Bruce Beasley, *Refuge*, Cast Bronze, 1993, 24\(\text{h}\) x 22\(\text{w}\) x 17\(\text{d}\)
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Editors. Ergun Akleman, Nat Friedman.


DECEMBER, 2006

Cover Photo: Bruce Beasley, Refuge, Cast Bronze, 1993, 24"h x 22"w x 17"d.

Article Submission

For inclusion in Hyperseeing, members of ISAMA are invited to email material for the preceding categories to hyperseeing@gmail.com

Note that articles should be a maximum of three pages.
Bruce Beasley’s long career as a sculptor can be divided into four periods. As summarized in Manfred Fath’s article Between Expression and Construction: Consistency and Change in the Work of Bruce Beasley: “There was his initial period in the 1960s when he worked with welded and cast iron, cast aluminum and industrial scrap; in the 1970s he worked with transparent materials; in the 1980s he constructed space-enveloping steel sculptures based on hexagonal forms.” (see www.brucebeasley.com for Manfred Fath’s article, as well as excellent articles by Marlena Donohue and Albert Elsen)

From 1987 to the present, he has been working on sculptures whose structures are based on intersecting rectangular forms. This concept arose from studying crystalline forms in nature. We will concentrate on these sculptures in this article. As formal geometric sculptures, they are impressive in their intricate composition and construction. However, Beasley’s main concern is for a sculpture to convey a profound gestural feeling, just as the pose of a dancer can convey gestural feeling. Thus the works have both a formal and expressionistic appeal.

Bruce Beasley uses a special CAD (computer aided design) program that allows a sculpture to develop one rectangular form at a time. Thus Beasley has to continually make design choices for how the forms intersect, their sizes, and their relative positions. This requires multiple revisions as the composition develops. In particular, the computer program allows the sculpture to be rotated in space so that Beasley can see the sculpture from all viewpoints. That is, the program allows complete hyperseeing as the sculpture develops. In Beasley’s own words: “I feel my process has a life of its own. I discover the piece as I create it – I find it as I work rather than having a preconceived notion in my head”… .”I manipulate the forms on my computer interactively with hand controlled stylus and dials. It is really quite a hands-on process. What it really feels like is doing a drawing in three-dimensional space”. (An Interview with Bruce Beasley, Marlena Donohue). The computer program can also print out patterns of the two-dimensional sides of the intersecting forms. These patterns can then be cut out of foam core and assembled to obtain a 3D model of the sculpture. The foam core model is then used to obtain a bronze sculpture.
A very strong recent work is the cut granite sculpture Encounter II, shown above. From a geometric viewpoint, Encounter is a composition of intersecting rectangular polyhedra projecting into space. The dramatic variety of light and shadow on the stone surfaces is very compelling. Thus as a combination of form, space, and light, Encounter II is an impressive formal success. Encounter II can also be seen architecturally as an abstract arch form with a minimal left side merging into a complex right side.

Encounter II can also be viewed as an abstract figurative sculpture. It can be seen as a convoluted torso with an arm or leg reaching out for support. The torso structure can also be seen as expressing life experience, where each polyhedral form represents a major event. One event emerges from the preceding event. Thus the abstract composition of intersecting forms can be seen as a sequence of events as each event gives birth to the next event. As the successive events move thru time, they twist and change direction, reflecting the complexities of life. Thus the development of the structure can also be seen as a record of a life. The supporting arm or leg represents the basic supporting life-force that keeps one going.

In contrast to the horizontal extension of Encounter, Spokesman shown above is a vertical composition of intersecting components. The surfaces are patinated bronze. Each component has its individual color. Spokesman can be seen as a sequence of events beginning with birth at the base followed by the rather precarious time of growing up with a group of events merging into a successful maturity. The vertical forms at the top can be interpreted as two figures whose lives have merged. This brings us to the next sculpture Refuge.
It is interesting how Bruce Beasley has conveyed very expressive feelings of life experience thru the medium of merged geometric forms. This work is related to the geometric compositions of polyhedral forms of David Smith, Tony Smith, James Rosati, and others. However, in Mr. Beasley’s sculpture, there are deeper meanings that arise as a result of the technical virtuosity that resulted in the development of the merged forms.

We also note that sculptures such as Landscape and Refuge can be seen as rock formations in landscape. This is crystalline structure on a monumental scale.

Thus Beasley’s works have multiple meanings as formal geometric compositions, narration of a sequence of events, as well as rock formations in landscape. No doubt each viewer finds their own interpretation of these sculptures, which are dense with meaning. For a more complete presentation of his work, the reader is referred to www.brucebeasley.com

The four photographs in this article are courtesy of Bruce Beasley.
For almost ten years, I have been running workshops at various conferences and universities around the world in which the participants create large models of four-dimensional polytopes using Zometool. Figure 1 shows a construction made last month, when I was invited to give a workshop at Dowling College, in Oakdale, NY. The resulting form is a beautiful sculpture, which creates a volume of space divided into tetrahedra and truncated dodecahedra in a visually engaging froth-like manner.

Some four hours were required for the assembly of its 3680 parts. Dozens of students attended at various times during the day, participating for intervals when their class schedules allowed. Figure 2...

Figure 1. Model of truncated 120-cell using Zometool. 6 foot diameter.
shows the crew present at the end of the construction. I would like to thank Lester Corrian and Fred Rispoli, who invited me, arranged the workshop, and organized the students.

The 120-cell is a 4D object, so it can not exist in our 3D world. It is just one of many interesting 4D forms that lead to beautiful 3D constructions. Various types of 3D models can be made of their shadows and cross sections. The Zometool model created here is a projection, which simplifies the structure considerably yet preserves some of its high symmetry. For information about Zometool, see their website, http://www.zometool.com. These plastic parts have the lengths and angles built in to allow for constructing many other interesting polytopes. Instructions for making this model are given in Zome Geometry, by George Hart and Henri Picciotto, (Key Curriculum Press, 2001).

Mathematicians have long appreciated the abstract beauty of higher-dimensional forms. For example, the truncated 120-cell was first described by Alicial Boole Stott a century ago. She made beautiful cardboard models of simpler polytopes. See e.g., http://www.ams.org/featurecolumn/archive/boole.html. But only recently could models of such high complexity be physically made. Figure 3 shows a six-inch plastic model made using a solid freeform fabrication process. I designed the structure and had it fabricated mechanically by a stereolithography process. It makes a beautiful intimate sculpture.

I enjoy teaching construction workshops like this one at Dowling College because it involves students at many levels. Educationally, these Zometool models get students physically involved, engage them to think about the patterns and structures present, and start communication about mathematical ideas. They are large enough that the participants become quite proud of the accomplishment. The result is a sculpture so beautiful that everyone wants a photo of himself or herself with it. For details of other large polytope construction workshops I have led, see my web site: http://www.georgehart.com.
The name “Planeliner” refers to the specific geometric progression therein. A series of profiled plates are placed concentrically on top of each other. The plate above the previous is smaller in diameter by a constant percentage, the thickness of the plates remain constant throughout. In side-elevation an exponential curve is generated.

Due to a percentage reduction in the diameter of the next level’s plate (set at -10 percent, therefore always leaving 90 percent at each level), the system is infinite. On viewing this sculpture one is experiencing a small section of an endless progression. The event stretches forever towards a plane at the base; and a line at its apex, although theoretically never reaching either.

The origin of this work goes way back to the frozen winter of 1986. Whilst walking besides a frozen creek I was surprised to see several strange formations erupting from the extensive ice sheet before me. I saw beautifully symmetrical concaved ice cones ranging from approximately 0.3 to 1.0 metres in diameter and up to 20 cm tall; this was a mysterious and fascinating scene to be sure.

Over the intervening years I have made several enquiries concerning the origin of these formations, but still no scientific explanation has come to light... Well, in trying to understand this phenomenon I have formulated my own supposition, which in turn has led to the creation of the “Planeliner” sculpture.

The drowned floor of this creek (mud bank, full of rotting vegetation) is also a massive reservoir of methane, and at times gas will escape from the mud. As an ex-angler I know this may happen from a single location, and in a way where single methane bubbles are liberated quite regularly, and of an even size; eventually breaking at the waters surface. Now, if simultaneous to this event an ice sheet begins to form on the surface of the water, then the circular ripples emanating from the “bubble break point” will disrupt any ice crystal formation in the area where wave energy levels are high enough.

There will be a circular boundary where consolidated ice sheet and di-
minishing waves meet. It is here that the flat ice sheet will be lapped by tiny waves allowing a new wafer thin sheet of ice to form very slightly above the original ice level. This activity will add height, and as the ambient temperature decreases will gradually creep towards the epicentre of the wave energy.

The most formative elements of this event may not necessarily depend upon the accurate frequency of waves. More important maybe is the relationship between the “Bubble break point” (where wave amplitude/energy is highest), and the proximity of the frozen boundary (where frozen water laps over newly formed ice).

It seems logical that as the ice sheet advances towards the “Bubble break point” the unfrozen water lapping onto the ice sheet will, with its increasing amplitude/energy have a greater influence; exponentially adding height to the ice the closer it gets. For me this exponential accent in the profile of the frozen cones is beautiful evidence of an interplay between energy levels; as the energy level of the ambient temperature drops, there is a proportional increase in wave energy as the “hole” in the surrounding ice sheet shrinks.

Whilst writing this possible explanation I do recall that each of these frozen cones did in fact have a pocket of trapped gas under its apex. This I imagine finally froze over as cause and effect became more and more localized.

If anyone reading this has photographs or information concerning these formations, I would like to hear from you.

Pioneer of that now termed the Art/Science forum, Simon is highly regarded as an artist researching the underlying patterns of nature through observation and scientific study. His passion is to celebrate natural wonder as a poetry of space.

Since graduating from the Royal College of Art in 1988 he has completed numerous public and private sculpture commissions, exhibited work both in the UK and abroad, and travelled widely as a guest at international festivals and symposia.

Throughout this period Simon has developed a wide ranging knowledge of geometric principles with a particular interest in natural efficiencies. Simons suggestion that “The truth of science is beauty.... the beauty of art is truth” is key in understanding the motivation behind much of his research into the nature and meaning of things, and has lead to many collaborative initiatives and projects.

In 1993 along with Prof. John Steeds and Prof. Sir Michael Berry of Bristol University Simon co-founded one of the very first “Artist in Residence” programmes at a University Physics department. His two year fellowship sponsored by the Wingate foundation was followed by a further initiative, the “Order in Space” project at Hewlett Packard’s European research headquarters, Bristol. This generously funded opportunity led to a fruitful collaboration with mathematician and visualisation programmer Dr. Andrew Burbanks, investigating amongst other things “higher dimensional spatial orders”.

In 2002 Simon returned to Bristol University, this time as artist in residence at the School of Mathematics, where a collection of works are on permanent exhibition.

Over 2005-2006 Simon has been working on an exciting commission for another Mathematics department, this time at Portsmouth University. He has undertaken a thorough investigation of the beguiling geometric structure of soap bubble foam. 3-D foam structures are still not fully understood scientifically, so therefore his innovative modelling system is certainly of interest to those working in this fascinating area.
Introduction.

Greg Johns was born in 1953 in Adelaide, South Australia. He trained at the South Australian School of Art, 1975-78, where he received a Diploma of Fine Arts. In 1980 he had his first solo exhibit at Bonython Gallery in Adelaide. Since then he has had numerous solo exhibits in Australia as well as at the Robert Steele Gallery in New York City. His work is represented in an extensive number of public and private collections and he has received a large number of commissions for monumental sculptures.

Greg Johns’ works can be grouped essentially into figurative sculptures and geometric sculptures. This article will concentrate on part of Johns’ geometric sculptures and discuss certain mathematical concepts that are implicit in his work such as closed curves that are either loops or knotted forms. In general, Johns’ sculptures have a certain strength and integrity. They are well thought out and have a variety of interesting form-space images from different viewpoints. This can be seen in the rotating images of sculptures on his website www.gregjohnssculpture.com. Thus his sculptures are ideal for hyperseeing.

Closed Curve Sculptures.

An open space curve is a curve in space with two ends like the letter C. A closed space curve is obtained by joining the two ends of an open space curve. Thus a closed space curve has no ends and is continuous like the letter O. We will discuss certain of Greg Johns closed curve sculptures. We begin with Two Into One shown in Figure 1. Here Johns has created an interesting horizontal figure 8 type of sculpture that is a closed curve in space with a uniform square cross-section. An important point is how the sculpture encloses space. The form hovers over the space on the left but opens up the space on the right. As one moves around the sculpture, the shape of the spaces (windows) will also change.

Viewed from above, one could see that the sculpture has half-turn rotational symmetry about a vertical axis through the center. Half-turn rotational symmetry about the vertical central axis implies the form-space image one sees from any viewpoint in the horizontal central plane is the same as the form-space image one sees from the viewpoint directly opposite, which is one half turn around from the original viewpoint. For example, the image in Figure 1 is the same image as one would see from the viewpoint directly opposite. Also the image from the right side is the same as the image...
from the left side.

In general, as one would walk around the sculpture, images from opposite viewpoints would be the same. Half turn symmetry assists one in hyperseeing the sculpture. It is only necessary to move half-way around the sculpture to see the complete range of views.

Two Into One is a closed curve in space. Suppose we imagine this closed curve to be made of flexible material like rope. We could then lay the closed curve down flat. By manipulating the rope, we could then deform the closed curve into a circle. In this case we refer to the closed curve as a loop. Thus a loop is the simplest closed curve in space.

A second loop sculpture Guardian Figure is shown in Figure 2. In this case the square cross-section is relatively large resulting in a strong presence. However, the sculpture is balanced on an edge support, which implies a certain lightness. The shape of the closed curve consists of C-forms that enclose the interesting central space similar to two curved hands enclosing space. Guardian Figure can be seen rotating on Greg Johns’ website www.gregjohnssculpture.com. This allows one to hypersee the form-space sculpture and appreciate the variety of views.

As in the case of Two into One, Guardian Figure has half-turn rotational symmetry about the vertical axis through the center. Thus as one walks around the sculpture, the form-space image one sees from any viewpoint is the same as the form-space image one sees from the viewpoint directly opposite. Placing the monumental object on edge is very effective, since it makes a heavy object appear light, like a dancer on point. This is also the case for the two sculptures shown below.

**Knot Sculptures.**

A knot is a closed curve in space that is not a loop. Thus a knot is a closed curve in space that cannot be deformed into a circle.

It can be shown that the monumental sculpture Continuous Division shown...
in Figure 3 is a knot. The uniform square cross-section is relatively large, which gives the sculpture a very strong presence. The effect of the “knotting” results in a form-space relationship that is interwoven in the center and becomes more open at the top and bottom. The sculpture also has half-turn rotational symmetry about a vertical axis through the center of the sculpture. Continuous Division can also be seen rotating on Greg Johns website.

A second knotted sculpture is shown in Figure 4. Here Johns’ has made the uniform square cross-section as large as possible and still allow for the knotting. The form dominates in the inner form-space relationship. One has a feeling for the very narrow spaces separating the curved forms. The sculpture also has half-turn rotational symmetry about a vertical axis through the center.

From a mathematical viewpoint, we note that the knot forms are both configurations of the trefoil knot 31, as listed in knot tables. For mathematicians there is this one trefoil knot. However, Johns shows how a sculptor can create completely different interesting knot sculptures based on this single knot. In general, one mathematical idea can lead to a variety of interesting sculptures.

**Summation.**

Greg Johns’ sculptures convey a theme of strength and all-around visual interest. They are strong due to clean curving forms with strongly proportioned square cross-sections. The choice of a three-dimensional curving form leads you around the sculpture to experience a variety of interesting images. These sculptures also have a special appeal due to that extra character in their inherent curved design and the way they are mounted. For a variety of additional sculptures by Greg Johns, see www.gregjohnssculpture.com

**Photo Credits.**

Grant Hancock for Two Into One. Greg Johns for all others.

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**MAKE YOUR OWN CHRISTMAS ORNAMENTS WITH POLYHEDRAL SYMMETRY**

ERGUN AKLEMAN

Let us assume that you are a very rich mathematician. Of course, the problem with this assumption is that being rich and being a mathematician is mutually exclusive.

But for the sake of argument, let us say that you are a rich mathematician who loves geometry and you want to give unique and unusual Christmas gifts to your rich friends who have everything. What will you do? Make your own Spherical Christmas ornaments and give them as gifts. Spherical Christmas ornaments are beautiful but they are generic and almost always have simple rotational symmetry. I will show you how to create your own unique Christmas ornaments having polyhedral symmetries.

The only expensive item you need to create these ornaments is a 3D printer. You can buy one for $30,000. Your ornaments will look better printed with 3D color printer. If you have more than $50,000 to spend, consider to buy a
Then, you need software to build your own ornaments. Download TopMod, which is completely free.

Start with one of the five regular polyhedra, tetrahedron, cube, octahedron, icosahedron or dodecahedron. Then, recursively apply the following process.

1) Move vertices to a unit sphere
2) Apply a remeshing algorithm
3) Go to 1 until you get a complicated looking surface.

This process provides you the initial polygonal mesh. As initial polygonal mesh, it is also possible to use an Archimedean solid.

Remark: The remeshing algorithms preserve the polyhedral symmetry. Therefore your polyhedral model will have the polyhedral symmetry of the initial regular polyhedron.

Now, apply the following process three times.

1) Move vertices to a unit sphere.
2) Apply simplest subdivision. (Simplest subdivision scheme is known as Ambo operation in polyhedral modeling).

At this stage, you should get nice curves drawn on the surface of unit sphere.

If you do not like the result, start again. If you like it, then you are ready to create Christmas ornaments.

Using rind modeling, create a crust and punch holes by leaving only the curves. The result will be a unique Christmas ornament that is also a high genus surface.

Print the ornament using your 3D printer. Then buy a can of gold colored spray paint and paint the surface with spray paint. The result will look like a Christmas ornament made from gold.

Have a Merry Christmas and a Happy New Year!

The photos show physical sculptures that are created by my students using the method presented in the article. The sculptures were printed using the 3D printer in our College of Architecture. I painted and photographed ornaments. Their diameters are between 8 cm and 12 cm.
It has always been intriguing and fascinating for me to see some sculptures having hyperbolic geometry. The reason why they are so interesting to me is that you can not get those kind of visual experience from your daily life objects.

Inspired by works like those, I think it will be fun to create similar works but giving you the kind of feeling of inside-out. More specifically, it will be nice to find some patterns to create a series of high-genus surfaces with an inside-out look. I have discovered a new sculpture family while taking a Computer Aided Sculpting course. In the course, we used a software package called, TopMod in addition to other modeling software like Maya and 3D Studio Max.

The sculpture family I have discovered can be constructed only using the TopMod. This software has many tools that help user to create shapes with hyperbolic geometrical structure. It gives user unbelievable advantage when coming to create high-genus objects, which is a highly automatic process to apply those operations to create handles and holes. It’s will be very difficult to duplicate them easily using other tools.

1. Select one of those basic shapes like cube, dodecahedron etc.
2. Apply “Column Modeling” operation on the selected object.
3. Apply “Doo-sabin” operation on the selected object.

The first Inout sculpture that is printed using a 3D printer. The sculpture was constructed by Yutu Liu starting from a toroidal shape. Physical sculpture was painted and photographed by Ergun Akleman.

More information can be found at [1].

Here are the steps to create those objects.
4. Apply “Rind Modeling” on the selected object.
5. Select pieces from the surface to remove.

“Column Modeling” is a very neat feature in Topmod. The algorithm behind this operation is that it replaces each edge with a column and creates “joints” to connect “columns.” The shape of “joints” is determined by the thickness and cross-sections of “columns.” In addition, segments and thickness can be used to obtain smooth objects. More information about “column modeling” can be found at [1].

“Doo-Sabin” is a subdivision scheme to obtain smooth geometries, which generates new meshes based on midpoints of old edges and centroid of old meshes.

“Rind Modeling (Thickness)” is an interactive operation inside Topmod, which create a crust for peeling or punching rinds.

Of course, you probably need to play with the “thickness” and other parameters to obtain the best results. Now we are ready to remove pieces to create the inside-out look. In many cases, you probably need to remove a large number of small pieces to have the finished object. From my personal experience, it’s better to just throw away many small parts; therefore it will give you a well-defined object. Again, it’s up to your personal preference. After you have done the job, the finished product should be like the one in figure no#.

You can work on many objects to create a series of inside-out look surfaces. So far we have tried creating many of them using objects like torus, soccerball, tetrahedron, icosahedron and dodecahedron etc. We have found that those created objects are surprisingly beautiful and elegant in the sense of their geometrical shapes. Furthermore, this concept is not only limited to “column modeling,” it should also work for other similar operations in Topmod such as “wireframe” etc. At last, we want to give a name for the series objects. So does “inok” or “inouk” ring the bell for you? Or you have a better idea?


Three virtual Inout sculptures constructed by starting from a icosahedron, a dodecahedron and a tetrahedron, clockwise starting from top image. Modeling by Ergun Akleman, Rendering by Yutu Liu.
ISAMA’07 in College Station
Texas A&M University, May 18-21, 2007.

Thank you much to Ergun Akleman for arranging for Texas A&M University, College Station, Texas to host ISAMA’07 at the College of Architecture, May 18-21. There will be a Proceedings with an electronic submission process and an exhibit. There is a hotel on campus, as well as dorm facilities. There is also an airport in College Station serviced by several airlines. Relevant information will be on the website http://archive.tamu.edu/isama07/

For four days Texas A&M will be Texas Arts and Mathematics!!

Joint Meeting of the MAA and AMS in New Orleans.

The annual joint meeting of the MAA and AMS will be held in New Orleans January 4-8, 2007. Fortunately, New Orleans is the home of the sculptor Arthur Silverman whose work is based on the tetrahedral form. Arthur has spoken at several of the Art-Mathematics conferences in Albany, Berkeley, and San Sebastian. Here is the announcement concerning Arthur’s talk and studio visit.

Arthur Silverman: Tetrahedral Variations.

Arthur Silverman graduated from Tulane Medical School in 1947 and pursued a highly successful career as a surgeon in New Orleans. He retired from his medical practice while in his fifties in order to concentrate on an earlier passion for sculpture. He was attracted to geometric sculpture and became infatuated with the tetrahedron. He has produced more than 300 sculptures based on the tetrahedron, predominately in stainless steel or aluminum (see www artsilverman.com). His signature work is a pair of tetrahedrons, each 10 ft by 60 ft in front of the Energy Center in downtown New Orleans (see cover page). There are twenty of his sculptures in public buildings and outdoor areas in New Orleans. A map showing locations of the sculptures will be available at the Art Exhibit. Arthur Silverman will be giving a talk Tetrahedral Variations on Saturday at 6 pm at the Marriott. A studio visit is also being planned for Sunday at 6 pm. If you plan to visit the studio, please contact Nat Friedman: artmath@math.albany.edu

Mathematics and Culture


Bridges Donostia

Mucho congratulations to Reza for the tenth annual Bridges Conference, Bridges Donostia, to be held at the University of the Basque Country in San Sebastian, Spain, July 24-27, 2007. Donostia is the Basque name for San Sebastian. Javier Barrallos will be the main organizer in San Sebastian. Javier has already organized two wonderful conferences in San Sebastian. Namely Mathematics and Design in 1998 and ISAMA 99 in 1999. San Sebastian is a beautiful city on the northern coast of Spain in the Basque country. Dorm rooms with private bath will be available at a very reasonable cost that includes breakfast. There will be an excursion to Bilbao to see the Guggenheim Art Museum, as well as an excursion to Zabalaga, the sculpture park of Eduardo Chillida, outside San Sebastian. This conference will differ from the 1998 and 1999 conferences in that you will NOT have your own bottle of wine at lunch. Thus the afternoon sessions are expected to be better attended!! Alas, some conference will no doubt end up asleep on the beach. Watch the Bridges website for information.

Nexus V11, 2008

Nexus V11: Relationships between Architecture and Mathematics is organized by Kim Williams and will be held in June, 2008. For information, see www. nexusjournal.com
Robert F. Kauffmann is an award-winning artist, writer, and computer programmer from Cinnaminson, New Jersey. Kauffmann developed his own artistic style while still in college, inspired by his background in computer science and mathematics. His designs portray visual paradox using mathematical structures as expressive tools. He calls this style Mathematical Surrealism.

Robert Kauffmann’s graphic artwork has been exhibited in numerous shows in Philadelphia, Chicago, New York City, Miami, and other venues nationwide. His work has also won a number of awards and been published in various periodicals.
AIMS & SCOPE

The Journal of Mathematics and the Arts is a peer reviewed journal that focuses on connections between mathematics and the arts. It publishes articles of interest for readers who are engaged in using mathematics in the creation of works of art, who seek to understand art arising from mathematical or scientific endeavors, or who strive to explore the mathematical implications of artistic works. The term “art” is intended to include, but not be limited to, two and three dimensional visual art, architecture, drama (stage, screen, or television), prose, poetry, and music. The Journal welcomes mathematics and arts contributions where technology or electronic media serve as a primary means of expression or are integral in the analysis or synthesis of artistic works. The following list, while not exhaustive, indicates a range of topics that fall within the scope of the Journal:

- Artist’s descriptions providing mathematical context, analysis, or insight about their work.
- The exposition of mathematics intended for interdisciplinary education.
- Mathematical techniques and methodologies of interest to practice-based artists.
- Critical analysis or insight concerning mathematics and art in historical and cultural settings.

The Journal also features exhibition reviews, book reviews, and correspondence relevant to mathematics and the arts.

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For information, see www.tandf.co.uk/journals/titles/17513472.asp
The travelling art exhibit that started in France is now in Greece and was in Thessaloniki in November [http://hermay.org/ARPAM/text/active.html]. Gilbert Béranger was the local organizer. He is a retired mathematician and a former director of the French Institute of Thessaloniki. He sent me a report and some reviews from the local Greek newspapers that I shall briefly comment on. The exhibit is now in Volos and will travel to other locations in Greece. The Mayor of Thessaloniki has expressed the wish to show the exhibit again in October, 2007, either in its present form or enlarged. The exhibit may also travel to Africa.

THE REPORT

Opening days : Monday to Friday, from 11a.m. to 1 p.m. and from 6 p.m. to 8 p.m., Saturday from 10 a.m. to 2 p.m. (Sundays November 13 and 27 from 10a.m. to 1 p.m.)

Reception at the formal opening on Nov. 6; over 100 people were present.

Visitors :

From Schools.
1116 children coming from high schools have visited the exhibition with their professors. In 7 cases, the professors prepared the students in order to give them some information on the content of the exhibition. The visit had two parts: first the pupils could move freely in the room, then they were grouped together in order to view the exhibition, discuss their observations and to give some complementary information about the works. Some manipulations had been prepared according to the mathematical level of the visitors in order to help them to understand some works.

Only two classrooms have shown indifference; in all the other ones, a majority of visitors were interested (attentive observation of the works, questions, surprises, number of turns around the Dick Termes sphere !) Vacation days were devoted to visit the exhibition, so that the pupils came with their parents. The pupils have particularly appreciated the works of Constant, Jeener, Field, Casselman, Kalantari, Rousseau, Friedman, Wright, and Colonna.

Adults :

About 250 people (formal opening reception not included)
Indisputably, the visitors have been very interested, frequently staying long before each tableau. They often spoke about their amazement and the pleasure given by the works, and asked questions concerning the mathematics. A large proportion had a scientific background.

Few artists came, but 24 designers remained long over the works by Colonna, Ripps, Hart, Constant. The exhibition was often described as « original » and « atypical ».

Criticism:
The absence of richer documents, of a Greek catalogue, of explanatory information for the public to popularise the exhibit, as well as
the short hours that the exhibit was open, have been regretted.

It would have been beneficial if there were computer terminals available to visit the websites of the artists and physical mathematical models to produce visualizations of some mathematical facts or techniques that appear in the works. It would also have been beneficial to have a conference with speakers discussing the works.

COMMENTS

First, we have to thank Gilbert. He has definitely understood the philosophy and the interest of the ARPAM project, and his efforts to encourage the best pedagogical benefits of the exhibition deserve appreciation.

The mathematics that underly the exhibition are in general quite recent and non-trivial. Besides, most of the computing techniques used to set up the visualizations are also sophisticated ones. François Colonna or Mike Field software for instance are unique, as significant as the touch of brush of any great painter.

There is a real difficulty in popularizing the detailed scientific content of the exhibition. Various levels of popularization can be conceived. The preparation of the material at each level is a full time occupation.

Time seems to be now a rather rare commodity, and until now the full exploitation of the content of the exhibition has not been undertaken. To ask some good students in art and mathematics to try to write presentations of the content of the exhibition could be a first class exercise.

For the moment we can only use two global documents: the catalogue, and some basic papers written for almost any kind of visitors showing the bounds of the general mathematical content of the works with physics.

We also have documents that should be translated in the language of the people where the exhibition is shown. Understanding Dick Termes work can benefit from two papers, one by himself on six points perspective and one by mine. Some papers by Bahman Kalantari can be used as an introduction to his work and technique. David Wright’s article published by the AMS Notices gives a first outlook of the mathematical content of his work. A paper by Richard Denner on the sphere eversion has just been finished which allows one to follow the process of eversion. To that list of papers, one should add the useful papers by François Apéry, Jean François Colonna, Mike Field, Nat Friedman, George Hart, John Sullivan and Dick Termes which appeared in the 2002 Springer book “Mathematics and Art, Mathematical Visualization in Art and Education”.

More experience and knowledge on the reactions of the visitors must yet be acquired. If we can sometimes get the immediate comments from them, it would be useful to get some ideas on the psychological and intellectual influences that the visit could have in the long run. In which senses do the people feel more familiar, or not, with the mathematical world? What might be the various consequences of such a greater familiarity? At the formal opening reception, two non-scientific ladies told me both how they were attracted by the works and how they felt frustrated because they did not grasp the deep significance of the works, nor the kind of intellectual machinery which had lead to their production. I was quite happy to listen to them: they had reached the first step of being interested in the works and were hoping for further enlightenment.

Both at the Thessaloniki exhibition and the Paris exhibition “Salon des Jeux mathématiques” (cf the previous website), there was the same reaction: all the kids (3-6 say) elected the David Wright’ work as the most interesting; they were fascinated by the balls. This fact has to be analyzed, understood, and to be taken into account. Among the reasons of the success, some of them are well-known by psychologists, I suspect that the kids have a subliminal anticipation of the movements that allow to pass from a ball to another one, being of the same size, or not. At that age, kids are very sensitive to movements and attracted by all what is moving.

More generally, we have to emphasize the fascination exerted by all the works which are moving slowly: the Termes sphere, the Charbonneau Möbius band (not shown in Thessaloniki), the Ripp’s “helix” (not shown previously, its belongs to the flexible and antiseismic geometry). Pedagogical lessons have to be drawn from these facts.

Even if more and more frequently the techniques of creation of the works use computers, the exhibition gives a visualization of mathematical objects, which are geometrical objects. It emphasizes again the place and the role of geometry, the term being of course taken in its broad sense. The fundamental property of a geometrical
object is to shape – a number has no shape. A shape can be defined as the end points of some set of trajectories; it thus involves both the static conclusion and the dynamical creation.

Visualization of shape needs light. Light comes from a source that can lie at a finite or infinite distance. We can get an idea of the nature of an object localized very far off by its shadow that we observe on a screen. A general presentation of two dimensional geometry (Euclidean or not) can be obtained in a stimulating way by the study of the projections of the shapes of objects. I.M. Yaglom, in his book titled “Geometric Transformations” published by the MAA, gives an excellent presentation of Euclidean and projective geometry. The other classical geometries can be illustrated and taught in the same way, through the visualization of intersections of cones and surfaces. The use of applets which allows movement of the source of the light and the positions of the figures would further understanding and diffusion of geometry, a main source of creation of mathematical art.

**BOOK REVIEWS**

**Informal**  
by Cecil Balmond,  
Prestel, New York.

Cecil Balmond is a structural engineer with the firm Ove Arup in London. He has worked with major architects and sculptors such as Rem Koolhaas and Anish Kapoor. Informal refers to his “cutting edge” way of solving structural problems. To quote Rem Koolhaas: “Cecil Balmond has, almost single-handedly, shifted the ground in engineering—a domain where the earth moves very rarely—and therefore enabled architecture to be imagined differently”.

**What Is A Bridge?**  
By Spiro N. Pollalis  
drawings by Alberto Diaz-Hermidas  

This book describes the making of Calatrava’s Bridge in Seville. Spiro N. Pollalis is Professor of Design Technology at Harvard. This is an excellent exposition describing Calatrava’s revolutionary design and is written for the general reader, although technical drawings are also included. Quote from The Structural Engineer, by W. J. Harvey: “Here is a case study to read and treasure. Every student of civil engineering should buy a copy before they enter university and ponder it as they progress into their careers”.

**Children viewing Nat Friedman’s Fractal Stone Prints**
This exhibit of mathematical sculpture was organized by Javier Barrallo and Ricardo Zalaya and they wrote an introduction to the catalogue, which is 95 pages. The sculptors are Helaman Ferguson, Bathsheba Grossman, George Hart, Rinus Roelofs, and Carlo Séquin. The images below were provided by Rinus and show the exhibit and sculptures by Rinus. Additional images will be shown in our January issue. There will be a website for the exhibit.
Communications

This section is for short communications such as recommendations for artist’s websites, links to articles, queries, answers, etc. For inclusion in Hyperseeing, members of ISAMA are invited to email material for the categories outlined on the cover to hyperseeing@gmail.com or Nat Friedman at artmath@math.albany.edu.

A Sample of Web Resources

1. www.kimwilliamsbooks.com
   Kim Williams website for previous Nexus publications on architecture and mathematics.

2. www.mathartfun.com
   Robert Fathauer’s website for art-math products including previous issues of Bridges.

3. www.mi.sanu.ac.yu/vismath/
   The electronic journal Vismath, edited by Slavik Jablan, is a rich source of interesting articles, exhibits, and information.

4. www.isama.org
   A rich source of links to a variety of works. For inclusion in Hyperseeing, members of ISAMA are invited to email material for the categories outlined in the contents above to Nat Friedman at artmath@math.albany.edu

5. www.kennethsnelson.com
   Kenneth Snelson’s website which is rich in information. In particular, the discussion in the section Structure and Tensegrity is excellent.

6. www.wholemovement.com/
   Bradfrod Hansen-Smith’s webpage on circle folding.

   The new webpage of Bridges.

8. www-viz.tamu.edu/faculty/ergun/research/topology
   Topological mesh modeling page. You can download TopMod.

9. www.georgehart.com
   George Hart’s Webpage. One of the best resources.

10. www.cs.berkeley.edu/
    Carlo Sequin’s webpage on various subjects related to Art, Geometry and Sculpture.

11. www.ics.uci.edu/~eppstein/junkyard/
    Geometry Junkyard: David Eppstein’s webpage anything about geometry.

12. www.npar.org/
    Web Site for the International Symposium on Non-Photorealistic Animation and Rendering

13. www.siggraph.org/
    Website of ACM Siggraph.
ISAMA’07
Sixth Interdisciplinary Conference of
The International Society of the Arts, Mathematics, and Architecture
College Station, Texas, May 18-21, 2007

CONFERENCE
ISAMA’07 will be held at Texas A&M University, College of Architecture, in College Station, Texas. The purpose of ISAMA’07 is to provide a forum for the dissemination of new mathematical ideas related to the arts and architecture. We welcome teachers, artists, mathematicians, architects, scientists, and engineers, as well as all other interested persons. As in previous conferences, the objective is to share information and discuss common interests. We have seen that new ideas and partnerships emerge which can enrich interdisciplinary research and education.

FIELDS OF INTEREST
The focus of ISAMA’07 will include the following fields related to mathematics: Architecture, Computer Design and Fabrication in the Arts and Architecture, Geometric Art, Mathematical Visualization, Music, Origami, and Tessellations and Tilings. These fields include graphics interaction, CAD systems, algorithms, fractals, and graphics within mathematical software. There will also be associated teacher workshops.

CALL FOR PAPERS
Paper submissions are encouraged in Fields of Interest stated above. In particular, we specify the following and related topics that either explicitly or implicitly refer to mathematics: Painting, Drawing, Animation, Sculpture, Storytelling, Musical Analysis and Synthesis, Photography, Knitting and Weaving, Garment Design, Film Making, Dance and Visualization. Art forms may relate to topology, dynamical systems, algebra, differential equations, approximation theory, statistics, probability, graph theory, discrete math, fractals, chaos, generative and algorithmic methods, and visualization.

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