The Influence of Mathematical Models on Art

Artists and Art Movements Influenced by Mathematical Models

Constructivism

Herbert Read says of constructivist sculpture that "it has often been noted that they approximate, unintentionally, to the visual models constructed by scientists to illustrate algebraic formula." (Read, p. 70)

Naum Gabo

Gabo was a sculptor and a major architect of the Constructivist movement. Apparently Gabo studied mathematical models during the time that he was in Paris (A+H), for a direct influence on his work see his *Construction in Space: Crystal* (1937) (for information see Anthony Hill article, see refs). Also have a reference for a comparison between *Spheric Theme* and Ennepers surface (see Manuel Corrada in refs).

Gabo's use of string in his sculpture seems to be related to the inspiration that he drew from mathematical models (A+H, p. 127) as well as out of material necessity (he was unable to obtain his usual material due to the war) and the influence of Barbara Hepworth (A+H, p. 128).

> "In 1936 he decided that the cube (cornered) concept of space was restrictive and looked for someting in science that could be considered a basic space model, but found it non-existent.
> "He then devised the `spheric' theme, an invention which he has used more or less consistently ever since. (The English scientist L. L. Whyte has written `...some dates are intesting, though they should not be overstressed. Gabo took up his spheric theme around 1936, Fejes began his systematic mathematical study of spherical point arrangements in Hungary in 1942 without knowing of earlier work, tentative attempts by J. J. Thomson from 1904 onwards..."...)

Barbara Hepworth

Hepworth was an abstract sculptor, involved with the Constructivist movement. She was close friends with Naum Gabo. A number of Hepworth's works seem to be inspired by mathematics and mathematical models (see below). While Hammacher claimed that this inspiration came from Hepworth's study of these models in Paris in her youth, Hammer and Lodder claim that the inspiration really came later. They quote a December 1935 letter from Hepworth to her husband Ben Nicholson: "John Summerson says there are some marvellous things in a mathematical school in Oxford -- sculptural working out of mathematical equations -- hidden away in a cupboard

-- I think I shall go to Oxford as soon as I get back from Leeds" (p. 115-116).

Also, Hammer and Lodder note that the string work in Hepworth's drawings from the 1940s is very similar to curve stitching, which according to them was widely taught to young people beginning in 1906 to encourage interest in mathematics. They note as well that during the 1940s, Hepworth was running a nursury. They note that Alan Wilkinson has implied that these drawings of Hepworth's were inspired by Gabo (e.g. Linear Construction No. 1), but that recent evidence does not support this (the timeframe is worong). Instead they suggest that Gabo's use of string was in part influenced by Hepworth's work.

In letters to Margaret Gardiner, Hepworth "expressed concern that the speed of progress in science alone could be detrimental to society, and implied that the potential social value of art and science was dependent on their developing at a similar pace" (Barlow, p. 96).

From (Barlow, p. 100): "An interest in the laws determining both artisitic and scientific 'form' can be seen to be one of the mor econstant aspectes of the discussions between Hepworth and Bernal." Barlow goes on to quote a particular letter from Hepworth to Bernal, who had given some critical comments previously on the sculpture *Three Forms*. Hepworth agrees with his criticism and says "...my state of mind when I did it was not sufficiently clear. Consequently the other 2 shapes have not the perfection that was required to solve the third shape..." (p. 100). Barlow also says that accorinding to Maurice Goldsmith, Hepworth enjoyed visits from Bernal, during which he would discuss with her the mathematics and geometry in her works (p. 103, see refs for Goldsmith's book).

From (Barlow, p. 104): "The extent to which Hepworth would have used a scientist's visual interpretation of this understanding [of nature] (i.e. mathematical models) as inspiration for the forms in her work is debatable. Her study of forms such as the mathematical models could be viewed rather as a means of enhancing her `form consciousness' as opposed to an accptance of them on a purely literal level."

A list of Hepworth's works that I have found so far that are possibly inspired by / related to mathematics:

- *Holed Polyhedron* (1936)
- *Pierced Hemisphere* (1937) -- cf: Models of Riemann surfaces in Fischer's book (A+H)
- *Helicoids in Sphere* (1938) -- cf. Steiner's Roman surface (A+H)
- *Sculture with Colour* (1940) -- cf. Spindle Cyclide in Fischer's book -- and (1943) -- cf. Fresnel's wave surface (A+H)
- *Drawing for Sculpture with Color* (1941)
- *Oval Sculpture No. 2*
- *Pelagos* (1946) -- cf minimal surface with one-parameter

family of parabolas in Fischer's book (A+H)
- *Wave* (1943-4) -- cf. cubic with A3 double point in Fischer's book as well as Moore's *Three Points* (1939-40) (A+H)
- *Involute II* (1956)
- *Orpheus* (1956)
- *Stringed Figure (Curlew)* (1956).

Henry Moore, 1893-1986

Moore's use of string in his sculpture for a certain period of time was clearly influenced by models. As Moore says himself:

> "Undoubtedly the source of my stringed figures was the Science Museum...I was facinated by the mathematical models I saw there, which had been made to illustrate the difference of the form that is halfway between a square and a circle. One model had a square at one end with twenty holes along each side, making eighty holes in all. Through these holes strings were threaded and lead to a circle with the same number of holes at the other end. A plane interposed through the middle shows the form that is halfway between a square and a circle. One end could be twisted to produce forms that would be terribly difficult to draw on a flat surface. It wan't the scientific study of these models but the ability to look through the strings as with a bird cage and see one form with in the other which excited me." (Henry Spencer Moore, p. 105)

For examples of work influenced by models, see especially *Stringed Figure* 1937 and *The Bride* 1939-40.

Antoine Pevsner

Along with his brother, Gabo, Pevsner helped to develop the constructivist movement (he co-authored the *Realist Manifesto* with Gabo in 1920). In 1923 Pevsner moved to France, where he lived for the rest of his life. Some of his sculpture seems to have been influenced by mathematical models. According to Anthony hill, "Although he always denied it Pevsner based his *Developable Surfaces* on a concept found in certain mathematical models. (Hill, p. 144). In addition to the *Devolopable Surface* sculptures, see *Construction for an Airport*, 1937.

Man Ray

Two of Man Ray's series of works relate directly to mathematical models. The first is a series of photographs titled *Mathematical Object*. These photographs were made from models at the Poincare Institute in Paris. According to Neil Baldwin this was a series "of photographs of items created in the 1880s by a physicist attempting to render algebraic formulae correctly. Max Ernst had taken Man Ray to see the objects on display at the Poincare institute in Paris and had photographed them in a deliberately impressionistic style" (p. 199). The photographs are featured in in the 1936 issue of *Cahiers d'art*. The series was shown at the New Burlington Gallery from June 11,

1936 to July 4, 1936, in a large exhibition of over 60 artists that had more than 1,500 visitors per day.

The series of paintings titled *Shakespearian Equations* were based on the photos from the *Mathematical Objects* series. Man Ray wrote a piece discussing his mathematical inspiration for *To Be Continued Unnoticed*, the catalogue of the Copley Gallery Exhibition which premiered the series (I have not yet seen the piece).

Surrealism

At least some of the surrealists had an admiration for mathematical models. I have read sources that say such models were dear to Man Ray and to Max Ernst. The front cover of the catalogue of the 1936 surrealist exhibition at New Burlington Galleries in London is a drawing of a statue of a man (with a monsters head) holding four mathematical models, and with another model at his feet.

Things to Research

- International surrealist exhibition catalogue (1936) from the MFA -- models on the cover, nothing specific about the models inside, but can I find another source
- Finish reading the Cahiers d'Art article, the one with Man Ray's photos
- Jean Arp: b. 1887. Jean Arp. Jean Arp was a founding member of Dada in 1916 in Zurich, exhibited in the first Surrealist exhibition in Paris in 1925, and helped to found Abstraction-Creation in 1931.
- Bauhaus and Moholy-Nagy. Moholy-Nagy went on to found the Institute of Design at the Illinois Institute of Technology. Suppsedly Sybil Moholy-Nagy's book has some stills of a M-N movie that involves models??
- 1922 Congress of Constructivists held in Dusseldorf.
- El Lissitzky 1890-1941. Studied architecture in Darmstadt and Moscow. In 1919 he began to work on a series of geomeetric paintins title "Proun." At the end of 1921 he left Russia and moved to germany. He met Moholy-Nagy there, who brought his ideas to western Europe and the US. Lived in Hannover 1925-1928, then returned to Moscow. There's a number of his works at the Busch-Reisinger Museum,Harvard.
- John Desmond Bernal -- scientist, specialized in crystalography, article in *Circle*
- Vantongerloo: in the 30s he employed equations in a number of paintings and sculptures, at least to judge by their titles. See p. 104 of Read's book for "Sculpture in Space: y=ax^3-by^3". He is the only sculptor to come out of the de Stijl group.
- John Summerson -- told Barbara Hepworth to go see models at Cambridge. Is the the architect 1904-1992? Seems likely, I'm going to look at some of his books at mugar.
- Jack Pritchard, Julian Huxley, Jim Crowther -- in Hepworth's London

circle
- Margaret Gardiner
- To me Man Ray's Le Retour a la Raison (painting) also seems inspired by mathematical models (painted in 1939).
- Max Bill. First to use topological concepts explicitly in his art (Endless Ribbon sculptures).
- Boccioni. His technical manifesto for futurist sculpture briefly mentions mathematics. See http://www.unknown.nu/futurism/
- Jackson and H'elion, both constructivists
- Le Corbusier, architect.
- Find something linking Max Ernst to models, if possible!

Some General Thoughts

"The notion that these two realms [mathematical and organic form], conventionally seen as opposites, wee in fact inextricably connected was implicit in scientific investigations such as Bernal's research into the microscopic sturcture of crystals, and D'Arcy Thompson's *On Growth and Form*, a book widely admired in Gabo and Hepworth's circle, and enthusiastically reviewd by Herbert Read when the second edition appeared in 1941. The two artists differed, however, in their interpretation of this idea. Gabo's *Crystalline Centre* evokes a scientific imagery of crystalline or atomic structure...Hepworth retains an emphasis on the tactile associations of solid form and natural materials." (A+H, p. 128)

"The Russian Constructivists were interested in mathematical models from the beginning as the technical demands of their work encouraged a basic knowledge in the engineering field just as the old art was dependant on optics, anatomy, etc.

from Hill, p. 144.

In his article "The Constructivist Idea in Art" in *The Circle*, Gabo argues that science and art come from the same creative spirit, but act in different ways upon the world. The layman has very little access to science (because it is technical and intimidating), but a greater access to art. "The force of Science lies in its authoritative reason. The force of Art lies in its immediate influence on human psychology and in its active contagiousness." (p. 8-9).

For constructivists, Gabo says, content and form are the same. "It [Constructivism] has revealed an universal law that the elements of a visual art such as lines, colours, shapes, posses their own forces of expression independent of any association with the external aspects of the world." (p. 7) This reminds me very much of mathematicians, who often believe they are involved in a universal discovery of truth, outside of and above any reference to the physical world or any particular science.

Mondrian evokes a similar sentiment in his essay "Plastic Art and Pure Plastic Art," also in *Circle*: "`art' is **not the expression of the appearance of reality such as we see it, nor of the life which we live**, but that **it is the**

expression of true reality and true life." (emphasis is his, p. 53). Here Mondrian is speaking of pure art, which for him should be non-figurative. Mondrian goes on to argue that true non-figurative art gives universal truth, whereas figurative art can give only a subjective truth.

Herbert Read, from "The Faculty of Abstraction" in *Circle*: "Just as surrealism makes use of, or rather proceeds on the assumption of, the knowledge embodied in psycho-analysis, so abstract art makes use of, or proceeds on the basis of, the abstract concepts of physics and dynamics, geometry and mathematics. It is not necessary for the abstract artist to have a knowledge of these sciences...;such concepts are part of our mental ambience, and the artist is precisely the individual who can make this ambience actual" (p. 66).

In *Modern Sculpture*, Read argues that while Vantongerloo and Moholy-Nagy's ideas are interesting, their works are conceptual rather than aesthetic and thus not sculpturally significant (Read). I wonder if the are too scientific and mathematical to be art.

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