

Special Section

# ArtScience: The Essential Connection

*Guest Editor: Robert Root-Bernstein*

The eleventh installment of a Leonardo special project exploring the work and writings of artistic scientists who find their art avocation valuable; scientifically literate artists who draw problems, materials, techniques or processes from the sciences; or others interested in such interactions.

## Call for Papers

What is the value of artistic practices, techniques, inventions, aesthetics and knowledge for the working scientist? What is the value of scientific practices, techniques, inventions, aesthetics and knowledge for the artist? When does art become science and science, art? Or are these categories useless at their boundaries and intersections?

Can an individual excel at both science and art, or is even a passing familiarity with one sufficient to influence the other significantly? Do the arts ever contribute significantly to scientific progress? Where will current scientific innovations lead the arts in the next few decades?

Submissions exploring these questions can be from artistic scientists who find their art avocation valuable; from scientist-artist collaborators who can demonstrate a scientific or artistic innovation; from scientifically literate artists who draw problems, materials, techniques or processes from the sciences; or from historians of art or science looking at past examples of such interactions.

Interested authors are invited to send proposals, queries and/or manuscripts to the Leonardo editorial office: Leonardo, 211 Sutter St., Ste. 501, San Francisco, CA 94108, U.S.A. E-mail: <isast@leonardo.info>.

## SPECIAL SECTION

## ArtScience: The Essential Connection

## CERTAIN OF HEISENBERG'S ARTS

Cultured Germans at the turn of the 20th century were expected to be fluent in Latin, Greek, philosophy, poetry, music and painting. Werner Heisenberg (1901–1976), as the scion of two eminent academic families, acquired such culture. He began playing the cello as a young boy and some years later learned to play the piano and guitar as well [1]. While in *Realgymnasium* (preparatory school), Heisenberg became skilled enough at the piano to consider a professional career, but felt that the opportunities to make his mark in the world were much greater in atomic physics. His subsequent Nobel Prize (1932) proved him right [2]. Music, however, would play two important roles in his career. One was as a constant accompaniment to his physical researches. He often expressed the opinion that the beauty found in music, poetry and physics was one and the same, expressing some kind of archetypal “central ordering” of the universe [3,4,5]. He found that even when he was hard at work on a new theory, he still needed time to explore this central ordering through diligent musical practice [6]. This practice also paid off professionally, for it brought Heisenberg into intimate contact with the social elite in each of the cities in which he worked, providing him with a network of influential and powerful friends [7]. He also met the woman who would become his wife, at a 1937 concert in Leipzig for which he played the piano part in Beethoven’s *Trio in G Major* [8].

Heisenberg also explored the avocations of drawing and painting. One hour of drawing per week for three years was required of all students at the *Realgymnasium* [9]. Heisenberg, as with almost everything he tried, did more than was required. As a college student, he became a leader in a cultural organization called

the *Neupfadfinder* (New Pathfinders), which took day trips around Germany, with activities such as hiking, mountain climbing, singing, playing music, reciting poetry and reading great literature. “Art,” as one of his fellow Pathfinders later explained, “was simply one of the accomplishments expected of them” [10], and so Heisenberg learned to paint. David Cassidy, Heisenberg’s biographer, describes “a book of quite good watercolors from that period” [11], which resides among the family’s private papers (Color Plate G).

Heisenberg was also a skilled craftsman. He and his brother collected technical toys and built mechanical and electrical engines, motors and induction coils during their teenage years [12]. “Their masterpiece was a 1.5 meter electric battleship, equipped with remote-controlled steering and electrically fired cannons; it was proudly displayed in the Heisenberg home for years” [13].

What is particular interesting about Heisenberg’s arts are their possible connections to his science. Cassidy notes,

As a physicist, Heisenberg possessed an unusual ability to perceive the physical result arising from a mathematical formulation after many complicated moves. Perhaps this skill, vital to any physicist, was enhanced for Werner by his many hours of complicated chess matches [14].

One might, however, just as easily speculate that such a skill was developed through Heisenberg’s ability to follow the complicated threads of a Bach musical score through their manifold permutations to a synthetic conclusion, or attribute it to his manual skill at building complicated things, or refer to his well-trained inner eye. For in discussing the nature of scientific understanding, Heisenberg states that understanding does not begin with mathematics but with the juxtaposition of “different intuitive pictures and distinct types of force” [15]. The content of physical thinking involves,

he writes, “transform[ing] them into a coherent, ‘meaningful’ picture” [16]. “Mathematics . . . play[s] only a subordinate, secondary role. Mathematics is the form in which we express our understanding of nature; but it is not the content of that understanding” [17]. “Hence,” Heisenberg suggests, “we ought to inquire more closely into the origin of the pictures on which our ideas are based” [18].

Might the arts be a clue to such pictures?

ROBERT ROOT-BERNSTEIN  
*Department of Physiology*  
*Michigan State University*  
*East Lansing, MI 48824*  
 U.S.A.  
*E-mail: <rootbern@msu.edu>*

## References

1. David Cassidy, *Uncertainty: The Life and Science of Werner Heisenberg* (New York: W.H. Freeman, 1992) pp. 14, 17, 23, 81.
2. Werner Heisenberg, *Physics and Beyond: Encounters and Conversations* (New York: Harper Torchbooks, 1971) pp. 18–19.
3. Heisenberg [2] pp. 10–11.
4. Werner Heisenberg, *Across the Frontiers* (New York: Harper and Row, 1974) pp. 166–183.
5. Cassidy [1] p. 545.
6. Cassidy [1] pp. 85, 139, 219, 269, 272–273, 323.
7. Cassidy [1] pp. 14, 273.
8. Cassidy [1] p. 367.
9. Cassidy [1] p. 24.
10. Cassidy [1] p. 82.
11. Cassidy [1] p. 82.
12. Heisenberg [2] p. 17; Cassidy [1] pp. 17, 39.
13. Cassidy [1] p. 17.
14. Cassidy [1] p. 83.
15. Heisenberg [4] p. 83.
16. Heisenberg [2] p. 4.
17. Heisenberg [4] pp. 146, 182.
18. Heisenberg [2] p. 4.