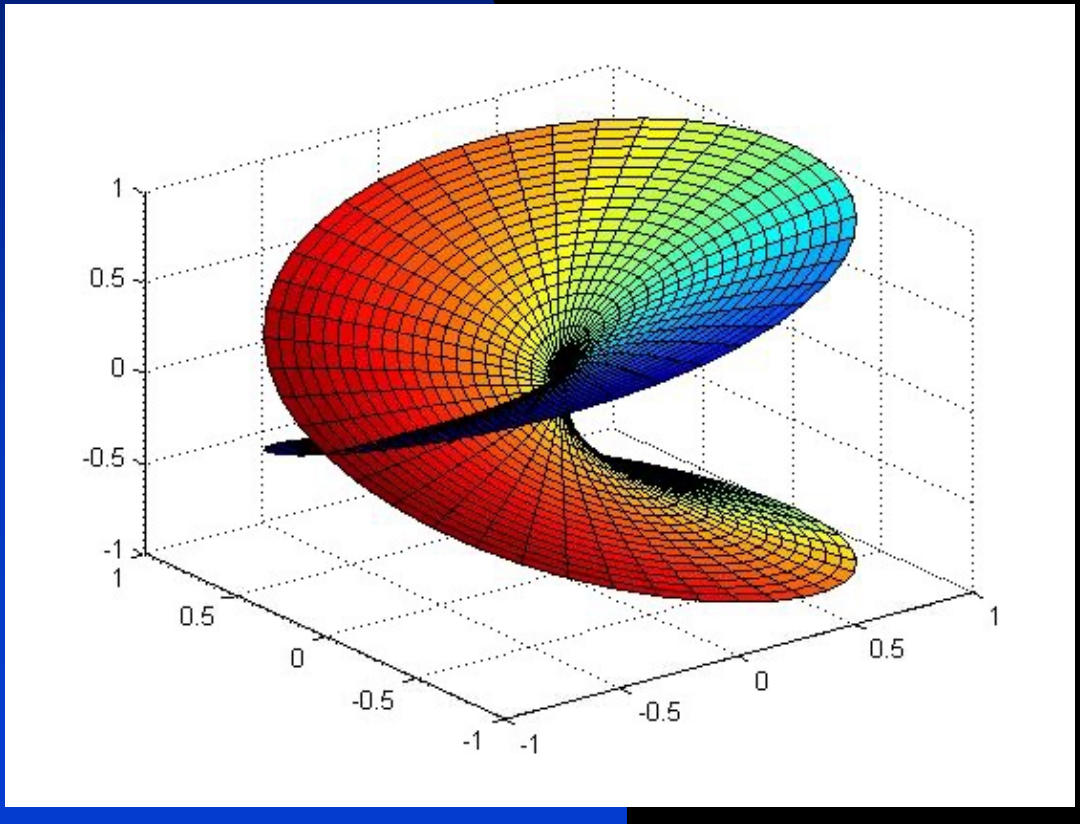
Art & Physics V

Dr Clare Z

“In mathematics, particularly in complex analysis, a Riemann surface, first studied by and named after Bernhard Riemann, is a one-dimensional complex manifold. Riemann surfaces can be thought of as "deformed versions" of the complex plane: locally near every point they look like patches of the complex plane, but the global topology can be quite different.”

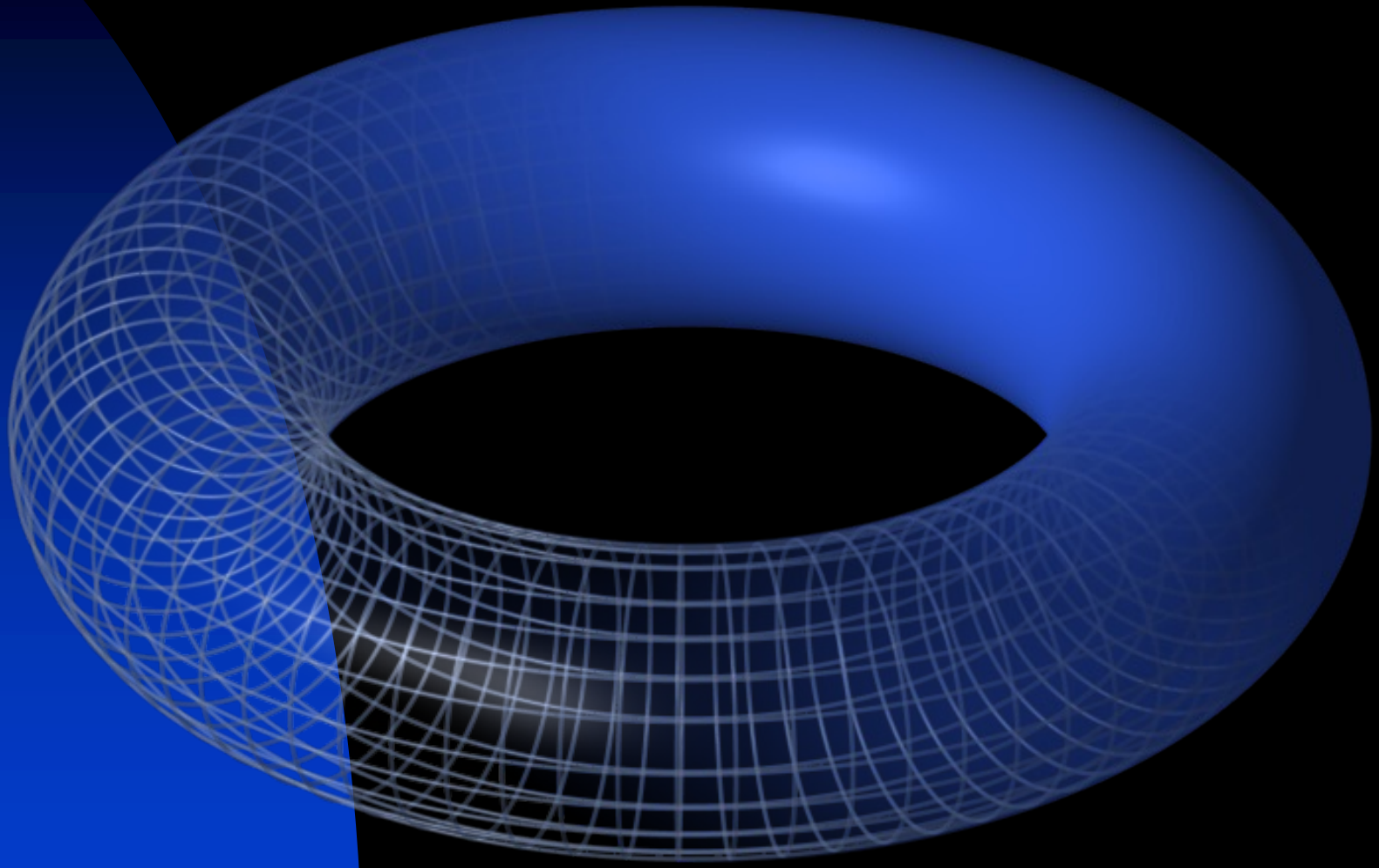
Riemann surface from Wikipedia

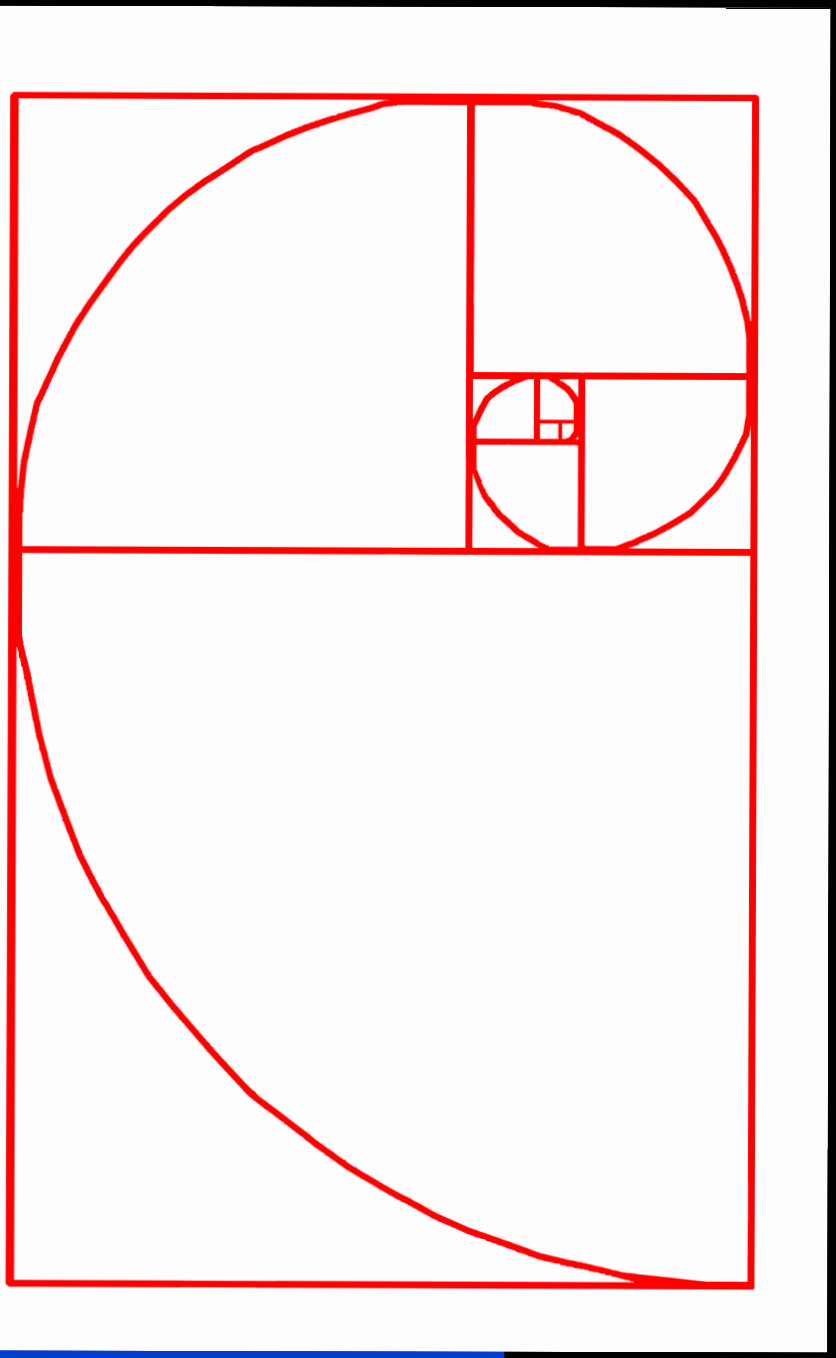


One of M. C. Escher's works, *Print Gallery*, is laid out on a cyclically growing grid that has been described as a Riemann surface.

“ . . . they can look like a sphere or a torus or a couple of sheets glued together.”

Riemann surface from Wikipedia

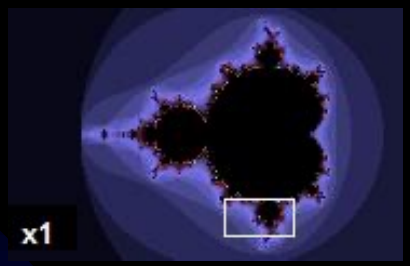


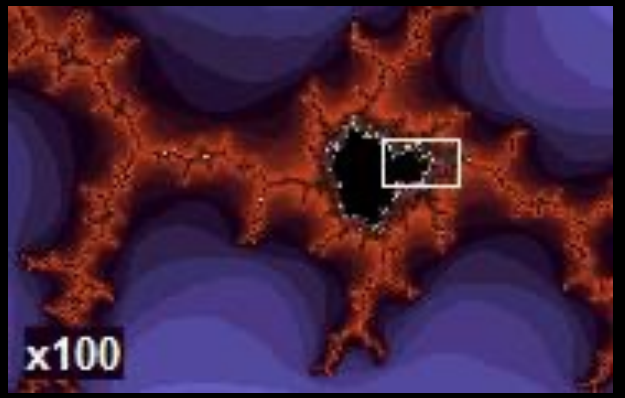


“Fibonacci spirals and Golden Mean ratios appear everywhere in the universe. The spiral is the natural flow form of water when it is going down the drain. It is also the natural flow form of air in tornados and hurricanes. Here’s another beautiful example of a Fibonacci spiral in nature, it’s the Nautilus shell and every book about sacred geometry contains one . . . ”

http://www.soulsofdistortion.nl/SODA_chapter5.html

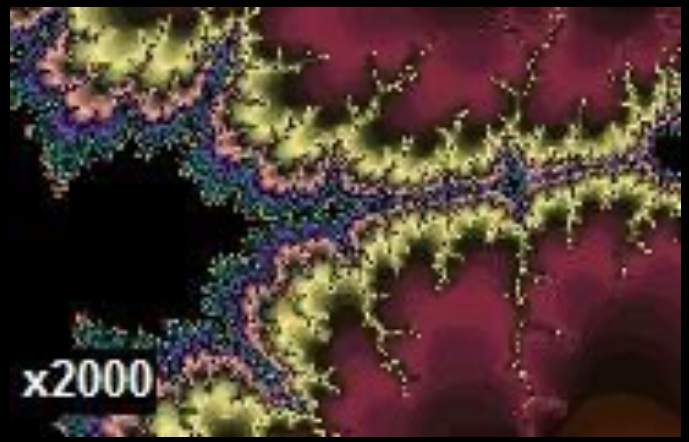
Wikipedia





"A fractal is generally a rough or fragmented Geometric shape that can be subdivided into parts, each of which is (at least approximately) a reduced-size copy of the whole, a property called self-similarity. The term was coined by Benoît Mandelbrot in 1975 and was derived from the Latin fractus meaning 'broken' or 'fractured'."

"Because they appear similar at all levels of magnification, fractals are often considered to be infinitely complex (in informal terms). Natural objects that approximate fractals to a degree include clouds, mountain ranges, lightning bolts, coastlines, and snow flakes."



“Fractal patterns have been found in the paintings of American artist Jackson Pollock.

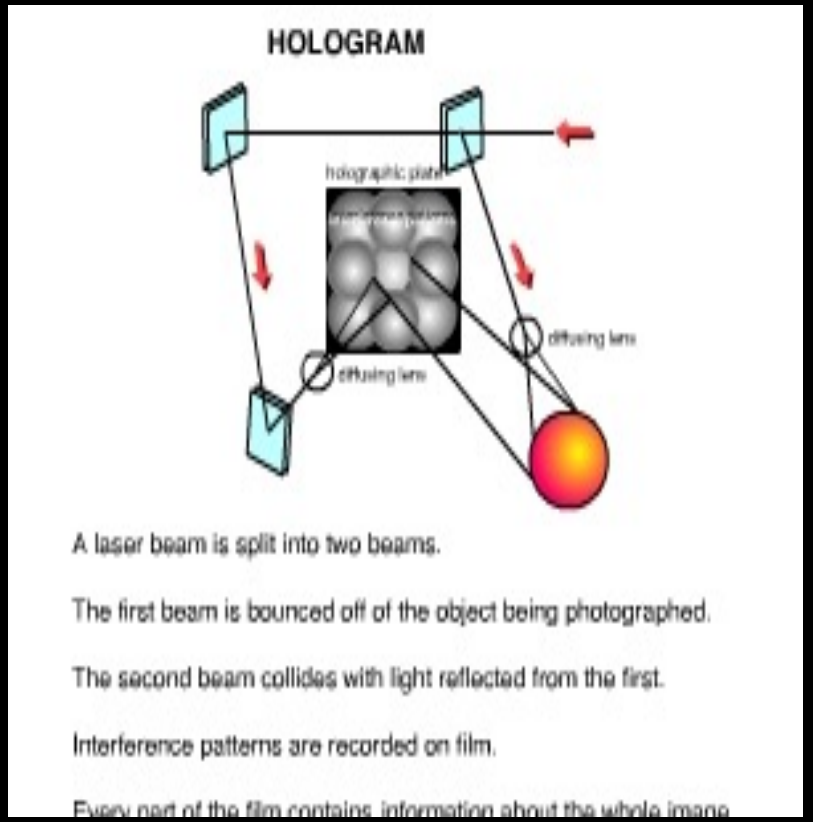
While Pollock's paintings appear to be composed of chaotic dripping and splattering, computer analysis has found fractal patterns in his work.”

Jackson Pollock Convergence Albright-Knox Art Gallery

Wikipedia

Holography in Art

"Early on artists saw the potential of Holography as a medium and gained access to science laboratories to create their work. Holographic art is often the result of collaborations between scientists and artists, although some holographers would regard themselves as both an artist and scientist."



"Salvador Dalí claimed to have been the first to employ holography artistically. He was certainly the first and most notorious surrealist to do so, but the 1972 New York exhibit of Dalí holograms had been preceded by the holographic art exhibition which was held at the Cranbrook Academy of Art in Michigan in 1968 and by the one at the Finch College gallery in New York in 1970, which attracted national media attention."

Wikipedia

"In formulating his law of universal gravitation, Newton, without calling it as such, discovered the concept of the force field. The first person to think of it, Newton was also the first to fathom its implications. For instance, his inverse square equation described how two objects separated by empty space, with absolutely nothing in between them, could act upon each other *at-a-distance*. . . . The mysterious force that mediates this strange action, causing mutual attraction between inanimate objects despite the intervening nothingness between them, Newton called gravity. Newton's formulation of gravitational action-at-a-distance became the basis for field theory."

Shlain

"Even before scientists realized that something was fundamentally incomplete about Newton's conception of gravity, Edouard Manet had begun to reexamine the sacrosanct conventions that had congealed about the notion of gravity in art, which required That painted objects of mass must rest firmly upon the painted ground." Shlain

“If the viewer uses the clues of perspective available from the action in the distance, he would have to conclude that Manet’s matador is standing in midair! . . . But Manet was a consummate draftsman: If he cut the ground out from under his subjects, he did so guided by his unerring artistic intuition.” Shlain

Mademoiselle Victorine in the Costume of an Espada (1863)

"Manet continued to use this stylistic peculiarity, freeing the subjects in his compositions from the laws of gravity and introducing a whole series of quirks that suggested something was missing from the commonly held beliefs concerning the subject of gravity. . . .

Manet introduced with great subtlety violations of the conventions concerning gravity that had guided artists since the Renaissance." Shlain

Woman with a Parrot (1866) and *The Fifer* (1866)
– "standing on an ambiguous surface." Shlain

The Dead Toreador (1864)
– "gravity-defying suspension in midair." Shlain

"Manet's contemporary Claude Monet also introduced some novel ideas about mass, density, and solidity. A constant feature of Monet's Impressionist style was the absence of crisp boundaries between his objects and the negative space surrounding them.

By blending the mass of his objects into that adjacent space, Monet diminished their substantiality. When 'light' is the adjective repeatedly applied to Monet's work, it refers not only to his choice of bright colors, but also to the way his subjects are invested with weightlessness and a certain sense of airiness."

Shlain

“In 1899 Monet began painting the Japanese bridge over his garden pool at Giverny, a subject he returned to repeatedly in the ensuing twenty years. But in his works there is no information about where the bridge rests. No pylons or footings are visible; instead, the viewer confronts a span that seems to float in midair. As Monet’s bridge series progressed, even the bridge’s substance began to fuse into the shimmering space surrounding it, and its weight and very mass appear to be subverted.” Shlain

“If Manet and Monet reopened the question about gravity, it was Paul Cézanne who addressed it in earnest. We have seen how Cézanne devoted his life to trying to understand the interrelationship of mass, space, and light. . . .
For previous Western artists it was the hierarchy of objects in a composition that was supposed to create the positive value of a painting. But Cézanne, despite his apparent endorsement of basic Euclidian solid geometry, seriously questioned its assumptions and endowed apparently empty space with an architectonic quality capable of affecting the objects it surrounded.” Shlain

Cézanne's Mont Sainte Victoire series (1904–1906) –
"the mountain began to dematerialize" and the space surrounding it
"seemed to thicken."

"Cézanne compressed space itself, squeezing
and reshaping it so that it became a reciprocal of the mass of the mountain."
Shlain

“More than any other artist, Cézanne exhaustively studied the essence of ‘apple.’. . . Cézanne’s representations of apples surreptitiously repealed Newton’s laws of gravity. Many of his still lifes contain a table full of apples, the fruit precariously perched on a surface that is obviously tilted. Why don’t the apples roll off? By insinuating into his canvases mountains that lose mass and apples that do not fall, Cézanne undermined the classical concepts of mass and space. And he did so a full generation before the scientific community discovered that the paradigm of mass, space, and gravity had to be revised.” Shlain

"By the end of 1905 Einstein had laid the basis of two totally new entities: the spacetime continuum and the energy-mass equivalence. Within a few months he had linked space to time and yoked energy to matter. Thus the original four corners of the impregnable fortress of Newtonian physical reality—space, time, mass, and energy—were now combined into two new binary Einsteinian entities, spacetime and mass-energy, each linked together by the paradoxical glue of the speed of a beam of light." Shlain

"Beginning in 1907 Einstein began to toy with the possibility that these two newly conjoined entities of his —spacetime and mass-energy—were also reciprocal, complementary aspects of each other. He had an intuitive feeling that the spacetime continuum and the mass-energy equivalence were somehow related, but he could not find a means to express their relationship in mathematical terms." Shlain

"In frustration, he turned to his boyhood friend Marcel Grossman, a knowledgeable mathematician. In their long conversations on the subject, Grossman told Einstein about a weird kind of non-Euclidian geometry that was the brainchild of Bernhard Riemann. . . .

Riemann was one of a small group of nineteenth century mathematicians who had the temerity to question the assumptions of Euclid's geometry. As it happened, his equations exactly fit Einstein's conception of the fundamental shape of spacetime.

Riemann's abstract, highly theoretical concept of space, believed to have no application in the real world, turned out to be very real indeed." Shlain

"In working out the interrelationship among space, time, energy, and mass, Einstein peered behind the multifaceted mask of illusion that hides the true identity of the universe. The general theory describes in mathematical detail how matter 'tells' spacetime how to curve and how curved spacetime 'tells' matter how to behave. The reciprocal relationship between Einstein's two new entities meant that each *informed* the other about the characteristics it was to exhibit. This complementary duality, the interplay between spacetime and mass-energy, results in a force we call gravity in our three-dimensional world." Shlain

“Because our language is constrained by our three-dimensional world of experience, there is, as yet, no common language in which to speak about the general theory and the reality it explains.

The images in avant-garde art and the insights of physics have to a large extent outstripped the ability of ordinary words to express these ideas.” Shlain

“This effect of mass compressing the space around it has a bizarre corollary, which is that time dilates in the vicinity of mass. A clock on the ground floor of a tall building will lag behind a clock on the top floor of the same structure, farther from the density of the earth.”

“Another extraordinary effect of the general theory is that mass affects color. Light in proximity to a massive object becomes blue-shifted; with increasing distance light becomes red-shifted.

This principle transposed to art implies that objects affect the color of space around them and the colors of space in juxtaposition to objects of mass are a relative value.” Shlain

“Einstein concluded that the force of gravity is no different from the force exerted by acceleration. Again Einstein, as he did in 1905, with the clarity of a naïve child, proclaimed that what is, is.”

“But if gravity is just acceleration, then what is accelerating when we stand still on the surface of the earth with our feet pressed firmly to the ground? Einstein proposed that the mass of the earth has warped the spacetime surrounding it. This four-dimensional stuff creates the illusion of a specific force in three dimensions that does not actually exist in spacetime.”

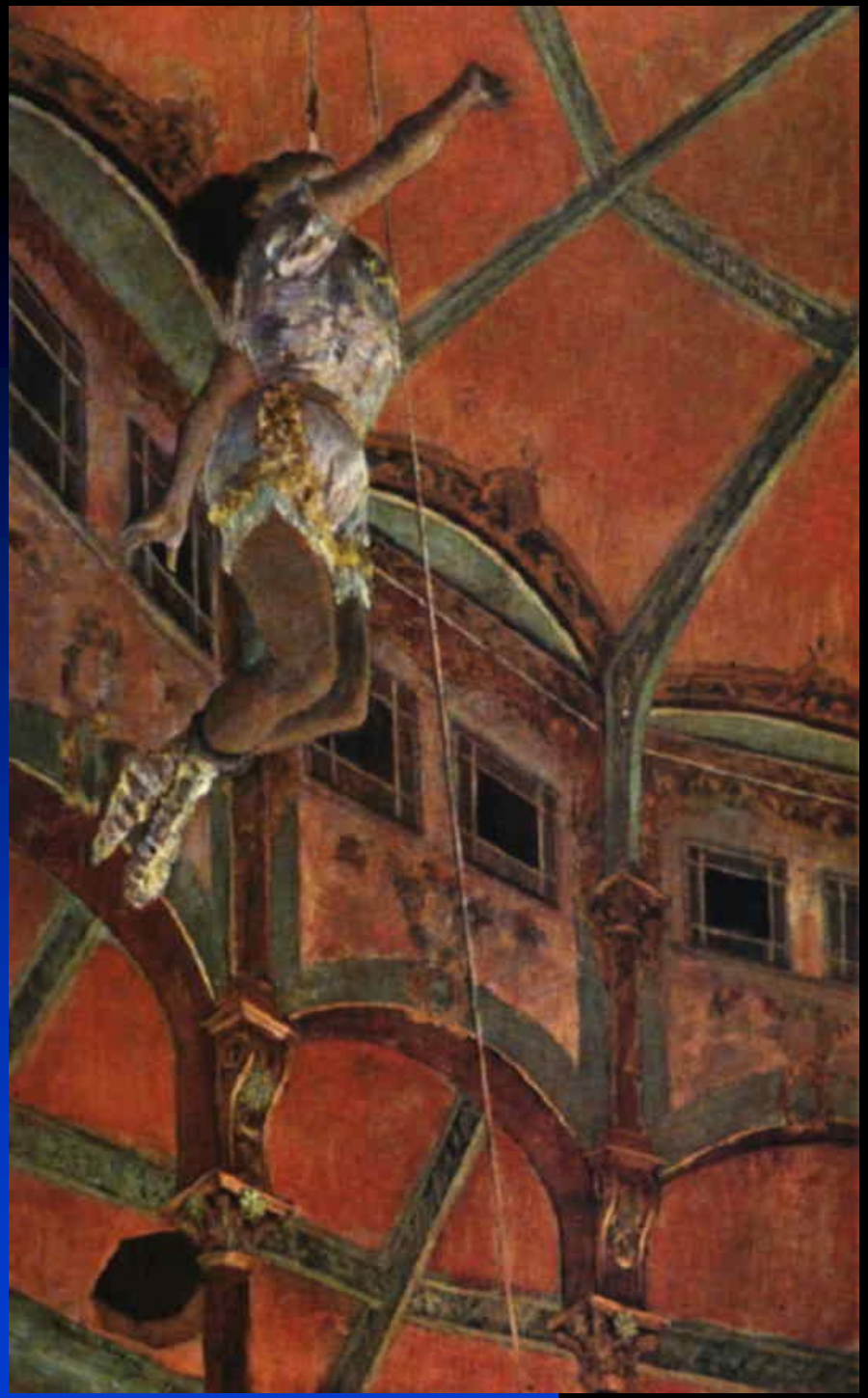
Shlain

"In the years between the publication of Einstein's special theory of relativity in 1905 and his grand connections late in 1915, there had been considerable consternation in the physics community. . . . Since the force of gravity also depended on the ether and the ether now did not exist, then on what principle, scientists asked, could action-at-a-distance, mass-affecting-distant-mass, operate?

The mystery of how a chunk of matter could affect another far-off mass with nothing in between remained as perplexing as ever. If there was no ether, physicists pondered, how does the earth act on the moon and why does an apple fall from a tree?"

Shlain

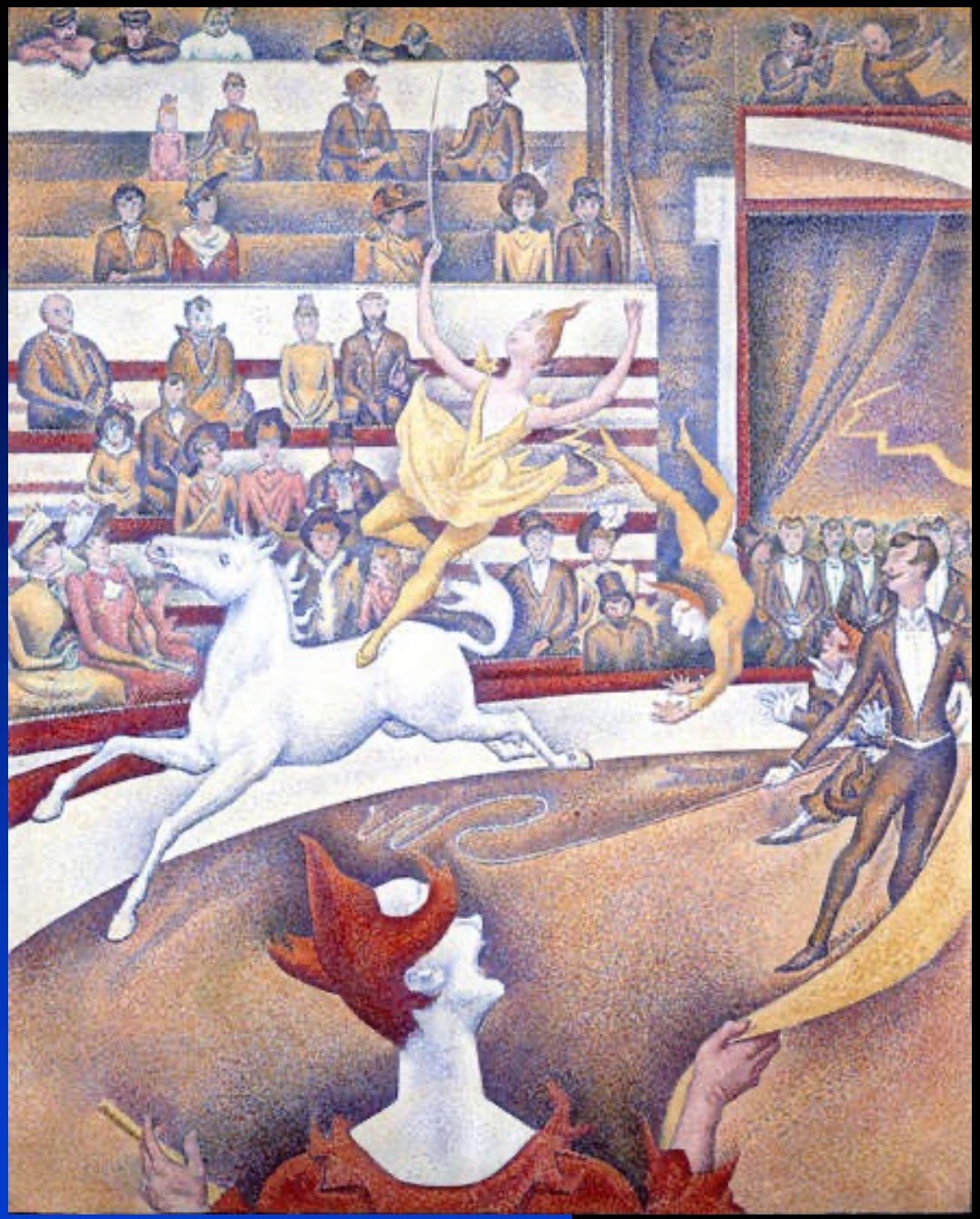
"Sensing, somehow, the illusion of gravity, modern artists began to examine themes of antigravity in the late nineteenth century long before Einstein revised our ideas about the relationship between mass and space." Shlain



"Edgar Dega's 1867 *La La at the Cirque Fernando, Paris* featured a Paris high-wire acrobat suspended in midair."

"Not only does his La La challenge the law of gravity, Degas has scrambled other conventional orientation clues as well: There is no horizon line evident in the painting, and by design, the ceiling struts and the angle of vision unsettle the viewer because of the composition's unusual perspective."

Shlain



"In sharp contrast to the static, architectonic schema of most of his compositions, Georges Seurat also used an acrobat motif in his *Le Cirque* by balancing a dancer on the back of a galloping horse so precariously that it seems nearly impossible that she will not be pulled off the horse by the force of gravity." Shlain

"In the few years immediately before Einstein revolutionized the question of gravity's nature, these jugglers and acrobats, for example in *Young Acrobat on a Ball* (1905), became the principal subjects of his [Picasso's] rose period." Shlain

"Van Gogh had marveled at 'the gravity of great sunlight's effects.' In both this statement and in his art, van Gogh communicated the weight of light. No other artist converted the sun's energy into such a palpable pastiche."

Shlain

Van Gogh did not know that after Einstein, the 'weight' of light would be calculated.

"Astrophysicists estimate that the equivalent of 160 tons of sunlight fall upon the surface of the earth in one year."

Shlain

"Soon, other artists introduced styles that resonated with the distant sounds of a fast-approaching new physical theory about the world. . . . Delauney did not portray the Eiffel tower realistically; instead, as in *Red Eiffel Tower* (1910), he dematerialized it.

Believing that no one view could encompass the essence of the tower, he disintegrated it by embedding isolated chunks amidst the matrix of spacetime." Shlain

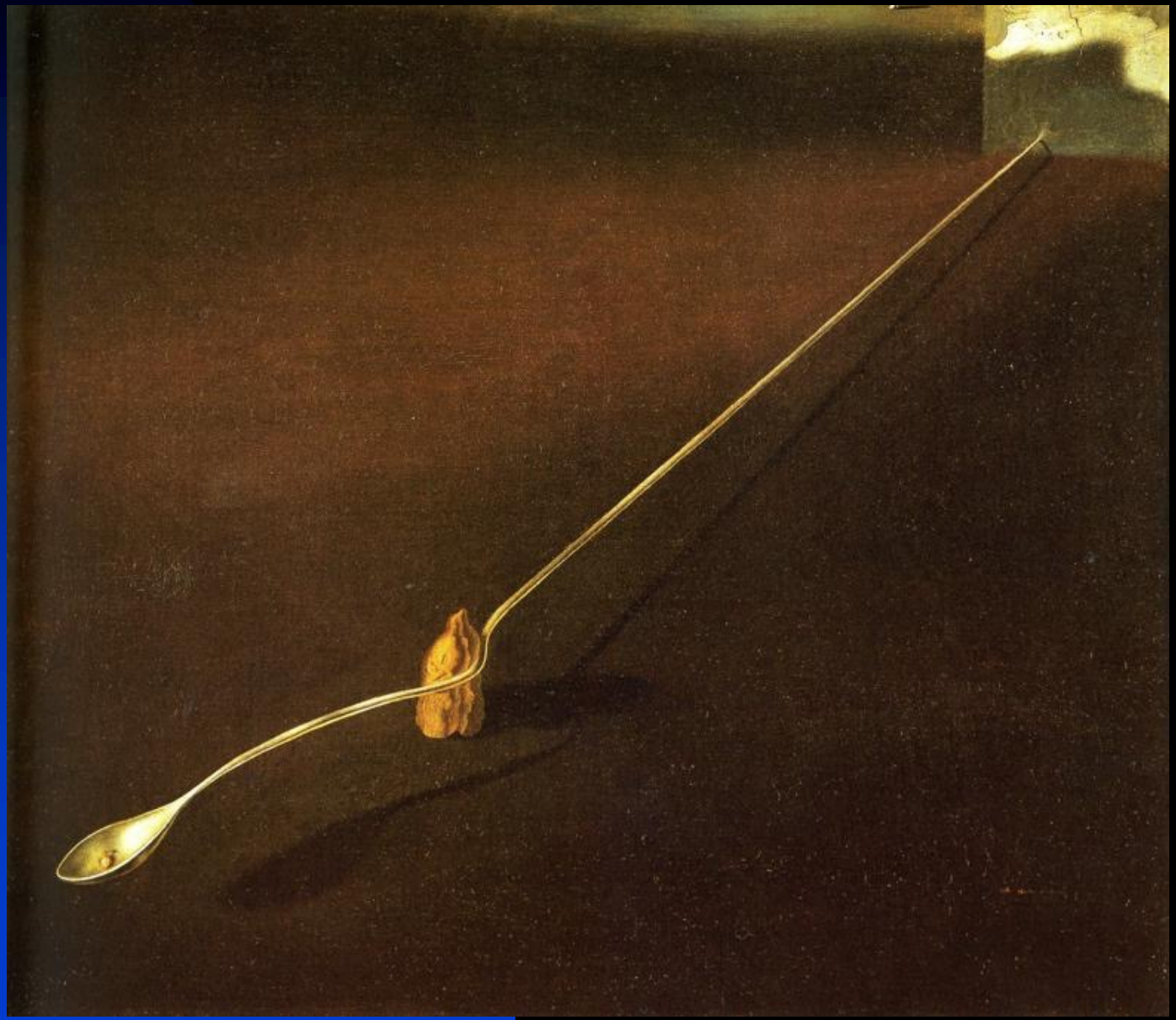
“During the second decade of the twentieth century Kandinsky, the first abstract painter, assumed that space had an inherent geometry and organized many of his later abstract works geometrically.” Shlain

“Marc Chagall, in particular, went beyond painting acrobats and jugglers as his immediate predecessors had done and made floating, flying, and levitation common sights in his art. Shlain

"In *I and the Village* (1911), Chagall introduced an image consistent with the concept of zero gravity." Shlain

"Before Einstein's revelations about gravity introduced exceptions to classical physics, Picasso created a series of paintings using classical themes full of conspicuously gross and heavy Greco-Romanesque figures, for example in *Three Women at the Spring* (1921)." Shlain

“Dali expressed with uncanny accuracy how a beam of light would appear passing through the warped spacetime near an object of mass in *Agnostic Symbol* (1932). . . .



Dali expresses in one surrealist painting the idea of bent light, warped space, and arrested time.”

Shlain

"In several surrealist works, such as *Le Chateau des Pyrénées* (1959), René Magritte singled out for reexamination one particular supposedly solid belief. There are few symbols in the psyche that are more massive than a mountain or a fortress. Magritte conjoined these two symbols.

He went further than Cézanne's experiments concerning the relationship between space and mountain. His levitating mountain crowned with a fortress brazenly violated Newton's basic law of gravitation.

In *The Sense of Reality* (1939), a boulder the size of a mountain floats free above an undisturbed landscape." Shlain

End of Part V