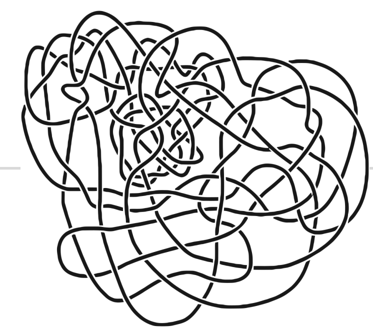
# Nicole Ondre: Primes

## July 8 – August 26, 2023

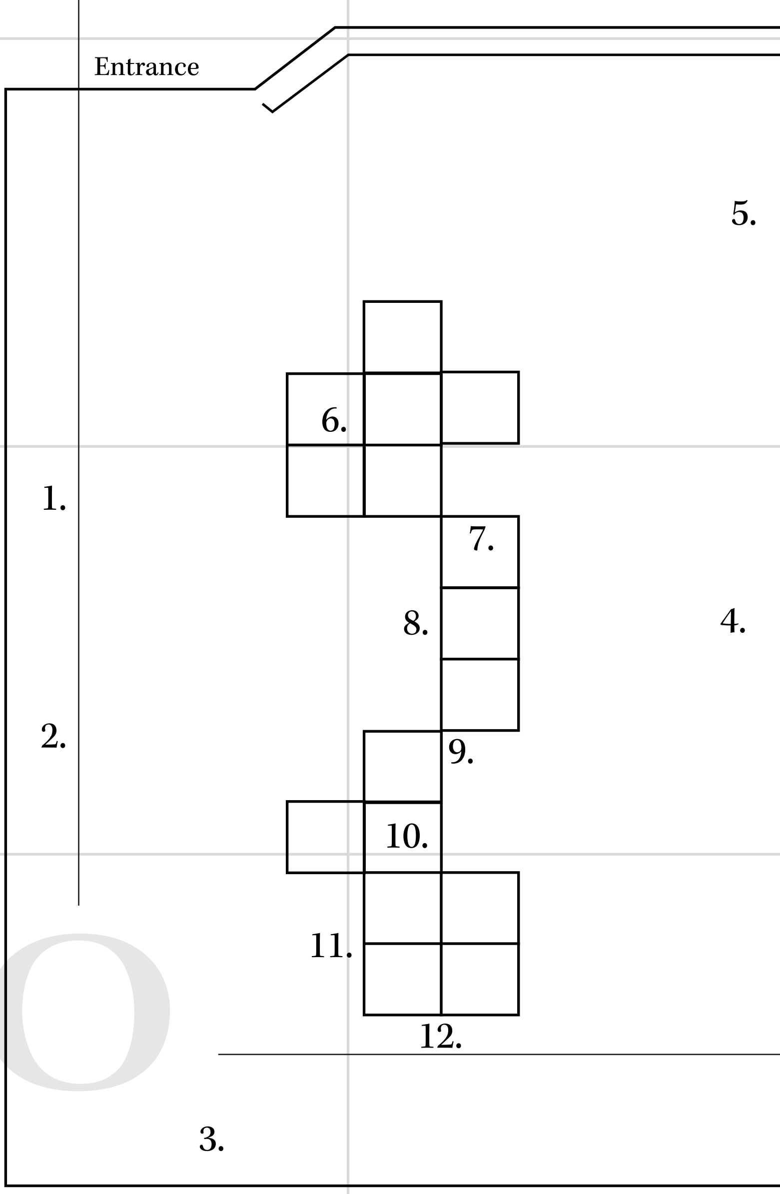
Tabulating knots is representative of the kind of mathematical logic generally foreign to the visual arts and rightly or wrongly reserved for the scientific disciplines. Because of this, the artist's solution to logical exercises is to cheat. When a system presents its boundaries, the artist rarely submits, slicing the Gordian knot apart rather than solving it as Alexander the Great did—or eschewing the puzzle entirely, as Ondre does, obfuscating the knots rather than clarifying, interpreting rather than enumerating. On the other hand, pure mathematics and art coincide at a single radical point, which is precisely where both practices admit no necessary or conventional correspondence with the "real world."

If you cross your arms naturally and take a piece of string in each hand, then slowly unfold your arms, the string will be tied into a trefoil knot that has three crossings and is the simplest non-trivial knot. Imagine your hands fused with the string, making your arms and body one big topologically distorted strand in the knot. As it turns out, executing the same operation with your legs, crossing them in either the half or full lotus position, and grasping a string with your toes before unfolding your body will yield only the unknot: a knot with zero crossings—a closed loop, a ring, a circle, *ensō*.



It is not uncommon for mathematicians to try their hand at aesthetics. Mathematicians' websites often have links to pages populated with colourful but gaudy digital diagrams built with computer software. These illustrations mark the true chasm between pure mathematical abstractions and artistic sensibility. Twice this author has submitted paintings of his own, based on mathematical tiling, to the mathematicians who discovered them. It would not be an overstatement to say the paintings were met with withered fanfare. One mathematician went so far as to suggest that the painting buried the unique mathematical properties with visual form, thereby completely losing their *raison d'être*.

"Spontaneous Knotting of an Agitated String" is a 2007 study that analyzed the spontaneous formation of knots by tumbling a string inside a box. Complex knots were easily formed within seconds and the probability P of knotting approached 100 percent with longer flexible string. In 3,415 trials, all prime knots with up to seven crossings were observed.[1]




1. *$11_{509}$* 2023. 34"x 6"x 3", Glazed ceramic.
2. *$9_{11}$* 2023. 38"x 6.5"x 3", Glazed ceramic.
3. *Sequence,* 2023. 16"x 18"x 5", Underglaze on ceramic.
4. *$6_1$* 2023. 4"x 19"x 4", Underglaze on ceramic.
5. *$8_2$* 2023. 36"x 10"x 4", Glazed ceramic.
6. *$8_{17}$* 2023. 4"x 32"x 18.5", Glazed ceramic.
7. *$8_{11}$* 2023. 7"x 23.5"x 12", Glazed ceramic.
8. *Catcher,* 2023. 5.5"x 42"x 18", Glazed ceramic.
9. *$10_{102}$* 2023. 4"x 22"x 13.5", Glazed ceramic.
10. *$7_4$* 2023. 4"x 13.5"x 18", Glazed ceramic.
11. *$8_{16}$* 2023. 3"x 6.5"x 35.5", Glazed ceramic.
12. *$9_2$* 2023. 6"x 25"x 5", Glazed ceramic.

To date, the compendium of non-trivial prime knots has been tabulated for up to nineteen crossings with a total of 352,152,252 distinct objects.[4] However, "the major challenge of the process is that many apparently different knots may actually be different geometrical presentations of the same topological entity, and that proving or disproving knot equivalence is much more difficult than it at first seems."[5]

Ondre performs her sculptural activities by interpreting a score. She has selected a set of mathematical objects called prime knots, the diagrams of which she interprets into the ceramic forms she builds, glazes, fires and exhibits on the floor and on the wall.

Question: “Does the dog have Buddha nature or not?”
Answer: “MU!”

The pieces are as at home on the floor or a table, where they settle comfortably, as on the wall, where they appear to hang naturally: some as though gravity has caused them to stretch a little and others in a taut way, presenting themselves like a cat’s cradle or stretched lips.

Could there be an erotics of mathematics? A sensuality of diagrammatic space? The corporeal aspect of eroticism is more than essential, but what about the mind? Psychedelic experiences may offer a commingling of diagram and sensation, but the intoxication erases deductive reasoning. In what way can one *feel* a logical set of steps or a collection of notations and formulas? It seems easy to imagine a musician excited by their score; therefore, it is not a stretch to picture the heart quickening when presented with the potentials offered in the tabulation of mathematical knots. “Mathematics may be looked to not only for ‘correct answers’ but for strategies of cognitive intuition.”[6] This perspective is important to consider, because there is a tendency to think of mathematics as a form of deductive reasoning only, forgetting the creative apprehension necessary to solve complicated problems and the pleasures offered by the miracle of thought itself. If thinking can be truly pleasurable, then we already know an erotics of the diagram is possible.

Some musicians interpret diagrams—that is, scores—which may be printed or drawn compositions of black lines and dots on a rectangular sheet of paper. The score details a coordination of time and pitch that the musician expresses by executing a series of movements with their body onto a musical instrument in order to produce on the instrument an organized collection of sound waves that are approximately equivalent to the code of the score. The musician intends for the sound waves to vibrate any nearby tympanic membranes, setting off a sequence of biological translation. A trio of tiny bone amplifications lead to liquid ripples inside the conch-like chamber of the inner ear, which motivate the hairs of the basilar membrane. Upon being wiggled and rubbed at their tips, the smallest ones—the stereocilia cells—open up to a rush of chemicals that generate an electrical signal carried by the auditory nerve to the brain. In this way, sound is a form of touch.

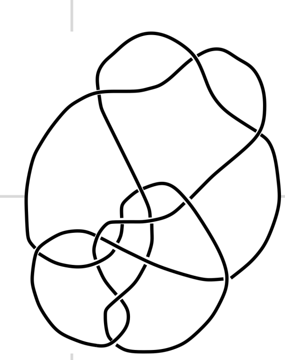
Knots exist in three-dimensional space and are not possible in two dimensions, since it does not possess enough space for the knots to be knots, with crossings where the “thread” of the knot goes over and under itself. A knot in four-dimensional space will dissolve, because the extra dimension affords the crossing loops enough space to be untangled, to fall or be lifted over and through one another. The crossings appear in Ondre’s work as primary aesthetic events, where the hollow clay tubes she has extruded fold and settle over one another, and where coloured glazing materials mark valleys and crevices between the strands of the hardened clay cords.

[1] Dorian M. Raymer and Douglas E. Smith, “Spontaneous Knotting of an Agitated String,” *PNAS* 104, no. 42 (2007).
[2] Eric W. Weisstein, “Knot,” MathWorld–A Wolfram Web Resource, last accessed June 30, 2023, https://mathworld.wolfram.com/-Knot.html.
[3] Martin Gardner, *Knots and Borromean Rings, Rep-Tiles, and Eight Queens* (New York: Cambridge University Press, 2014), 18.
[4] Benjamin A. Burton. “The Next 350 Million Knots,” *36th International Symposium on Computational Geometry*, no. 25 (2020).
[5] “Knot tabulation,” Wikipedia, last modified November 5, 2022, https://en.wikipedia.org/wiki/Knot_tabulation.
[6] Gilles Châtelet, *Figuring Space: Philosophy, Mathematics and Physics*, trans. Robert Shore And Muriel Zagha (Alphen aan den Rijn: Wolters Kluwer, 2000), xii.

Eli Bornowsky from in that been a from work a abstract math has exhibited studied BFA Emily Carr University, Vancouver significant of mysticism, a of colour. array takes Bornowsky produced art, holds art. from painting, with MFA Bard College, Annandale-on-Hudson, New York. abstract at emphasis and and is He his references a forefront around has wide science, has of Eli work at to lives New York City the special a and White Columns (Online) dialogue on and painter Bornowsky an Frequently Recently King’s Leap, NY exploratory who been approach drawing on body consistently Kayokoyuki, Tokyo.

“In mathematics, a knot is defined as a *closed*, non-self-intersecting curve that is embedded in three dimensions and cannot be untangled to produce a simple loop (i.e., the unknot). While in common usage, knots can be tied in string and rope such that one or more strands are left open on either side … [t]o a mathematician, an object is a knot only if its free ends are attached in some way so that the resulting structure consists of a single looped strand.”[2]

Ondre reverses the topologists’ accounting procedure. Whereas knot theorists notate, naming distinct knots with polynomials, for example, Ondre improvises with the mathematical accounting. She begins by sketching each knot with a rope or bicycle tube, and then, once the prime knot’s crossings are in place, she manipulates the looping lengths. As long as the order of the knot crossings persist, all the plastic stretching, drawing, flattening and distorting of the knot will be homeomorphic to the original diagram, although it may be difficult to identify in the end. The distorted figures approximate intestinal skeins, elongated labial wrinkles, baroque crumpled fabric folded around the crossed legs of a sitting monk or the squished graph of a polyhedron or crystal. Each piece is calligraphic too, as if a hand-scribbled signature has been connected by its tail to its head.



There are approximately 3.7 x $10^{13}$ cells in the average human body. Each cell contains 1.8 metres of DNA. (Laid end to end, the human body contains 67,662,298,079 kilometres of DNA.) The DNA is densely tangled up, twisted and linked inside the nucleus of each cell. To be replicated well, the DNA must be untangled. The mechanism by which the topoisomerase and recombinase enzymes untangle the strands is not observable in the laboratory, but knot theory and tangle calculus present a model to understand how the action takes place two trillion times per day.

Topologists often suggest rubber as the malleable material that one should imagine in order to visualize how specific properties of an object are preserved through continuous change of shape or size. For example, a circle, a square and a triangle are all topologically the same; that is, each figure is a closed curve that separates the plane into two parts (an inside and outside). Or, to put it another way, each figure has one hole. But clay is an equally good material as—or even better than—rubber for physical topological experiments and especially sculpture. Lacking elasticity, clay does not spring back to its original shape; rather, it records the sculptor’s sense of touch.

The knot diagrams could be thought of as musical chords, but instead of denoting a set of pitch intervals, they designate a collection of crossings, over and under, alternating or otherwise, which is called the “order” of the knot: “the minimum number of crossings to which the knot may be reduced by deformation.”[3]

Written and designed by Eli Bornowsky, based on Peter S. Ozsvath’s *Grid Homology for Knots and Links.*