Bending the Parabola, Breaking the Circle: The Idea of a Cusp in *Gravity's Rainbow*

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Among the images from mathematics appearing throughout *Gravity's Rainbow*, two particular curves dominate. One, of course, is the titular parabola, which, as Steven Weisenburger points out, symbolizes "disease, dementia, and destruction" (10). The second is the circle. Weisenburger observes that "drinking games and dances move in circles; the Herero villages used to be arranged mandala-like; and in every episode are windmills, buttons, windows, eyes, Ferris wheels, roulette wheels, rocket insignia, and other cast-down indexes of the novel's grand cycling" (11); and "*Gravity's Rainbow* is not arch-shaped, as is commonly supposed. It is plotted like a mandala" (9). The book's circular structure becomes readily apparent in the last episode, when the descent of the rocket toward the movie theater seems to reflect the "screaming [. . .] across the sky" (GR 3) that begins the novel.

A third mathematical concept occurs frequently in the novel as well: the idea of a singular point on a curve. The mathematical definition of a singular point holds that at such a point the first derivative fails to exist. More intuitively, a singular point is a place where a curve has either a break or a sharp corner. Lance Ozier points out that singular points are associated in *Gravity's Rainbow* with "the idea of transformation from one world order into another or from one state of being into another" (203).

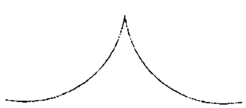

Fig. 1

Mathematicians recognize several types of singular points, but *Gravity's Rainbow* gives special attention to one, the cusp. In mathematics, a cusp is a singular point on a curve where a sharp point occurs. Near such a point, the curve looks like a needle-sharp mountaintop with curving slopes (Fig. 1). Circles, with their uniform resistance to straightness, their gentle insistence on repetition, have no cusps. Parabolas are also cusp-free, despite the threat of destruction (and hence transformation) associated with them in *Gravity's Rainbow*. However, both of these curves do possess latent cusps, which can be revealed by breaking the curves, and the image of a cusp breaking either a parabola or a circle occurs several times in the novel.

Many images of cusps appear in a passage listing examples of singular points: "All Margherita's chains and fetters are chiming, black skirt furled back to her waist, stockings pulled up tight in classic cusps by the suspenders of the boned black rig she's wearing underneath." The "holy minarets" and "rose thorns" mentioned a few sentences later are other examples. The other singularities in the passage—"cathedral spires [. . .] the crunch of trainwheels over the points as you watch peeling away the track you didn't take . . . mountain peaks rising sharply to heaven [. . .] the edges of steel razors [. . .] the infinitely dense point from which the present universe expanded" (396)—are not necessarily cusps. Mountain peaks and razors are sharp, but may not have the inward-curving property required to be cusps.

The idea of a cusp is singled out in the episode where Miklos Thanatz is pulled from the Oder Haff by the metal-clad Polish undertaker who is making a special effort to get struck by lightning. The narrator describes how a lightning strike causes a "discontinuity in the curve of life," the curve which, for most people, has "ups and downs that are relatively gradual [. . .] with first derivatives at every point." Pynchon's image for a sudden change of direction in this curve is not just any "singular point," but a cusp: "do you know what the time rate of change *is* at a cusp? *Infinity*, that's what! A-and right across the point, it's *minus* infinity!" (664).

In this description, Pynchon's mathematical training serves the narrator well. He recognizes that the cusp is distinct from other singularities in that its first derivative (the time rate of change) must take an unimaginably huge leap. The change in the time rate of change itself from infinity to minus infinity at the "Δt across the point" (664) means that an imaginary person walking from left to right along a curve with a cusp must struggle against gravity more and more as she nears the cusp. The climb becomes progressively steeper until she reaches the top, but after she clears the top, there is an instantaneous period (a delta-t) of free fall, after which the person slides down a slope which becomes gentler the further down she goes. So a moment of impossible struggle changes to a moment of complete freedom.

The novel associates cusps, like other singular points, with transformation, but identifies cusps specifically with *sudden* transformation. In fact, two types of cusp appear in the novel. One is the survivable cusp, such as the death of a member of one's family or the realization that one is falling in love. Pynchon's Polish undertaker hopes his lightning-bolt experiment will enable him to better understand the effect of a survivable cusp: "He wants to know how people behave

Fig. 2

before and after lightning bolts, so he'll know better how to handle bereaved families" (665). The other type is the nonsurvivable cusp, such as death itself, but especially sudden, violent death, exemplified by rocket strikes in the novel. The lightning strike seems to exist at the boundary between these two types of cusp: sometimes one survives being hit by lightning, and sometimes one does not. Those who survive are transported:

> It will *look* like the world you left, but it'll be different. Between congruent and identical there seems to be another class of look-alike that only finds the lightning-heads. Another world laid down on the previous one and to all appearances no different. Ha-*ha!* But the lightning-struck know, all right! Even if they may not *know* they know. (664)

Hence a person who survives a lightning strike achieves a moment of transcendence. Whether this is a good thing or not is ambiguous. For, as the narrator describes, the lightning-heads go on to form secret societies, keeping their insights to themselves and excluding those not in the know. So the survivable cusp can be viewed as bringing people together (like the circular symbols) or as separating people (like the rocket's parabola).

Either a circle or a parabola, both normally cusp-free, can be transformed in such a way as to create a cusp. With a circle, all one has to do is cut it at any point and then rotate half the circle within its plane 180 degrees about the point antipodal to the cut; the cusp will appear at the antipodal point (Fig. 2). A parabola (oriented so it resembles the path of a rocket after *Brennschluss*) should first be rotated within its plane 90 degrees about its highest point, and then have its upper half (in this new orientation) rotated another 180 degrees; the cusp will appear at the highest point on the curve (Fig. 3).

Thus cusp formation can be viewed as bending the parabola or breaking the circle. Both parabolas and circles have very specific

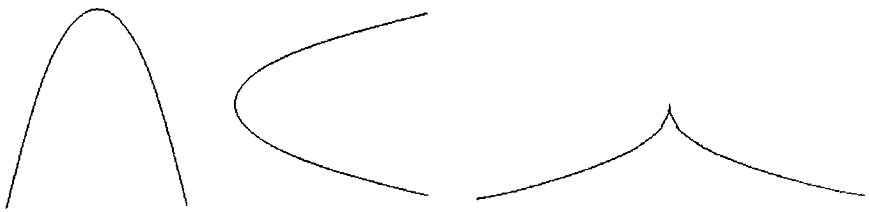

Fig. 3

definitions. To identify a curve as a circle, one must be able to find a point P (the center) and a distance r (the radius) such that the curve consists of all points in the plane that lie r from P. To identify a curve as a parabola, one must be able to find a line l (the directrix) and a point F (the focus) such that the curve consists of all points in the plane that are the same distance from both l and F. The transformations described above create curves that fail to meet the criteria for either a circle or a parabola.

While it is true that any curve, such as a straight line (in mathematics, curve is a broad category of objects which includes straight lines), can be bent in such a way as to form a cusp, a straight line would require a large degree of bending to form a cusp, and to describe precisely how to carry out this deformation would be difficult. With a circle or parabola, however, the cusp is latent in the original curve, and it only takes a couple of easily described rotations to reveal it. At a cusp, a curve must (for an instant) become completely vertical, and this verticality must be achieved when the cusp is approached from either its left or its right side. A circle always has two points at which the curve becomes vertical; each of these points is halfway to being a cusp before any deformations are performed. The parabola pictured above (Fig. 3) has a single point (the topmost) at which the curve is horizontal, and after the first rotation, the curve is vertical at that point; however, after the first rotation, the curve is still a parabola. (The orientation of the original parabola was chosen for its resemblance to the path of a rocket, not for any inherent mathematical reason.) So a parabola's vertex is halfway to being a cusp as well.

Several images of cusps breaking either circles or parabolas occur in *Gravity's Rainbow*. For example, in a poignant episode involving Roger Mexico and Jessica Swanlake, we are told that the "crossed arcs of Roger and Jessica are so vulnerable, to German weapons and to British bylaws" (53). The crossed arcs here are instances of cusps (falling in love) that interrupt parabolas (the respective arcs of Roger's life and Jessica's) and set them on a different course. An earlier episode details how the transformation which occurred at the cusp has affected Roger:

> And there've been the moments, more of them lately too—times when face-to-face there has been no way to tell which of them is which. Both at the same time feeling the same eerie confusion . . . something like looking in a mirror by surprise but . . . more than that, the feeling of actually being joined . . . when after—who knows? two minutes, a week? they realize, separate again, what's been going on, that Roger and Jessica were merged into a joint creature unaware of itself. . . . In a life he has cursed, again and again, for its need to believe so much in the trans-observable, here is the first, the very first real magic: data he can't argue away. (38)

This passage prefigures the cusp transformation described in the lightning-strike episode, where the "other class of look-alike" reflects the "no way to tell which of them is which." The cusp breaking the parabola here also represents in miniature the larger situation. Roger and Jessica live under the constant threat of destruction from the V-2 rockets raining on London: they live on a parabola. But, through human contact, they find momentary comfort in this horrible situation.

In a later episode detailing Säure and Gustav's ongoing debate about music, the following description of Anton Webern's death occurs:

> "Shot in May, by the Americans. Senseless, accidental if you believe in accidents—some mess cook from North Carolina, some late draftee with a .45 he hardly new how to use, too late for WW II, but not for Webern. The excuse for raiding the house was that Webern's brother was in the black market. Who isn't? Do you know what kind of myth *that's* going to make in a thousand years? The young barbarians coming in to murder the Last European, standing at the far end of what'd been going on since Bach, an expansion of music's polymorphous perversity till all notes were truly equal at last. . . . Where was there to go after Webern?" (440–41)

Webern's death is seen as the breaking of an arc in Western music which began with the development of polyphony in the Middle Ages and progressed by adding more and more harmonic complexity. The cusp is Webern's death, and at the delta-t across the cusp is Carl Orff: "'Is it finally over? Or do we have to start da capo with Carl Orff?'" (441). "Da capo with Carl Orff" signifies a break from the dodecaphonic school of Webern and a return "toward ancient patterns of rhythm and tonality" (Weisenburger 207).

Is such a return a hopeful transformation? That is, is the new world which music enters at this cusp better or worse than the previous one? Gustav sees it as a tragic end to the process of incorporating "'more and more notes into the scale, culminating with dodecaphonic democracy'" (440). In other words, to Gustav, Webern's death is a nonsurvivable cusp for western music. But Säure, who loves Rossini and rejects Gustav's idea of "'musical freedom,'" is hopeful. And his defense of Rossini reflects the survivable cusp of Roger and Jessica:

> "With Rossini, the whole point is that lovers always get together, isolation is overcome, and like it or not that is the one great centripetal movement of the World. Through the machineries of greed, pettiness, and the abuse of power, *love occurs*. All the shit is transmuted to gold." (440)

The narrator tips the balance in favor of hope by acknowledging (perhaps grudgingly, or perhaps encouragingly) that Rossini's *Tancredi* tarantella "really is a good tune" (441).

Finally, the last episode furnishes a particularly dramatic example. The novel ends with a rocket descending on a crowded movie theater in which *we* sit. This impending rocket strike is a cusp which will break the circular structure of the book—not to mention the parabola of our lives. It provides brutal though ambiguous closure. On the surface at least, this cusp is nonsurvivable: the people in the theater seem unlikely to survive the rocket strike. But ending the novel before the rocket completes its flight breaks another curve, the rocket's parabola. Thus at the end of the novel these doomed people are still alive, and again (as with Roger and Jessica, and with Säure) there is potential for hope at this cusp: "There is time, if you need the comfort, to touch the person next to you"; and ("if song must find you") "There is a Hand to turn the time" (760).

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Works Cited

Ozier, Lance W. "The Calculus of Transformation: More Mathematical Imagery in *Gravity's Rainbow*." *Twentieth Century Literature* 21.2 (1975): 193–210.

Pynchon, Thomas. *Gravity's Rainbow*. New York: Viking, 1973.

Weisenburger, Steven. *A* Gravity's Rainbow *Companion: Sources and Contexts for Pynchon's Novel*. Athens: U of Georgia P, 1988.