CHAPTER 12

Toward a Happy Life: Max Dehn at Black Mountain College

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For the historian, the purest joy is to relish the contemplation of the ups and downs of the development, of the connections, of the breaks and transitions, to try to see the divine spark in each of the creators and to relive their productive moments.
– Max Dehn [1983, p. 19].

Time decorates the grave of Max Dehn. Fallen twigs and leaves of wild rhododendron wreathe the site, bright green moss outlines the two terracotta rectangles that form his headstone, and pale blooms of lichen dapple the unglazed surface and shallow impressions that bear his name and dates. The modern type, composed of simple arcs and lines unburdened by serifs, and the well-proportioned ceramic tiles easily accommodate these natural ornaments. So does the stoneware itself, fired from found clay, a reddish-brown sediment deposited across the Appalachian landscape by thousands of years of weather and erosion.

The story of Dehn's time at Black Mountain College, to which he dedicated nearly the last eight years of his life, has been told many times. Following a series of unsatisfying appointments, the German WWII refugee mathematician found a home in the small progressive liberal arts college. Its communal form of education, European faculty – including a number of esteemed artists, musicians, and writers – and forested mountain landscape attracted him. For little more than room and board, he taught mathematics and philosophy, tutored ancient Greek and Latin, and inspired an intuitive appreciation for mathematics, often while walking nearby trails in the wooded foothills of North Carolina. Under his guidance two gifted students went on to become mathematicians, and many more benefited from his humane wisdom as well as the generous spirit that he and his wife, Antonie (Toni) Dehn, shared. One summer day, only weeks after the college granted him emeritus status, Dehn died abruptly of a pulmonary embolism probably released when he rushed up a trail to preserve a stand of flowering trees from being wrongfully cut down.

This narrative of Dehn's Black Mountain years, as spare and inviting to elaboration as his grave marker, has accommodated what evidence has surfaced since it was first presented in 1967 by his friend and former colleague Carl Siegel [Siegel, 1979]. By contrast, accounts of the college in the intervening decades have evolved dramatically. For the historian of visual, literary, or performing arts, Black Mountain College (1933–1957) signifies one of the most "productive moments," to borrow

Dehn's words, in the cultural history of America. Over time, it has come to represent an experimental and interdisciplinary avant-garde that overtook and surpassed modernism. This chapter aims to reconsider Dehn's engagement with Black Mountain College in relation to the creativity and productivity that marked his life as a whole and to the pedagogical ideals and avant-garde imagination that have become the college's legacy.

Our portrait of the mathematician of Black Mountain College draws from his 1930s publications on the nature and origin of mathematics and the arts; course notes made separately by Dehn and by three students from his 1948 class Geometry for Artists; his undated manuscript entitled Psychology of Mathematical Activity; and college records that express his philosophy of education. Like many histories of the college, ours relies also on interviews and remembrances of faculty and students documented by others.[1]

"Max Dehn was a sort of mental 'Windex'," according to student Harry Weitzer. "He encouraged you to look through windows previously opaque, to think about dense subjects like Death, what is a Number(?), and Love. Few subjects failed to interest him, and through him, you" [Weitzer, n.d., p. 2]. The metaphor puts Dehn shoulder-to-shoulder with his students, looking out from the same side of their mental windows. In this way he shared with Josef Albers, the artist-teacher responsible for the college's educational structure, the goal "to open eyes." As Albers emphasized the perceptual rift between "physical fact and psychic effect," [Albers, 1963] Dehn was developing a psychological foundation of elementary mathematics that incorporated non-logical elements. Archival materials suggest that Dehn and the college further absorbed and clarified each other's instructional aims and creative possibilities in the 1949–1952 period between Albers's departure and the appointment of poet Charles Olson as college rector, the beginning of what was arguably Black Mountain College's most experimental final chapter before it dissolved in 1957.

A visit to Black Mountain College

Black Mountain College was established in the foothills of the Blue Ridge Mountains of North Carolina (Figure 1) by a group of disgruntled academics who, led by John Andrew Rice, a classicist and follower of philosopher John Dewey, had resigned from Rollins College in Florida. Accompanied by a small coterie of devoted students, they were in search of greater academic freedom, especially freedom from bureaucratic and high-handed administrators. As an acolyte of Dewey, whose theory of education was frequently broadly summarized as "learning by doing," Rice set out to make hands-on art education central to the general liberal arts curriculum then customary at American undergraduate colleges.

These events, which coincided with the Nazis' closing of the by then internationally known Bauhaus in Germany, resulted in the Bauhaus teacher-artists Josef Albers and his wife Anni Albers being invited to form the core of the educational

[1] The primary archives we consulted are: the Max Dehn Papers ("Dehn Papers") in the Archives of American Mathematics, The Dolph Briscoe Center for American History, The University of Texas at Austin; the Black Mountain College Project Collection and BMC Archives in the Western Regional Archives, North Carolina ("BMC Archives"), and the Ruth Asawa papers, Dept. of Special Collections and University Archives, Stanford University Libraries, Stanford, California ("Asawa Papers").

FIGURE 1. Studies Building across Lake Eden, Black Mountain College, ca. 1940s. Photograph by Claude Stoller.

framework for Black Mountain College. As Josef expressed it in the college Bulletin: “art is a province in which one finds all the problems of life reflected – not only the problems of form (e.g. proportion and balance) but also spiritual problems (e.g. of philosophy, of religion, of sociology, of economy). For this reason art is an important and rich medium for general education and development” [Albers, 1934, p. 2]. After 1934, as events in Europe escalated towards war, several scholars from the continent, drawn by the strong presence of the Alberses, began arriving. Among them were psychiatrists Fritz and Anno Moellenhoff, Swiss artist and theater designers Xanti and Irene Schawinsky, Viennese conductor Heinrich Jalowetz, and psychiatrist Erwin Straus. The Dehns were among the later arrivals.

The college invited Dehn as a guest speaker early in 1944. At the time, he was a tutor at St. John’s College in Annapolis, Maryland on a temporary appointment, and Toni was enrolled at the Art Institute of Chicago to resume studies begun decades earlier at the Kunstgewerbeschule in Hamburg before their marriage. Decades later she would recount that the Dehns’ contact at Black Mountain College was Erwin Straus [Harris, 1978]. Straus had coauthored a pair of papers [Straus and Wohlwill, 1924a,b] with Friedrich Wohlwill, a physician and neurologist at St. Georg Hospital in Hamburg and the brother-in-law of Max’s sister Hedwig (Dehn) Wohlwill.

As reported in the Community Bulletin, Dehn’s March 16th lecture told “the story of twenty-five thousand years of development in mathematics in a humorous, refreshing manner,” that made “the subject quite interesting for even the layman.”

The enthusiastic account, signed by student Flora Ricks, ends with the following elaboration of Dehn's theme:

> Animals, he pointed out, recognize units and pairs; and prehistoric man decorated his cave walls with geometrical forms. The development of symbols is a necessary preliminary to progress in Mathematics, and this was begun in about 2000 B.C., by the Babylonians. However, an essential method of solving problems, that of proof, was invented by the Greeks. It is interesting to note that although many fundamental theorems were proved thousands of years ago, it has not been until comparatively modern times that their importance has been recognized as the basis upon which all metrical geometry, prospective [sic] geometry and the mathematics of precision can be built.[2]

Brief as it is, the record suggests that Dehn's historical survey of mathematics impressed on the audience several features that distinguish his rather unusual perspective on the discipline, one that sees mathematics as: a basic capacity of human (animal) beings; rooted in a prehistory that coincides with the prehistory of art; a practice that, despite the importance of its symbolic notation, is defined by proof, not computation; and a science whose modern ideas rely crucially on insights that originated in antiquity. Implicit in this view of mathematics is that its history is a history of ideas. "Dehn saw the progress of mathematics in the conception of new ideas," his PhD students later recalled, "not in investigations into special cases and generalizations. His admiration was for creativity" [Magnus and Moufang, 1954, p. 224].[3]

Readers by now familiar with Dehn's contributions to the modern foundations of geometry and its exposition (cf. Chapters 2, 3 and 5) will infer what "fundamental theorems ... proved thousands of years ago" may have interested him, and through him, his listeners. In a 1928 address to a non-specialist audience at Frankfurt University, "The Mentality of the Mathematician," he had emphasized the belated appreciation of the Archimedean postulate, the "foundation stone of ... any ... rigorous theory that proposes to harmonize arithmetic and geometric phenomena" and the roots of projective geometry, which "deals with the remarkable and beautiful properties of figures that remain invariant under projection. But in antiquity the problem was not formulated in full generality. After the Renaissance, when interest in projective geometry was inspired by the use of perspective in painting, the problem was first treated in typically modern fashion ... " [Dehn, 1928]. At the time of his Black Mountain visit, Dehn had just reinscribed these ideas, among others, in English for a series that *The American Mathematical Monthly* editor hoped would "cover the whole history of mathematics in compact form" [Dehn, 1943, p. 357n]. In the month of March, 1944, he completed the fourth of four installments, to which Toni contributed illustrative maps of the ancient world.

Whether or not the *Monthly* series served as a draft of Dehn's guest lecture, it offers vivid examples of his philosophical and pedagogical approach to certain

[2] BMC Community Bulletin 1943-44 #24 p. 5, BMC Archives.

[3] Unless stated otherwise, translations are our own, with significant help from Peter Kalal, Jon Ording, and Google.

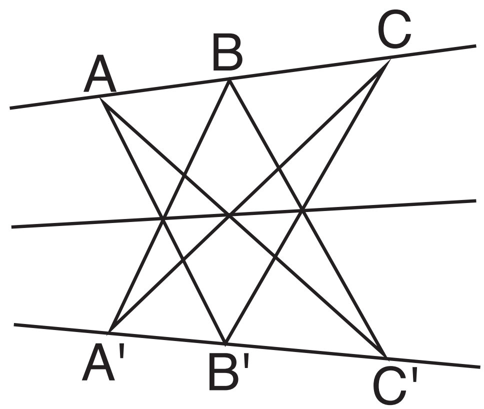

FIGURE 2. The theorem of Pappus: "Let A, B, C, be three points on one line, A', B', C', three points on another line, then the lines AB' and BA', BC' and CB', CA' and AC', respectively, meet in three points lying on one line" [Dehn, 1944b, p. 153].

key concepts in courses he would develop upon his appointment to the college.[4] Prominent among these is the idea of *configuration*, which Dehn attributes to a theorem of Pappus of Alexandria (Figure 2), circa 300 C.E.: "This theorem marks an event in the history of geometry. From the beginning geometry was concerned with measures: lengths of lines, areas of plane figures, volumes of bodies. Here we have for the first time a theorem which is established by the ordinary theory of measures but is itself free of all elements of measurement; it states the existence of a figure which is determined through the incidence of lines and points only. It is the first 'configuration' of projective geometry, and it was shown more than 1500 years later that this configuration alone is sufficient to build up projective geometry in the plane" [Dehn, 1944b, p. 153].

Dehn's correspondence in advance of his visit offers some clues about his interests and intellectual attraction to Black Mountain College at the time. In a letter to Erwin Straus dated February 9th, 1944, he proposed a few different subjects for his guest lecture, "I might speak about The Psychology of Mathematical Activities or about Common Roots of Mathematics & Ornamentics or Some Moments in the Development of Mathematical Ideas. Please let me know which subject you and your community prefer. Looking forward to getting your critical remarks on my papers."[5] Neither Dehn nor Straus identify in their correspondence the papers to which Dehn refers. They may have been installments from the *Monthly* but, given the topics he suggests, it seems more likely that he sought feedback from the professor of psychology and philosophy and his celebrated arts faculty colleagues on a yet more ambitious historical investigation of a very different sort.

Psychology of Mathematical Activity is the working title of an undated 226 page manuscript preserved at the Archives of American Mathematics. It begins with the story of its beginning:

[4]Not to mention his "humorous, refreshing manner," for example when he calls Archimedes "primarily a research man" whose pride was "perhaps not the sign of a philosophical mind" [Dehn, 1944a, p. 27].

[5]Dehn to Straus, February 9, 1944, Dehn Faculty File, BMC Archives.

> Some time ago I tried to present the roots that, deep in the human soul, are common to artistic and mathematical activity. Through this consideration I came to an arrangement that seemed quite useful, especially in the art of ornamentation. Since at that time I was only able to present these things very briefly, some only in outline, I wanted to try to give a systematic presentation of ornamentation on the basis of this arrangement, into which the known forms can be clearly integrated. But at the beginning of this work I came to the question: what *distinguishes* mathematical activity from that of the ornamental artist (*des Ornamentikers*)? And after that: what is characteristic of mathematical activity at all? And here, according to the reason for the question, the main emphasis should be placed on the processes in the soul. In the beginning this seemed like a side question that was easy to deal with, but soon I got caught up in ever new general and specific questions, and I was led to make a lengthy investigation, the results of which I would like to present here.[6]

Dehn cites his own work sparingly, but one infers that the preliminary effort from "some time ago" is the pair of articles "The Mathematical Ability in Humans" [Dehn, 1932], which presents itself as "the introduction to a history of mathematics" that aims "to link the science of mathematical science with the whole of human activity"[7] and the long paper "On Ornamentation" [Dehn, 1939]. Straus selected the last topic, "Some Moments in the Development of Mathematical Ideas," and suggested that there "might be an opportunity in the art class to speak on one of your other subject[s], namely 'Common Roots of Mathematics and Ornamentics.'"[8] His only further advice was that Dehn should travel from Annapolis to Black Mountain by Pullman rather than coach.

If Dehn did speak to an art class it is difficult to imagine one more sympathetic. Josef Albers (Figure 5) based the studio courses at Black Mountain on the foundational curriculum, or *Vorkurs*, that he had studied and taught at the Bauhaus. Albers characterized the first course, Drawing, as "a handicraft instruction, strictly objective, unadorned through style or mannerism" that began with "general technical exercises: measuring, dividing, estimating; rhythms of measure and form, disposing, modifications of form" [Albers, 1934, pp. 4-5]. Exercises often involved repetition with the aim of developing line control while also expanding student perceptiveness; "disposing" assignments demanded visualizing the line ahead of the pencil to achieve symmetry, balance, and regularity. Many of the results from this class and Basic Design coincide with the ornamental forms that preoccupied Dehn, including lattices, waves, spirals, and meanders (see Figure 3).

Dehn's 1939 study "On Ornamentation" pursued a quasi-axiomatic presentation that began with rudimentary motifs before synthesizing more complex types from these. At first he considers the markings found on Stone Age pottery, in particular, a row of equally spaced marks set horizontally around an earthenware

[6] [Dehn, undated, p. 1], emphasis in the original. Section 4 below provides detailed information on the manuscript.

[7] [Dehn, 1932, p. 1], translation from [Bergmann, 2012, p. 194].

[8] Straus to Dehn, February 15, 1944, Dehn Faculty File, BMC Archive.

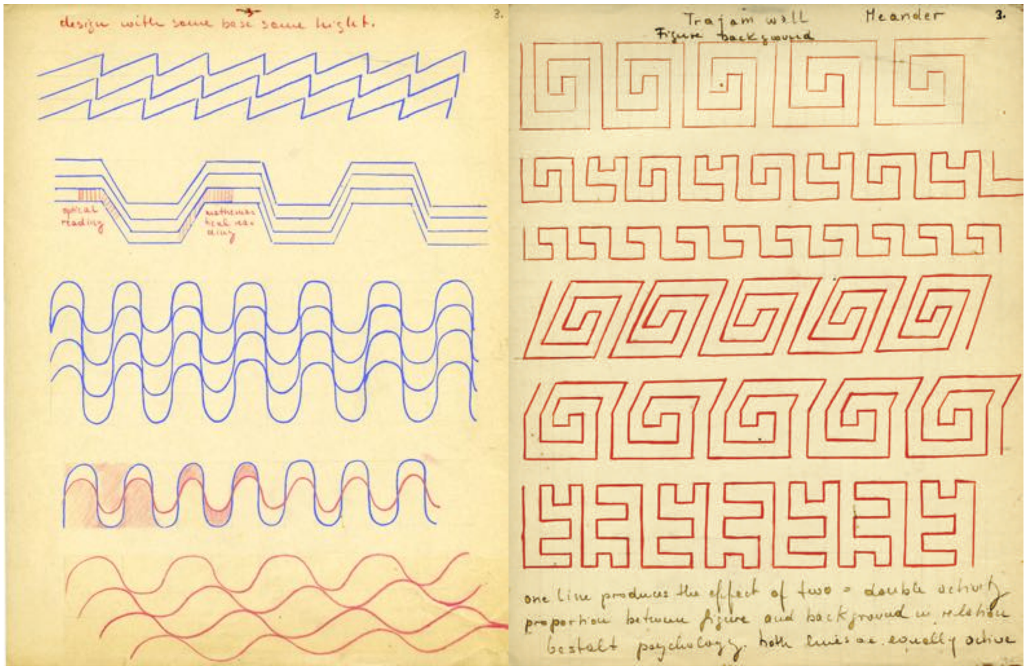

FIGURE 3. Student drawings from Josef Albers's 1945 Basic Design Course at Black Mountain College by Lore Kadden Lindenfeld.

vessel. He observed that the execution of even such a humble pattern demanded that the artist coordinate three different instances of order: the equivalence of each mark to the next mark; the equivalence of each space between a pair of marks and the space between the next pair; and the proper choice of separation so as to evenly divide the vessel's circumference. "The solution," Dehn observes, "affords satisfaction as the solution of a reckoning assignment" [Dehn, 1939, p. 130].

By stacking rows so each mark is positioned between two neighboring points of the previous row the sense of a "rule" or "higher *rhythm*" emerges. Inevitably the artist is drawn to connect the dots, thereby dividing the surface into a lattice or "two-dimensional rhythm" that Dehn celebrated as a momentous event in the history of mathematics: "this new thing, *the unintended*, is already to be denoted as a *Theorem* . . . one of the first mathematical theorems ever encountered by a human" [Dehn, 1939, p. 135, emphasis in the original]. Dehn proceeded to more complex ornaments of checkerboards, meanders, spirals, ribbons, and so forth (e.g. see Figure 4), before concluding that,

> among all these forms, only a few principles must be acknowledged, basic tendencies of the human spirit which are inextricably bound up with music, architecture, and every artistic expression. These principles are mathematical in nature and mathematical propositions are discernible in many ornaments. Thus we are able through our observations to find a connection between the beautiful works of those who create sensuous forms and the manifold shapes with which the mathematician works in the abstract [Dehn, 1939, pp. 152-3].

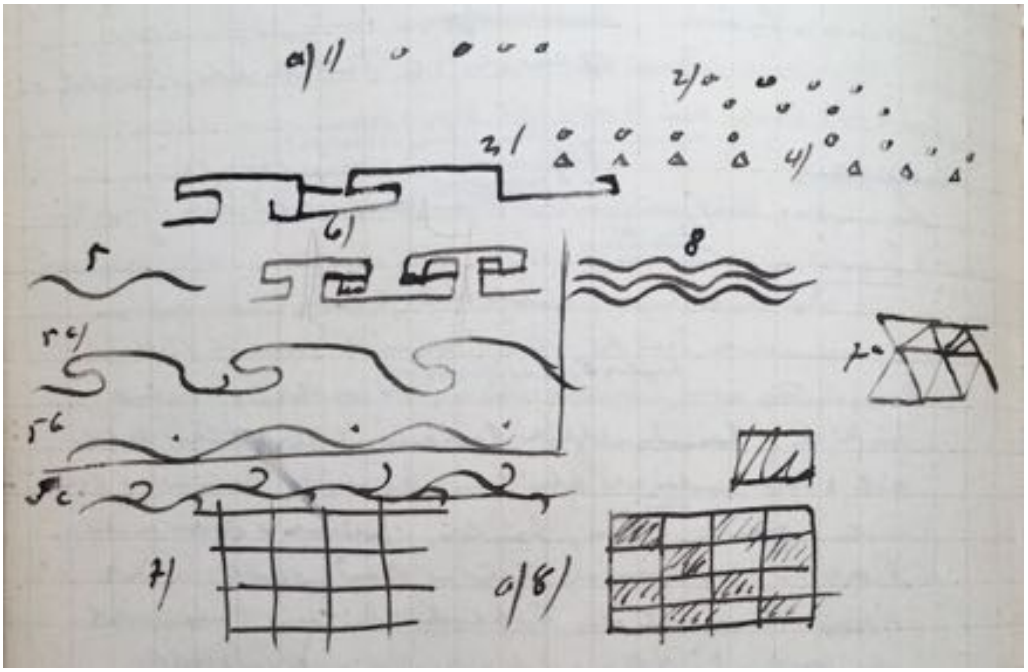

FIGURE 4. Elements of ornamentics in "Grundlagen der Geometrie" notebook, Max Dehn Papers.

Faculty appointment

The enthusiasm expressed in the Community Bulletin about Dehn's visit was mutual. According to his elder daughter Maria (Dehn) Peters, "when he was invited to visit Black Mountain College, he fell in love with it at once, and this love stayed with him" [Peters, n.d., p. 24]. The aims of Black Mountain College, as described by Anni Albers in the College Bulletin, mirror his vision of creative mathematical development: "Too often today education tends to develop receptive qualities and to neglect productive abilities. In most fields so much knowledge has to be acquired before new contributions can be made that a student is frequently confronted with results without being brought to understand the creative approach that led to the original discoveries. Naturally he cannot be expected to make new discoveries, but he can be brought to acquire an attitude that leads to discovery."[9]

Mathematics at Black Mountain College was taught by Theodore Dreier, who had left the Rollins physics department in 1933 to co-found the college. Dreier also served as the fledgling corporation's primary fundraiser, and by 1944 he was due a sabbatical. But internal disputes postponed Dreier's leave by a year. Dehn, however, had only to wait until the short days of December for the college's offer, such as it was. He negotiated a salary of $40 per month (today's equivalent of $680), including room and board.[10]

[9]Black Mountain College Bulletin 2:3, 1943.
[10]Dec 29, 1944 Special Meeting of the Board of Fellows, BMC Archives.

FIGURE 5. Max Dehn at right with colleagues (from far left) Elliot Merrick, Johanna Jalowetz, and Josef Albers at Black Mountain College, circa 1945. Photographer unknown.

His initial appointment as visiting professor allowed the possibility for him to leave mid-year for a permanent position should the opportunity present itself, but within months the faculty that constituted the governing Board of Fellows appointed Dehn Professor of Mathematics, a two-year position it renewed until his retirement in 1952. After Max had left the Illinois Institute of Technology for St. John's in 1943, Toni had kept their apartment in Chicago where she was employed at the Montgomery Ward department store as a commercial artist and designer. Largely for financial reasons, she remained in Chicago until March 1947 [Peters, n.d., p. 24a].

In his first term Dehn taught Introduction to Mathematics and Dialogues of Plato.[11] Courses in geometry and calculus followed later, balanced by more offerings in philosophy. Dreier returned from leave in fall 1946 to teach physics and analytic geometry. The absence of curricular distribution or attendance requirements at the college left instructors free to alter or entirely abandon any planned course of study, and few descriptive details accompany the provisional, often generic, course titles announced in the college bulletins and newsletters.[12] Dehn exercised these freedoms

[11] Course cards of students Ati Gropius and Betty Jennerjahn, BMC Archives.

[12] Course titles announced for mathematics vary, with introduction to mathematics appearing as Elementary mathematics, Introductory Mathematics, Basic Mathematics, or Introduction to Elementary and Higher Mathematics, whereas geometry courses appear alternately as Descriptive Geometry, Geometry without algebra, Geometry (Elementary, projective, and analytic), or Geometry for Artists. Calculus was simply Calculus, or possibly Advanced Mathematics. Outside mathematics, course listings included Problems in Philosophy, Ethics, Principles of Philosophy,

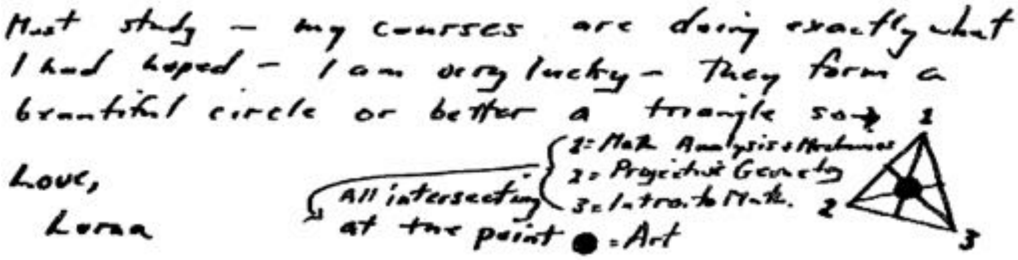
Must study – my courses are doing exactly what
I had hoped – I am very lucky – They form a
beautiful circle or better a triangle so→ 1
1= Math Analysis + Mechanics
2= Projective Geometry
3= Intro. to Math. 2
All intersecting at the point ● = Art 3
Love,
Lorna

FIGURE 6. Detail of letter from Lorna to her mother, 1947, discussing math class and discussions with Dehn and Dreier.

to effect learning experiences that, while difficult to trace in official records, left lasting impressions on his students.

Lorna Blaine came to Black Mountain from New England in summer 1945 to study painting and stayed on as a regular student, eventually taking every mathematics course Dehn offered during her three years at the college. In an undated letter home from the college (Figure 6), she wrote, "my courses are doing exactly what I had hoped – I am very lucky – they form a beautiful circle or better a triangle." She diagrammed her curriculum as a projective configuration of six lines through four points labeled: "1 = Math. Analysis + Mechanics, 2 = Projective Geometry, 3 = Intro. To Math. All intersecting at the point • = Art."[13]

Harry Weitzer described himself as "a very square peg failing to fit the round hole provided by my Jewish middle class St. Louis family" before finding his way to Black Mountain to study art [Weitzer, n.d., p. 1]. The college assigned Dehn to be his academic advisor.

> My favorite of his classes was "Descriptive Geometry," which dealt with points in space and pure logical proofs that you knew where they were. We brought to class only a straight edge and pencil. We used no measurements, only lines and proofs. Once, standing on a chair (as his example required the reach), his chalk line wrapped neatly around a black painted pipe that crossed the board. Proud of his proof, he asked, "can you see the music?" To him, the harmony of mathematical relationships and those of music were of the same order [Weitzer, n.d., "Dehn" p. 1].

Weitzer also studied Philosophy with Dehn, who took a Socratic approach.

> We had no text, and his assignments were such as "Next time we will talk about Knowledge: think about it in the meantime." [. . .] There were about six or seven in our Philosophy class, which met once a week in his study. I remember the session with the assignment "Progress." We were all post-war cynics and thought we were mentally tough. One by one we crumpled under his questioning which had taken several hours. I remember Hank Bergman was the last to admit that there seemed to be

and Theory of Knowledge. Student transcripts ("course cards") that have so far been released from the BMC Archives confirm that most of these announced offerings were offered.

[13]Lorna Blaine letter, undated, BMC Archives. We thank Marjorie Senechal for bringing this letter to our attention.

> at least some progress. In the silence that followed the "Ach So!", we began to turn the tables and tried to find out what Max thought about progress. Finally, he said that he had not been playing fair. At his age he could allow himself the luxury of doubting there was progress, but at our time of life that was something we could not afford [Lane, 1990, p. 192].

For students who sought to engage mathematics at a deeper level, Dehn led advanced tutorials. Black Mountain College was not accredited and relied on external examiners to evaluate students who applied for graduation after having completed their program of studies. In the two dozen years of its existence, sixty students graduated, and Dehn arranged examiners for two mathematics students: Emil Artin came from Princeton University to examine Peter Nemenyi, and Alfred Brauer from nearby Chapel Hill examined Trueman MacHenry.[14]

Dehn also held tutorials outside mathematics. Mildred Harding, whose husband John Adams taught anthropology, once joined a Greek tutorial. "From Max's, and Homer's, first words, I was enraptured," she remembered. "His eyes twinkling, Max read a few lines in Greek from the Calypso episode, confessed himself in love with Calypso, told us the story briefly, translated, then read a little more Greek, translated, paused for questions and comments" [Harding, 1986, p. 84]. Charles Olson wrote to fellow poet Robert Creeley, "I have again flung myself loose into those areas which are my concern: am studying Greek, for the 1st time, with an old German, Gottingen, named Dehn here (along with Con), and already know the first three lines of the ODYSSEY!"[15]

Geometry for Artists

Max Dehn left behind a sizeable record of at least one of his Black Mountain College courses. The folder labeled "Geometry for Artists Class BMC Winter & Spring 1948" in his archive contains eighty-one pencil drawings of remarkable precision and complexity. These are complemented by the notes of students Ruth Asawa, Albert Lanier, and Eine Sihvonen.[16] In graphite with occasional accents in colored pencil and ink, the diagrams range from simple sketches to elaborate compass and straight edge constructions with scores of lines. Captions are sparse but formal similarities across the drawings and the dates that Dehn and Asawa noted allow at least a reasonably consistent ordering.

Each day of the four month workshop was devoted typically to a single construction. It began in mid-February with a drawing of a sphere. A meridian line running through north and south poles projected to an ellipse. Students learned three ways to find the pair of tangent lines from an exterior point, or "pole," to a circle. A method that Dehn credited to Philippe de La Hire incorporated the polar, which is the line through the two points where the pair of tangents from the pole meet the circle. Pole and polar satisfy a reciprocal relationship that foreshadowed dualities and projective transformations soon to take center stage. In one of the

[14] Both graduates went on to complete doctoral studies in mathematics. See Chapter 11 for their stories.

[15] Olson to Creeley, September 30, 1951 in [Davidson, 1981, p. 211]. "Con" is short for Constance Wilcock, Olson's first wife.

[16] Asawa and Lanier's notes are preserved in the Ruth Asawa papers (M1585), Dept. of Special Collections and University Archives, Stanford University Libraries, Stanford, CA and the Asawa Estate, San Francisco, CA. The BMC Archives include a photocopy of Sihvonen's notes.

more elaborate assignments, students found the shortest paths between two points on projections of the globe. For his part, Lanier located approximate coordinates of Asawa's Los Angeles birthplace to which he joined those of Black Mountain (see Figure 7).

Circles disappear from the drawings by March as Dehn turned to projective geometry proper. Students constructed ten Desargues configurations of ten points and ten lines, starting each with a different choice of center (see Figure 8). A prize problem challenged students to demonstrate how to halve and double a line segment given only a parallel to the segment and an (unmarked) ruler. The ellipse returned as a section of a cone along with its conic cousins, the parabola and hyperbola, before spring break.

In April, the class worked through the theorems of Brianchon, Pascal, and Pappus. The balance leaned toward descriptive geometry with spirals, waves, helices, and double spirals in May. These and other curves appeared as planar projections from simple curves in the cylinder, cone, and sphere. The course concluded with the five regular solids and Euler's polyhedral formula. Dehn once referred to the tetrahedron, hexahedron, octahedron, dodecahedron, and icosahedron as "pure spatial ornaments," [Dehn, 1939, p. 144] but here, as if purity left them too plain, he wrapped their polygon faces with projections of a circle or trefoil knot (see Figure 9).

Taken together, the eighteen weeks of Geometry for Artists makes for an unusual course, by any standard. It is a blend of descriptive and projective geometry, applied and pure, demanding both dexterity and logical acumen. Dehn provided this brief course description when he offered the course for the last time, in spring 1952: "Special phenomena, projective configuration, structure of the theorems in geometry."[17] This leaves open the nature and purpose of the course, the picture of geometry it presented, and the sense in which it was a course "for artists."

Geometry for Artists does not appear to have been a course in perspective, as has been reported.[18] Central or one-point perspective drawings are constructed in relation to a fixed vantage point – the location of the observer's eye. The basic configuration of the center of projection, sight lines, picture plane and horizon appear briefly in the notes, but there is no evidence that Dehn instructed students in techniques of central perspective or that students made perspectival drawings.

As the distance between the center of projection and the picture plane increases without bound, sight lines align and central projection becomes orthogonal projection. This abstract limit is also known as parallel or right-angled projection. A magazine clipping among Dehn's Papers, "High noon on the Polynesian clock," shows a stand of palm trees in the midday sun, their shadows projected very nearly vertically to the ground beneath.[19]

The distinction between the two kinds of projection appears to have been Dehn's point of departure for the course. "Diff[erence] betw[een] artistic + math drawing" is the header of the first page of his notes, dated February 13th. A sequence of small sketches beneath illustrate the projection of a meridian ellipse

[17] Spring 1952 Bulletin, BMC Archives.

[18] Mary Emma Harris described it as "a course in perspective geometry that dealt with classical relationships such as the Golden Mean and optics" [Harris, 1987, pp. 109-10].

[19] "Drawings, sketches, undated," Dehn Papers.

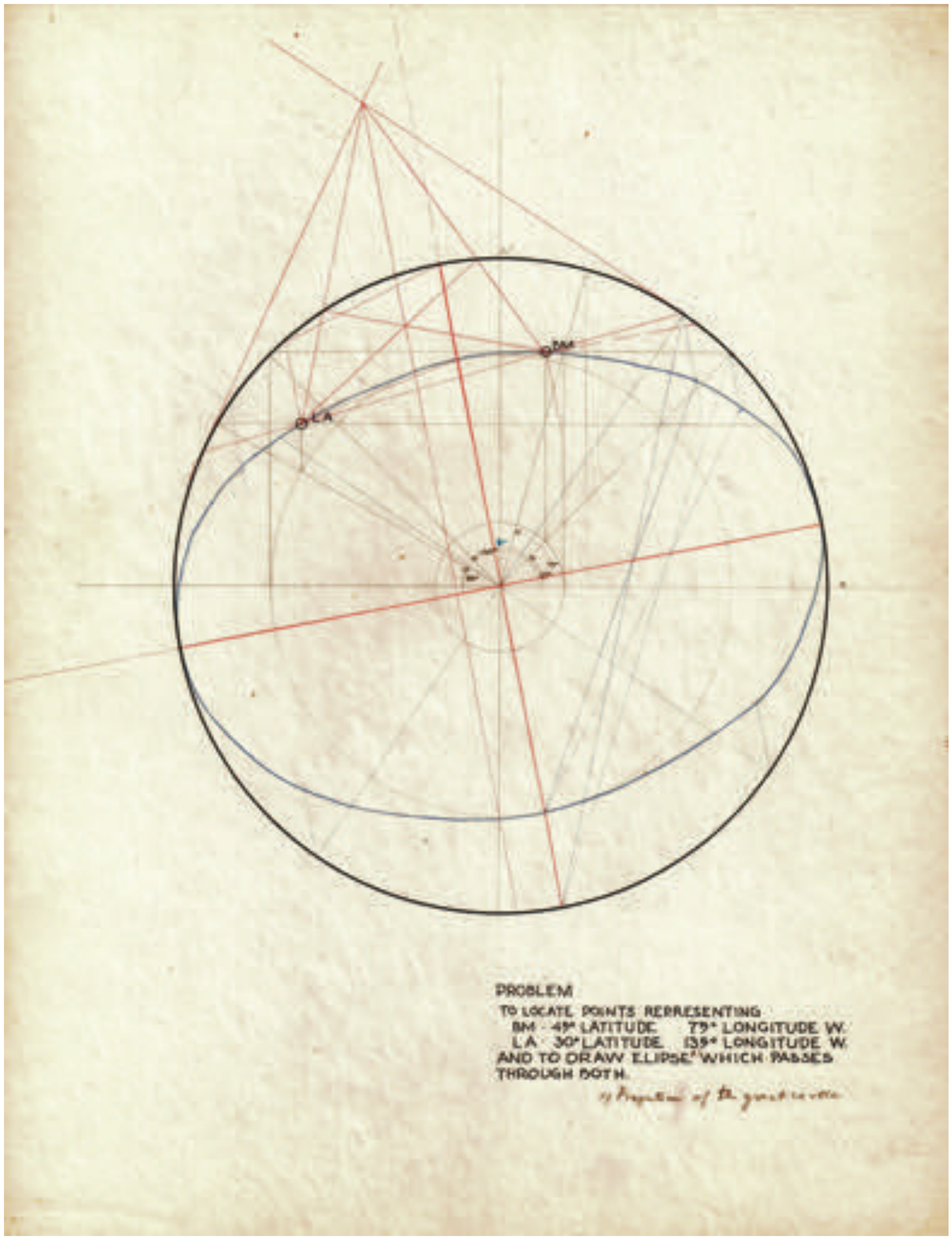

FIGURE 7. Albert Lanier, notes on construction of meridian ellipse connecting Los Angeles and Black Mountain, student notes from "Geometry for Artists," 1948. Courtesy of Ruth Asawa Lanier, Inc.

from a sphere, and the caption reads "circle projection of sphere at right angle = orthogonal projection." All the three-dimensional objects that Dehn's students constructed in Geometry for Artists (spheres, cylinders, cones, cubes, etc.) are rendered in parallel projection.

This classification leaves open the question of how and why Dehn conceived of his geometry course "for Artists."

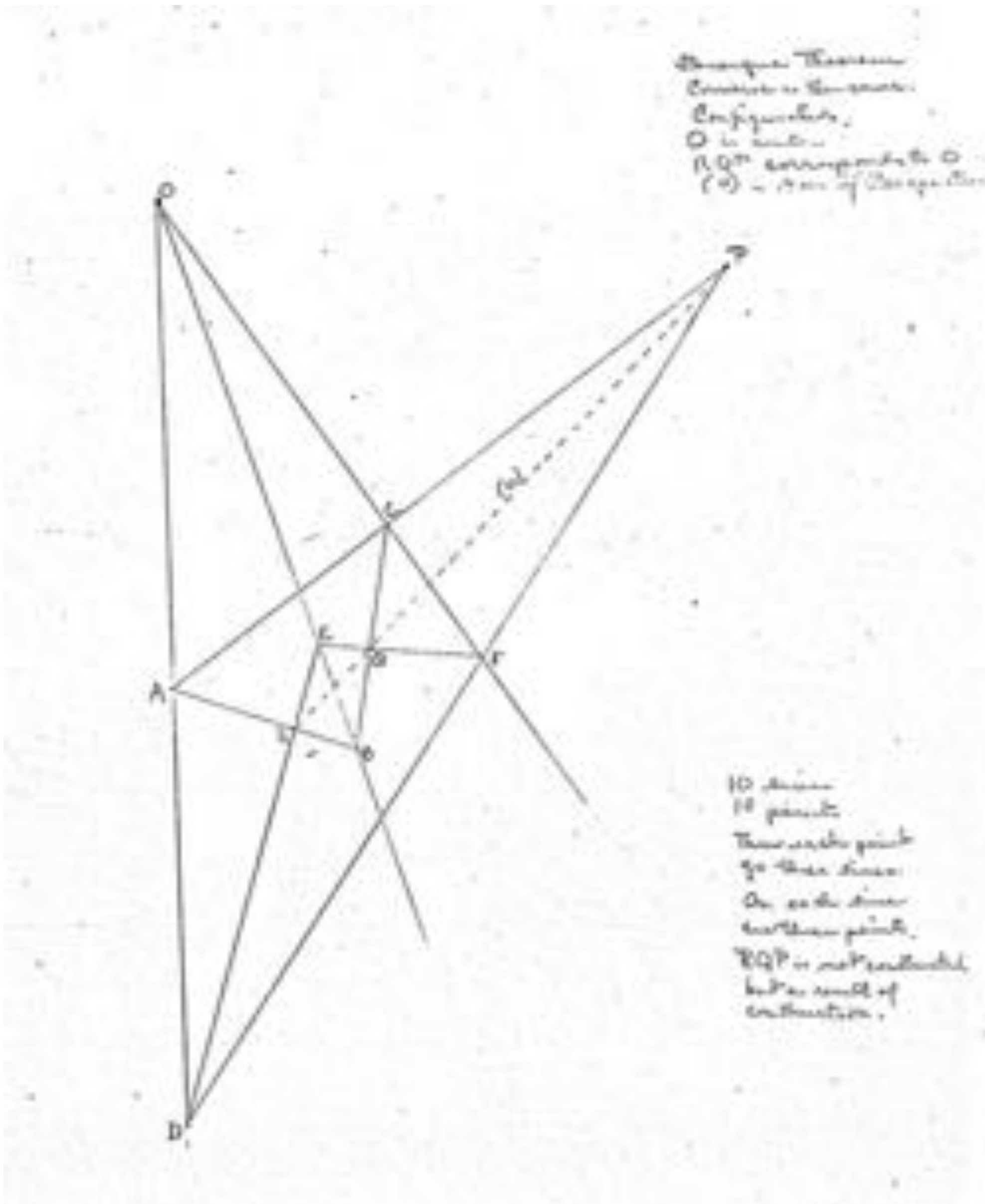

FIGURE 8. Desargues' theorem, student notes by Eine Sihvonen "Geometry for Artists," 1948.

To the extent that mathematics can be viewed as a craft, the ruler and compass are among its most elementary tools. Apart from the projective configurations, the constructions Dehn assigned could just as well have been furnished by any number of technical drawing manuals for artists.[20] More specifically, the "special phenomena" that he selected – circles, ellipses, spirals, helices, double spirals – adhere closely

[20]Dehn may have had in mind Albrecht Dürer's 1525 archetype, *A Painter's Manual* [Durer and Strauss, 1977]. A literal translation of the original title is suggestive: *A Manual of Measurement with Compass and Straightedge* (*Unterweisung der Messung mit dem Zirkel und Richtscheit*).

to the collection of forms that students learned to draw in their studio art courses with Josef Albers. Albers stressed the importance of training the eye and hand through freehand drawing (he never taught perspective) and relied on unintuitive features of geometry, such as the hidden hexagonal cross-section of a cube. This example and other examples resurfaced in Geometry for Artists, where they were deduced rigorously. One could say, somewhat reductively, that Dehn's course was a rational recapitulation of his colleague's course: "Geometry for Albers."

Dehn's study "On Ornamentation" offers another sense in which to interpret Dehn's use of the term "Artists." He writes that "the domain of ornamentation is abandoned if the person seeks in the first place to represent, if ornament is subordinated to representation, if, one could say with some exaggeration, perspectival depiction is placed above symmetrical arrangement" [Dehn 1939 p. 150]. In this context, his February 13th class notes may imply that geometric drawings fall within the domain of ornamentation. Indeed, orthogonal projection, while still a form of representation, is distinguished from perspectival projection by its symmetry: parallel lines project to parallel lines. In this way, we can view Geometry for Artists as a course that instructed the perspective artist in the ways of the ornamental artist, a more symmetric form of representation that resonated with a "higher rhythm."

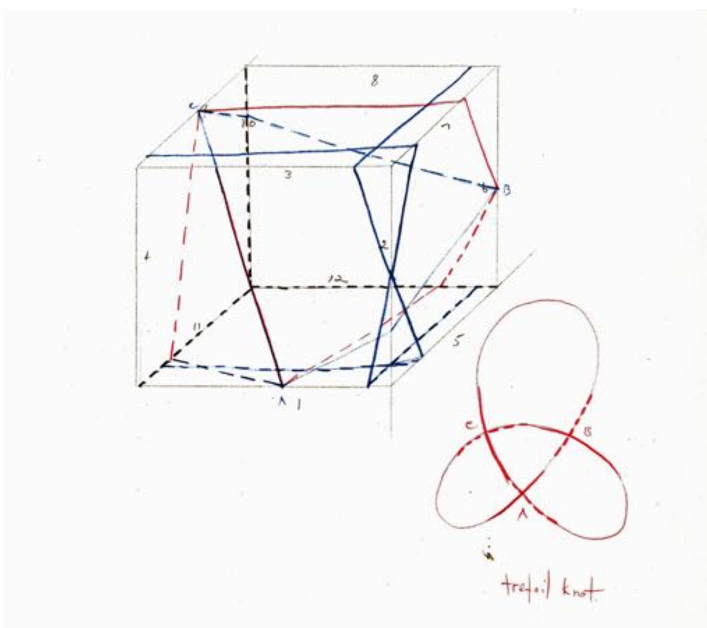

FIGURE 9. Ruth Asawa, notes on two projections of the trefoil to closed arcs on a cube, student notes from "Geometry for Artists," 1948. Courtesy of Ruth Asawa Lanier, Inc.

Some artists in the class, no doubt, failed to "see the music," but some did. Yet others found in Dehn's class a source of insight to which they would return after the end of term. In the fall of 1948, Lanier wrote to Asawa from San Francisco, where the two would eventually marry, raise a family, and develop their art and architecture practices: "I am [in] Dehn's math notes and I will make drawings of conic sections and famil[ies] of curves – Circles, Ellipses, Parabolas, Hyperbolas –

singly and together and repeated and in isometric and perspective – trying to learn to think in space more and then maybe to solids. This is a playful approach to geometry which is the foundation of new and more daring structural systems."[21] Years later, Asawa also found herself returning to her studies with Dehn, among others at Black Mountain College: "Teachers there were practicing artists, there was no separation between studying, performing the daily chores, and relating to many art forms. I spent three years there and encountered great teachers who gave me enough stimulation to last me for the rest of my life – Josef Albers, painter, Buckminster Fuller, inventor, Max Dehn, the mathematician, and many others. Through them I came to understand the total commitment required if one must be an artist."[22]

Dehn as working "artist"

Asawa's depiction of her teachers echoes founder John Andrew Rice's vision: "The law of a teacher at Black Mountain is to function as a working 'artist' in the teaching world, to be no passive recipient or hander-out of mere information, but to be and increasingly to become, productive, creative, *using* everything that comes within his orbit, including especially people."[23] If most people at the college were at least vaguely aware of how accomplished Dr. Dehn was, no one seems to have known what intellectual endeavors he pursued there. Erwin Straus, with whom he had begun a correspondence regarding his research and would have likely been his primary interlocutor had accepted a fellowship at Johns Hopkins just before Dehn's arrival.

One person with whom Dehn shared his research was Wolfgang Köhler. Köhler, a pioneer of Gestalt psychology, had directed the Psychological Institute at the University of Berlin (where Straus was a member of the medical faculty) before his open criticism of the Nazi regime and their interference with his work necessitated his accepting a position at Swarthmore College in Pennsylvania. It is unclear when and how the two first came into contact, but Dehn sent Köhler a sample of his investigations. In a March 24, 1945 letter, Köhler replied: "It is so gratifying to hear a mathematician talk about the human fundamentals of mathematical thought without any technical equipment."[24] He found the work to be reminiscent of existing studies in mathematical discovery, problem solving, and phenomenology, citing in particular Henri Poincaré, Karl Duncker and his book *On the Psychology of Productive Thinking*, and a "youthful publication" of Edmund Husserl, most likely *Philosophy of Arithmetic: Psychological and Logical Investigations*. The content of the letter and its placement in his archives implies that what Dehn sent Köhler was very likely an excerpt from his *Psychology of Mathematical Activity*.

The undated manuscript of *Psychology of Mathematical Activity* is divided across three folders in his archive: One folder is labeled "Untitled handwritten pages numbered 55-225 on the relationship between mathematics and ornamentation [?] described by Magnus." The second is labeled after the book's epigraph "*Animi sui complicatam notionem evolvere*" ("to unfold a complicated concept of the mind," from Cicero, *De Officiis* III.76) and contains thirty-six revised, typewritten pages

[21] Lanier to Asawa, November 30th, 1948, Asawa Papers.
[22] Website of the estate of Ruth Asawa, https://ruthasawa.com.
[23] Black Mountain College Bulletin, Spring 1952, emphasis in original.
[24] Köhler to Dehn, March 24, 1945, Dehn Papers.

and a handwritten page numbered 40. The third folder contains the intervening pages numbered 41-54, a two-page English outline of the book, and Köhler's letter. Given the limited scope of this chapter, we confine our study to that which can be gleaned from the most legible portion of the manuscript; the following partial synopsis derives from Dehn's typewritten outline and revisions.

Psychology of Mathematical Activity begins with an introduction to the "analytical method" with which it approaches psychological phenomena. Inspired by the axiomatic approach, it sets out to identify basic feelings that constitute the psychological prerequisites for mathematical activity. The first chapter concerns the "character" of mathematical statements. These are distinguished from chess problems, for example, by their infinite scope and the conviction with which they are held. Chapter Two takes up the process of comprehending elementary mathematical notions and results. Using the example of the algebraic identity $(a+b)^2 = a^2+2ab+b^2$, Dehn unpacks the mental processes involved with the use of symbols, sequences, numbers, and the "musical score" that counting and arithmetical operations entail. The third chapter turns to mathematical proofs. The essential feature of proof, he finds, is not the perfection of its reasoning but that its reasoning can be perfected. Beyond indirect proofs and proofs by induction, Dehn considers the role of memory, concentration, and the relationship between "mathematical reasoning and the reasoning behind cave paintings." The final chapter he outlined is on "productive activity." It is the most overtly psychological chapter as it addresses the motivations that drive mathematical activity. These include personal motives, such as "curiosity," "satisfaction derived from conquering difficulties," and "happiness found in creating harmonic structures," as well as social motives, such as "possessive spirit (priority)," "ambition," and "*Geltungstrieb*" – the drive for recognition.

Dehn introduces each psychological dimension of mathematical activity tentatively, cautioning readers against drawing any final conclusion let alone an epistemology. Nevertheless, through numerous examples, the *Psychology* contends that feelings play a constitutive function in mathematics that ought not be discounted. For instance, the following remarkable passage attests to the double-edged nature of "the feeling of absolute correctness" of a proof:

> The essential thing is the *feeling* that the proof is correct in and of itself, without the authority of any particular teacher or general tradition. This distinguishes the mathematician from the non-mathematician, who accepts such a fact even without proof because that is how it may be taught and learned. The mathematician, who has the feeling of absolute correctness, may yet be mistaken and consider a false proof correct. Indeed, [when this happens] he is almost always wrong because he is unaware of all the elements in the proof that depend on the collective in which he grew up, especially the language, but also more mathematical elements often taken for granted. [Dehn, undated, p. 33a, emphasis in the original]

The relevance of teaching and learning to Dehn's *Psychologischen Grundlagen*, as he referred to this project, is evident here and throughout the manuscript. In the introduction, he explains that consideration of psychological situations in learning mathematics is central to the method by which he achieves the results of his philosophical investigations. Preliminary as it is, our review of *Psychology of*

Mathematical Activity in the context of his teaching suggests that the converse may have been just as true: consideration of philosophical investigations were central to the method by which Dehn led students to achieve mathematical learning. When the University of Wisconsin invited him to teach in Madison for the fall of 1946, for example, he devised the course Concepts, Problems and Methods on the topics of: "Basic operations, the concept of numbers, and projective and metric geometry. Axiomatics. General methods, the *non-logical elements in Mathematics*."[25] Indeed, it would be difficult to know how to make sense of the surprising last topic without knowledge of Dehn's research at the time.

Dehn in the college community

In certain respects, the college offered Dehn a return to the communal atmosphere he had fostered as director of the Frankfurt Mathematics Seminar, with its reading seminar, hikes in the Taunus, and afternoon coffee at his and Toni's home. At Black Mountain, students accompanied Dehn on daily walks through forest paths above the college, stopping here and there to observe the root structure of a tree, a wild flower, a snake. On Sundays he organized outings in the farm truck to hike the ridge trails of Graybeard Mountain (Figure 10). Dorothea Rockburne was never formally one of his students, but she learned about mathematical principles in nature during walks with Dehn. She went on to a distinguished career as an artist and credits him for leading her to "an understanding of a more universal creative process" [Peifer, 2017, p. 1324].

The communal nature of Black Mountain College, in contrast to Frankfurt University, derived from a work program. All students and faculty were involved in the operation and maintenance of the campus. By the time Dehn arrived to the Lake Eden campus, faculty and students had cleared timber, cultivated a vegetable and livestock farm, and constructed the iconic Studies Building. Dehn enjoyed the honest work, too. Students remembered "hunting mushrooms" and "building a rough stone bridge with a world-class mathematician" [Lane, 1990, p. 148].

The faculty owned the college, and administrative decisions were made collectively, often in marathon meetings, sometimes ending in stalemate or resignations. According to historian Martin Duberman's chronicle of the college, Dehn was "a much-beloved figure" who found himself "the 'man in the middle' when new hostilities erupted within the community in the late forties" [Duberman, 1972, p. 229]. In a letter to Josef Albers, Dehn wrote, "I am always glad to do something for BMC which I consider – in spite of occasional trouble – a wonderful place where I can be together with young people without any institutional impediments. There, I can use what little abilities I have to transmit to them what I think is leading most surely towards a happy life. Not to forget the beauty of the surrounding nature which, I think, is of the greatest value to transform young and old people who live in it."[26]

Dehn's involvement with the college community extended beyond its classrooms, work program, and wooded trails. When the Alberses took extended leave in 1946, Dehn's niece Franziska Mayer managed the weaving studio in Anni's absence. Mayer had studied weaving in Stockholm before spending the war years in Newfoundland working for the International Grenfell Association. She was the

[25] Emphasis added. The syllabus is reproduced in Chapter 11.

[26] Max Dehn to Josef Albers, February 23, 1949, BMC Archive.

FIGURE 10. Max Dehn and students at top of Graybeard Mountain. Photograph by Margaret W. Peterson.

daughter of Dehn's sister Marie Dehn Mayer, who was killed in the Holocaust. Dehn organized a reduction in the college's meagre food budget in order to send four care packages to his friend and former student Willy Hartner in war-torn Frankfurt on Christmas 1947 [Remmert, 2016]. The Dehns were also frequent participants in the Asheville Chapter of the Southern Conference for Human Welfare, "a progressive group organized for the purpose of encouraging intelligent and effective citizenship."[27]

In the spring of 1948, the Alberses returned from their travels in Mexico and New Mexico where they had pursued their long-standing interest in pre-Hispanic art. Shortly afterward, prior tensions between established and newer faculty resurfaced. Amidst these hostilities, Dehn accepted a second invitation to teach at the University of Wisconsin for the 1948–49 academic year (see Chapter 11). Given the diminished size of the faculty then, Dehn agreed to return for monthly lectures on mathematics and philosophy.[28] Remarkably, given its financial precarity, the college paid for Dehn to commute from Madison by air.

Matters deteriorated further. Dehn's efforts to persuade Josef, whom he had nominated to the position of rector, were ultimately unsuccessful, and the Alberses resigned from Black Mountain College in spring 1949. Dehn was to return that summer to lead a course in "Mathematics for Artists" but taught in the Notre Dame Mathematics Teacher Training Program instead. It had been founded by Arnold Ross two years earlier and would later transform into the Ross Math Program for high school students, which continues "to instruct bright young students in

[27] Black Mountain College Bulletin 5:4, 1947.

[28] Josef Albers to the Dehns, October 2, 1948, Dehn Faculty File, BMC Archives.

the art of mathematical thinking" to this day.[29] "With particular reverence and appreciation," Ross noted "the summer term when the late Professor Max Dehn taught a course in Projective Geometry in our program."[30] In Dehn's absence, Buckminster Fuller organized the 1949 summer institute program.

Mary Emma Harris outlined the dire situation facing the college when Dehn returned:

> The survival of Black Mountain College depended not so much on outside events as on the ability of its faculty to redefine its educational goals and solve its administrative and financial problems. During the first sixteen years of its history, the college had evolved from a small experimental school offering a general curriculum into a unique creative community where the most vital work being done was in the arts. Still there were elements of both colleges in the community, and the dichotomy between what the college had set out to accomplish and what it had become was a source of conflict and confusion. Yet the critical years 1949 through 1951 were a period of indecision and internal conflicts, and by the fall of 1951 only a miracle could have saved the college [Harris, 1987, p. 168].

Dehn presided over the first faculty meeting of the 1951-52 academic year. He reopened a discussion of the college's educational aims, offering his own view that its purpose was simply to teach students "to think, to be tolerant, to understand patterns."[31] The discussion resumed the following month with poet Charles Olson and anthropologist John Adams. Dehn outlined how different disciplines cultivate the capabilities that he felt students needed most:

> Mr. Adams ... wonders if we shouldn't stress that students for the first year or two should take subjects stressing general disciplines; that as Dr. Dehn had pointed out, some subjects lend themselves more readily to basic disciplines ...
>
> Mr. Dehn said that he though[t] not only of math but of foreign languages, especially ancient lang[uages] where the structure is very strict, as a subject out of which knowledge of structure should come, then to go on to broaden knowledge; perhaps very strict work in music would do; perhaps biology since it is so broad and rich is not right for beginners but maybe for the second year; history is still more difficult and requires a very disciplined mind; then crowning all to grasp all together, philosophy ...
>
> Mr. Olson said that what makes the strata of the usual Amer[ican] education is not admitting that the individual is more complex than any curriculum... that he objected to a theory of chronological order of studies ...

[29]The Ross Mathematics Program website, https://rossprogram.org

[30]The Notre Dame Mathematics Teacher Training Program Summer 1959 report, p. 13 https://bpb-us-w2.wpmucdn.com/u.osu.edu/dist/e/5164/files/2014/12/1959-Training-Program-2k618yy.pdf.

[31]Minutes of the regular meeting of the Faculty and Corporation of BMC, October 5, 1951, BMC Archives.

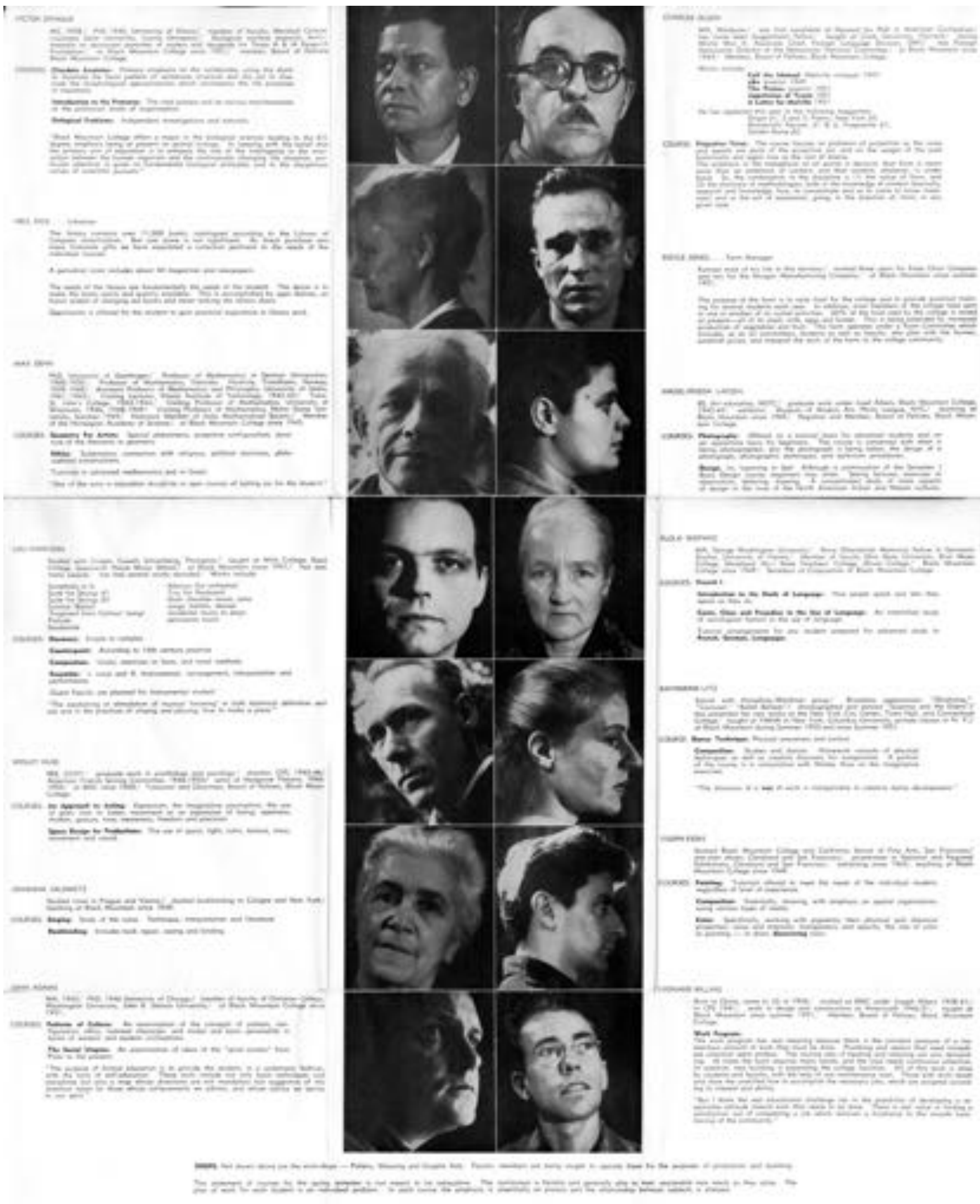

FIGURE 11. 1952 Spring Bulletin, overside broadside of courses including photographs and bios of faculty.

Mr. Adams said that Mr. Olson was objecting not to Mr. Dehn's method but to method.

Mr. Olson said that we gain by the fact that we do not make plans for a curriculum.[32]

[32]Minutes of the regular meeting of the Faculty and Corporation of BMC, November 21, 1951, BMC Archives.

Instead of resolving differences and committing themselves to one approach over the others, Olson suggested that the college project the multiplicity of educational perspectives of its faculty as a feature, rather than a problem. The majority, including Dehn, agreed and the spring 1952 bulletin displays the entire faculty of Black Mountain College in this spirit (Figure 11). Fourteen headshots sit one atop the other in two pillars, their credentials and course offerings flanking the composite faculty portrait like wings of a double totem pole. Beside his portrait, beneath course listings of Geometry for Artists and Ethics, Dehn distilled his psychological philosophy of education into one line: "One of the aims in education should be to open sources of lasting joy for the student."

Olson, who subsequently assumed leadership of Black Mountain, envisioned a plan for the college that would capitalize on the exceptional strengths of a diverse and professionally active faculty. The model was inspired by his and Dehn's monthly visits to the college during the 1948–49 year, when they would "descend on the place like arcangels and go away like banana skins" [Harris, 1987, p. 172]. For financial reasons, the college implemented a different program, even as both Olson and Dehn continued to plan scholarly itineraries beyond the Blue Ridge Mountains.

Dehn accepted an invitation to teach in Germany for the 1952-53 academic year. He was to give a seminar on "Mathematics in the Renaissance" at the University of Frankfurt in the fall and on "Historical presentation of the significant results, methods and concepts in mathematics" at the University of Göttingen in the spring [Remmert, 2016]. The correlation between the latter topic and his Madison course suggests that Dehn intended to further develop his psychological investigations.[33]

By this time, Dehn's German pension was finally transferred, and he and Toni were able to plan their retirement from the college. Through the Federal Housing Administration, they obtained a mortgage for a modest house on the outskirts of the town of Black Mountain.[34] In search of a successor, Dehn approached a number of contacts with the college's offer of emeritus status in exchange for room, board, and a light teaching load, but without success.[35] In a twist, the faculty organized a special meeting without Dehn and decided unanimously to confer the honor to *him*, which they did at the close of the spring term.

Dehn appreciated the privilege and agreed to serve the college in an advisory capacity, but within three weeks, on June 27th, he died. The previous day he had tried to preserve a stand of flowering trees in the vicinity of a beloved picnic site from inadvertently being felled in an ill-conceived plan to raise funds through the sale of timber. His effort that day or the early arrival of midsummer heat or both were blamed for the release of the blood clot that lodged itself in one of his lungs. Coincidentally, on the same day, June 26, 1952, Ruth Asawa gave birth to her and Albert Lanier's second son. In honor of their teacher they named him Hudson Dehn Lanier.[36]

[33] That the course was planned for Göttingen may also explain why Dehn, a polyglot who delivered his lectures in the local language, made his typed revisions in German.

[34] Dehns to Asawa and Lanier, June 12, 1952, Asawa Papers.

[35] Faculty meeting minutes 1952. Dehn had recently proposed Dirk Struik.

[36] Toni Dehn to Ruth Asawa and Albert Lanier, October 6, 1952, Asawa Papers.

Dehn as late modernist

What initially attracted us to research Max Dehn at Black Mountain College was the possible impact that his interactions with its celebrated student and faculty artists had on their art work. The more we uncovered about his endeavors as a "teaching 'artist'" however, the more we felt compelled to concentrate our attention on his own creative work, despite the growing realization that its depth and complexity exceeded the scope of our remit. By reconstructing the syllabus for Geometry for Artists and analyzing his *Psychology of Mathematical Activity* and contribution to the intellectual life of the college, we have aimed to dispel the tacit notion that Dehn's Black Mountain appointment was some form of retirement; to attract further study of his late work; and to provide context with which to meaningfully evaluate what effect he may have had on his students and colleagues.

To isolate and pursue lines of influence is a complicated affair of disentanglement to be sure. Many of the artists at Black Mountain who were receptive to Dehn had encountered mathematical sources prior to his arrival just as he had been preoccupied with art before Straus invited him. The meander that threads through notes and writings of Josef and Anni Albers and Dehn, for example, represents a common yet independent interest in the origins of design that predates their meeting by many years. One also has to guard against facile equivalences, to which formalist approaches to material culture seem especially vulnerable. That Charles Olson chose to name his 1950 manifesto "Projective Verse" does not by itself imbue the essay with mathematical meaning – it warrants further examination. As Dehn cautioned in his study of ornamentation, "in this analysis, the emotional origin must always be considered lest we interpret our findings as having more mathematics in mind than the maker of ornaments intuited" [Dehn, 1939, p. 129].

In closing, we confine ourselves to highlight a single, albeit broad, resonance between the work of Dehn and his Black Mountain colleagues. In her essay "Imaginary Landscape" for the exhibition catalog, *Leap Before You Look: Black Mountain College 1933–1957*, art historian Helen Molesworth observes that despite the differences great and small that separated the visual, performing, and literary artists at the college, "nearly all were committed, in profound ways, to the exploration of form" [Molesworth and Erickson, 2015, p. 51]. In three brief case studies, she recounts how painter Josef Albers, composer John Cage, and poet Charles Olson innovated their respective domains through structural experimentation in the use of color, time, and breath, adding (p. 57):

> They also explored the in-between – Albers, in the relativity of color's perception; Cage, in the parity of sound and silence; and Olson, in the movements connecting writer and listener. Indeed, both Albers and Cage shared Olson's sense that "it is not the things in themselves but what happens between things where the life of them is to be sought." It is precisely the space between their formal rigor and their openness to perception and its contingencies that places their practices in the nascent shift from modernism to postmodernism, and turned Black Mountain College into the unlikely wellspring of avant-garde culture.

Viewed from outside the discipline, all of mathematics may appear to be a formalist exploration of figures of one kind or another. Yet even the casual observer of Dehn's mathematics teaching record at the college would recognize the priority he placed on figures of a particular sort – projective configurations. As structures, configurations are defined in terms of the incidence of points and lines "free of all elements of measurement," making them intrinsically relational or schematic. The content of some configurations is even preserved when the roles of point and line are exchanged, as in the case of Pappus's theorem (Figure 2). In this sense, configurations are a vivid mathematical expression of "not the things in themselves but what happens between things."

Projective configurations, Dehn would be the first to acknowledge, were neither new nor a creation of his own. But the elementary modern geometry course he developed around them was a pedagogical experiment that derives from his unique philosophy of mathematics. Dehn was a modernist in the sense that he understood mathematics as "an autonomous body of ideas, having little or no outward reference, placing considerable emphasis on formal aspects of the work" [Gray, 2008, p. 1]. At the same time, he warned against the "false method of merely formal generalization" and "Descartes' delusion" that one could "comprehend the whole world by means of pure reason" [Dehn, 1928, pp. 22-3]. The basic assumption of his meditation on the origin of mathematics is that "it arises from the methods of logical inference – both conscious and *unconscious* – that allow us to 'manufacture' hitherto unknown facts" [Dehn, 1932, p. 131, emphasis added]. Through his investigation of non-logical elements he sought to reduce the sensations in mathematical activity to a collection of particularly simple elements, "basic feelings." As such, his *Psychology of Mathematical Activity* represents a departure from mathematical modernism no less profound than that of the work of his anti-establishment artist students and colleagues at Black Mountain. One could say, by analogy with Molesworth's assessment of Albers, Cage, and Olson, that Dehn explored the psychological between the logical.

In some respects, Dehn's *Psychology* anticipates later studies of the social and psychological underpinnings of mathematics. For example, Brian Rotman has characterized "mathematical thought as a kind of waking dream" in which the mathematician imagines an idealized "subject" who instructs an idealized "agent" in ways reminiscent of Dehn's description of the psychic or "soul" processes involved in mathematical activity [Rotman, 1993, p. xii]. Whereas Rotman reinscribes the body into mathematical practice through semiotics, cognitive scientists George Lakoff and Rafael Núñez have sought more direct connections between biology and the nature of mathematical ideas, arguing, rather less tentatively than Dehn, that "mathematics as we know it arises from the nature of our brains and our embodied experience" [Lakoff and Núñez, 2000, p. xvi]. Of course, Dehn was not a semiotician or a cognitive scientist, and their aims differed from his.

There is a notable contrast between the abundance of Dehn's Black Mountain College activity and its scarcity in published accounts. To be fair, much of the literature on the college is the product of investigations into the arts at the college, and the visual record of mathematics and science at the college is thoroughly upstaged by Buckminster Fuller. On the mathematical side, the only hint that Dehn had work in progress is a reference to "largely unpublished studies of ornamentation" in the memorial by Magnus and Moufang. The obituary that Willy Hartner wrote for his friend in *Die Frankfurter Allgemeine Zeitung* is no less opaque: "He has worked at six or seven smaller colleges over the past ten years, the longest at the progressive Black Mountain College in North Carolina, where, besides mathematics, he studied Plato, the history of philosophy, especially Oriental philosophy, gradually adopting many of its ideas into his own philosophy of life." Perhaps Dehn was too conscientious to share his incomplete manuscript with mathematicians. We hope that this preliminary study initiates deeper investigations that will bring forward, among other things, more of his unpublished *Psychology*. In 1947 Dehn reviewed Swiss mathematician Andreas Speiser's *Die Matematische Denkweise* for the *Monthly*. His review of the book opens with the following passage, which we expect will likely serve just as well to describe Dehn's own contribution.[37]

> In this book we have the philosophy of a mathematician. It is written with the enthusiasm of a distinguished mathematician who penetrates the arts and the world in his peculiar way. It will transmit, I imagine, this enthusiasm to every mathematician who is not only a craftsman but possessed by the sacred fire as the poet and philosopher ought to be. [Dehn, 1947]

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[37]We wish to thank Marjorie Senechal for inviting us to the Mathematisches Forschungsinstitut Oberwolfach Mini-Workshop: Max Dehn: his Life, Work, and Influence which prompted this collaboration. The second author received support for this research while a visitor to the Program in Interdisciplinary Studies at the Institute for Advanced Study in Princeton, NJ. We are grateful to the following members of the Dehn family: Antonio Alcala, Joanna Beresford Dehn, Dr. Matthias Brandis, Max Dehn Jr., Enrique Mayer, Renata Mayer Millones, Maria Mayer Scurrah, and Peter Spencer.

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