astronomer Rayet was appointed to oversee the newly constructed observatory in Bordeaux. Astronomical reports were gathered from all corners of the world during the last quarter of the century. Meteorological curiosities, comets, spiral nebulae and the passage of planets were observed, and upcoming cosmological events reported to the public. Observation points were set up in a number of French towns beginning in 1878. Following the complaints of Flammarion, a public observatory was instituted in Paris. Directed by Léon Jaubert, it offered telescopes, a library and series of lectures. The Universal Expositions provided showcases for advances in astronomy under the Third Republic. An enormous telescope was one of the featured attractions in 1878. Telescopes, lunar and solar maps, and models of the solar system were on view in 1889. At the spectacular show at the Optical Palace in 1900, breathtakingly detailed photographic plates at the end of a long telescopic lens gave the viewer the illusion of being only four kilometres from the moon. A diorama re-created a voyage to a star. A series of images depicted the birth of the earth. From the basket of a balloon, one could watch a progression of images that simulated a balloon trip, with the earth receding from view. In postwar France, the new perspective of a “shrinking world” in an expanding cosmos and the growing interest in celestial phenomena can be tied to national sentiments about diminished position and power in the world, the claustrophobia of urban dwellers and escapist fantasy. Ever since Nadar first photographed the lilliputian earth from a hot air balloon in 1856, a fascination with the minuteness of the planet when seen from far above had gripped the French imagination. Until the end of the century, the balloon remained the utopian symbol of the future, of the great space voyage and man’s potential conquest of the air.

Invented in France by the Montgolfier brothers in 1783, the hot air balloon was strongly associated with French nationalism. Goya’s Balloon (1813-1816), painted at the end of devastating Napoleonic invasions of Spain, may allude to political oppression by France. Rather than suggesting freedom from the terrestrial realm, it hovers, an ominous and dominating presence, as crowds below flee in panic from the terrifying apparition. The balloon played a significant role during the Franco-Prussian War: under Nadar’s direction, more than sixty of them were used to fly mail and military personnel out of Paris when the city was under siege in 1870. Then, used in memorabilia and monuments to the war dead, the balloon became a renewed symbol of nationalism and a reminder of recent tragedy. The balloons of 1870 encouraged additional experiments in construction. An enormous balloon teth-
Odilon Redon
*On the Horizon the Angel of Cetitude and in the Sombre Heaven a Questioning Eye*
Plate 4 from "To Edgar Allan Poe" 1882, black lithograph on ivory chine. 44 x 30.5 cm
Chicago. The Art Institute of Chicago
Charles Stuckey Collection

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Odilon Redon
*Germination*
Plate from "Dans le Rêve," 1879

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Lucien Lévy-Dhurmer
*The Silence,* 1893
pasted on paper. 54 x 29 cm
Private collection

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1 Early science fiction writers like Jules Verne suggested that balloons and other inventions would make it possible to travel beyond the earth's atmosphere. Space flight also appealed to other novelists and poets. See for example Laforgue's *Lettre de Notre-Dame le Lune* (1885), Maupassant's "L'Homme de Mars," Hugo's *Une Rêle,* with its dream visit to a lunar landscape, and Gide's later *Voyage d'Utan.*

...ered to the ground and capable of transporting fifty people at a time was one of the attractions at the Paris Universal Exposition in 1878. Flying at heights of upwards of nine hundred metres over exotic structures like the Chinese pagoda and Algerian mosque, the balloon ride was billed as a "voyage around the world." The Symbolist Odilon Redon's fantastic conflation of an eye and a balloon in 1878 drew its inspiration from the Exposition's balloon and is the basis for the lithograph *The Eye, like a Strange Balloon, Moves towards Infinity* (1882). The image, with its mournful upwardly gazing eye, suggests not the fulfillment of collective celestial fantasy, the "voyage around the world," but a failed attempt at humanity's release from the material world. The severed head the balloon transports may be an allusion to the martyrs of the Franco-Prussian War. However, postwar escapist meditations were generally less gloomy. Many speculated that, whether or not one could ever be entirely free of earth, life might exist elsewhere. The new astronomy had given rise to a renewal of the extraterrestrial life debate. The spectral bands found in the heavens were believed to correspond with terrestrial elements and thus seemed to confirm similar operating principles and shared elements throughout the universe. Stars resembled the sun structurally and were constituted of similar elements, such as hydrogen, sodium and magnesium, which led to the belief that they too might be surrounded by planets much like our own. The discovery of new nebulas suggested the possibility of whole new planetary systems in the process of creation.

The concept of extraterrestrial life was supported by a surprising number of astronomers. Janssen reported what he thought to be water vapour on Mars, asserting the possibility of life there. Flammarion, the most influential of those who believed in life on other planets, wrote more than seventy books on the subject. His first, *La Pluralité des mondes habités* (1862), was an immediate success. Flammarion's work gained increased visibility after the Martian canal debates began in 1877. New telescopes made it possible to detect on Mars what some saw as canals that could only have been built by intelligent beings. When this sighting was "confirmed" in 1886 with the aid of the powerful new telescope at the Nice Observatory, the extraterrestrial life debate gained even greater popularity in France.

Some of Redon's imaginative cosmological lithographs from the late nineteenth century suggest an engagement with this debate. *On the Horizon the Angel of Cetitude, and in the Sombre Heaven a Questioning Eye* (1882), with its planet-eye conflation, scattered stars and angelic presence, may respond to Flammarion's Introduction to the 1864 edition of *La Pluralité,* which the artist owned. On the search for intelligence elsewhere and its divine affirmation, Flammarion wrote, "The curious stared inquiringly at the horizon, seeking to guess what possible races of beings could have pitched their tents up there ... Soon it became evident that the doctrine [of the plurality of worlds] is a direct confirmation of astronomical science ... and that the greatness of Creation and the majesty of its Author shine nowhere else so brightly as in this interpretation of the work of nature." On the idea of existential solitude in a universe of many humanities, a mood that is close to Redon's work, Flammarion wrote, "But the admiration aroused in us by this most moving scene of nature soon turns to an indefinable sadness, because we believe ourselves to be strangers to these worlds where solitude..."
appears to reign [...]. In these deserted and silent shores, we seek a gaze in answer to our own." Redon's lithograph may contain other allusions as well, for in late nineteenth-century France, ideas on the habitability of other planets were often joined with speculations that after death the soul might find a better existence on some celestial orb. Such ideas were not new. In Another World (1844), Grandville satirized the contemporary utopian socialist Fourier's ideas on the voyage of the soul. According to Fourier, after death, human souls exist in the ether of the earth until the planet dies; then, they pass to other worlds. Flammarion, influenced by Reynaud's Terres et ciel (1854), which espoused spiritual transmigration, was among the pluralist writers who lumped rebirth together with extraterrestrial life. After the loss of the war, this spiritual escape from a doomed and lonely planet had renewed appeal. Victor Hugo and Van Gogh were among those who ruminated on the soul's journey to rebirth on other planets.13

The powerful forces of the invisible, immaterial world being revealed by astronomy and the popularization of the idea of legions of souls passing from this world to others informed the growing current of spirituality and interest in Oriental philosophies like Buddhism in the late eighties and nineties. The emerging occultist movement would draw upon the idea of spirituality and the stars, wherein beings from other planets might act as spiritual advisors on earth or the human spirit might travel to other realms.

French Symbolist and Rosicrucian Joseph Peladan heralded this new trend as early as 1884 with his novel Le Vice suprême. In it, the initiate Princess d'Este follows a doctrine that espouses a theory of astral light. Astral life was a fundamental tenet of theosophy, which influenced Sâr Péladan and many other Symbolists after the mid-eighties. According to theosophical belief, an astral self surrounds and permeates the physical body. At death, the cord between them is severed and the astral body begins its life of progressive improvement in other realms. Lévy-Dhurmer, who often exhibited at Péladan's salons, suggested the mysterious connection between the spirit and the stars in Silence (1893).

Although one of the assumptions in the examination of the late nineteenth-century revitalization of mysticism has been that it involved a reaction to science for having depoecitized the world, astronomy in France from the 1860s on actually fostered a sense of wonder and the imaginative possibilities inherent in the idea of limitless space.

Progressive astronomers were those who were willing to admit that our "tiny earth" was the least of all worlds in the universal scheme of things. For many Symbolist artists and other late nineteenth-century celestial dreamers, natural and supernatural forces might well coexist throughout space's endless expanse. Outer space suggested fantastic possibilities and habitations for the human soul never imagined in quite the same way before the dawn of the new astronomy.

While science was bringing new information to bear upon the earth's place in the universe, scientific knowledge was also being applied to forms of religious faith beyond rigid Catholic dogma, and as perspectives shifted, the modern soul found fertile terrain in this romantic vision of an active, expanding cosmos.