

Seeing the Light: At the Crossroads of Art and Science

May Term in Luxembourg, 2011

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Background

George Seurat's "pointillist" paintings took the late 19th-century art scene by storm. Close up, his brush strokes and colors presented the viewer with a seemingly random and almost meaningless appearance. But from a comfortable viewing distance, his scenes, typically of familiar places and activities, created a glistening and exciting effect on all who beheld them.



Where did the idea for such a bold break with then-current techniques come from? How did Seurat know what combinations of apparently unrelated patches of color would produce the exact effects he wanted, or, in fact, what made him think that the dots would blend, in the viewer's eye and mind, at all? More than a small part of the credit must rest with M. E. Chevreul, whose scientific investigations on light and color, summarized in his *chef d'oeuvre*, "De la

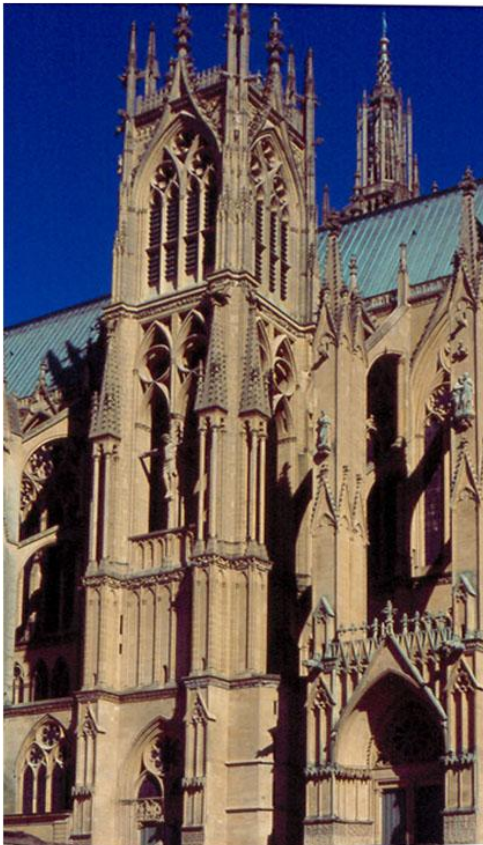
Loi du Contraste Simultané des Couleurs"¹ stimulated Seurat and his colleague Paul Signac to carry out their own artistic experiments, as carefully conceived and executed in their domain as Chevreul's were in his.

In the late 15th century, Leonardo da Vinci, whose combination of talents in art and science has never been surpassed, was among the earliest developers of the geometric constructions needed to guide the painter in achieving a realistic, three-dimensional perspective effect on the two-dimensional canvas. Later painters, including Johannes Vermeer in the 17th century, produced incredibly accurate perspective and an uncanny representation of the play of light, shadow, and reflection in their paintings. How could Vermeer, without science, have outdone Leonardo in this difficult aspect of his craft? Recent studies² have produced convincing evidence not only that he was familiar with some of the then-newly-developed optical devices and techniques, but also that he actually used them in making some of his preliminary layouts and sketches. As we shall see, in countless other instances, the science of the times has informed and enhanced artists' creative work.



These visual masters' experiments with new ideas and approaches were, more often than not, developed concurrently with innovations in musical styles and composition. In turn, artists and composers alike were responding to (and helping to create) changes in their own societies, including, to a greater extent than sometimes recognized, the latest discoveries and technological advances in the sciences. The famed "well-tempered clavichord" used by Johann Sebastian Bach was developed through an on-going dialogue between musicians and scientists: how can musical instruments be tuned so as best to preserve the "natural" relationships between different notes while still recognizing the practical limitations in building real-world keyboard instruments?

At the dawn of the 20th century, long-standing paradigms were being overturned in many intellectual and creative fields. In physics, Albert Einstein, contemplating how events look from the points of view of different observers, developed his theory of relativity, with its cornerstone understanding that no frame of reference was more privileged than any other. Arnold Schoenberg, experimenting with a similar notion in music – that no single key should be preferred over any other – developed the quintessential approach to atonal music with his "12-tone" system of composition. Pablo Picasso and Georges Braque, noting how significantly differing viewpoints contribute to our sense of what any object looks like, created their remarkable "cubist" paintings, which reveal to the beholder many inter-related aspects of each depicted object at a single glance. Did all of these clearly parallel ideas come out of thin air,



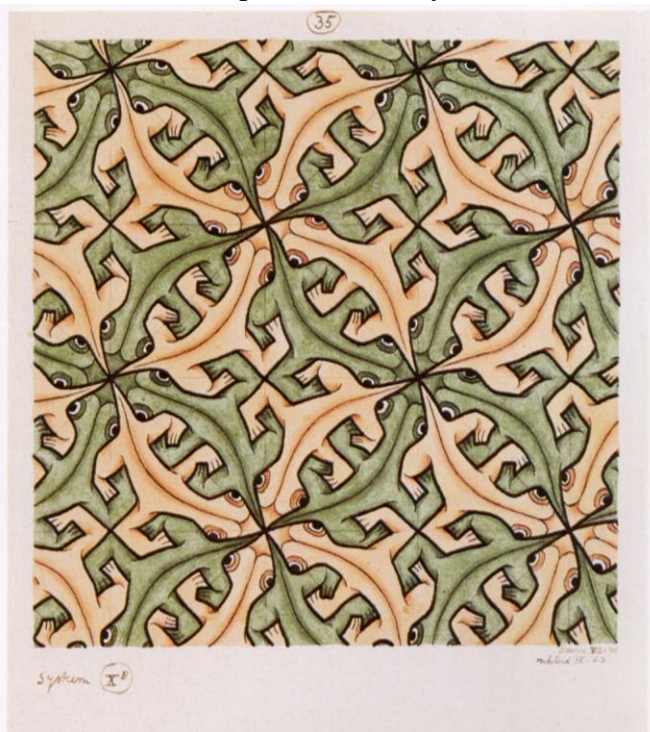
independently, to each of these diverse geniuses? Of course not; all three grew up in Europe at a time of intellectual ferment. Hints of the full story can be found in A. I. Miller's recent book on Einstein and Picasso.³

During the past decade, two beautiful books exploring these sorts of ideas were published. One, by Lynn Gamwell,⁴ helps us to see a wide variety of relationships among art, science, and "the invisible." The other, by Margaret Livingstone⁵ investigates the roles human physiology and processes in our brains play in our sense of the artistic. Further valuable insights into the intersections of these areas of study can be found in a series of papers by a diverse set of psychologists, neurologists, sociologists, artists, and philosophers published in two volumes of the *Journal of Consciousness Studies*.⁶

The course

In "Seeing the Light," we will explore the physics of light and sound, physiological and psychological aspects of visual and aural perception, and some of the many ways in which these ideas influenced, consciously or not, the art of pivotal Western painters and composers.⁷ The parallel histories of science, art, and music will provide the thread of continuity for our studies. Our studies will center on hands-on experimentation. We will investigate some properties of light

and color, and of sound waves. We will explore, through visual and aural illusions, aspects of the physiology of vision and hearing, as well as how the brain interprets its sensory stimuli. We will look at selected examples of art works, and follow with some experiments in color mixing, perspective, and optics. We will listen to examples of music produced in the same eras, with commentary from course co-instructor Susanne Blatt. As an important part of our studies, capitalizing on the culturally remarkable location provided by our base in Luxembourg, we will take field trips to view some prime examples of artists' works and scientists' ideas. We will study some of the fantastic forms contrived by nature, on display at the Palmengarten in Frankfurt; some stunning human creations at the cathedral in nearby Metz (a few dozen kilometers across the border in France). During a two-day stay in the Netherlands, we will visit a wonderful collection of early 20th-century art at the Kröller-Müller Museum in Otterlo, as well as the magnificent collection of old masters at the Mauritshuis in The Hague. Also in The Hague, we will tour the Escher Museum, housing the world's largest display of the works of M. C. Escher, who combined great skill in graphic art with a mathematician's curiosity about space and symmetry.



Assignments

An outline of the course schedule can be found on the last page of this document. During our four weeks together, there will be reading assignments in the course textbooks; each student will collect their sketches and experimental work in a portfolio, along with daily journal notes; and students will work in small groups to develop a term project going more deeply into some aspect of the materials we are studying. A collection of reference books will be available at our course base, the Klouschter in Mondorf-les-Bains, to aid in this work.

Target audience

With its eclectic mix of physics, scientific investigations into visual and aural perception, and examples from art and music history, as well as its hands-on approach to all aspects of the material, "Seeing the Light" can provide valuable background for students in nearly any field of study. It should be especially valuable as science background for art or music students, but, equally well, it could serve as an introduction to art and music for students in the physical sciences or psychology. *No prior science courses are required.*

References

1. English version of Chevreul's 1839 French edition, re-titled "The Principles of Harmony and Contrast of Colors." Translated by Faber Birren; Schiffer Publishing Company, West Chester, PA (1987).
2. Philip Steadman, "Vermeer's Camera: Uncovering the Truth Behind the Masterpieces," Oxford University Press, Oxford, UK (2001).
3. Arthur I. Miller, "Einstein, Picasso: Space, Time, and the Beauty that Causes Havoc," Penguin Putnam, Inc., New York, NY (2001).
4. Lynn Gamwell, "Exploring the Invisible: Art, Science, and the Invisible," Princeton University Press, Princeton, NJ (2002).
5. Margaret Livingstone, "Vision and Art: The Biology of Seeing," Harry N. Abrams, Inc., New York, NY (2002).
6. "Art and the Brain," *Journal of Consciousness Studies*, Volume 6, #6 and #7 (1999), edited by Joseph A. Goguen, and Volume 7, #8 and #9 (2000), edited by Joseph A. Goguen and Erik Myin; Imprint Academic, Thorverton, UK.
7. Martin Kemp, "Visualizations: The *Nature* Book of Art and Science," University of California Press, Berkeley, CA (2000).

“Seeing the Light” class schedule – 2011 May Term

WEEK 1 – Arrival Tuesday, May 24

Overview: light, color, vision, and art

Shapes in nature and human culture: symmetries, fractals, fibonacci

Wednesday, May 25 – Tour of Luxembourg City (all three classes)

Thursday, May 26 – Field trip to Metz, France (box lunch)

- **Cathedral Ste. Etienne; Gothic structure; stained glass windows: 14th century and 20th century (including several by Chagall)**

WEEK 2

The geometry of light – pinhole cameras, reflection, refraction; perspective

How we see and hear: the human eye and ear, the brain, and sensory perception

Begin work on team projects

Tuesday May 31 – Field trip to Frankfurt, Germany (box lunch and cash dinner)

- **Palmengarten (botanical gardens)**
- **Dialogmuseum – Seeing *without* the light (reservations starting 3:00 p.m.)**

Wednesday, June 1 – Tour of Trier, Germany (all three classes)

WEEK 3

The eye of the artist: more on light and color; Impressionism in art and music

Illusions; how realistic can art be? Can our ears be fooled, too?

Thursday, June 9 – Field trip to Luxembourg City (box lunch and cash dinner)

- **National Museum of History & Art – history of Luxembourg, art collection**
- **Natural History Museum: shapes in nature, crystals, fossils**
- **Afternoon, join our classmates, meet with students from University of Luxembourg for joint activities**

WEEK 4

Intersections of science and the arts: relativity, cubism, and 12-tone music

Project completion and term wrap-up

Tuesday/Wednesday, June 14 and 15 – Overnight field trip to Otterlo and Den Haag, The Netherlands -- Hotel IBIS Den Haag Centre (box lunch, cash meals)

- **Kröller-Müller Museum, Sculpture Garden, and Park**
- **Mauritshuis: Rembrandts, Vermeers (including “Girl with a Pearl Earring”)**
- **Escher in Het Paleis: symmetry, illusion and the infinite**
- **Short stop in Delft – Vermeer displays**

Thursday, June 16 -- Leir luncheon in Frisange

Departure June 17

Textbook (Additional assignments will use reference books in the class “library.”)

“**Vision and Art: The Biology of Seeing,**” by Margaret Livingstone (Harry N. Abrams, paperback, 2008)