

FROM THE GOLDEN SECTION TO “SYMMETRIC” INTERSECTION OF ART AND SCIENCE IN THE AGE OF INFOR-MATHS (IN-FORMA-THEMATICS)

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Publications:

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Abstract: *After discussing that the golden section was not really an intersection of art and science until the 19th century, we focus on possible intersections of art and science in the Information Age: from ethnomathematics to tilings, from polyhedra to non-linear mathematics. The term InforMathematics (introduced together with Ferenc Nagy) refers not only to information (and the need of informality in interdisciplinary research), but also to forma and visualization, and new themes in art and science.*

1 ISIS-PROLOGUE: AGAINST SPLIT BETWEEN DISCIPLINES AND HELPING THE CRACKS ON THE WALLS

ISIS-Symmetry was born in August 1989 with the goal of bridging the “two hemispheres”, art and science, of our “split culture”. I used this expression, instead of Charles P. Snow’s “two cultures”, emphasizing that we have just one culture, where the two sides should cooperate. My term has an association with the topic of “split brain” (asymmetry of the brain). The functions of human brain also require a link (*corpus callosum*) between the two hemispheres. Of course, the mentioned “one culture” is

multi-cultural: we have a special interest in ethno-science and East-West comparative studies (cf., Ogawa, et al., *Katachi U Symmetry*). Although the exact sciences produced some “universal results”, the style of thinking and the methods of education could be very different. While the conservation of matter and the conservation of energy are laws of nature, we should extend these by a convention at the level of our society: the conservation of information, including not only the genetic material of species, but also human ideas, with an emphasis of those ones of native people. It is also important that we should have no walls among cultures, but we should learn from each other.

Interestingly, our First Congress and Exhibition in Budapest (August 1989) coincided with the first crack on the Berlin Wall. The Hungarian government opened the Austrian-Hungarian border to East German tourist, i.e., the shortest “Minkowski distance” between East Berlin and West Berlin was via Budapest. The absurdity of this route became obvious and the majority of people preferred the shortest “Euclidean distance”, which soon eliminated the entire wall. The Congress and Exhibition also had a similar importance in the smaller circle of artists and scholars from East and West: we provided some “bridges” and a meeting place for many people who never ever met because of geographical and disciplinary borders.

Twelve years after, we may need some additional directions with a modified philosophy. First of all, let us start with a case study.

2 THE GOLDEN SECTION: FROM “MATHEMATICAL FOLK-LORE” AND “LEGENDS” TO FACTS

Perhaps the golden section is the best-known concept that links art and science – as it is believed - since ancient times. However, almost nothing is true from those historic statements on the importance of the golden section in art, which became “public knowledge” via many papers, books, and encyclopaedias. Most of the well-known “examples” for the use of the golden section in Egyptian and Greek buildings and sculptures, Gothic churches, and Renaissance paintings are based on modern measurements, which are not conclusive:

- the measured data are not definitely identical with the original dimensions,
- the rounded data may indicate various different proportional systems (e.g., if we have the ratio 0.64 one may ask: is it the “manifestation” of the golden section $(-1 + \sqrt{5})/2 = 0.618...$ or the simple ratio $2/3 = 0.666... ?$).

In order to state that an artist clearly used the golden section, we may need some further records, including (1) clear statements on this, (2) regulating lines that identify the geometric construction of the golden section, (3) systematic usage of a set of ratios of neighbouring Fibonacci numbers, $2/3$, $3/5$, $5/8$, $8/13$, $13/21 (= 0.619...)$, ... , which approximate the golden number ($0.618...$), the numerical value of the golden section. Without such pieces of evidence, it is impossible to state that the artist really tried to use this relatively complicated irrational number.

Interestingly, the term *golden section* is very new. The same concept gained new names and importance through the ages:

- (1) Ancient mathematics: *akros kai mesos logos* (extreme and mean ratio) - a purely mathematical concept, a circumscription of an idea, with no surviving evidence that it was used in art.
- (2) Renaissance culture: *divina proportio* (Pacioli) - a mathematical-mystical concept, perhaps an expression adopted from Leonardo who used it just metaphorically.
- (3) Scientific revolution: *sectio divina* (Kepler) - a concept that is a “jewel” of mathematics and useful for calculating the data of some Platonic solids.
- (4) Mathematics education in the 19th c.: *der goldene Schnitt* (*sectio aurea*) - a useful term for teaching of mathematics, which is important in botany (Braun) and associated with human proportions (Zeising); the golden age of the topic (Fechner, Liszt).
- (5) Science and art in the 20th c.: *golden cut/mean/ratio/proportion/section* - alternative names that are used by various scholars and artists.

“Golden sectionism” in aesthetics (Zeising, 1854), with many overstatements, led to anti-golden-sectionism. On the other hand, we may need a balanced “mean” between the two “extremes”. Thus, we should also consider that the golden section is related to some scientific discoveries, including optimal algorithms (Kiefer) and various structures of fivefold symmetry (Penrose tiling, quasicrystals, Bucky balls, etc.).

Of course, the legends on the golden section are also important: these reflect the thinking of groups of people. Perhaps golden-sectionism was also associated with a desire to find some “universal principles” in art, which were successful in science. However, this topic was not really an intersection of art and science through the ages.

3 INTERSECTIONS IN THE AGE OF INFOR-MATHEMATICS

The Information Revolution made new possibilities for cooperation between artists and scholars. The new possibilities for visualization of complicated mathematical and scientific ideas popularized many new problems where scientific discoveries may “meet” with artistic beauty (see our journal *Visual Mathematics* and Slavik Jablan’s related lecture). Both artists and scientists may learn from the other side:

- artists may deal with new “forms” (topological surfaces, fractals, strange attractors, etc.) and may use new tools (computer programs, holograms, etc.)
- scientists may learn a better visual approach,
- educators may use the aspects of beauty in science education and may deal with exact methods in the humanities.

I also believe that there will be a new age in mathematics: after 2500 years the very idea of “mathematical proof”, which remained unchanged since the time of Euclid, may have a new meaning. I guess that Hales’s solution of the Kepler Conjecture (presented at our last congress) and the related computer programs will be checked not by some referees, but perhaps by volunteers via the Internet (cf., the Four-Color Problem earlier).

In short, we should refer to the *Information Revolution*, to *forma* and visualization, to

new *themes* in art and science, to new approaches in *mathematics*, as well as to the need for *informal* approach. All of these are imbedded into the expression *InforMathematics*, which was introduced by Ferenc Nagy and myself.

Let us try to identify some possible intersections of art and science:

- Ethnomathematics for education (an Australian example: string figures)
- Tilings and patterns in anthropology, design, and mathematics
- Polyhedral Structures in art, science, and technology (from Plato to Bucky)
- Order/disorder, symmetry/dissymmetry (or fuzzy symmetry)
- Morphology (formology) in East and West, North and South (comparative studies)
- Non-linear mathematics (fractals, chaos, etc.) and media art.

4 ISIS-EPILOGUE: INTER-SECTION (*IS*)

The bridges were important over borders, but now we may need more:

- *InterSection* (as a set-theoretic operation) of art and science or of distant disciplines
- For the first time in 400 years or so, art and science are coming back together, claims Cochrane, a leading figure of new technologies (*Tips for Time Travellers*, London, 1997, p. 98). Perhaps this is an overstatement, but we may make a less strong statement without hesitation: we have much more possibilities for intersection of art and science.

- *InterNetwork of Minds* (cf., Minky's Society of Minds)

New forms of cooperation are obviously possible via the Internet. The only problem is that too much information could be too little: it is very difficult to find the right tree in a very large forest. Thus, we need not only networks of computers, but also networks of minds that extend the search engines.

- *Local-global symmetry* (cf., the relationships between point groups and space groups in crystallography, as well as the Curie principle)

Do we need globalization? Do we need localization? We need both where the local symmetry is very important and strongly contributes to the necessary globalization. One side should not force the other: we need a harmonic relationship between them with a lot of freedom (see, e.g., the local information at the global Internet).

Thinking about the new form of ISIS: we need, instead of one center, many local hubs and projects that are either founded or completed by groups of volunteers. Will video-conferencing replace our meetings? In the case of interdisciplinary topics, where most people do not know each other in advance, the congresses are still important. Some of the topics are so new that we may need more personal communications: the eye contacts, the touches, and ... the "magic" of meetings.