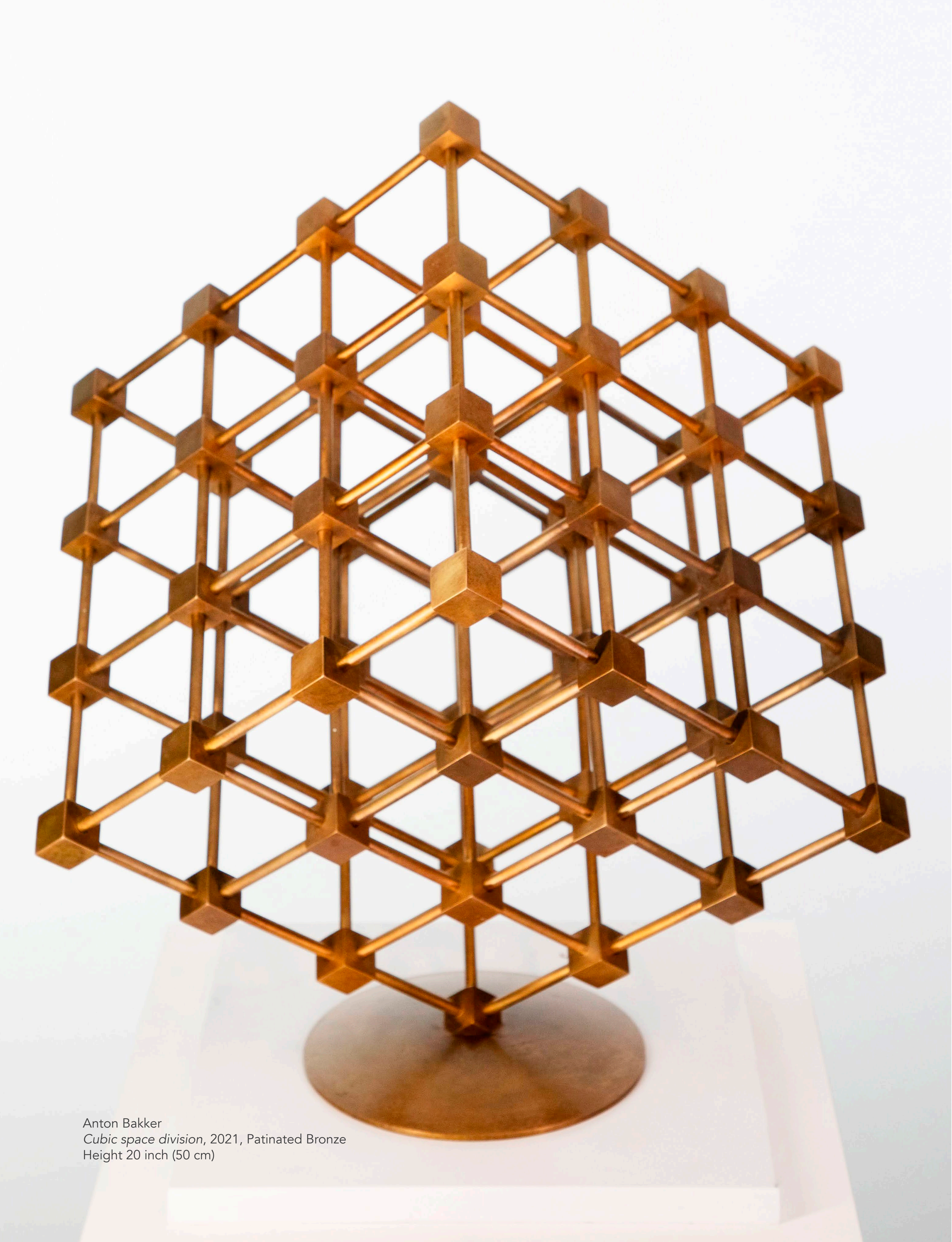
Anton Bakker

Perspectives of Symmetry

Anton Bakker never set out to be an artist, but when he found beauty in numbers and the shapes they could generate, he jumped from science to art -- taking mathematics with him. "Perspectives of Symmetry" is a project in giving form to concepts -- which all art does, but here the concepts are numerical, readily recognized by mathematicians. In fact, the generated shapes are themselves part and parcel of advanced mathematics, but in bringing them forth as inherently beautiful forms, Bakker awakens us to the transcendent power of the universe at its null point -- not reduced to numbers, but elevated to them.

Beauty resides in symmetry, Bakker insists, and emphasizes the point by describing elaborate symmetric structures that beguile the eye. These structures are striking just as drawings, but as sculptures they stand as monuments to the human mind, the natural order, and the magical potency of numbers. Bakker›s artworks maintain the elusive drama of modern abstraction by finding its basis in numbers and the relationships numbers represent. The glory of pure form, as the geometers of ancient Greece and the architects of the Islamic renaissance knew, needs no justification; numbers are beauty incarnate.



Anton Bakker
Cubic space division, 2021, Patinated Bronze
Height 20 inch (50 cm)

Anton Bakker

Anton Bakker is a contemporary artist specializing in sculpture and its digital possibilities. He has been influenced by the people and experiences of his life in the Netherlands, France, and in the United States, where his artistic practice has been based for more than 30 years.

While growing up in the Netherlands, Bakker met mathematician and artist Dr. Jacobus "Koos" Verhoeff at the suggestion of his sister's classmate. What began as a simple introduction over a shared interest in computer technology turned into a 40-year artistic collaboration. Koos was a professional acquaintance and informal advisor on mathematical matters to the famed M.C. Escher. As an expression of his gratitude, Escher gifted Koos one of his prints. It was through Koos that Bakker became influenced by Escher's unprecedented approach to perspective.

As their relationship developed, Koos and Bakker began to explore computer-based methods to find intriguing and beautiful paths within cubic lattice structures and polyhedra. Cubic lattices form the basis of the most stable molecular forms of many elements.

In the 1980s, Bakker moved to the United States, and he and Koos had their first joint sculpture exhibition in Albany, New York. Subsequently, Bakker leveraged his growing knowledge of computer science to pursue a career in technology, landing a position that required relocating to Paris for much of the 1990s. While in Paris, Bakker resumed regular face-to-face work sessions with Koos. Together, they created multiple lattice-derived sculptures that were exhibited throughout Europe.

Meanwhile, Bakker was at the forefront of a new tech field, working with innovators in Belgium to explore the possibilities of 3D printing. Upon returning to the U.S. in 1997, he started a business centered on data analysis all the while maintaining his artistic practice. His solutions for practical design and construction problems opened new possibilities for connecting lattice points with curved and polylinear paths. By applying these techniques at both small and large scales in steel and; bronze,as well as in virtual reality, Bakker has created unique sculptures that have been collected privately and publicly throughout the United States and Europe.

Bakker sold his tech business in 2018, shortly after the death of Koos, to devote himself to art full time. Today, he uses technology to compose paths in order to find those with a unique beauty that transforms as viewers shift their points of view. With the aid of a computer interface, Bakker searches vast lattice expanses to identify points that generate intriguing paths in a quest to challenge the limits of perception and perspective.

Anton Bakker Statement

As a sculptor creating digital and physical forms, I strive to take viewers on a journey of truth and discovery by asking them to engage with various perspectives. Using custom-built technology, I create paths by connecting points in space. The curved and polyline paths that I compose are not arbitrary; rather, they are patterns derived from nature's archetypes.

The human attraction to symmetry extends deep into the unconscious realms of our minds.

Natural patterns and symmetries also play a key role in present-day technology. For 40 years, I have used technology both in my artistic explorations with my mentor, Koos, and in my business to analyze patterns. I now use technology solely to discover the beauty that hides in the minuscule yet vast world of atomic lattices.

One way that I explore perspectives is by constructing objects at vastly different scales and in multiple dimensions. The viewer's relationship with my work changes whether they walk around a sculpture in a home, as part of an outdoor installation, or in a virtual landscape. My sculptures reveal dynamic symmetries that ask the viewer to reflect on the beauty and multiplicity of perspectives inherent in all things.

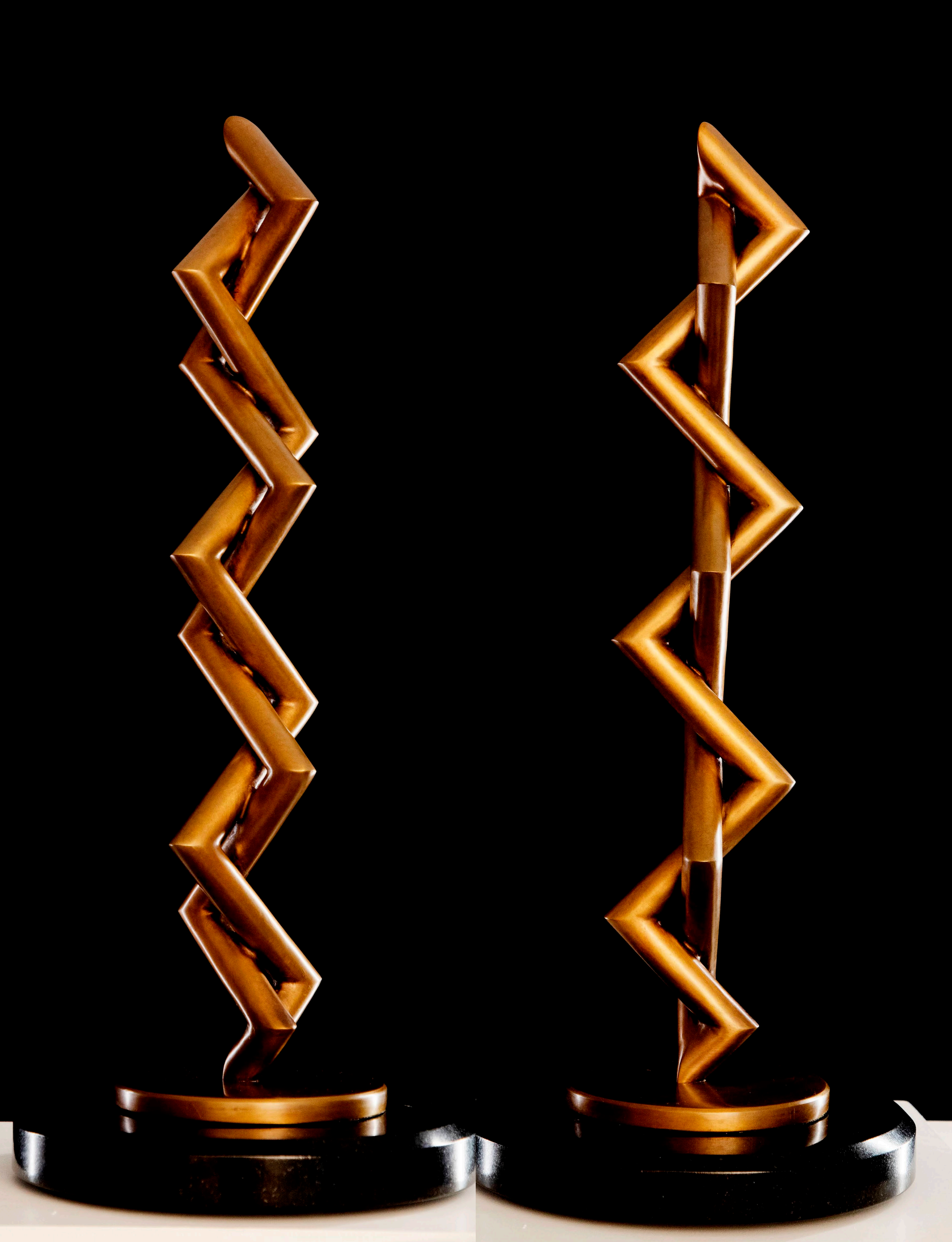
- Anton Bakker

Polylines

Connect the dots is a simple game we play with pencil on paper to outline a hidden image. We connect numbered dots, in order, with line segments. Most often, these connected edges form a non-intersecting loop that can be called a simple closed polyline path, a polygonal circuit, or just a polygon. The game can be played as well in 3-dimensional space, where the numbered dots can be chosen from an infinite regular array of points called a lattice. A familiar lattice is the cubic lattice, a 3-d version of square graph paper: its points determine the corners of neatly stacked cubes that fill space.

Instead of numbering dots to be connected, a polyline path can also be traced out (on the plane or in space) by giving a series of instructions for the pencil (or "turtle") to follow: Move x units far in direction y, then turn through angle z, then continue in a sequence of Moves and Turns for perhaps different x, y, and z values. In space, a Turn may also include a roll, like an acrobatic airplane move. To complete a circuit, the last Move connects the path back to the original starting point. In the plane, instructions that repeat exactly the same Moves and Turns trace out regular polygons: equilateral triangle, square, regular hexagon, etc. In space, polyline paths can dip and twist in many directions before completing a circuit.

Anton Bakker
Opus 24582, *Round Cubic Fence Around Nothing II*, 2021
Patinated Bronze
Height 20 inch (50 cm)



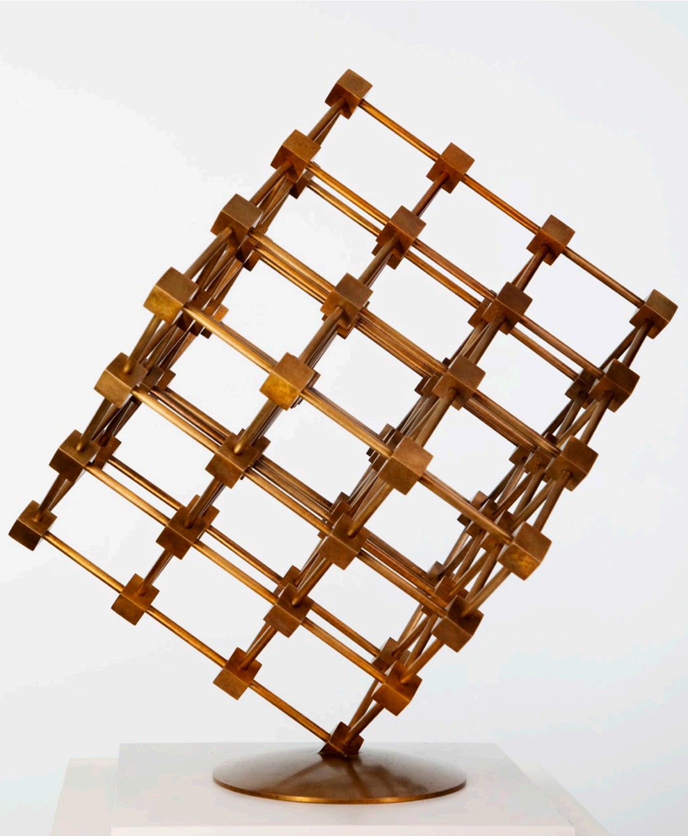
Anton Bakker
Opus 24582, Round Cubic Fence Around Nothing II
Stainless Steel
Height 20 inch (50 cm)

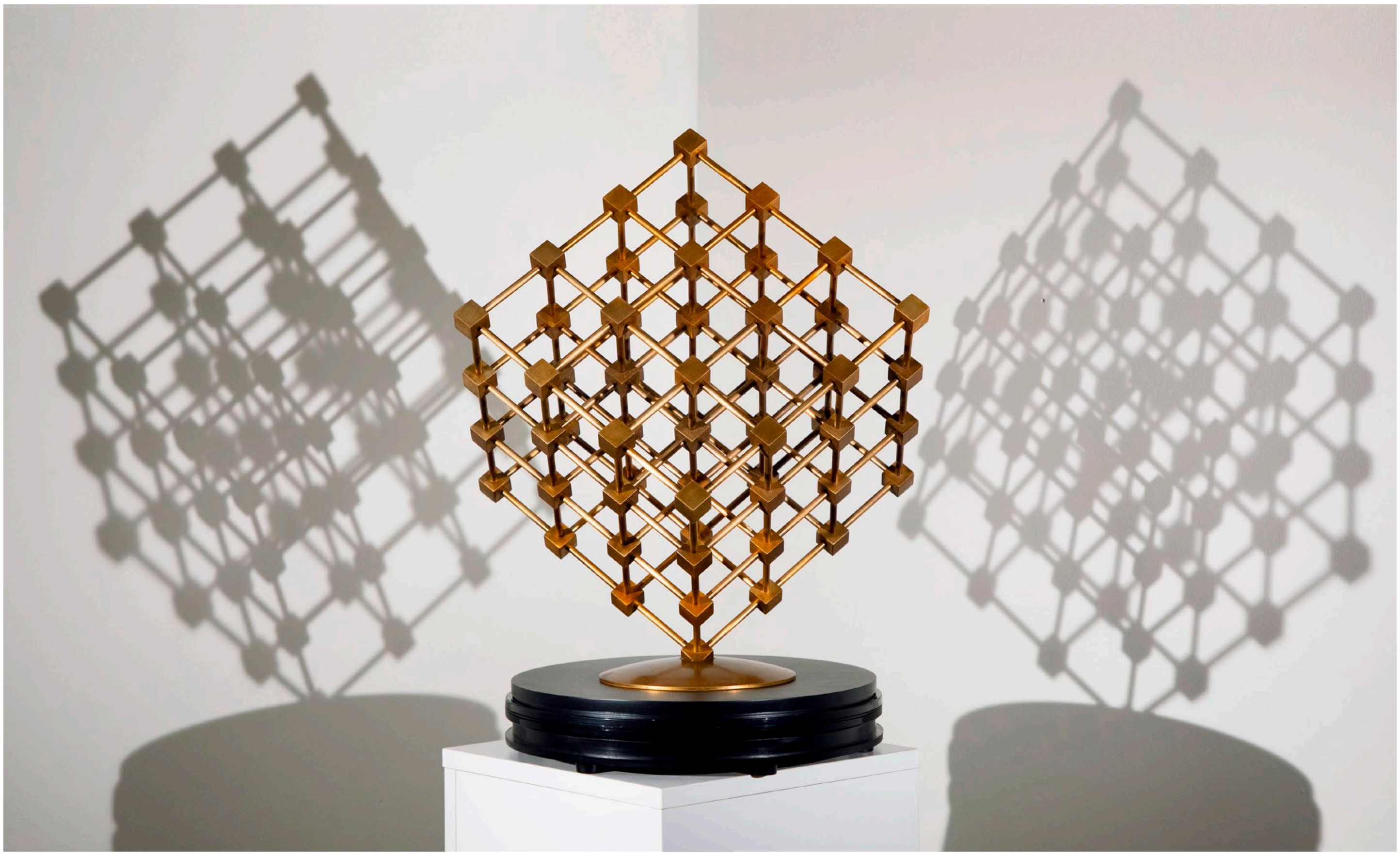
Anton Bakker
Opus 951465, Cubic braiding II, 2021
Stainless Steel
Height 20 inch (50 cm)

Anton Bakker
Opus 951465, Cubic braiding II, 2021
Patinated Bronze
Height 20 inch (50 cm)

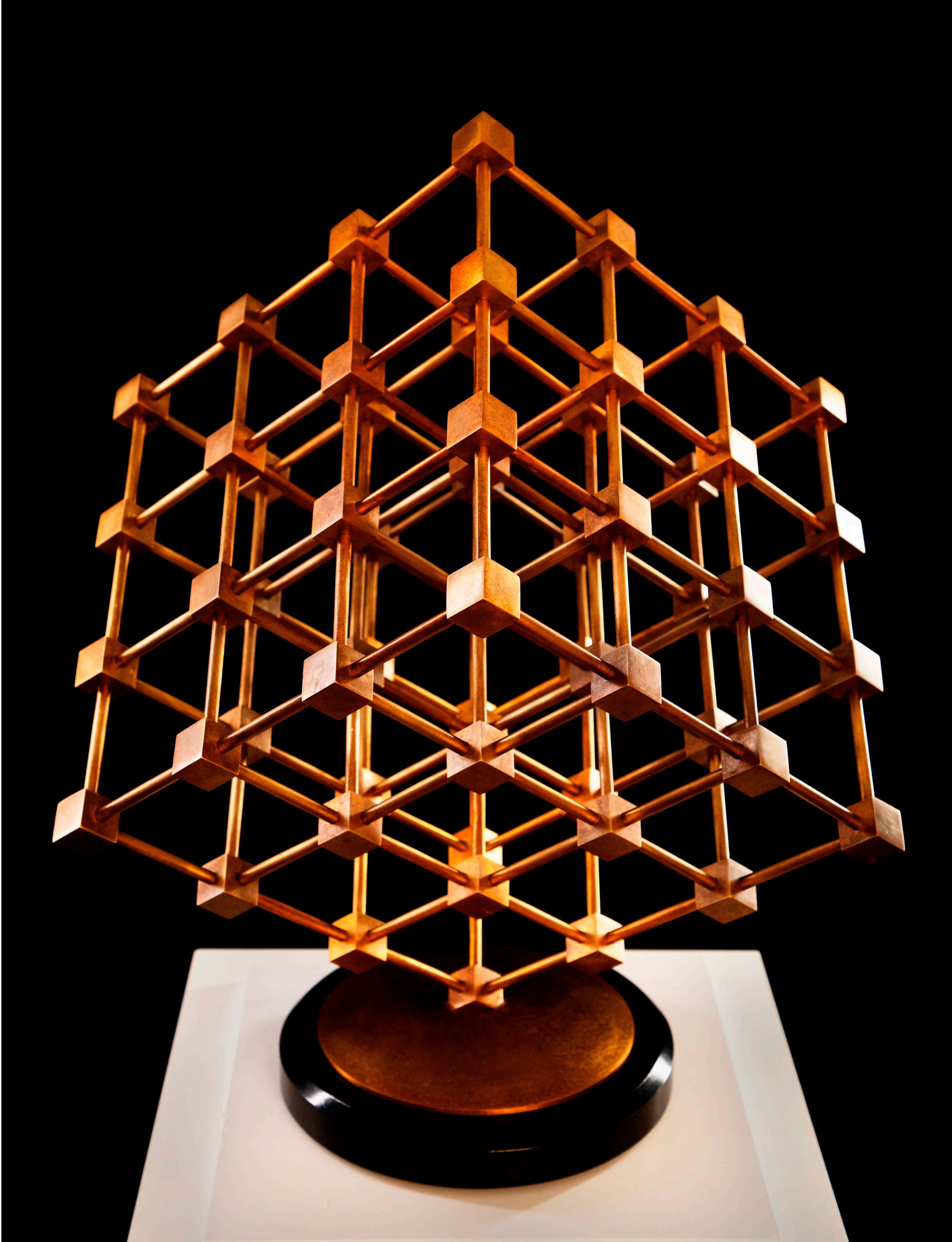
Anton Bakker
Opus 24582, *Rombic cubic fence around nothing II*, 2021
Stainless Steel
Height 20 inch (50 cm)

Anton Bakker
Opus 951465, Braiding #2
Red Powder Coated Stainless Steel
Size 8 foot tall,





Anton Bakker
Cubic space division, 2021
Patinated Bronze
Height 20 inch (50 cm)



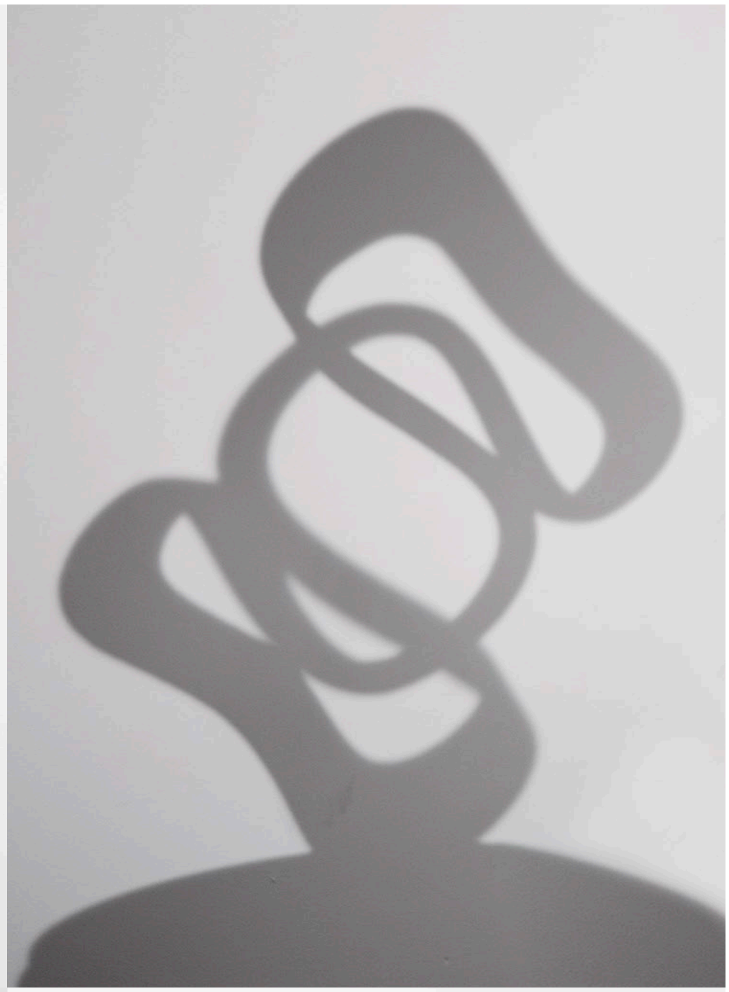
Curves

Polylines have abrupt, often sharp corners as they trace out a circuit. These paths do not flow, they jerk. To smooth a polyline path into a flowing curve, Bakker uses what mathematicians call spline interpolation. This is a bit like fitting a thin springy strip of steel around a set of pegs to form a curved path that touches each peg.

Cubic functions (the simplest is y = x3) have curvy, S-shaped graphs. They have the remarkable property that, given four points (not all on a line), there is a cubic function whose graph goes through those four points. If the four points are fairly close to each other, the piece of the cubic curve running through them (called a spline) closely approximates line segments that connect the points. Using splines, Bakker can replace each sharp V-shaped corner of a polyline path with a U-shaped curve. The result is a smoothly curvaceous circuit that travels through all the corners of the polyline path.

The curved loop that results from smoothing a polyline circuit in space is merely a skeleton doodle with no thickness and no body. This must be provided by the artist. A simple thickening coats the curve so it has a uniformly shaped cross-section such as a circle (which produces a tube covering), a square, or triangle. The width and thickness of the curve's covering can be varied for aesthetic reasons. This can suggest a change of speed and spread as the curve flows, much like water flowing in a creek that meanders through changing terrain.

Anton Bakker
Opus 980011, Curved Cubic Cycle, 2021
Patinated Bronze
Heigh 20 inch (50 cm)

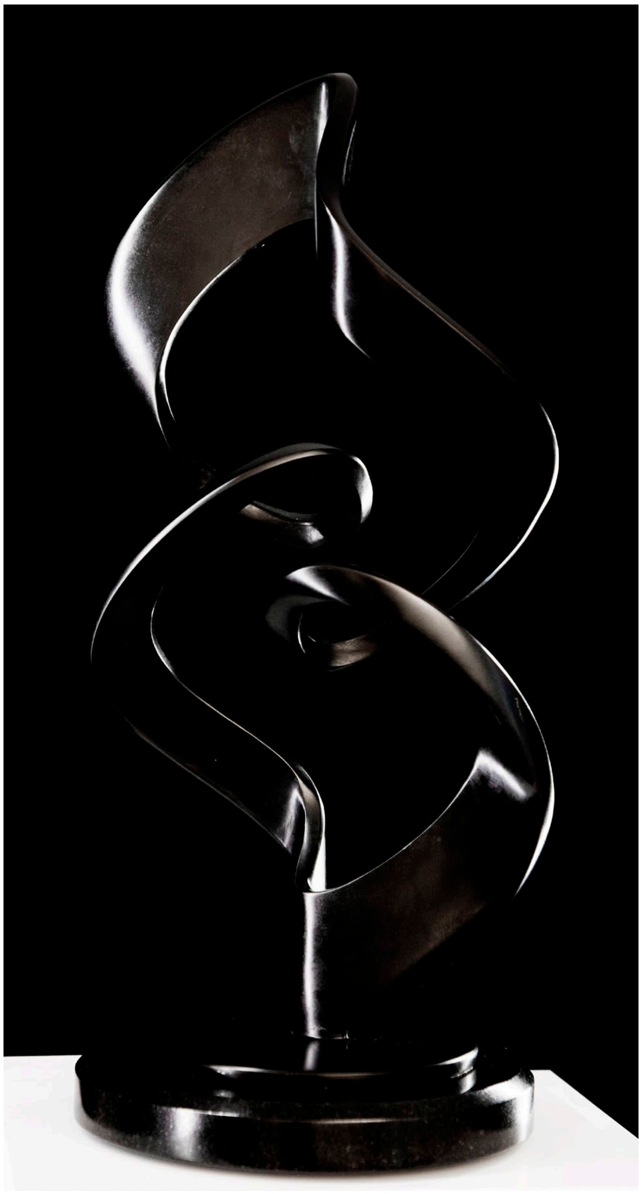
Anton Bakker
Opus 61143, *Curved cubic cycle*, 2021
Patinated Bronze
Height 20 inch (50 cm)

Anton Bakker
Opus 587456, *Curved cubic cycle*, 2021
Patinated Bronze
Height 20 inch (50 cm)

Anton Bakker
Opus 965842, *Curved cubic cycle*, 2021
Patinated Bronze
Height 20 inch (50 cm)



Anton Bakker
Opus 980011, *Curved cubic cycle*, 2021
Stainless Steel
Height 20 inch (50 cm)

Anton Bakker
Opus 875123,*Curved cubic cycle*, 2020
Patinated Bronze
Height 20 inch (50 cm)

Anton Bakker
Opus 587456, *Curved cubic cycle*, 2021
Patinated Bronze
Height 20 inch (50 cm)

Knots

Knots are familiar shapes, yet they can be dauntingly mysterious (especially when trying to untangle a messy one). Knowledge of some knot formations is a necessity for sailors, yet there is much we don't know about knots – so mathematicians study "knot theory."

Mathematical knots are closed. They do not have two loose ends, like shoelaces that can be untied. To make the simplest mathematical knot, take a length of string or flexible wire and bend it so the two ends cross each other. Now take the end that is "on top" and twist it to go under, then over the other end. Finally, glue the two ends together. This is called a trefoil knot. In its most symmetric presentation, it looks like three identical rings woven together. It is impossible to undo this or any mathematical knot without cutting it.

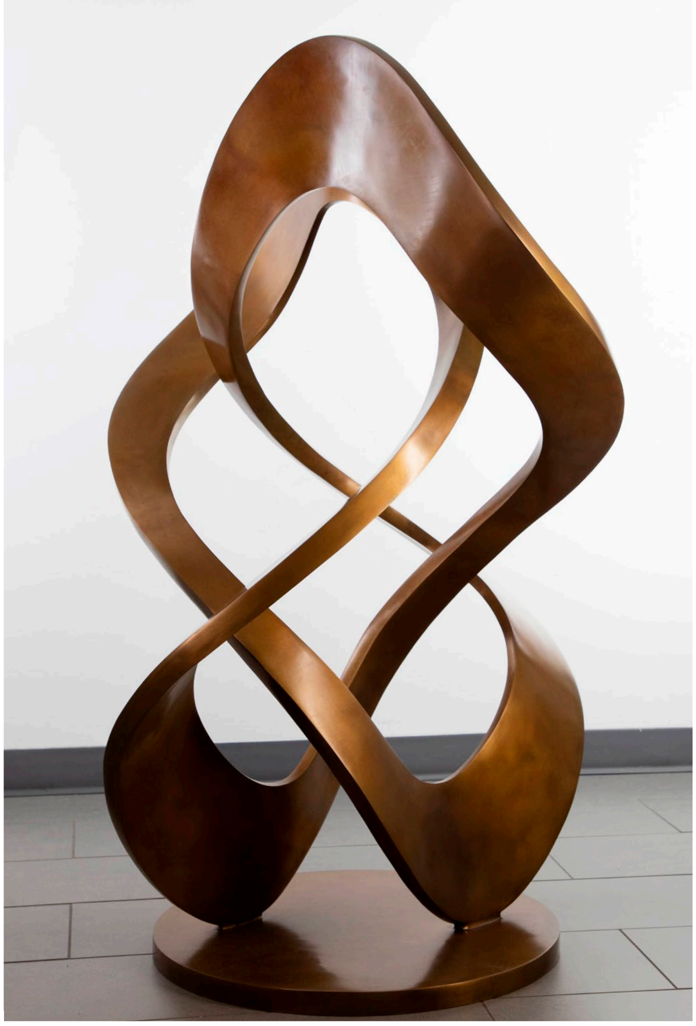
When Bakker gives instructions to his computer program to connect copies of a polyline generator in order to form closed circuits in space, some of the circuits among the thousands produced may be mathematical knots. The program contains a filter that can identify which of the circuits are knots, and from these the artist can select what becomes the basis for a knotted sculpture.

Anton Bakker
Opus 325846, *Koos Knoopje curved figure eight knot*, 2021
Mirror Polished Stainless Steel
Height 5 foot tall


Anton Bakker
Opus 191008, *Curved cloverleaf knot*, 2021
Mirror Polished Stainless Steel
Height 5 foot tall


Anton Bakker
Opus 191008, *Curved cloverleaf knot*, 2021
Patinated Bronze, Height 20 inch (50 cm)

Anton Bakker
Opus 325846, *Koos Knoopje curved figure eight knot*, 2021
Mirror Polished Stainless Steel
Height 15 inch (38 cm)



Anton Bakker
Opus 191008, *Curved cloverleaf knot*, 2021
Patinated Bronze
Height 5 foot tall

Spirals

In the plane, when an object rotates about a fixed point while simultaneously moving away from that point, it traces out a spiral path that constantly curves outward. Rope is often coiled in this manner on a boat's flat deck. A spiral path can also begin far away from a fixed point when an object rotates about that point while moving ever closer to that point. Think of the tightly wound head of an emerging fern.

In space, a spiral path is traced by an object that rotates about a fixed axis while moving away from that axis, and has the additional freedom to move upward, like a waterspout, or like the ridges of a screw traveling from tip to head. A spiral path can even begin at a point and rotate while moving outward and upward, and then, reaching the widest distance from its axis, spiral inward about the same axis while continuing its upward journey. This is the path of a theoretical ship that travels the globe from south pole to north pole with its compass always at a fixed angle to the globe's meridians; the path is called a loxodrome, or rhumb. In space, the artist has the freedom to create a spiral path about one axis, then have the curve turn to spiral about a different axis.

Anton Bakker
Opus 185131, *Twin spiral knot*, 2021
Patinated Bronze
Height 20 inch tall
- Available in 5 foot as well




Anton Bakker
Opus 185131, Twin spiral knot
Stainless steel
Height 20 inch (50 cm)
Available in 5 foot and 10 foot as well

Möbius

A thin strip – of paper, say, or springy metal or wood – can be bent into a ring by joining its two ends. If you don't twist the strip, you get a simple cylindrical ring, like the hoop that holds together the staves of a wooden barrel. But if the strip is twisted before the ends are joined, the ring that is formed has what is called a Möbius twist, named after the mid-19th century German mathematician August Ferdinand Möbius (although the form was known to the ancient Romans). This form has some surprising properties. A single twist of 180° will join the top edge of one end of the strip to the bottom edge of the other end, producing a one-sided loop. That is, you can trace a continuous path along the centerline of the loop, parallel to the edges, until you return to the starting point, and in doing so, you will have traveled along the centerline of both the front and back side of the original strip.

The polyline circuits and their curved counterparts that are the skeletons for Bakker's sculptures often twist as they visit points in the cubic lattice. Möbius twists can become apparent when the skeletons are coated so their cross-sections have rectangular shapes. The cross-sections travel like a roller coaster car on the skeleton path, sweeping through the sculpture's circuit. The cross-sections of the coating are varied for aesthetic interest, but also must vary so that at the beginning and end of the circuit the cross-sections match and can fuse.

Anton Bakker
Opus 965842, *Möbius curved cubic cycle*, 2021
Stainless Steel
Height 10 inch (25 cm)

Anton Bakker
Opus 965842, *Möbius curved cubic cycle*, 2021
Stainless Steel
Height 10 inch (25 cm),

Anton Bakker
Opus 965842, *Möbius curved cubic cycle*, 2021
Patinated Bronze
Height 15 inch (38 cm)

Fractals

The term "fractal" suggests fracturing or splitting. Mathematicians use the term to describe a figure made up of an infinite number of parts, each part a scaled version of a single part, with the scaling constantly diminishing the size of repeated parts. Look closely at a fern, or a head of broccoli. These are finite, or partial, versions of fractals: when you look closely at the parts that compose them, the parts are smaller versions of the whole.

A fractal can be created by beginning with a particular figure or shape and then following a set of recursive instructions. That is, an action is performed on the shape such as adding to it, or splitting it, which creates new smaller shapes similar to the original. The instructions are then applied to these new smaller shapes, and the process repeats again and again, ad infinitum. A fractal tree, for instance, can be created by splitting the original "trunk" into two thick branches that are smaller copies of the trunk. These two branches in turn each split in exactly the same manner, and the process repeats again and again as smaller and smaller branches grow on the tree.

Anton Bakker
Koos fractal tree II, 2020
Design - Koos Verhoeff
Patinated Bronze, Height 5 foot tall

Anton Bakker
Koos fractal tree II, 2020
Design - Koos Verhoeff
Patinated Bronze, Height 20 inch

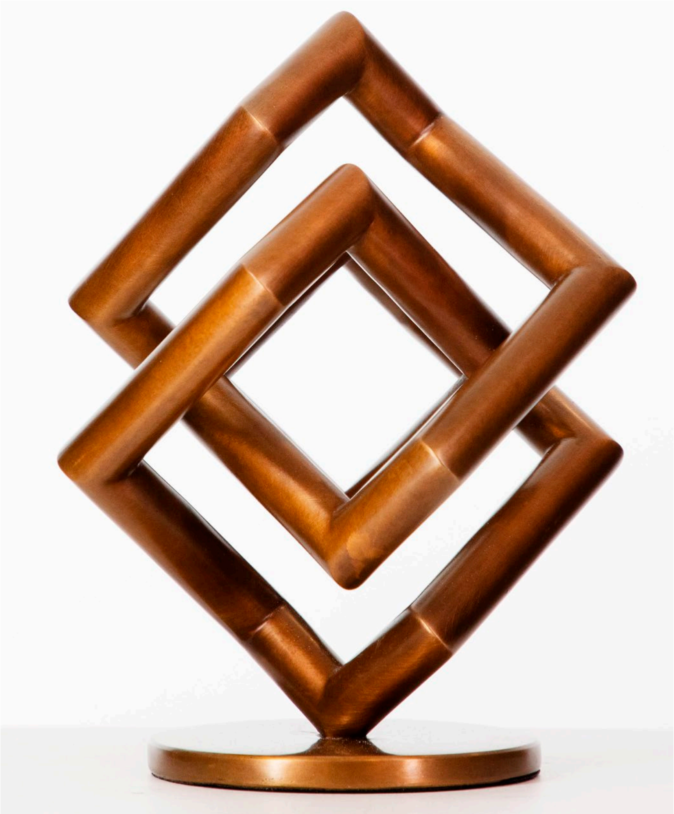
Anton Bakker
Koos fractal tree II, 2020
Design - Koos Verhoeff
Patinated Bronze, Height 20 inch

Optical illusions

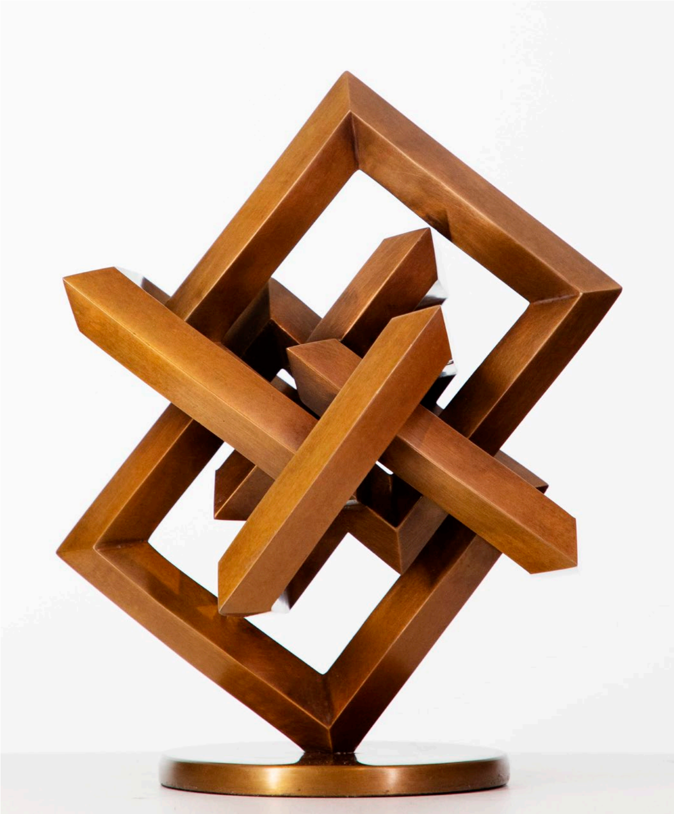
Optical illusion is a playground for artists. Every artist who depicts a solid, "real" object on a 2-dimensional canvas strives to create the illusion that the object viewed is 3-dimensional; the artist can employ a host of visual tricks to accomplish that goal. For centuries, masters of trompe l'oeil (fool the eye) have created illusory cornices, windows, balconies, and doors to enhance or enliven otherwise bare walls.

In 3-dimensional space, artistic tricks are not needed to produce illusory images. Instead, our eyes and brains themselves supply us with illusions: we see, or think we see, something that is not really what it is. If you look straight into a shallow round bowl, for example, your brain might not be able to determine if the shape is concave (scooped out) or convex, like a mushroom's dome.

The viewpoint from which we observe a 3-dimensional object can be crucial to our "seeing" and understanding the object. Unless the object is transparent, we cannot see parts of it that are obscured by other parts covering them. We can only see a projection, or shadow, of what is directly in front of us. Bakker capitalizes on this property so that his sculptures provide teasing optical puzzles: if I observe the sculpture from this viewpoint, can I guess the full sculpture's shape? Only by rotating the sculpture in space, viewing it from many angles, can you discover its surprising symmetries.



Anton Bakker
Opus 12570, Two Squares Optical Illusion, 2021
Patinated Bronze
10 inch (25 cm)



Anton Bakker
Opus 548001, Ode to M.C. Escher, 2021
Patinated Bronze
10 inch (25 cm)

Leila Heller Gallery would like to thank Anton Bakker for all his support
to make this amazing exhibition successful.

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Front and back covers:

Opus 980011 – Curved Cubic Cycle, 2021
Patinated Bronze 20 in / 50 cm

Interior Covers: Front
Cubic Space, 2021
Patinated bronze 20 in / 50 cm

Interior Covers: Back
Opus 875123 – Curved Cubic Cycle, 2021
Patinated bronze 20 in / 50 cm


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