widespread application. Artists working in cyberspace, and more specifically with bio-telematic systems and technoetic structures, can be agents of human evolution. The full flowering of a truly interactive art, widely diffused and deeply enjoined, may bring about a society fit for the new millennium.

References and Notes

1. The term "technoetic" refers to the technology of consciousness, according to Roy Ascott, "A Glossary" in the "Essays" section of the on-line installation "Techno Seduction," produced by the Cooper Union for the Advancement of Science and Art and accessible at <http://www.cooper.edu/art/techno/essays/gloss.html>.

2. "Hypercortex" is defined as "the global network of collective cognition," according to Ascott [1].

3. According to David V. Tansley, "All esoteric tradition agrees that man consists of a variety of bodies that are distinct from his physical form." In that tradition, with appropriate preparation and protocols, the "subtle body" links mind to mind and spirit to cosmos. See David V. Tansley, *Subtle Body* (London: Thames and Hudson, 1977) p. 6.

4. "Cyberception" is defined as "the emergent human faculty of technologically augmented cognition and perception," according to Ascott [1].

5. Roberto Mangabeira Unger, *Politics: Theory Against Fate*, Zhiyuan Cui, ed. (London: Verso, 1997) p. 415.

6. Unger [5] p. 13.

MATHEMATICIANS: THE NEW ARTISTS?

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The last few years have seen a revival of interest in the possible connections between mathematics and artistic creativity. The principal motivation for this new interest is the large diffusion of computers with strong graphical capabilities. This diffusion has heightened the roles of intuition and creativity in the aspects of mathematical research connected to the possibility not only of visualizing previously known phenomena but making visible the invisible [1].

Mathematical ideas are not subject to fashion, nor do they vary through the centuries; a theorem proved by Euclid is valid today and will be valid forever. How many other human activities can claim these characteristics of universality and immortality? Is mathematics the true art? In his essay "Mathematics in Western Culture," Morris Kline wrote:

> Of course the creative process must produce a work that has design, harmony and beauty. These qualities too are present in mathematical creations [2].

Clearly, some peculiarities emerge in considering the question of creativity in mathematics and in trying to compare it to artistic creativity. On the one hand, mathematicians claim theirs as the real universal art; on the other, they claim to be the only ones able to understand this truth—so only the participants in the scientific community can take part in this "banquet of gods" [3]. The only apparent conclusion is that trying to analyze relationships between mathematical and artistic creativity is a waste of time.

In any case, we may discuss the possibilities opened by new technologies for the relationship between art and mathematics. The key is to focus on the main directions along which we may obtain results of interest for each field. In the visual investigation of scientific problems, mathematicians have obtained images that have provoked the interest not only of the scientific community but of a wider audience—artists in particular. These artists, feeling excluded from being able to fully utilize the new visual tools, have asked for cooperation from mathematicians and experts in computer graphics.

The use of computer graphics has made it possible to actually see unimaginably complex, graphic mathematical objects, opening wide spaces to artistic creativity. Mathematicians very soon became aware of this extremely important aspect of their research [4].

Until a few years ago, it would have been impossible to imagine a book like *Symmetry in Chaos: A Search for Pattern in Mathematics, Art and Nature.* Its authors, the mathematicians Michael Field and Martin Golubitsky, wrote in the introduction:

> In our mathematics research, we study how symmetry and dynamics coexist. This study has led to the pictures of symmetric chaos that we present throughout this book. Indeed, we have two purposes in writing this book: to present these pictures and to present the ideas of symmetry and chaos—as they are used by mathematicians—that are needed to understand how these pictures are formed. . . . One of our goals for this book is to present the pictures of symmetric chaos because we find them beautiful, but we also want to present the ideas that are needed to produce these computer generated pictures [5].

The authors recall Heinz-Otto Peitgen and Peter Richter's book, *The Beauty of Fractals* [6], adding:

> It is worth noting that the images we present have a different character from those found in fractal art. While fractal pictures have the sense of avant-garde abstract modernism or surrealism, ours typically have the feel of classical design [7].

Who could have imagined a few years ago that such declarations could have been found in the introduction of a volume written by two mathematicians?

We face a revolution in the relationship between mathematics and art that may engender a very profound creative cooperation between the two—perhaps a new Renaissance? [8]

References and Notes

1. This was the view of David Brisson, as stated in Michele Emmer, *Dimensions* video in the series *Art and Mathematics* (Rome: FILM 7 INT., 1984). The film is dedicated to Brisson.

2. Morris Kline, *Mathematics in Western Culture* (Harlondsworth, U.K.: Penguin, 1953) pp. 521–522.

3. François Le Lionnais, *Les grands courants del la pensès mathèmatique* (Paris: A. Blanchard, 1962) p. 5.

4. For an idea of both the growing importance of visual aspects in mathematics and the possible connections between some of the most recent mathematical research and the work of artists who use mathematically influenced visual techniques, see Michele Emmer, ed., *The Visual Mind: Art and Mathematics* (Cambridge, MA: MIT Press, 1993) or the *Visual Mathematics* special issue of *Leonardo* **25**, Nos. 3/4 (1992).

5. Michael Field and Martin Golubitsky, *Symmetry in Chaos: A Search for Pattern in Mathematics, Art and Nature* (New York: Oxford Univ. Press, 1992) p. vii.

6. Heinz-Otto Peitgen and Peter Richter, *The Beauty of Fractals: Images of Complex Dynamical Systems* (Berlin: Springer, 1986).

7. Field and Golubitsky [5] p. viii.

8. Michele Emmer, "Le mathèmaticien artiste," in M. Frémiot, R. Malina and J. Mandelbrojt, eds., *Le Status esthétique de l'art technologique,* special issue of *Alliage* Nos. 33/34 (1998) pp. 39–50.

SAME PERIOD, SAME PROBLEMS?

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Technological art, whether traditional (painting, sculpture, music, literature) or more contemporary (multimedia, network or interactive media), is characterized by the juxtaposition—or the superposition—of several artistic disciplines. These disciplines have undoubtedly developed in various ways throughout the courses of their histories; although some of them may have been interrelated in the same aesthetic current, they have not necessarily been