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# Mathematics in the Mind's Eye: Michael Schultheis Paints Poetic and Conceptual Geometries

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## Synopsis

Michael Schultheis is an established artist and a formally-educated mathematician. In his practice the two disciplines are inextricably linked. His large-scale lyrical paintings at first glance seem to focus on the effects of light and atmospheres, representing cloudscares or waterscapes in resonant color. Yet moving through these mists are decidedly mathematical references — drawn geometric shapes and hand-written equations. These are employed by Schultheis to represent the physical world or to express feelings (or both). For example, he may examine the structure of a pine cone or reflect on human relationships or do both at the same time. The resulting works of art present a personal world understood conceptually through geometry and made tangible through paint.

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Encounter one of Michael Schultheis' large paintings for the first time and you are immediately pulled into a dynamic, pictorial space. The pull feels no less than heavenward. Swirling, golden clouds part to reveal an infinity of blue. The ether seems to extend into oblivion, into the vastness of the universe. Golden shapes — planets, petals, spheres, wings — detach themselves from the foreground and are propelled into the emptiness, disappearing where we too might long to follow. Other works of art come to mind:

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Renaissance paintings or frescoes depicting various deities ascending into a glorious heaven between parted clouds; or later works by Romantic painters seeking the Sublime in mountainous or watery regions where eddying mists are pierced by celestial light.



Figure 1: Michael Schultheis, *Cardioid Limaçons of Pythagoras* (2014), acrylic on canvas, 48 × 72". Private Collection.

The luminosity of Schultheis' painting creates a sense of exaltation not unlike these divergent artistic forebears. With transparent areas of scumbled paint, flickering touches of white, and heightened colors, his work appears to capture light, shimmering and evanescent. Light streams from above, illuminating vaporous passages, turning mysterious floating shapes golden, and casting other areas into shadow. Although many works are quietly luminous, others are theatrical, even operatic, in their presentation.

The Sublime is not the purview of painters alone. Architects, too, have long created buildings whose grandeur is designed to overwhelm and elevate. One such creation is especially significant here: the Pantheon, that Ancient Roman masterpiece of mathematics and architecture, with its high dome lit

only by an open oculus at the apex. The visitor's gaze turns aloft to this only source of light. The gaze is instinctively towards the heavens.

Each of Schultheis' paintings has a hidden homage to the Pantheon and, more importantly, to the man who inspired it, the Greek mathematician Archimedes. Incised faintly into the surface of each painting is a fine line describing an arc or half-circle, and at its apex, at the top of the canvas, is a small indentation representing the oculus. The incised shape provides a compositional element, a suggested source for the radiance of the painting itself, and a crucial clue to the artist's intentions and his singular ways of seeing and thinking.

This is the surprise . . . Schultheis is a highly trained mathematician. As a painter he is no less a mathematician and lover of geometry. Archimedes and the other Ancient Greek mathematicians/philosophers — Pythagoras, Plato, Aristotle, Euclid, *et al.* — are his inspiration. But above all, it is Archimedes, considered the greatest mathematician ever, who informs and illuminates all of Schultheis' thinking as an artist.

Archimedes' greatest discovery is that a sphere inside a cylinder of the same dimensions is two-thirds the size of the cylinder in volume and surface area. The Pantheon is designed around this truth, its dome being a perfect half-sphere. Archimedes' idea can be drawn, or modelled in three-dimensions, or written as an equation:

$$V_s = \frac{4}{3}\pi r^3.$$

The written equation enables those versed in the language of mathematics to conjure immediately in their mind's eye the sphere and cylinder, without need of drawing or model. This conceptualization is, Schultheis suggests, the purest and most precise of all visual experiences of geometric forms in art, and it is the premise on which his practice as an artist is built. Underlying the expressionistic brushwork of his paintings are actual handwritten equations. While these white, scribbled notations function as calligraphic markings, they are far from meaningless. They contain specific information. Reading these equations, a mathematician can envisage the geometric shapes Schultheis is creating, just as a musician reading a score might hear the music the composer intends. Schultheis then renders the same geometric shapes in paint, expressing more tangibly, and perhaps with less purity, what the written equations say. Needless to say, these painted geometric shapes that rotate

and mutate across the picture plane and that sometimes look like exquisitely colored petals, flowers, butterflies, or leaves are the portal through which the more mathematically-challenged viewer must access Schultheis' work.

Handwritten equations, painted geometric forms, expressionistic brushwork, color and luminosity — these are the means by which Schultheis conveys his meanings and his subject matter. Each painting is in his words “a conversation”<sup>2</sup> with himself, a mindscape of current thoughts ... about contemporary mathematics, ancient history, his daily activities, his life, and his relationships. From a small pine cone picked up on a walk to the eternity of William Blake's eponymous poem, all that Schultheis encounters is explored and understood through geometry. Even his grief at the thoughtless killing of some fledgling swallows is eased by the application of mathematics.<sup>3</sup> While Schultheis sees the physical world as did Paul Cézanne, treating “nature by means of the cylinder, the sphere, the cone,” he also constructs geometries about love, family, and emotions. For him, as for Archimedes, “all is mathematics.”

In the painting *Dreams of Pythagoras* (2014), for example, written equations record Schultheis' thinking about a geometric form, the limaçon (see Figure 2 on the next page). Taking its name from *limax*, Latin for a small snail, a limaçon is formed when one circle rotates around another. Different curved shapes can be formed: some resemble a kidney bean or heart shape; some have an inner loop, some none. Schultheis reflects on the discovery of the limaçon which made an early appearance in a 1525 treatise by German artist and theorist, Albrecht Dürer. Since then several other mathematical systems have been used to describe the form. All this and more is referenced in Schultheis' handwritten notations. But he further hypothesizes that the limaçon is the perfect geometric shape to represent an individual's interior and exterior consciousness as described by psychiatrist Carl Jung. This in turn leads him to think about the meeting or overlapping of individual consciousnesses and to ponder the possibility of finding a “soulmate.” He revisits the Greek myth, where Zeus, in an effort to create more humans, splits each body in two, and leaves these incomplete beings to wander the world, one east, one west, in search of the other half.

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<sup>2</sup>All quotes by Michael Schultheis are from conversations with the author during 2015.

<sup>3</sup>Series of four paintings, *First Equation for Swallows* through *Fourth Equation for Swallows*, 2015.



Figure 2: Michael Schultheis, *Dreams of Pythagoras* (2014), acrylic on canvas, 60 × 96". Private Collection.

Schultheis imagines each limaçon/consciousness, spinning on its axis as it circumnavigates the globe. He works out variables that might make the desired meeting unlikely, or at least incomplete: individuals' orbits could be eccentric or elongated; speeds could vary; the plane of orbits could differ. Each scenario he imagines is recorded in a different equation and gives rise to a geometric shape, "geoms" he calls them. The geoms become a source of inspiration in themselves and he riffs on them as he works, repeating shapes, depicting them from different angles, making patterns, and sending several off into infinity. The universal allegory has become a geometric model. But the model is not just a hypothetical exercise: it has been imbued with personal meaning. It brings the artist an understanding of human relationships in general and in particular. It explains why, since orbits differ, one person might be keen to connect while the other holds back. Or why, even after finding one's "soulmate," staying in the same orbit can be hard! The geometric model has significance beyond geometry. It encompasses Schultheis' thoughts, feelings, and life experiences. It enables him to make sense of the world.



Figure 3: Michael Schultheis portrait. (Photo credit: Nancy LeVine).

Before Schultheis began painting, almost two decades ago, he worked full-time in software development. Earlier, as a student of mathematics and economics, he had watched as his professors wrote in chalk on a blackboard. Then, employed by Microsoft, he led teams who brainstormed ideas on a whiteboard. In both instances, formulae and equations were written, erased, added to, and rewritten. The scale of the board and the reach of an outstretched arm meant that, typically, writing went down the left hand side of the board and continued down the right. Eventually the central area was blurred by erasures. The finished board had long had a visual appeal for Schultheis, but it was after he began to photograph boards for documentation purposes that he truly understood the photographs recorded something with an aesthetic form and beauty of its own.

While he is not the first to be inspired by mathematicians' notations on a chalk board — photographers Paul Berger and Alejandro Guijarro come to mind — Schultheis is unique in the direction this inspiration takes him.

Thoughts of the chalk board inform how he approaches the canvas and suggest the composition and size of each painting. His first action is to create a line towards the bottom of the canvas. In simple terms this line reminds him of the tray at the base of the chalk board. In compositional terms it creates a pediment, a threshold into the space of the painting itself. Next, he begins writing equations that are on his mind, often from his reading of scholarly math books and journals. The writing moves down the left hand and then the right hand side of the canvas. Then, as he reflects and builds the work, he integrates thoughts and experiences, erasing the original equations and, as in a palimpsest, overlaying the writing and its traces with colorfully painted geometric forms, as his expressionistic brushwork develops a life of its own.

Schultheis is a self-taught artist. Learning from books and studying at first-hand the work of other artists, he has developed a methodology of his own. One such artist is the 19<sup>th</sup> century Romantic painter, J. M. W. Turner, whose quest for the spiritual in art led him to depict tumultuous skies and dramatic effects of pure light. Turner's profound influence is evident in Schultheis' mature work. Schultheis' earliest artistic ventures took the form of experiments with watercolor, oils, and even printmaking: but he found these unsatisfying. Then he discovered he could develop a use of acrylics to achieve the atmospheric layering and airy transparency he sought. Along the way he also tried many forms of art — figure painting, landscape, still life, and abstraction — before coming to understand that his only choice was to paint "what he knew." What he knew, and loved, was mathematics.

This had been true from an early age. Schultheis comes from a family that has farmed for generations in the relatively isolated region of Southeast Washington State, where the Palouse plateau drops precipitously into the Snake River canyon. Until he started school, the farm was his only world. Already he was noticing mathematical patterns around him. A solitary lilac tree had buds that fascinated him with their four-part structure. Even his clothing entailed numbers. As the youngest of eight, his hand-me-downs were marked by his diligent mother with eight symmetrical dots — one dot for each child who had worn the clothes. On wash day, clean clothes were redistributed to the siblings, piled according to the number of dots in ascending order up eight steps. Before the young Schultheis could read his name, before he could count, he could nevertheless immediately recognize himself in the eight-dot geometric pattern. Today, these are among the life experiences that the artist examines in his work.

An early task on the farm was in the root cellar. The young boy was sent to organize and inventory the jars of preserves — oldest in front, newer behind. It was the first stirrings of interest in mathematical systems that many years later would develop into an understanding of databases. Even play involved mathematics. A favorite toy that gave hours of pleasure was the Spirograph. Its geared wheels allowed a pencil to draw the most elaborate roulette curves and mathematical patterns. In later life Schultheis would come to know these geometrical patterns as hypotrochoids and epitrochoids.

It is no surprise that Schultheis proceeded to study mathematics and economics as an undergraduate at Washington State University, just a few miles from his family home. He followed this with a master's degree in labor economics and econometrics at Cornell University. After his studies, Schultheis was all set to pursue a successful corporate life in software development and did for several years. But soon he was making the momentous decision to abandon his business career in order to make art. He began to paint the world as he alone saw it and in the process created an art — he calls it “Analytical Expressionism” — the like of which had not existed before. Exhibitions, commissions, and sales have followed and Schultheis has found a responsive audience among mathematicians and non-mathematicians alike.

Those who know math can conceptualize Schultheis' geometric forms and readily “see” them. The geometries used include simple Euclidean as well as more complex non-Euclidean methodologies such as Cartesian and Polar coordinate systems.<sup>4</sup> The equations and “geoms” Schultheis creates are understandable to those who would have studied calculus at college level. Yet his paintings do not speak to this esoteric group alone. For those not privy to the visual language of geometry, Schultheis' renders the geometry visible by painting it. With expressive gesture, use of color, line, and form — all the elements that make up visual art — he communicates to a broader segment of viewers. Thus both categories of viewer have a valid, albeit different, experience. It is as if aesthetics and mathematics, the artist and the geometer, find common ground in these works.

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<sup>4</sup>Euclidean geometry is the study of flat space; its concepts can be drawn on a flat surface. The Cartesian coordinate system can be used for 3-D geometry where the  $x$ -coordinate represents horizontal position, the  $y$ -coordinate represents vertical position, and the  $z$ -coordinate is the third dimension. The Polar coordinate system uses a fixed point (the pole) and a fixed directional line from which to measure the radius and angle.

Thinking about the intersection of art and math, Schultheis expresses genuine admiration for those 20<sup>th</sup> century abstract artists — from Kandinsky to Serra — whose art involves geometry. But before 20<sup>th</sup> century abstraction, we must go back almost four centuries, to the Renaissance, to find any other art that includes overt references to mathematics and geometry. (At least in the Western world, that is. Geometry is of course inherent to Islamic art.) For many Renaissance artists, art and geometry were indivisible. These are the artists Schultheis most admires. Piero della Francesca, he points out, owned a copy of Archimedes' Codex and himself wrote treatises on arithmetic, algebra, and geometry. Piero's mathematical understanding of the theory of perspective and use of the device in his frescoes was to change the course of art history . . . and is still taught in art classes today. Leonardo da Vinci's much-reproduced drawing of "Vitruvian Man," where outstretched arms and legs describe a circle and a square, reveals an artist for whom art, science, and geometry are all necessary to describe the fundamental truths of nature.

When artists return to geometry at the dawn of the 20th century, it is precisely because they want to remove themselves from the obligations of reproducing an illusion of the natural world. No longer is a painting to be a "window on nature." Malevich's *Black Square* of 1915 is the death knell for perspective. Other geometric shapes of circle, cylinder, sphere, arc, cube — whether in the work of Rodchenko or Mondrian, Braque or Albers, Ellsworth Kelly or Donald Judd — allow artists a new purity of purpose, enabling them to create works of art that are both nonrepresentational and nonreferential. Geometric forms are chosen exactly because of their abstract quality, their perceived lack of connection to the natural world. Twentieth-century Geometric Abstraction, which encompasses many greatly lauded artists, has scant room for narrative, metaphor, or feeling. Instead, emphasis is on the two-dimensional nature of the picture plane, the canvas support, or the painted surface itself. Works are rendered in a neutral and objective fashion, painted as smoothly as you would an automobile and even, in the case of sculpture, constructed out of industrial materials.

Schultheis aspires "to push the boundary of geometry in art," but clearly Geometric Abstraction as defined could not be further from his intentions. His choice of geometry allows for metaphor, hidden storytelling, and subjectivity. His paintings are not neutral surfaces but employ atmospheric perspective to create depth and internal movement. Nor is his geometry the simple, "high-

school” Euclidean geometry used by practitioners of Geometric Abstraction: he uses a much broader range of non-Euclidean methodologies as well as calculus, econometrics, and trigonometry.

Yet there is an inherent dichotomy in his work. On one hand, he describes his written equations as the only true “geometric art,” since they are mathematically exact. (Geometry is by its very nature exact. Imprecise geometry is an oxymoron.) In addition, his equations become the purest of geometric art as they are actualized only in the mind’s eye of the viewer. From this point of view, Schultheis’ art is conceptual — clear, reductive, and perfect. Since the art of most Geometric Abstract painters exists in the physical world, their shapes can never be pure geometry, only imperfect or loose approximations. According to Schultheis, these approximations are indeed sometimes mathematical impossibilities. Yet — and this is the dichotomy — Schultheis, in making paintings about geometry, also operates in the physical world. The large size of many of his canvases means that viewing is an especially active physical experience, as we trace the surface writing and allow ourselves to be drawn into the space beyond. His energetic “geoms” that fly across the picture plane are rendered with painterly, expressive marks and elegant gestures. While Schultheis’ written equations may be pure geometry, his brushstrokes, though beautiful, offer the imprecision, and fallibility, of real life.

Most people, including most artists, see art and mathematics as poles apart. A few artists, however, isolated in the ever-widening pluralism that is 21<sup>st</sup> century art, have been inspired to bring elements of both practices together. Many of them work with computers and digitization. The work is diverse and varied, and none of these artists is part of a group or a movement. Neither is Schultheis. He is alone in the art he makes. Where others might use a computer to draw geometric shapes on the page, he wants his imagined geometries to take form in the mind’s eye. Where others might borrow from the realm of mathematics, he lives in that realm. He sees life and the world in terms of geometry and presents that vision in paintings that we can find beautiful without needing to be mathematicians ourselves. In his paintings, art and mathematics, which have traveled so long alone and in different directions, have finally eluded Zeus ... they have found each other and become one.