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EDYTA FRELIK
UNIWERSYTET MARII CURIE-SKŁODOWSKIEJ, POLSKA
https://orcid.org/0000-0003-2065-5795
edyta.frelik@mail.umcs.pl

Rhetorical twins: The fractal and organic geometries of Benoit Mandelbrot and Tadeusz Mysłowski

Retoryczni bliźniacy. Fraktalne i organiczne geometrie Benoita Mandelbrota i Tadeusza Mysłowskiego

Abstract

The article considers the subject of art/science intersections by presenting the affinities between the mathematician Benoit Mandelbrot and the visual artist Tadeusz Mysłowski. In the Introduction, their encounter is contextualized in an overview of earlier approaches to the study of such intersections, especially the changes in rhetorical theory and practice which led to the so-called rhetorical turn in the last decades of the 20th century. In Part 2, the evolution of visual rhetoric and the rhetoric of mathematics as autonomous subject areas within the broader field of rhetoric is discussed as constituting crucial parallel developments that now provide scholars with adequate tools to analyze and describe instances of rhetoricization of scientific and artistic communication. In Part 3, the example of the Mandelbrot/Mysłowski conjunction is scrutinized to bring out the rhetorical ramifications of their respective geometries – of fractals in the case of the mathematician and of elemental geometric-organic forms in the case of the artist.

Przedmiotem rozważań są związki sztuki z nauką omawiane na przykładzie pokrewieństwa między matematykiem Benoitem Mandelbrotem i artystą wizualnym Tadeuszem Mysłowskim. Ich relacja jest skontekstualizowana we wstępnym przeglądzie wcześniejszych prób badania takich związków, ze szczególnym uwzględnieniem zmian w teorii i praktyce retorycznej, które doprowadziły w ostatnich dekadach 20. wieku do tzw. zwrotu retorycznego. W części drugiej wyłonienie się retoryki wizualnej i retoryki matematyki jako autonomicznych dziedzin tematycznych w obrębie szeroko rozumianej retoryki jest przedstawione jako kluczowe dla wypracowania przez współczesnych badaczy adekwatnych narzędzi umożliwiających analizę i opis przykładów retoryczności komunikatów naukowych i artystycznych. Część trzecia pokazuje, jak powinowactwo myśli i działań Mandelbrota i Mysłowskiego ujawnia się w warstwie retorycznej ich rozważań o geometrii – fraktali w przypadku matematyka i elementarnych form geometryczno-organicznych w przypadku artysty.

Key words

Benoit Mandelbrot, Tadeusz Mysłowski, art/science intersections, visual rhetoric, rhetoric of mathematics
Benoit Mandelbrot, Tadeusz Mysłowski, związki między sztuką i nauką, retoryka wizualna, retoryka matematyki

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EDYTA FRELIK
UNIWERSYTET MARII CURIE-SKŁODOWSKIEJ, POLSKA
https://orcid.org/0000-0003-2065-5795
edyta.frelik@mail.umcs.pl

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1. Introduction

Historically speaking, rhetorical theory evolved almost exclusively from the study of discourse because of its apparently superior properties in comparison to non-discursive forms of communication. Accordingly, the processes and conventions through which meaning is produced by means other than those of discursive language were largely ignored, or at least marginalized. As a result, for a long time disciplines that rely primarily on nonverbal practices and means or that transcend ordinary language by using abstract structures and formal representation fell outside the scope of rhetorical analysis. This has been the case both with arts that communicate mainly through visual means (line, shape, color and texture in painting and sculpture), auditory means (sounds and silences in music), and body movement (dance) and with sciences that do not involve empirical observation but rely on abstract systems, symbolic representation, and logical reasoning. The most obvious example of such a science is mathematics – a self-contained system whose language is distinctly different from everyday language. Geometry is a particularly interesting branch of this abstract domain because it combines numbers (abstract concepts) with spatial forms, which in turn makes it relevant to the visual arts, where geometric patterns, both discernible and subliminal, play an important role in organizing space and directing the movement of the viewer's eye.

In this paper, I place in rhetorical perspective the striking affinities between the ideas and works of two apparently very distant minds: that of the Polish-born French-American mathematician Benoit Mandelbrot (1924-2010) and that of the New York-based Polish visual artist Tadeusz Mysłowski (b. 1943). These affinities may at first sight seem fortuitous and thus inconsequential, but I posit that their discovery by the latter and subsequent acknowledgment by both marked an important moment in the long but understudied history of art/science intersections.

Mysłowski made his discovery at a time when many concurrent developments in critical, philosophical and scientific thought occurred that would eventually lead to several historical “turns” in different disciplines during the closing decades of the twentieth century. Among them, the rhetorical turn occupies the central position because it most profoundly affected and reflected, as Herbert W. Simons writes in *The Rhetorical Turn* (1990), the era’s “widespread dissatisfaction with objectivism” and the growing “conviction that the practice of inquiry might more usefully be understood in rhetorical terms” (1-2). It was largely thanks to various rhetorical dislocations taking place in those years that many long-held views both about processes taking part in the human world and about their relation to the broader reality were eroded and eventually abandoned, opening new pathways for critical thought. One of them led to redefining the perennial notion of the essential incompatibility of traditional rhetorical principles with the non-discursive communicative strategies used in other domains, especially in the visual arts and mathematics.

Kenneth Burke (1966) famously claimed that as “symbolic action” rhetoric should include, besides verbalization, “all other human symbol systems such as mathematics, music, sculpture, painting, dance, architectural styles, and so on” (28), for when such fields of human creative endeavor as art and science are pushed to the periphery our perception and understanding of cultural processes and symbols outside of the sphere of speech and writing is seriously impaired. His observation that reality is a “clutter of symbols about the past combined with whatever things we know mainly through maps, magazines, newspapers, and the like about the present” (5) is directly relevant to the present argument because it helps bring into focus the prevalence of images in today’s rhetorical environment, especially the ways in which they, as Sonja K. Foss (2004) writes, “provide access to a range of human experience not always available through the study of discourse” (144). The same can be said about the work of scientists, whose concerns and actions are now seen as commensurate with and relevant to other kinds of practices and productions that constitute culture.

Affinities between tangible works of art and abstract mathematical objects have been acknowledged and explored from both ends of the art/science nexus at least since the rise of the modernist avant-garde, whose emergence at the beginning of the 20th century coincided with the revolutionary changes in modern-day physics spurred by Einstein’s special theory of relativity introduced in 1905. Although few non-specialists were able to grasp the intricacies of such advanced scientific ideas as the fourth dimension and non-Euclidean geometry, these ideas became, as art historian Linda D. Henderson (2004) points out, “important elements of cultural discourse” (431), inspiring many intellectually-minded artists and writers to respond creatively. Conversely, there is relevant, though mainly circumstantial, evidence that quite a few of the seminal representatives of the new sciences were not only conversant with the accomplishments of the artistic avant-garde, but also openly acknowledged the existence of affinities between the revolutionary impulses in both art and science. Throughout the twentieth century, this awareness steadily grew and today it is a constitutive part of the mindset of many scientists conducting cutting-edge research in many different disciplines. A representative example is the eminent biologist David Krakauer, who candidly admits to being inspired by art and invokes the names of such painters as Giorgio de Chirico, Mark Rothko and Jackson Pollock. According to him, these inventive rebels made important contributions to the culture of which scientists are also a part, that is, one which promotes propensity for experimentation, iconoclasm and resistance against authority (Jałochowski 2019, 13-23).

The scope of the intersections and affinities between modern art and modern science has been the subject of numerous articles and books by artists, art historians and critics, literary scholars, philosophers, sociologists, scientists, and science historians produced over the past eighty years. Representing different temporal and disciplinary perspectives, different theoretical frameworks and different interpretive methods, they do not form a cohesive body of scholarship, but they all confirm the soundness of intuitions and claims about the importance of acknowledging that both art and science are forms of creative thinking that rely on certain principles and as such they may interact, intersect and inspire each other in relevant ways. Physicist and music critic Martin Johnson, biologist C.H. Waddington, and physicist Thomas S. Kuhn are important early examples of modern scientists' recognition of art-science commonalities.

The investigation of these commonalities was brought to another level in the last decades of the 20th century when a spate of important publications set the theoretical and methodological ground for new research pathways to be explored in the new millennium. The contributions of several authors stand out because of the scope, innovative character and impact of their work. Henderson's monumental studies of the impact of scientific ideas on such modernist masters are widely recognized as models of consistent application of rigorous methods of analytical inquiry to meticulously researched and prudently selected instances of art (1983; 1998). Equally influential have been Leonardo scholar Martin J. Kemp's books (1990; 2006; 2016), discussions of the impact of technologies on the humanities by chemist-cum-literary scholar N. Katherine Hayles (1984; 1990), and physicist and author Arthur I. Miller's popular publications on art/science intersections (2000; 2001; 2014; 2019).

Other important late 20th-century instances of the growing interest in many disciplines in the links between art and science as different but commensurate systems of representation and knowledge production include *The Aesthetic Dimension of Science* (1982), which offers a record of a Nobel lecture series and a round table among three scientists, a composer and a metaphysician focusing, among other topics, on the question of whether the general cultural milieu formed by the arts has significant influence on science, and two collections, *Art and Science* (1986) and *Picturing Science, Producing Art* (1998), which gather essays by scholars representing a broad spectrum of disciplines, such as art theory and history, psychology, sociology, philosophy, history, history of science, physics, biology, and new approaches developed in gender and feminist studies, body studies, science and technology studies, and cognitive studies.

In the first decades of the 21st century, art/science studies evolved into a truly interdisciplinary field within which multiple ways of exploring their intersections were introduced. Notable examples of new approaches are the books by Siân Ede (2005) investigating the aesthetic component of scientific communication, Gavin Parkinson's book on Surrealism and modern science (2008), and Felipe Cucker's book on mathematics and art (2013). However, in the present context the most crucial development in early 21st-century critical discourse is the shift in the field of rhetoric towards non-verbal communication, especially with reference to visual objects and abstract structures and formal representations like those found in mathematics.

2. The rhetorical turn

When visual rhetoric emerged as one of the developments of the rhetorical turn, there was, as the editors of *Defining Visual Rhetoric* point out, "little agreement on what exactly scholars intended when they used the term, and no reliable way to distinguish the work done under the rubric 'visual rhetoric' as a coherent category of study" (Hill and Helmers 2004, ix). But certain particular outcomes of the turn were quite unequivocal, and those pertinent to the question of how closely visual rhetoric and the rhetoric of mathematics are connected were among them.

In Part 3, a focused look at the chance encounter between Mandelbrot and Mysłowski will bring out specific examples substantiating my argument that, rhetorically speaking, it was far from being a case of merely coincidental synchronicity, but was rather a matter of unavoidable and necessary confluence on a larger scale. For now, it is important to note that while the term "visual rhetoric" primarily designates a theoretical perspective, it also has another meaning. As Foss argues, visual images and objects work and are culturally meaningful not only because we have developed analytical tools for "reading" them as such, but also because, one, as communicative artefacts they have inherent power to shape people's perception and understanding of phenomena, and two, whether as tangible art objects or abstract mathematical concepts, they are all products of "the purposive production or arrangement of colors, forms, and other elements to communicate with an audience" (2004, 304). That is why in order to grasp their persuasive power we must look beyond what happens at the receiving end of the communicative process (the participation of the audience in the construction of meaning and its analysis and interpretation by scholars) and also consider the very nature, whether visual or abstract/conceptual, of objects themselves and the processes that occur between and among them, both because of and irrespective of arbitrary human action. Or, as Foss explains, when studying objects' relationship to persuasion, we must look for the presence of these three characteristics: "The image must be symbolic, involve human intervention, and be presented to an audience for the purpose of communicating with that audience" (2005, 144).

This strategy has important precedents in many fields in which visual phenomena were studied in the last decades of the 20th century. Notable examples include the work of semiotician Roland Bathes, art critic John Berger, visual communication scholar Paul Messaris, or theorist of media, visual art, and literature W.J.T. Mitchell. Like many others who contributed to the rhetorical turn by situating themselves at the crossroads of more than one discipline, they introduced in their respective domains new ways of thinking about the communicative dimensions of images, which in turn prompted many rhetoricians to develop, as Foss puts it, "a set of conceptual lenses through which visual images become knowable as communicative or rhetorical phenomena" (2005, 145), thus providing "access to a range of human experience not always available through the study of discourse" (2005, 143).

In this connection, the rhetoricality of the Mandelbrot/Mysłowski conjunction can be argued for effectively because today we have such conceptual lenses through which we can look at mathematical communicative artefacts as well. But it should be remembered that while the rhetoric of mathematics has only recently been identified as an autonomous subject area within the broad discipline of rhetoric, it is in fact deeply rooted in the ideas of the most important instigators of change in 20th-century rhetoric, Kenneth Burke, Chaïm Perelman and Lucie Olbrechts--Tyteca, who, as James Wynn and G. Mitchell Reyes argue, "significantly expanded the shared conceptual space between [the] fields" of rhetoric, mathematics, and language (2021, 18). Especially Burke's identification of rhetoric with "symbolic action" prompted rhetoricians to embrace all of the other human symbol systems besides the verbal ones and thus bring into focus the persuasive power of human emotions beyond those the rhetor's argumentation aims to evoke in the audience.

The subsequent valorization of the feelings affecting the rhetor's choices and actions ended the traditional dissociation of science and rhetoric as separate and incompatible enterprises – one based on objective and unbiased demonstration, the other on argumentation and persuasion – and brought into the spotlight a factor that for so long eluded both rhetoricians and historians of science – namely, the aesthetic dimension of communicative artefacts produced by mathematicians, which is particularly evident in the metaphors they employ.

A comprehensive overview of the evolution in the last few decades of the outlook of communications scholars, rhetoricians of science and mathematicians themselves on the role aesthetics may play in popularizing mathematics among non-expert audiences is provided by Alex Csiszar (2003), who supports his observations with statements by several mathematicians, including Armand Borel, who called mathematics "art, a poetry of ideas" (1983, 15). Interestingly, Borel in turn invokes English mathematician Godfrey Harold Hardy, who as early as 1940 declared that he was "interested in mathematics only as a creative art" and stated that "it is a melancholy experience for a professional mathematician to find himself writing about mathematics" (2018, 55). Emphasizing the distinction between "the 'nobler' uses of mathematics . . . which it shares with all creative art" and its "'crude' utility" in promoting "the material well-being and comfort of men" (2018, 56-57), the latter was also one of the first to address the issue of popularizing mathematics among non-experts.

As Borel noted, acknowledging mathematics' similarity to the arts does not change the fact that the mathematician's "unique feeling for intellectual elegance and beauty of ideas in a very special world of thought. . . . can hardly be shared with non-mathematicians: Our poems are written in a highly specialized language, the mathematical language" (1983, 15). Because it is a language that is fundamentally incomprehensible to laymen, mathematicians often resort to various strategies to generate belief and trust in their theorems and proofs outside of the mathematical community in order for them to be recognized as cultural products, or communicative artefacts. Some do so indirectly, by establishing relations with other sciences whose advantage in terms of generating interest and understanding among lay audiences is that they communicate largely by means of ordinary language, which means they can use such stock devices, which increase their persuasiveness, as those known to writers and poets – metaphor, simile, allusion, hyperbole, chiasmus and others. An example of this is given by rhetorical scholar Celeste Condit, who describes how the introduction of statistical methods to the study of variation, evolution, and heredity in biology prompted the use of metaphors such as "stock-breeding" to increase the persuasive power of the mathematical component (1999, 15-27).

In this article a more rarefied example is presented of how to make mathematical statements and accounts, as Wolfgang Krull puts it, “appear not only correct but evident and compelling” (1987, 49) by bringing out the aesthetic qualities of mathematics and its affinity to various high arts. Aware of the risk that, as Csiszar warns, “in spite of good intentions, such accounts may only further mystify what they purport to explain” (2003, 240), I believe the case of Mandelbrot, discussed below, mitigates such reservations.

3. Benoit Mandelbrot and Tadeusz Mysłowski’s no chance encounter

Born in Warsaw, Mandelbrot emigrated in 1936 with his family to France, where he studied mathematics, eventually getting his doctorate from the University of Paris in 1952. In 1958, he began a thirty-five-year career as a fellow at IBM. He was also associated with Harvard and Yale, where he taught economics and applied sciences besides mathematics. For long considered a maverick, he finally came into his own by publishing, in 1975, the French version of his book on fractals, translated into English in 1977 as *Fractals: Form, Chance and Dimension*, subsequently revised, updated and retitled as *The Fractal Geometry of Nature* (1982, 1983). Finally recognized as an original and important thinker, Mandelbrot became a household name when James Gleick wrote a popular article about him in *The New York Times Magazine* in 1985, calling him “the man who reshaped geometry” and changed “the way scientists look at the natural world” (1985, 64).

One of the most important mathematical treatises ever written, Mandelbrot’s “essay” on fractals is also one of the most outstanding instances of the rhetoricization of scientific discourse by means of strategies that are now accepted as part and parcel of visual rhetoric and the rhetoric of mathematics. An important part of the instant appeal of his book was that he wrote it in a style that purposely exhibited what in those days was defined as a key feature of all “postmodern” thought and performance, namely, to use Scott Baker’s words, the speaker’s “sensitivity to his . . . own rhetorical practices” (1990, 232). This sensitivity is visible, for instance, in his lengthy introduction, where he flaunts his awareness of his own status in relation both to his subject matter and to his two prospective audiences: mathematicians and non-mathematicians.

Acknowledging that “every so often [he feels] the need to engage in private conversation, so to speak, with specific groups of readers who might be overly troubled if some point were left unmentioned or unexplained” (1983, 24), he makes clear that such “conversations” are not really meant to appease potential critics among “the purest among mathematicians” (1983, 21), but, quite the contrary, are intended to display his resistance to mathematical orthodoxy. Introducing in the last part of his book a series of historical and biographical sketches, he notes that traditional mathematicians often use "Gauss's dictum, 'when a building is completed no one should be able to see any trace of the scaffolding,' . . . as an excuse for neglecting the motivation behind their own work and the history of their field." "Fortunately," he adds, "the opposite sentiment is gaining strength, and numerous asides in this Essay show to which side go my own sympathies." The "several longer stories" and other "odds and ends gathered in library forays" both highlight his own "passion" for certain figures and his motivation "to educate and entertain the reader" (1983, 45).

Importantly, there is no self-contradiction in Mandelbrot's approach to writing, no inconsistency in his saying in one breath that his essay is "a work of popularization" and that "popularization is not its purpose," no deception in the paradoxical nature of his style, which he describes as both "informal" and "precise" (20). While using a lot of "undefined mathematical terms" (14) that are only comprehensible to experts, he writes in straightforward expository prose to make the book "accessible to scholars and students not necessarily specializing in the various subjects tackled, many of which are esoteric" (20). He even encourages non-expert readers to "scan" and "skip" (14). Rather than undermining the cohesiveness of the argumentation, this in fact enhances its effectiveness, largely because, as a consistent discursive strategy, the text's digressiveness is directly an emanation of the mathematical theory it divulges.

Mandelbrot explains: "Almost every case study we perform involves a divergence syndrome. That is, some quantity that is commonly expected to be positive and finite turns out either to be infinite or to vanish. At first blush, such misbehavior looks most bizarre and even terrifying, but a careful reexamination shows it to be quite acceptable . . ., as long as one is willing to use new methods of thought" (3). In the spirit of the narrative self-awareness that was the hallmark of postmodernity in the art and literature produced in those days, he adds: "Now that the diverse objectives of this Essay are outlined, we examine its manner. It too attempts to integrate several distinct facets" (3).

The desultory logic of his exposition is further highlighted by what is the most unique and attractive, or seductive, aspect of the book – the 467 plates showing fractals. Access to IBM's advanced computer graphics technology enabled Mandelbrot to produce spectacular illustrations, which he on several occasions describes using straightforwardly aesthetic terms, saying, for instance, that "fractal geometry reveals that some of the most austerely formal chapters of mathematics had a hidden face: a world of pure plastic beauty unsuspected till now" (4). He points out that in the past fractals would have been considered as "pathological" structures fit for "a gallery of monsters" (1), but now they strike with their "astounding beauty" (3). Though he is sure that his readers do not need to be persuaded on this account, he happily reports: "I hear and read of both the intended and the unintended illustrations being described as a 'New Form of Art'" (23).

At the same time, while conceding that fractals "may be viewed as a new form of minimal geometric art" (23), he is wary about the conventional wisdom that the affinity between art and mathematics manifests itself most clearly in representational simplicity. Such a view, he warns, may itself be an oversimplification because, unlike modernist architecture and minimalist art, fractals are not restricted to "standard shapes: lines, circles, spirals, and the like" and in fact show more "kinship to Grand Masters paintings or Beaux Arts architecture" (23) than to Bauhaus structures, which he dismisses as "scalebound throwbacks to Euclid" (24). Such a view may strike some as démodé, or regressive even, but what it really shows is that as a scientist Mandelbrot felt obliged to first of all be true to the rules of his "dry" discipline. That is also why he openly states that, in a work like his, images "are an essential tool, but only a tool" and that "any attempt to illustrate geometry involves a basic fallacy." He explains it by pointing out that "a straight line is unbounded and infinitely thin and smooth, while any illustration is unavoidably of finite length, of positive thickness, and rough edged" (22).

This important insight directly ties Mandelbrot's inquiry into the nature of fractals as both mathematical and visual communicative artefacts to the discoveries that Tadeusz Mysłowski made independently around the same time by delving into the grid, a structure famously described by Rosalind Krauss as "emblematic of the modernist ambition within the visual arts" (1979, 50). Born in Lublin, Mysłowski studied art in Kraków in the 1960s and then for a year in Paris. In 1970, he emigrated to America, settling in New York City, where he has lived and made art since. He considers first seeing Manhattan from the airplane as the pivotal moment which changed his visual perception completely: he was struck by the dominant horizontal and vertical directions in the city's structure, recognizing in it the rigid abstractness of geometrical forms he associated with Constructivism. Steeped in European modernism, he decided to pursue geometric abstraction, a form he had come to know and admire most while studying the works of Malevich and Mondrian. He soon began to experiment with the grid, in which, years before the publication of Krauss's essay, he saw precisely the qualities Krauss would later highlight. Importantly, unlike Krauss, he did not separate the purely spatial aspects of the grid from the purely temporal ones, but considered them complementary and inseparable, as commensurate dimensions that need to be treated as such if one, as he did, wants to divine beneath the manifest surface a "hidden structure" (Mysłowski 2018, 21).

With no prior knowledge of American history and of the English language, Mysłowski was naturally predisposed, as a visual artist, to first of all notice palpable shapes – points, lines and planes. He instantly realized that the geometry of Manhattan's streets, avenues, blocks and skyscrapers that so enthralled and stunned him during his first encounter with America was a good springboard from which to begin a deep enquiry into the city's infinite complexity. As his familiarity with its multicultural and multilingual landscapes increased, he began to collect and process information about its history, its ethnic and cultural origins, and its multilayered and multidimensional technological fabric that constitutes the physical matrix of urban life.

Although formally trained as a painter, he considered himself a successor of constructivists, whose identity "was not of the Bohemian, but rather modeled after the scientist, technician or architect" (2018, 142). To get at the essential constituents of New York's "hidden structure," he first intuitively, and then through methodical inquiry, began to investigate the city's past and present, surveying on foot and with camera in hand its streets and neighborhoods. He studied chronicles and records and collected articles and pictures cut out from newspapers, magazines and books he chanced upon. Particularly attracted to visual representations of the city as a physical space designed to accommodate residents and their busyness, he treated his exploration of Manhattan from the ground "like a map problem, thinking of the places where a street and avenue cross each other as the intersection of two lines" (2018, 118).

What fascinated him was the cohesiveness of the composite outline of the city emerging from drawings, photographs, maps, city plans, cartograms, charts, and topographies, a cohesiveness he instantly recognized as similar to the central pattern in the works of geometric abstractionists. By dint of sheer fortune, the job he got at a textile company helped him develop a technology-based procedure for processing the perceptions and materials he collected. His previous training in graphic design came in handy, and he was quickly promoted from a menial position to that of technician, which provided him with access to professional photographic equipment and techniques of imaging.

For his first American project, *New York Faces* (1976-1980), Mysłowski selected a small segment of the Manhattan grid and collected about 5,000 portraits of passers-by taken in a digital photo booth machine he had rented. He then processed them on the computer and printed out in black-and-white on A4 perforated paper used in offices for text and numeric data. Scaled up to c. 30-40 cm, the images had the relatively low resolution of a standard office inkjet printer, making the matrix of black rectangular pixels visible to the eye at close range. The grid-like structure of these printouts was so obviously analogous to the grid of a Manhattan street map that in his next project, *Avenue of the Americas* (1974-1979), he decided to focus on the rectangularity of the city blocks and the regular lattice of streets and avenues.

Employing state-of-the-art photographic technology, he generated a large number of modular series from source images by having their parts magnified. The process involved stacking and aligning matching and incongruous frames, superimposing positives and negatives, and isolating different fragments as autonomous new images in which the original rectangular shapes and contours were transposed or merged through reduction of resolution and equalization of contrast in dark and bright areas. The grid of each source image, progressively fractured step-by-step by enlarging its details, gradually disintegrated and morphed in unpredictable ways – some parts became isolated segments of the visible geometric structure sunk into the white background, while others blended into blots of blackness that less-and-less precisely marked the rectangular spaces originally circumscribed by the crisscrossing horizontal and vertical lines of the street plan. Within the coordinates inscribed in the grid's rigid pattern, new perpendicularities manifested themselves, upsetting and disrupting the grid's perfect regularity.

In numerous other works he created between 1974-1998, Mysłowski's sole focus was the cross as the most elemental form constitutive of the structure of the grid – two lines intersecting at the right angle. Lacking philosophical or scientific background, he was not exactly a methodical and articulate thinker and polemicist, but he still felt the need to justify and explain his art, intuitively sensing that his project had cogency that transcended merely aesthetic concerns. He compiled a kind of sourcebook of his visual ideas, in which the cross was considered from the most diverse vantage points (both perceptual and mental) in order to bring into play a multitude of connotations. In a hefty volume titled *Then & Now* (2018), which documents his evolution as an artist and a speaker, in the section dedicated to the cross, he juxtaposes images and descriptions confirming the universal agency and appeal of the cross in many different cultures and periods with reproductions of his own graphic works, sculptures and installations, his observations on various subjects as well as fragments of other people's statements and illustrations cut out from periodicals and books (many truly unidentified "found objects"). Combining a simple, minimalist graphic vocabulary with often rudimentary and at times clumsy verbal expression to convey the historical, cultural, social, aesthetic and personal connotations of his transmutations of New York's grid and portraits of its inhabitants, the volume presents his projects as rich communicative artefacts that are acts of cultural translation involving mediation and rewriting.

From the perspective of translation studies, a discrete field developed in the wake of the so-called cognitive turn in many disciplines, such acts are "constructive process[es] in which the translator actively constructs a new meaning that is appropriate for the target culture and audience" (Zheng, Tyulenev and Marais 2023, 169). The uniqueness of Mysłowski's performance as a cultural translator and rhetor lies in the fact that his works embrace and capitalize on the ambiguity of both the cultural context they spring from and the audience they are meant for. The artist ascribes this duplicity to his status of a permanent "transmigrant" whose "vision [is] made clear by distance and separation." Reflecting on how his emigration to America has affected his artistic identity, he adds: "Each place is my home and the place I'm coming back to. This dualism is the place where I belong" (2018, 21). The nature of this dualism is encapsulated in the Latin root of the word translation – *translation* – which means "carrying across" or "bringing across" from one space, or one time, to another.

This aspect of Mysłowski's visual rhetoric was famously recognized when, in early 1996, IBM contacted him about acquiring the right to use his cross images in the company's commercial "Solutions for a Small Planet" to be aired in March at the Academy Awards ceremony, an event watched by millions of viewers across the world. For lack of evidence to the contrary, we have to assume it was a mere coincidence that ten years earlier an IBM employee had received this letter from Mysłowski:

> Dear Professor Mandelbrot, I am an artist who has lived in New York for the last 16 years. I am writing this letter because it was a very significant moment for me to be introduced to your thought and work ("The Man Who Reshaped Geometry," by James Glieck [sic], *New York Times Magazine*, December 8, 1985). I subsequently obtained your book, *The Fractal Geometry of Nature*, which has become my bible and has helped me to clarify problems in my own work... Presently my work is on exhibit in New York at Carpenter + Hochman Gallery, 420 West Broadway. I am enclosing a small catalogue of the show. The work was done before I knew of yours. Do you see any affinity between your theories and my flowing space structure? (Mysłowski 2018, 50)

A few days later, Mandelbrot wrote this in his response to Mysłowski: "The closeness of the affinity between what you do and some of what I was doing circa 1978 is astonishing" (Mandelbrot 1986, quoted in Mysłowski 2018, 50). He also promised to send the cover he had once designed for a magazine, a promise on which he delivered only five years later after receiving a present from Mysłowski – a set of eight white ceramic plates decorated with black decals, which the mathematician described as "extraordinarily beautiful" (Mandelbrot 1991, quoted in Mysłowski 2018, 52). He did not, but might as well have also said that they almost look like variations of his own design, which he recreated from the "original" and signed for Mysłowski. The design shows fractal shapes emerging from a black rectangle in exactly the same fashion Mysłowski's crosses, multiplied in geometric structures, metamorphose into fluid forms.

The affinity between the two men, now acknowledged by both, became even more obvious when Mysłowski published *Towards Organic Geometry: 1972-1994* (1994), whose completion marked a turning point in his investigations, confirming his deepest intuition about geometry as fundamental to visual perception and conceptualization of relations among things, including human beings and the world they inhabit. As in his earlier projects, the central optical artifact was still the grid, but this time it was subjected to an entirely different transformational procedure. Having selected 163 photographic images derived from his favorite segment of the New York street map, the artist generated 10,000 pictures in which interaction of light and chemical process produced accidental effects, such as loss of sharpness at the expense of perceivable physical imperfections and flaws in the prints. Experimenting in the darkroom with various photographic devices and developing procedures to enlarge, invert or reduce the photographed grids, he made this crucial discovery: the greater the magnification of a detail, the less geometric its structure appears – sharp edges become blurred, straight lines get sinuous, and their intersections no longer form angles but become irregular curves. As a result, squares, rectangles, triangles and other polygons within the crystalline structure of the grid are progressively transformed into non geometric free forms whose biomorphic shapes resemble cells in a living organism. Visually and conceptually, Mysłowski's book is a twin of Mandelbrot's *The Fractal Geometry of Nature*, the main difference being that it lacks any text. The fact that the artist more than redressed this apparent deficiency by publishing *Then & Now* is less important than the visionary insights both testify to. These insights are encapsulated in the following statement Mysłowski inscribed into one of his crosses: "In the universe, there exists a countless number of crosses. If we can let them speak for themselves and become capable of hearing their words, something we cannot even conceive of now would happen. The form would show us a new dimension, inspiring new ways of thinking" (2018, 39).

Mysłowski's conviction that, like words, images inspire thoughts is of the same kind that motivated Mandelbrot to preface his articles about numbers and figures with visionary-sounding introductions. The artist's album of organic geometric forms is an utterly compelling communicative artefact because it is rhetorical in the same way as the mathematician's famous, and itself largely visual, "essay" on fractals. Despite approaching geometry from two very different angles – that of mathematics and that of visual art – Mandelbrot and Mysłowski arrive at a common ground where their respective perspectives, tools and materials are all used to convey the same message: geometric forms can be employed to demonstrate that the patterns and the irregularities we encounter in the world all have the same fundamental nature which can be represented, comprehended and explained by means of either or *both* numbers and figures. Fragmenting figures into fractals or cells, they show, allows scientists and artists alike to bring to light the fundamental building blocks of all natural objects and phenomena without destroying nature's mystique that has appealed to and motivated both scientists and artists since time immemorial.

Finally, one other striking affinity between Mandelbrot and Mysłowski is that as rhetors they often employ the same devices and appeal to similar sentiments. For instance, revealing not only a sound understanding of and respect for time-honored strategies of effective communication but also a sensitivity to poetic diction, both resort to citation as a form of indirection to acknowledge their influences and inspirations. In his introduction to *The Fractal Geometry of Nature*, Mandelbrot thus quotes the seventeenth century English scholar Richard Bentley:

> All pulchritude is relative. . . . We ought not . . . to believe that the banks of the ocean are really deformed, because they have not the form of a regular bulwark; nor that the mountains are out of shape, because they are not exact pyramids or cones; nor that the stars are unskillfully placed, because they are not all situated at uniform distance. These are not natural irregularities, but with respect to our fancies only; nor are they incommodious to the true uses of life and the designs of man's being on earth. (1983, 6)

Mysłowski, in turn, closes a lecture he gave in Japan in 2000 by citing a poem by Malevich:

> Earth mind consciousness linked in the chain of things created
> But poet and artist were tricked by the fervor of the earth
> The earth showed them simple things
> But they sought a hidden mystery in them.
> They sought something that need not have been sought.
> The more they sought the more they split into millions
> Of tentacles of earth – into mind and language.
> The thread of mind and word and sound cleaved
> To things to form a huge network, a spidery web
> In which consciousness became entangled.
> Many painters and even more poets resounding
> Desperate walls, indignant moans sobs before the mouth
> Of the mystery of earth. (Malevich 1911-13, quoted in Mysłowski 2018, 435)

The closeness of the tenor of these statements may not be immediately apparent, but rhetoric comes in handy again: in the context at hand, are they not truly interchangeable?

References

Primary sources:

Mandelbrot, Benoit B. [1977] 1983. *The Fractal Geometry of Nature*. W. H. Freeman and Company.

Mysłowski, Tadeusz. 2018. *Then and Now—New York City Fragments: Tadeusz Myslowski at the Crossroads.* Muzeum Lubelskie.

Mysłowski, Tadeusz. 1994. *Towards Organic Geometry: 1972-1994*. Irena Hochman Fine Art.

Secondary sources:

Baker, Scott. 1990. “Reflection, Doubt, and the Place of Rhetoric in Postmodern Social Theory.” *Sociological Theory* 8 (2): 232-245. https://doi.org/10.2307/202208

Borel, Armand. 1983. “Mathematics: Art and Science.” *The Mathematical Intelligencer* 5 (4): 9-17.

Burke, Kenneth. 1966. *Language as Symbolic Action: Essays on Life, Literature, and Method.* University of California Press.

Csiszar, Alex. 2003. “Stylizing Rigor: Or, Why Mathematicians Write So Well.” *Configurations* 11 (2): 239-268. https://doi.org/10.1353/con.2004.0018

Condit, Celeste. 1999. *The Meanings of the Gene: Public Debates About Human Heredity.* University of Wisconsin Press.

Cucker, Felipe. 2013. *The Crossing Paths of the Arts and Mathematics*. Cambridge University Press.

Curtin, Deane W., ed. 1982. *The Aesthetic Dimension of Science.* 1980 Nobel Conference. Philosophical Library.

Ede, Siân. 2005. *Art and Science*. I. B. Tauris.

Foss, Sonja K. 2004. “Framing the Study of Visual Rhetoric: Toward a Transformation of Rhetorical Theory.” In *Defining Visual Rhetoric*, edited by Charles A. Hill and Marguerite Helmers. Lawrence Erlbaum Associates.

Foss, Sonja K. 2005. "Theory of Visual Rhetoric." In *Handbook of Visual Communication: Theory, Methods and Media*, edited by Ken Smith, Sandra Moriarty, Gretchen Barbatsis, and Keith Kenney. Lawrence Erlbaum.

Gleick, James. 1985. "The Man Who Reshaped Geometry." *New York Times*, December 8. https://www.nytimes.com/1985/12/08/magazine/the-man-who-reshaped-geometry.html.

Graubard, Stephen R., ed. 1986. *Art and Science*. University Press of America.

Hardy, Godfrey Harold. 2018. *A Mathematician's Apology*. Martino Fine Books.

Hayles, Katherine N. 1990. *Chaos Bound: Orderly Disorder in Contemporary Literature and Science*. Cornell University Press.

Hayles, Katherine N. 1984. *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century*. Cornell University Press.

Henderson, Linda. D. 1998. *Duchamp in Context: Science and Technology in the Large Glass and Related Works.* Princeton.

Henderson, Linda. D. 2004. "Editor's Introduction: I. Writing Modern Art and Science – An Overview; II. Cubism, Futurism, and Ether Physics in the Early Twentieth Century." *Science in Context* 17 (4): 423-466. https://doi.org/10.1017/S0269889704000225

Henderson, Linda. D. [1983] 2013. *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*. MIT Press.

Hill, Charles A., and **Marguerite Helmers**, eds. 2004. *Defining Visual Rhetoric*. Lawrence Erlbaum Associates.

Jałochowski, Karol. 2019. *Heretycy, buntownicy, wizjonerzy. 22 Podróże z największymi umysłami naszych czasów*. Copernicus Center Press.

Jones, Caroline A. and **Peter Galison**, eds. 1998. *Picturing Science, Producing Art.* Routledge.

Kemp, Martin. 2006. *Seen/Unseen: Art, Science, and intuition from Leonardo to the Hubble Telescope.* Oxford University Press.

Kemp, Martin. 2016. *Structural Intuitions: Seeing Shapes in Art and Science.* University of Virginia Press.

Kemp, Martin. 1990. *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat.* Yale University Press.

Krauss, Rosalind. 1979. "Grids." *October* 9: 50-64. https://doi.org/10.2307/778321

Krull, Wolfgang. 1987. "The Aesthetic Viewpoint in Mathematics." *The Mathematical Intelligencer* 9 (1): 48-52. Translated by Betty S. Waterhouse and William C. Waterhouse.

Miller, Arthur I. 2014. *Colliding Worlds: How Cutting-Edge Science Is Redefining Contemporary Art.* W. W. Norton & Company.

Miller, Arthur I. 2001. *Einstein, Picasso: Space, Time and the Beauty that Causes Havoc.* Basic Books.

Miller, Arthur I. 2000. *Insights of Genius: Imagery and Creativity in Science and Art.* MIT Press.

Miller, Arthur I. 2019. *The Artist in the Machine: The World of AI-Powered Creativity.* MIT Press.

Parkinson, Gavin. 2008. *Surrealism, Art, and Modern Science: Relativity, Quantum Mechanics, Epistemology.* Yale University Press.

Simons, Herbert W., ed. 1990. *The Rhetorical Turn: Invention and Persuasion in the Conduct of Inquiry.* University of Chicago Press.

Wynn, James, and **G. Mitchell Reyes**, eds. 2021. *Arguing with Numbers: The Intersections of Rhetoric and Mathematics*. Pennsylvania State University Press.

Zheng, Binghan, Sergey Tyulenev and **Kobus Marais.** "Introduction: (Re-)Conceptualizing Translation in Translation Studies." *Translation Studies* 16 (2): 167-177.