

Form and Forming

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This article is the preface to a book-in-progress, tentatively entitled “To the Infinite and Back Again: An Introduction to Projective Geometry through Self-Study.”

PICTURE A TRIANGLE — to start with, an equilateral triangle (i.e. a triangle with all three sides of equal length). Next, picture one of the three sides getting longer. Observe which sides and angles change also and which do not. Next, let one angle get larger (or smaller). Again, observe the whole triangle in its changing and unchanging aspects. Continue to transform the imagined triangle willfully and wakefully. Let it take on all kinds of shapes. They can be acute, right, or obtuse triangles. Conclude by transforming the triangle back into an equilateral triangle.

Now, picture a circle. Let the circle gradually get larger without displacing its center. Let the circle become very large. Next, let the circle contract and get very small, but don't let it disappear into the center. Let it expand and contract again several times. End with the mental picture of a well-formed circle of a comfortable size.

Each of these two picturing exercises may take several minutes. While they seem to be simple they can serve as concentration exercises and assist us in gaining focus and becoming centered.

Reflections on the Exercises

In the triangle transformation exercise, we cannot change a part without changing the whole.

Every concrete triangle has a certain shape and size. It and all its parts are specific. By mentally transforming an imagined triangle we overcome the specificity. The pictured triangle becomes fluid, but is always governed by the formative principle of triangle-ness.

When we draw a triangle, we must always draw a specific one. Placing two triangles next to each other, we can ask, “How can I transform the one into the other?” In mental picturing, we can perform a fluid, continuous

transformation from one shape into the other. On paper, we cannot do that. We have to draw separate “snapshots” in order to indicate a continuous transformation.

The idea, *triangle*, is inherent and expressed in every particular triangle. It in-forms it. While we can picture and draw particular triangles, and while we can picture a continuous triangle transformation, we cannot picture the idea itself. It remains invisible, so to speak, but is nevertheless at work in every imagined triangle and in every triangle we find in the world.

The idea of a triangle or circle can be articulated as a definition or a verbal description. That way the idea might remain abstract. When we perform the triangle transformation exercise, in contrast, the idea becomes palpable. We transform each triangle in accordance with the idea. In our inner activity we put to work and experience the idea as a formative principle.

When we do the circle-picturing exercise after the triangle transformation exercise, we can experience the contrast between these two different form principles.

With these mental exercises we have entered the (soul) space where all true mathematical activity takes place and where we are open to ideas. It is not through looking into the outer world—for instance, not through measuring angle openings or lengths of line segments—that we arrive at insights that hold true for all triangles, or all circles. Drawings can support us in our work; we might need them. However, the actual mathematical reasoning is a pure thought process.

Although mathematical truths about triangles cannot be found by empirical means, no triangle in the outside world will contradict these truths.

One virtue, therefore, of engaging in mental picturing exercises is that we learn to be present in that thought space and to dwell in it with full consciousness, intention, and clarity. We learn to work and observe in that space. Picturing is an inner activity. It takes effort to willfully form and transform mental images of geometric forms.

It is possible that I picture concentrically growing or contracting circles or changing triangles only as I have

seen them in animations. In that case, the inner activity of creating and transforming the form is missing. It happens without me. I am a mere onlooker. The inner involvement, however, is what matters. Without it, there is no exercise.

Such inner work can help us practice the kind of active thinking we need in order to explore the formative principles at work in nature, in plants, in animals, as well as in social life. In this book we will make ample use of mental transformation exercises. Projective geometry offers a wealth of opportunities to practice active thinking.

Working with Clay and with Freehand Drawing

For some people, forming, holding, and transforming mental images of a geometric form is not easy, or may even be impossible. In that case, there are other ways to facilitate a deepening experience of form and forming.

Forming a sphere with clay can be one of them. We can form it from the inside out by putting small pieces of clay together and gradually forming a sphere. Or we can take a fist-sized clump of soft clay and form it into a sphere from the outside by gently pressing it into shape with outstretched palms of both hands.

Another very effective technique to assist in grasping geometric forms more fully and creatively is freehand drawing. Drawings of concentrically growing or contracting circles can be done after the freehand drawing of a circle has been practiced. A large piece of paper (“newsprint” quality is inexpensive and suits the purpose) is taped onto a table surface. You draw with crayons or fat, colored pencils while standing. First you take time to form an inner, mental image of a circle. Then you move your hand in a circling motion above the paper, shaping the form in the air before finally lightly tracing it on the paper.

When I introduce the exercise in a workshop and draw a freehand-circle on the black board, I step back and take a look. What I have drawn is not a perfect circle. While we might not be able to do a better job, we all are able to perceive how the form on the board deviates from the ideal. We easily see where it is dented, bulging, lop-sided, or egg-shaped. This tells me that we all carry the ideal circle within us, and that the outward appearing form with its imperfections evokes for us the ideal form.

I once learned about a professional potter who was able to throw a perfect bowl or cup on her potter’s wheel at any time. It was a high skill and, for her, routine. If a cup, however, did turn out less than perfect, it was regarded as special and sold for more!

I sometimes begin a course with a group exercise. The room is set up for freehand drawing and the tables are placed in a loop. After preparing as described above, we each draw lightly a large freehand circle on the paper in front of us, to the best of our ability—just one single line. Then we put the crayon down and, on a signal that I give, we all move to the next station on our right. We pick up that station’s crayon, observe the form in front of us, acknowledge its imperfections, and draw a second form overlaying the first (always only a single line) by trying to improve it. When done, we put the crayon down and, together, move on to the next place. We continue until we return to the place where we started. Here, with more pressure on the crayon, we finalize the shape.

The outcome of this exercise is always reassuring. Each form has been worked on by every member of the group. (In case of a big group I form smaller groups of eight to twelve people.) We experience that collaboration is constructive and helpful. A critical eye that detects imperfections is asked for. We correct each other’s work. We sometimes experience that we can get caught in the existing form and are not able to change it forcefully enough. It takes confidence and trust to even out a bulge or lopsidedness. The forms in the end are pleasantly round and well-shaped, each a successful group effort.

Inviting collaboration and replacing our widespread competitive social habits as learners with helpful interactions and interest in each other’s work are keys to a positive learning experience.

