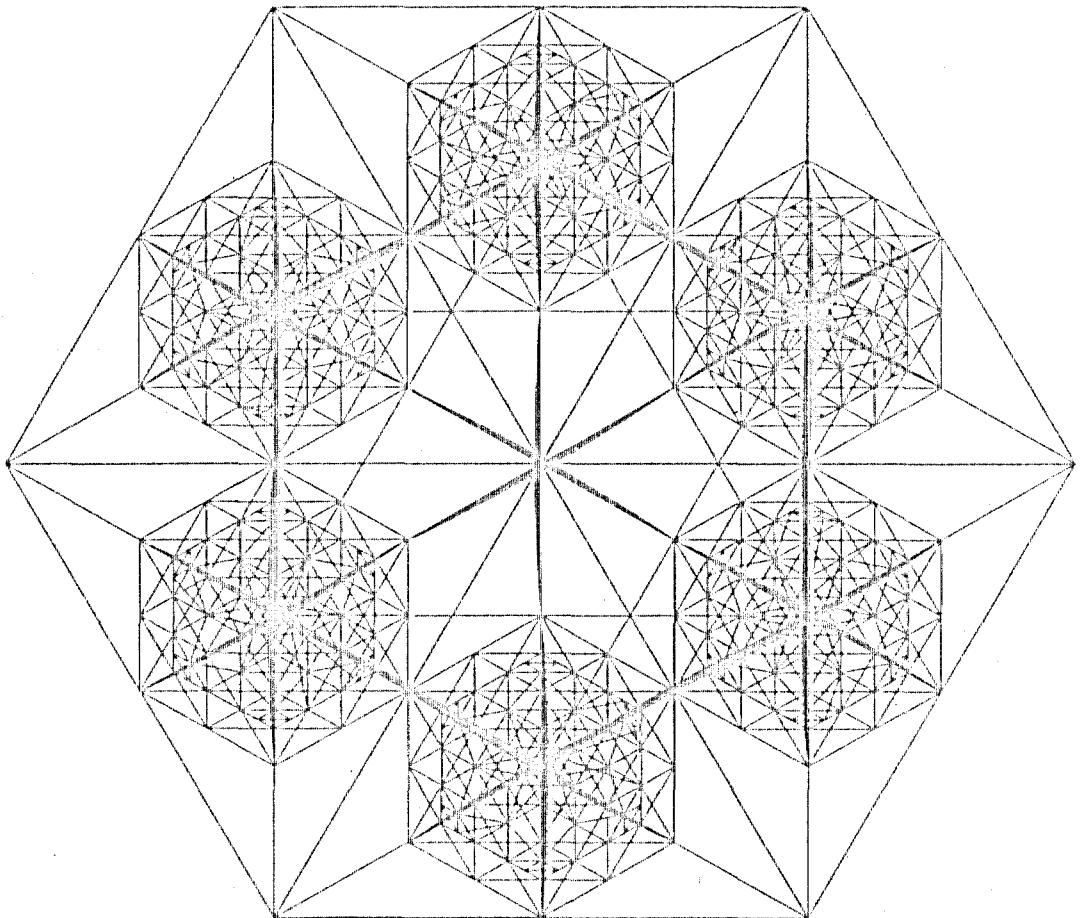


Symmetry: Culture and Science

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Large synergetical structure on hexagonal figure
Aerial view

SYMMETRY: THE INTERFACE OF ART & SCIENCE

SPACE, ARCHITECTURE, AND THE UNCONSCIOUS

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Gerald Edelman: "How can signals be represented or transformed in such a system so that there is an orderly representation in space and time? The space problem, has been shown in principle to be related to the existence of less degenerate repertoires, arranged so that there is a map between the outside world and what is in the brain."

Disobeying the advice of an old shepherd not to climb the Windy Mountain [Monte Ventoso in Italy] because he could become insane, Petrarca became the author of one of the most amazing feats of the vanishing Middle Ages. He climbed the mountain and there, disturbed and fascinated by the numbness caused by the scale of the scenery, he wrote a letter to Dionigi da Borgo San Sepolcro. Petrarca had discovered in the scenery his differentiated condition as an individual.

For the first time he was a man 'apart' from the others.

In the 1960s and the beginning of the 1970s many people believed that after a space voyage an astronaut would return emotionally 'unbalanced', 'disconnected' from the average patterns of social behaviour. This belief disappeared soon after because micro-computers and graphic computers introduced a sort of cosmic space into our homes. The Press did the same thing regarding the Middle Ages, but it took a much longer time to render the imagination independent from daily life and to convert it into a sort of scenery.

In *Aircraft* Le Corbusier shows how the new space experience produced by the airplane takes place: a sensorial perception where scale, time, light, and gravity are intensely synaptic. Animation and cinema have shown how this happens.

At the beginning aeronauts were also classified as social misfits, 'eccentrics'. Howard Hughes certainly knew about this. Our space-time perception is cultural: an illusion in continuous mutation. A metamorphosis unleashed by intense contamination amongst media of diverse natures, different 'props', various languages.

Gombrich, Umberto Eco – among others – have demonstrated how this phenomenon of mutations works in our system of meanings: our iconological mutation. From Villard de Honnecourt to the holographic cinema, as if knowledge were composed of asymmetric de-phased plates, allowing multiple combinations, exponential mutations.

The Press has fragmented, uninformed, and organized the Occidental world. The electronic and informatic universe de-uniformed, integrates, and disorganizes Western man. Our sense of 'order' today is very different from the mechanical 'order' of the 19th Century.

After the holographic cinema, the next step appears to be superconductivity.

In our complex network of meanings, the specular relationship between man and space falls definitively from the Euclidean universe.

What is the distance between space and thought?

Translating this by opposites: taking the brain as the architectonic frame: space and brain. What is the distance between brain and mind?

Werner Herzog filmed *Out of the Dark*: the life of Helen Keller – who became blind, def, and dumb while a child. It is a film which the cinematographic image itself becomes, step by step, one icon of one of the borders par excellence of man's exteriority.

Out of the Dark.

In 1984 the Argentinian writer Jorge Luis Borges confessed, during an interview with a television network, that he saw no usefulness in the use of cassette recorders to 'write' his texts, regardless of being engulfed in the most complete blindness for many years.

Informatics has disorganized the world and more clearly shown that our senses alternate dynamically.

Logical loopings and insoluble paradoxes are end results of combinations of different natures of perception that make 'impossible' all teleological attempts to decode the correspondence between space meaning and brain state. Structures open and close at the same time, which, in mathematical terms, put us near the space-time conditions in great gravitational masses.

Throwing himself back in time, Sigfried Giedion gave us a good idea, in his famous article 'Space conception in prehistoric art', of how these mutations in our system of meanings take place: "in the Museum of Laugierie Basse there was a small triangular block of stone with curved sides which called my attention because of its form. I took it into the sunlight. It then became evident that on its upper face, if

pronouncedly tipped downward, there was engraved outline of a bull. Its back haunches, as well as its hind legs, disappeared on the stone. However, the outline of the back was firmly engraved with a clear-cut bulge in the position of the shoulder blade. As is frequently the case in any pre-historic work of art, the head was vigorously moulded. At first sight it looked as if the animal was grazing on a narrow ledge of slightly convex ground with the front legs strongly enhanced standing on a lower level. When I raised the stone to replace it in its setting, I rotated it by pure chance to an angle of 180°. This gave the opportunity to see that the curve of the ground formed the neck and the breast of another animal which, according to our way of looking a painting, would be described as leaning on its head. The elongated neck and head of this gazelle-like creature stood out clearly under the angled light. The rest of the body was only rudimentarily outlined. Certainly, the animal had been portrayed in a full run. One front leg was placed along side the bull's head which, also due to the alteration of the light, had disappeared – at least from *our* sight. But through pre-historic man's eyes they were free."

The question is this: how does this complex reflection between man and space take place? What is our system of meanings?

Dr. Gerald Edelman, Director of the Neurosciences Institute of the Rockefeller University, recently proposed a new theory to decode the relationship between the structuring of the synaptic system and sensorial inputs. This means: the understanding of the nature of the brain's organization responsible for the perceptive functions.

Edelman has created a Darwinian theory for the brain. A theory, in a way, alien to the hypotatic logic of the Occident for which the instructional model is much more natural. A selective theory – whatever it may be – is, in logical terms, a coordinating operation of parts; a paratactic approach. Edelman worked out his theory starting from the discoveries he made in the field of immunology for which he received the Nobel Prize in 1972.

Information is stored in the brain by means of powerful probabilistic maps: synaptic pattern structures are formed from sensorial inputs, our senses and our perceptions. Space meanings as a logical resultant of brain workings in these maps.

Brain mapping produced by a system of synaptic shots.

Patterns created by sensorial data, sensorial inputs.

Patterns of synaptic connections.

Mathematically, our concept of 'number' reassumes its medieval 'topological' characteristic.

Gerald Edelman, Leif Finkel, and John Pearson have elaborated graphic simulations in computers which no longer operate algorithmically, but by selection in order to show plastically our cognitive mapping. Simulation in computer graphics to show a specular mapping of various faces: inputs and outputs.

In this network of informational paths, from outside-inwards and from inside-outwards, we have what we call mind, or super-signal: a signal that comprises all

others. A sort of informational 'black hole' and, at the same time, an informational 'pulsar'. And so, each human accomplishment, minute as it may be, is a sort of two-way mirror; frozen at an instance: a clone of this cognitive mapping that carries in itself subliminary logical references of that system.

Every code refers to another; every language brings a spatial component which is its epistemological paradigm; every language refers to some type of space and to some sort of logic.

Styles, civilizations and cultures reflect different logical principles in a permanent process of mutation. Architecture is, thus, an image of this mutation. If it were possible to provoke an immediate and radical alteration in our cognitive maps for an Egyptian model, or another one similar to that of the people who lived in Jericho about 10.000 years ago, the effect would certainly be hallucinating.

Our brain, cleverly asymmetric in its multi-dimensional plates of synaptic patterns, operates random and exponential combinatorial complexes.

Selective maps mirror themselves in archetypal systems.

Memory: a probabilistic assembly of data. The articulation between logical moires which are indexes of each other; in a greater or smaller degree of redundancy; in a bigger or less degree of degeneration, as specified by Edelman. Dynamic synaptic patterns: a structural galaxy as ephemeral as Schrödinger's cat, as a chance. A sufficiently ephemeral galaxy to allow the existence of various patterns in the same space and time.

It is a specular universe in continuous auto-regenerating loopings which leads us to the Incompleteness theorem of Kurt Gödel and the existence on our planet of not only a biosphere, but also an "ideosphere" as Douglas Hofstadter has shown.

The idea of signifying space or, in other words, making architecture, travels more and more from the outside to the inside of man. Logical mutation in great pockets of human life means behaviour mutation; a mutation of mentalities.

To operate space means to operate a complex of sensorial inputs.

Architecture as a frozen clone of our cognitive system.

Freud judged our mental universe as understood through the brain and acts of consciousness.

Thus, what we call the unconscious is nothing more than this complex probabilistic map that recreates itself from the constant regeneration of inputs and outputs in our brain, in our language, and between our brains and our language. Space as a frozen fragment; a frozen fragment of the unconscious. Its image. Mind.

The first astronauts from the U.S.A. went into space in small ballistic capsules attached already developed military attacking missiles.

Language is the condition of the unconscious.

When I lived in America, I flew for the first time in an airplane and later I made frequent trips. I could discover, on the ground, the tangled lines of Picasso — lines that go, then come back, that elongate themselves and then destroy themselves; I have seen the simplified solutions of Bracque and the vagrant line of Masson.

Yes, I have seen all of this and once more I understood that creator is always a coeval.

Gertrude Stein
Paris, 1938

BIBLIOGRAPHY

- Aries, Philippe, Duby, Georges, direction, (1985) *Histoire de la Vie Privée 1, 2*, Paris: Sevil.
- Arnheim, Rudolf (1986) *El Pensamiento Visual*, Barcelona: Ediciones Paidós Iberica.
- Blackwell, William (1984) *Geometry in Architecture*, New York: John Wiley & Sons.
- Cage, John (1983) *M-Writings '67-'72*, Middletown: Wesleyan University Press.
- Cage, John (1983) *X-Writings '79-'82*, Middletown: Wesleyan University Press.
- Doczi, György (1981) *The Power of Limits*, New York: Shambhala.
- Eco, Umberto (1975) *La Struttura Assente*, Milano: Valentino Bompiani.
- Eco, Umberto (1979) *A Obra Aberta*, São Paulo: Perspectiva.
- Edelman, Gerald (1985) Neural Darwinism: Population thinking and higher brain function, In: Shafto, M., ed., *How We Know*, Nobel Conference XX, San Francisco: Harper & Shafto.
- Edelman, Gerald, Finkel, Leif H., and Pearson, John C. (1987) Plasticity in the organization of adult cerebral cortical maps: A computer simulation based on neuronal group selection, *The Journal of Neuroscience*, N.Y., 7 (12) December, 4209-4223.
- Edelman, Gerald, Reeke, Jr. George N. (1988) Real brains and artificial intelligence, *Daedalus*, N.Y., Vol. 117, No. 1.
- Edelman, Gerald, Reeke, Jr. George N., *Selective Networks and Recognition Automata*, New York: Department of Developmental and Molecular Biology, Rockefeller University.
- Freud, Sigmund (1969) *An Outline of Psycho-Analysis* [Abriss der Psycho-Analyse, in German], New York: Norton & Company.
- Freud, Sigmund (1975) *Totem y Tabu* [Totem und Tabu, in German], Madrid: Alianza.
- Freud, Sigmund (1980) *Proyecto de Una Psicología para Neurologos* [Entwurf einer Psychologie, in German], Madrid: Alianza Editorial.
- Fuller, Richard B. (1978) *Operating Manual for Spaceship Earth*, New York: E. P. Dutton.
- Fuller, Richard B. (1981) *Critical Path*, New York: St. Martin's Press.
- Fuller, Richard B., *I Seem to Be a Verb*, New York: Bantam.
- Giedion, Sigfried (1966) *Space Conception in Prehistoric Art*, Boston: Beacon Press.
- Giedion, Sigfried (1986) *El Presente Eterno: Los Comienzos de la Arquitectura*, Madrid: Alianza.
- Gödel, Kurt (1979) *O Teorema de Gödel e a Hipotese do Continuo*, Lisboa: Fundação Calouste Gulbenkian.
- Gombrich, Ernest H. (1959) *Art and Illusion*, Washington: National Gallery of Art.
- Gombrich, Ernest H. (1980) *El Sentido de Orden*, Barcelona: Gustavo Gili.

- Gombrich, Ernest H. (1987) *La Imagen y el Ojo*, Madrid: Alianza.
- Hofstadter, Douglas R. (1981) *Gödel, Escher, Bach: An Eternal Golden Braid*, New York: Penguin.
- Hofstadter, Douglas R. (1985) *Metamagical Themes: Questing for the Essence of Mind and Pattern*, New York: Penguin Books.
- Jencks, Charles, Baird George, direction, (1975) *El Significado en Arquitectura*, Madrid: Blume.
- Jung, Carl Gustav (1981) *A Dinâmica do Inconsciente* [Die Dynamic des Unbewusster, in German], Petropolis, Brazil: Vozes.
- Lacan, Jacques (1977) *Psicoanálisis, Radiofonia & Television*, Barcelona: Anagrama.
- Lacan, Jacques (1982) *O Seminário — Mais Ainda ...* [Le Seminaire — Livre XX: Encore, in French], Rio de Janeiro: Zahar.
- Le Corbusier (1987) *Aircraft*, Paris: Adam Biro.
- Loar, Brian (1986) *Mind and Meaning*, London: Cambridge University Press.
- McLuhan, Marshall (1962) *The Gutenberg Galaxy — The Making of Typographic Man*, Toronto: University of Toronto Press.
- McLuhan, Marshall (1964) *Understanding Media: The Extensions of Man*, New York: McGraw-Hill.
- Negroponte, Nicholas (1975) *Soft Architecture Machine*, Massachusetts: MIT Press.
- Oliver, Paul (1980) *Shelter, Sign and Symbol*, New York: The Overlook Press.
- Passini, Romedi (1984) *Wayfinding in Architecture*, New York: Van Nostrand Reinhold Company.
- Peirce, Charles Sanders, *Collected Papers*.
- Pignatari, Décio (1981) *Semiótica de Arte e da Arquitetura*, São Paulo: Cultrix.
- Rasmussen, Steen Eiler (1982) *Experiencing Architecture*, Massachusetts: MIT Press.
- Rosenfield, Israel (1986) Neural Darwinism: A new approach to memory and perception, *The New York Review of Books*, October 9.
- Rudofsky, Bernard (1979) *L'Architecture Insolite*, Paris: Tallandier.

SYMMETRO-GRAPHY

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Images on the front and back cover of this issue are the *Aerial view, Perspective, and Side view of the Large Synergetical Structure on Hexagonal Figure (1990)* from

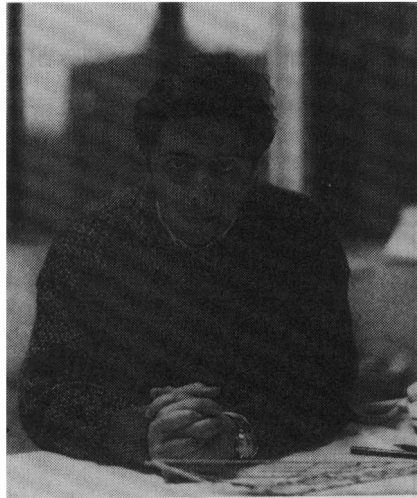
VIRTUAL ARCHITECTURE Virtual Environments and Architecture

projects by Emanuel Dimas de Melo Pimenta (1981-1991)

published by ASA Art and Technology Limited, UK, 1991, 219 p.
and has been launched simultaneously in California, Germany, United Kingdom,
and Portugal.

VIRTUAL ARCHITECTURE, dedicated to John Cage and René Berger, is a kind of inventory of Pimenta's most representative digital architectural projects between 1981 and 1991. The impact created by virtual realities on spatial perception is clear. The ambient 'inside' a computer leads a new structuration of synaptical networks, i.e. new 'perception'. Each project was made inside virtual environments of computers and plotted by machines plus than A0. The machines used were 486/33 and each project uses around 30 MegaBytes of memory.

Emanuel Dimas de Melo Pimenta (b. São Paulo, Brazil, 1957) is the Project Chairperson for Architecture and Music in the Board of ISIS-Symmetry. He is an architect, urban planner, designer, and composer of experimental music. He has worked as commissioned composer for the Merce Cunningham Foundation in New York since 1986. His works are included in the *Universalis Encyclopaedia* and in the *Sloninsky Baker's Dictionary of Music*. He has researched on artificial intelligence and spatial meaning, virtual environments and perception.



* See his address between September 1, 1993, and August 31, 1995 on p. 328 .

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SYMMETRIC REVIEWS 3.3 (BRIEF NOTES ABOUT NEW PUBLICATIONS)

The 'Symmetric Reviews' (SR), as a regular subsection, contains brief notes about books and papers, usually not longer than 20 lines. These are not conventional reviews; their main goal is to emphasize the connections with symmetry and, in some cases, the required background. Currently, all notes are written, or adapted from the indicated sources, by the section editor. We hope, however, to form a group of reviewers in the future.

Correspondence should preferably be sent to both the section editor (for reviewing; see his address between September 1, 1993, and August 31, 1995 on p. 328) and the Budapest Office (for the data bank).

SR 3.3 – 1 (Aesthetics: science and art)

Engler, Gideon, Aesthetics in science and in art, *British Journal of Aesthetics*, 30 (1990), No. 1, 24-34.

This paper was presented at the 11th International Congress of Aesthetics, Nottingham, 1988. The concepts of symmetry, simplicity, order-coherence-unity, elegance, and harmony are discussed in detail. Although this order of concepts gives some indication of their importance in doing science, the author considers simplicity more fundamental than symmetry. The paper analyzes many interesting quotes from leading scientists and aestheticians (e.g., Heisenberg's view about the "miracle of symmetry as the original archetype of creation"). Illustrations: none. References: 33. Address: P.O. Box 2139, IL-76121 Rehovot, Israel.

SR 3.3 – 2 (Geomorphology; Geometry: tilings)

Fedorov, A[leksandr] E[vgen'evich], and Gerasimenko, V. Ya., Deshifirovanie regularnoi setki lineinykh neodnorodnostei po kosmosnimkam i ee mineralogicheskie osobennosti (na primere Severa Evropeiskoi chasti SSSR), [Deciphering of a regular network of linear inhomogeneities after aerial photographs and its mineralogical features (the example of the North of the European part of the U.S.S.R. [Russia]), in Russian], In: Mozhaev, B.N., ed., *Avtomatizirovannyi analiz prirodnykh lineamentnykh sistem: Sbornik nauchnykh trudov*, Leningrad: Vsesoyuznyi geologicheskii institut [VSEGEI], 1988, 106-116 and 131.

This paper is reviewed together with the next item SR 3.3 – 3, which is a comprehensive monographic survey of the same topic. Illustrations: 5. References: 3.

SR 3.3 – 3 (Geomorphology; Geometry: Tilings)

Fedorov, A[leksandr] E[vgen'evich], *Gegsagonal'nye setki lineinykh neodnorodnostei Zemli*, [Hexagonal Networks of the Linear Inhomogeneities of the Earth, in Russian], Moskva: Nedra, 1991, 126 pp. (Rub. 0.45).

The theory of tilings (tessellations) in the plane has a Renaissance in geometry, as well as in recreational mathematics. Usually the authors like to connect this topic with geometric crystallography; indeed, the Penrose tilings made a remarkable 'career' in the theory of quasicrystals. We should add, however, that the crystallog-

raphers need rather 3-dimensional tessellations (as the Penrose tilings were also generalized in that direction). This fact strongly limits the direct applications of tilings in crystallography. Are there other scholarly fields where the theory of tilings has a direct use? The answer is: yes. The author of this book demonstrates that geomorphology is also such a field (we may also mention soil science, especially the works by I. N. Stepanov, and the results in connection with the geometry of biological tissues by H. Honda). Indeed, the book starts, after the introduction, with a chapter entitled "Topologicheskie i geometricheskie svoistva setok" [Topological and geometrical properties of networks]. Here it is introduced that notation of networks (tilings) which is used by the geometer L. Fejes Tóth: $\{3, 6\}$ is formed by regular triangles, six at each vertex; $\{6, 3\}$ is formed by regular hexagons, three at each vertex. These are called as $\{3, 6\}$ -hexagonal and $\{6, 3\}$ -hexagonal networks, respectively. Natural objects, however, never represent perfectly regular arrangements. Therefore the author also refers to the work by Zeitung that focuses on the topologically deformed networks in the context of the theory of architecture. The main part of the book demonstrates various hexagonal networks formed by tectonic units in the North of the European part of the U.S.S.R. [Russia] (it was also discussed in an earlier paper, see SR 3.3 - 2), in the Ural mountains, and in Central Europe. All of these were identified by aerial photographs made from spacecraft. The investigation of these hexagonal networks, including both kinds $\{3, 6\}$ and $\{6, 3\}$, provides valuable data to identify those locations which are rich in various chemical elements. Illustrations: 71. References: 74. Address: 123060 Moskva, ul. Marshala Sokolovskogo 7, kor. 1, kv. 4, Russia.

SR 3.3 - 4 (Structural biology: virology; Space structures)

Koch, A. S[ándor] and Tarnai, T[ibor], The aesthetics of viruses, *Leonardo*, 21 (1988), 161-166; Reprint, *Bulletin: Buildings- and Civil Engineering Structures*, No. 80, Budapest: Institute for Building Science, 1988.

This paper is an interesting continuation of an idea, pioneered by H. S. M. Coxeter (see in: Butcher, J. C., ed., *Spectrum of Mathematics*, Auckland: Auckland University Press, 1971, 98-107), that some geometric, architectural, and virological structures can be interlinked (see, e.g., Coxeter's and Goldberg's research on polyhedra, Bucky's geodesic domes, Caspar and Klug's studies on viruses). This new paper by the virologist Koch and the building engineer Tarnai presents a rich set of illustrations, including not only geometric figures and an electron micrograph of virions, but also an art object and two geodesic constructions in Hungary, a detail of Hieronimus Bosch's *Garden of Earthly Delights*, and a radiolarian drawn by Haeckel. (We should remark, however, that precisely the cited paper of Coxeter, p. 98, criticized Haeckel's biological illustrations: the shapes, as D'Arcy Thompson suspected, may have been influenced by Haeckel's fertile imagination). The discussions about constructions of quasi-identical subunits and the emphasis on quasi-perfect structures may have a great importance for the readers of various scholarly or artistic interests. Illustrations: 8. References: 18. Addresses: A. S. Koch, 2nd Department of Pathology, Semmelweis University of Medicine, Üllői út 93, H-1091 Hungary; T. Tarnai, refer to the Board of ISIS-Symmetry.

SR 3.3 – 5 (Crystallography: point groups and space groups)

Lima-de-Faria, J[osé], On the problem of the measure of the symmetry of crystal structures, [with Portuguese abstract], *Garcia de Orta, Série de Geologia*, 14 (1991), Nos. 1-2, 45-50.

The author remarked earlier that the measure of symmetry of crystal structures has been treated incompletely, and he suggested a new approach based on the multiplicity of the general position of space groups (see, The hierarchy of symmetry, [Abstract], *Zeitschrift für Kristallographie*, 185 (1988), 286; cf., Symmetry in crystallography and in everyday life, *Symmetry: Culture and Science*, 1 (1990), 313-318). The present paper gives a further analysis of this problem and discusses a controversy raised in connection with the earlier approach. The author defines the density of symmetry by the number of general equivalent positions per unit of volume. He emphasizes that the density of symmetry, which is important in phase transition, should be considered separately from the symmetry itself. The paper includes four very useful tables on the hierarchies of the crystallographic point groups and space groups in both two-dimensional and three-dimensional spaces, respectively. Illustrations: 3. References: 6. Address: Refer to the Board of ISIS-Symmetry.

SR 3.3 – 6 (Anthropology: Australian, kinship systems, group theory)

Lucich, Peter, Cayley graphs and the decoding of Australian class systems, *Shadow: The Journal of the Traditional Cosmology Society*, 6 (1989), 75-81.

The paper is an interesting contribution to the application of algebraic group theory in social anthropology; cf. Lévi-Strauss' works on kinship systems and his cooperation with the mathematician André Weil. The representation of groups by Cayley graphs is a well-known method in mathematics: the vertices of a graph stand for the elements of the group, while the directed (arrowed) edges stand for the generators (cf., Grossman, I. and Magnus, W. *Groups and their Graphs*, New York: Random House, 1964). From the author's introduction: "[...] several Cayley graphs from mathematical group theory are isomorphic to the models used by ethnographers in portraying the Australian class systems. In this note the diagrams are seen as realisations of mathematical groups, and they indicate how formal properties of the class systems can be described essentially by referring them to their group-theoretic features. This in turn suggests one possible way of decoding the various class systems and their mutual interrelations." For further details see Lucich's monograph *Genealogical Symmetry: Rational Foundations of Australian Kinship* (Armidale, New South Wales: Light Stone Publications, 1987). Illustrations: 5. References: 11. Address: Department of Sociology, University of New England, Armidale, N.S.W. 2351, Australia.

SR 3.3 – 7 (Anthropology: Australian, kinship systems, group theory)

Lucich, Peter, The rational in the real: Explaining the symmetries of Australian Kinship and cosmology, *Mankind*, 19 (1989), 241-260.

This paper gives further details in connection with the application of symmetry (group theory) to anthropology; cf. SR 3.3 – 6. After discussing how to reduce a genealogical network to a group-theoretical (Cayley) graph, the author relates some wallpaper groups and their black-and-white versions to various Australian kinship systems. Symmetries are also used for classifications in cosmology. Some of

the kinship diagrams are very similar to ornamental works. The author, comparing the symmetry groups of kinship systems and of ornamental works of the same tribes, did not find significant connections beyond the general principles of homogeneity and order. This reviewer once had a discussion with the Cambridge anthropologist Chris Chippindale on related questions, and we agreed that the social structures have no direct impact on the symmetry groups of ornamental art. The reason for the manifestation of one or another symmetry group in the ornamental art of different groups of people is a very complex problem; here the cognitive, technical, social, etc. aspects should be carefully considered. Lucich's paper gives a further inspiration for the continuation of these discussions on a broader scale. Illustrations: 6. References: 83 (pp. 258-260). Address: Department of Sociology, University of New England, Armidale, N.S.W. 2351, Australia.

SR 3.3 – 8 (History of science: Hungarian)

Nagy, Dénes and Nagy, Ferenc, A magyar iskola az informatika kultúrtörténetében, [The Hungarian school in the cultural history of informatics, in Hungarian], In: Nagy, Ferenc, ed., *Magyarok a természettudomány és technika történetében 2*, Budapest: OMIKK, 1989, 293-308.

This paper demonstrates the importance of interdisciplinarity and of the connection between eastern and western cultures, but has only indirect connection with the topic of symmetry. Some cultural background to the interesting fact that a relatively large number of Hungarian or Hungarian-born scholars (Gabor, Szent-Györgyi, Szilard, von Neumann, Wigner, and others) made significant contributions to science and technology is discussed. The authors emphasize, in addition to the Hungarian educational system, three aspects: (1) "democracy in the café" which compensated to some extent for the disadvantages of the social structure; (2) East-West connections in the sense of both the borders of Eastern and Western Europe and the linkage of oriental and occidental cultures; (3) the Hungarian language, a structurally different (non-Indo-European) language in the western cultural circle, as a factor in developing artificial languages. See also the essay in English by Dénes Nagy entitled "Zoltán Bay and the Hungarian connection" (*Hungarian Book Review*, 31 (1989), Nos. 2-3, 25-28, available also in German and French). Illustrations: 7. References: 27. Address: Dénes Nagy, refer to the Board of ISIS-Symmetry; Ferenc Nagy, OMIKK (National Technical Information Centre and Library), Budapest, P.O. Box 12, H-1428 Hungary.

SR 3.3 – 9 (Biomathematics: group theory, self-organization)

Petukhov, S[ergei] V[alentinovich], *Geometrii zhivoi prirody i algoritmi samoorganizatsii*, [Geometries of Living Nature and Algorithms of Self-Organization, in Russian], Matematika-kibernetika 1988/6, Moskva: Znanie, 1988, 47 pp.

This brochure is published in a popular scientific series which is addressed to a broad audience, including both specialists and laypersons. Although the author presents new research results, he adopts a clear style without too many mathematical details. Note that some background in the theory of transformation groups and differential geometry is required, but even in the case of complicated details the well selected illustrations help the reader to follow the main points. The most important concepts and ideas are also discussed in a historic context. Generalized, non-Euclidean, symmetries play a central role in the approach; see also the mono-

graph by the same author *Biomekhanika, bionika i simmetriya* [Biomechanics, Bionics, and Symmetry, in Russian], Moskva: Nauka, 1981; as well as the educational film *Tsiklicheskie gruppy preobrazovaniia v biomekhanike* [Cyclic Transformation Groups in Biomechanics, in Russian], Moskva: Soyuzfilm, 1986. Petukhov's work can be interpreted as a continuation of the approach pioneered by D'Arcy Thompson in 1917, focusing on the geometric aspects of biological form and growth, and also extending some results of the theory of self-organizing automata of John von Neumann. Note that this brochure includes probably the first ever printed information on the symposium *Symmetry of Structure (First Interdisciplinary Symmetry Symposium and Exhibition)*, Budapest, 1989, and thus it could inspire wide-ranging interest in this interdisciplinary meeting in the U.S.S.R. Illustrations: 34. References: 38. Address: Refer to the Board of ISIS-Symmetry.

SR 3.3 – 10 (History of crystallography: Fedorov)

Shafranovskii, I[larion] I[larionovich], Frank-Kamenetskii, V[iktor] A[I'bertovich], and Dolivo-Dobrovolskaya, E[lena] M[aksimovna], eds., *Evgraf Stepanovich Fedorov: Peregiska. Neizdannye i maloizvestnye raboty*, [Evgraf Stepanovich Fedorov: Correspondence. Unpublished and Less Known Works, in Russian], Nauchnoe nasledstvo, Vol. 16, Leningrad: Nauka, 1991, 318 pp.

E. S. Fedorov (1853-1919) is one of the pioneers of modern crystallography, who, independently of the German mathematician A. Schoenflies, enumerated all the possible 230 space symmetry groups in 1890-91. This discovery can be interpreted as the 'periodic table' of crystallography, which is useful not only to classify the known ideal crystalline materials, but also to predict the structures of those which will be discovered later. The publication of the present book coincides with the centenary of the cited discovery. The first part of the book includes, after two introductory articles by Frank-Kamenetskii and Shafranovskii, the correspondence of Fedorov with the leading German crystallographer and mineralogist P. von Groth, in Russian translation (the full text of 196 letters by Fedorov and 27 selected letters of the total 49 ones by Groth, pp. 20-155), as well as Fedorov's correspondence with two Russians, V. I. Vernadskii, the pioneer of geochemistry (all the survived 11 letters by Fedorov, pp. 156-161), and N. A. Morozov, populist and author of scientific works (all the surviving nine letters by Fedorov and two letters by Morozov, pp. 162-167). In addition to this, the book also contains the following works by Fedorov in Russian (pp. 168-280): I[mperatorskaya] P[eterburgskaya] Akademiya Nauk [The Imperial Academy of Sciences of St. Petersburg], *Iz itogov trinadtsatipyatiletiya* [From the results of 35 years], *Kostyumi predmetov prirody* [The clothes of objects of nature (note that the expression 'clothes' is used in a metaphorical sense)], *Edinstvo chelovechestva i edinstvo nauki* [Unity of mankind, unity of science], *Dokladnaya zapiska o prepodavanii kristallografii v Gornom institute* [Lecture note on the teaching of crystallography in the Mining Institute], *Sem' let v mire kamnei* [Seven years in the world of stones]. These materials are extended with very useful comments by the editors. (Note, however, an 'Isisological' misprint: the early 19th century periodical *Isis* is quoted as *JSJS* on p. 284). Note that O. Faltheiner, who is frequently mentioned in this book, earlier published the Fedorov-Groth correspondence in the original German language. Illustrations: pictures of Fedorov, Groth, Vernadskii, and Morozov, facsimile of some letters and manuscripts. References: bibliographic notes in the commentaries, pp. 281-310. Address: I. I. Shafranovskii

and E. M. Dolivo-Dobrovolskaya, Leningradskii gornyi institut (Leningrad Mining Institute), SU-199026 Leningrad, 21-ya liniya dom 2, U.S.S.R.; V. A. Frank-Kamenetskii, Kafedra kristallografii, Leningradskii gosudarstvennyi universitet (Department of Crystallography, Leningrad State University), SU-199034 Leningrad, Universitetskaya naberezhnaya 7/9, U.S.S.R.

Dénes Nagy

BIBLIOGRAPHY

Symmetry related publications by István Hargittai:

Hargittai, I., Hargittai, M., *Symmetry through the Eyes of a Chemist*, Weinheim: VCH Verlagsgesellschaft, 1986. 458 pp;

Paperback edition: New York: VCH Publishers, 1987;

Russian edition: *Simmetriya glazami khimika*, Moscow: Mir, 1989, 494 pp.

Hargittai, I., ed., *Symmetry; Unifying Human Understanding*, New York, Oxford, etc.: Pergamon Press, 1986, XIII+1045 pp.

Hargittai, I., Vainshtein, B. K., eds., *Crystal Symmetries; Shubnikov Centennial Papers*, New York, Oxford, etc.: Pergamon Press, 1988. I-IX, 351-669 pp.

Hargittai, I., ed., *Symmetry 2, Unifying Human Understanding*, Oxford: Pergamon Press, 1989, XI+1080 pp.

Hargittai, I., Hargittai, M., *Fedezzük föl a szimmetriát!* [Discover Symmetry, in Hungarian], Budapest: Tankönyvkiadó, 1989, 148 pp.

Hargittai, I., ed., *Quasicrystals, Networks, and Molecules of Fivefold Symmetry*, New York: VCH Publishers, 1990, XIII+314 pp.

Hargittai, I., ed.: *Fivefold Symmetry*, Singapore, New Jersey, etc.: World Scientific, 1992, XVI+563 pp.

Hargittai, I., Pickover, C. A., eds., *Spiral Symmetry*, Singapore, New Jersey, etc.: World Scientific, 1992, XVII+449 pp.

Hargittai, I., Hargittai, M., *Symmetry: A Unifying Concept*, Bolinas, CA: Shelter Publ., in press, 1994.

**SFS: SYMMETRIC FORUM OF THE SOCIETY
(BULLETIN BOARD)**

All correspondence should be addressed to the editors: György Darvas or Dénes Nagy.

ANNOUNCEMENTS

EXHIBITION

Ars (Dis)Symmetrica '93

INVITATION

The exhibition *Ars (Dis)Symmetrica* will be organised in Budapest, Hungary, in the *Kilátó Gallery* at the old water-tower on the Margaret Isle. The exhibition will be open from 10th June to 11th July 1993.

Ars (Dis)Symmetrica is organised by *Symmetrion* - The Institute for Advanced Symmetry Studies. As it is well known, *Symmetrion* was founded by the *International Society for the Interdisciplinary Study of Symmetry* (ISIS-Symmetry) in 1991; *ISIS-Symmetry* was formed in August 1989, parallel with its first exhibition *Symmetry/Asymmetry* in the *Hungarian National Gallery* of Budapest. The second exhibition of ISIS-Symmetry, *Symmetry of Patterns* took place in the *Synergetics Institute*, Hiroshima, Japan, August 1992.

Ars (Dis)Symmetrica is planned to follow the positive traditions of these former artistic-scientific events. It is hoped to be the first exhibition of a regular series. The main goals of *Ars (Dis)Symmetrica* are to represent close connections between, and the mutual influence of, arts and sciences. 2D and 3D, static and mobile, as well as any other kind of work are all welcome.

To keep the artistic standard of the exhibition, as well as considering the limited space in the exhibition rooms, a professional jury will decide whether the submitted works could be displayed or not.

The main patron of *Ars (Dis)Symmetrica* is *Miklós Marschall* Deputy Mayor of the city of Budapest.

You are kindly invited to submit your work(s) to the 1993 *Ars (Dis)Symmetrica*!

Your items, suggested to be exhibited, are expected to the following address:

László Beke, Chief Curator
Hungarian National Gallery
P.O. Box 31,
Budapest
H-1250 Hungary

Deadline of submission: 31st May 1993.

You are welcome among the exhibitors of Ars (Dis)Symmetrica 1993.

CALL FOR PAPERS

Katachi U Symmetry: An International Symposium

Tsukuba Science City (near Tokyo), Japan, November 21-25, 1994

Katachi is the principal Japanese word expressing form, shape, figure, pattern, and also distortion of form (cf., the concept dissymmetry), while *U* refers to union. The symposium will focus on artistic and scientific activities related to *katachi* and *symmetry*. An additional goal is to compare the Western preference for symmetry and the Eastern tendency for symmetry breaking. Obviously these goals are very close to the main interest of ISIS-Symmetry, thus we encourage our members to join this event.

Actually, the symposium will be organized in cooperation with *ISIS-Symmetry* and five Japanese societies or groups: *Ars*⁺, *Katachi no bunka kai* (Form and Culture Society), *Katachi no kagaku kai* (Society for Science on Form), *Kojigen kagaku kai* (Institute of Hyperspace Science), and the *Origami Science Forum*. The General Chairman of the Organizing Committee is Tohru Ogawa (Tsukuba Science City), the Honorary Chairman is Kōdi Husimi (Tokyo). They are assisted by a Japanese Committee and an international Advisory Board. The main language of the symposium is English. The Japanese participants may give their lectures in Japanese, but those will be translated.

In the framework of this symposium, ISIS-Symmetry proposes a session entitled

Symmetry, dissymmetry, broken symmetry in art and science:
Dialogue of East and West,

which will be chaired by György Darvas and a Japanese colleague. Briefly about this session: According to the famous phrase by Pierre Curie, "the dissymmetry makes the phenomenon". Indeed, there is no perfect symmetry in nature or art, but rather some symmetry violations make the phenomena or events more useful or exciting for the researcher and the artist (practical and aesthetical values). The idea of broken symmetry plays an important role in the oriental, especially Japanese, arts. On the other hand, Western art and science also discovered the advantage of creating and seeking broken symmetry. The session will discuss these aspects in both interdisciplinary and intercultural contexts.

The list of the planned sessions (not yet final):

- Science on form,
- Geometrical arts and morphology,
- Invisible - visible: Viewing invisible images by comparing them to visible form,
- Sensing order,
- Symmetry, dissymmetry, broken symmetry in art and science:
Dialogue of East and West.

The participants may present (a) papers, or (b) artistic works (and performances). In both cases please send a camera ready extended abstract (maximum of four pages, A4-size, it may include black-and-white photographs), and an additional photocopy of this abstract, by *May 9, 1994*.

The heading of abstracts should follow the following format:

[All of the four margins (top, bottom, left, and right) should be 2.54 cm (1 inch)]

FROM FORM TO FORMISM
(TITLE WITH CAPITAL LETTERS)

William M. SYMMETRIST
Institute of Dissymmetry
University of Katachi-Symmetry
5 Morphology Street, San Formino, CA 12358 U.S.A.

The abstract should be sent with a *Submission Form* with the following details:

- author(s),
- title of the contribution,
- the category of the contribution: (a) papers, or (b) artistic works,
- the necessary devices, or, in case of artistic works, the required space (table, board, etc.),
- the preferred session,
- mailing address, phone, fax, e-mail.

The registration fee is Yen 40,000.

Finally, we would like to remark that this symposium will be organized according to "Japanese style", which is characterized by late decisions and then quick actions. Thus, do not expect any extensive correspondence or even the distribution of circulars before Spring 1994. Be assured, however, that everything will be resolved in November of 1994, and we will have a great symposium in Tsukuba Science City!

Please request up-dated information from the General Chairman and send all correspondence, including the abstracts, to his address:

Tohru Ogawa, *Katachi U Symmetry*, Institute of Applied Physics, University of Tsukuba, Tsukuba Science City, Ibaraki-ken, Japan 305;
Phone and Fax: 81-298-53-5028.

SYMMETRIC NEWS

***Fokozatos szimmetria* [Gradual Symmetry, in Hungarian] Inaugural lecture by István Hargittai**

István Hargittai, who was elected as an Honorary Member of ISIS-Symmetry, gave his inaugural lecture on February 11, 1992, during a special meeting of ISIS-Symmetry held at the Technical University of Budapest. The new Honorary Member of ISIS-Symmetry is the Head of the Institute of General and Analytical Chemistry of the Budapest Technical University and Head of the Department of the Structural Chemistry Research Group of the Hungarian Academy of Sciences. He authored and edited a large number of books on symmetry, which significantly inspired interdisciplinary communications. His list of symmetry-related works is published in the section *Symmetro-graphy* (p. 324).

The special meeting was opened by György Darvas, the Executive Secretary of ISIS-Symmetry, who introduced the new Honorary Member. It was followed by President Dénes Nagy's brief survey on the interdisciplinary aspects of symmetry. The Diploma of the Honorary Membership was presented to István Hargittai by Vice-President Sergei V. Petukhov, who arrived for this meeting from Moscow.

The inaugural lecture discussed the gradual generalization of symmetry, starting with the simple bilateral symmetry and ending with the most complex symmetries used in crystallography and structural chemistry. Each step was illustrated with many slides of both natural objects and art works. The lecture was followed by discussion, where, similar to the topic of the lecture, both scientific and artistic aspects were considered. The special meeting was attended by about 300 people, including many leading scientists and artists of Hungary. This large number is unusual in case of interdisciplinary events.

It should be added that during the *2nd Interdisciplinary Symmetry Symposium and Exhibition* (Hiroshima, August 17-24, 1992) ISIS-Symmetry elected two further Honorary Members: Kōji Husimi [Koji Fushimi] (Japan) and E. P. Wigner (U.S.A.). They will be introduced in a forthcoming issue. Together with them, ISIS-Symmetry has now eight Honorary Members. The other five are J. J. Burckhardt (Switzerland), V. A. Frank-Kamenetskii (Russia), H. Heesch (F. R. Germany), I. I. Shafranovskii (Russia), and C. S. Smith (U.S.A.), who were inaugurated during the *1st Interdisciplinary Symmetry Symposium and Exhibition* (Budapest, August 13-19, 1989).

Change of Dénes Nagy's address

The President of ISIS-Symmetry, Dénes Nagy will join the University of Tsukuba in Tsukuba Science City, Japan, in the near future. During his visiting professorship, he will spend less time at his other affiliations at the University of the South Pacific, Fiji and at the Eötvös Loránd University, Hungary. His primary address (until August, 1995) is the following: Institute of Applied Physics, University of Tsukuba, Tsukuba Science City, Ibaraki-ken, Japan 305. Phone: 81-298-53-6786; Fax: 81-298-53-5205; E-mail: nagy@kafka.bk.tsukuba.ac.jp .

SYMMETRIC EVENTS (CALENDAR OF SYMMETRY RELATED EVENTS)

Here we list not only the events which are organized, or co-organized, by ISIS-Symmetry (those are indicated in the first line), but also other meetings and exhibitions having some connection with the general topic of symmetry or focusing on art-science relationships. Addresses of Board Members of ISIS-Symmetry are on the inside covers.

Regular events

Monthly meetings – Budapest, Hungary ISIS-Symmetry
Szimmetria Kör / Symmetry Circle. No meetings in summertime. Invited speakers (in chronological order): Árpád Szabó, Dániel Czakó, Ernő Lendvai, Sándor Kürthy, István Gazda, Ervin Deák, Ferenc Vidor, György Darvas, József Zsolnai, Béla Lukács, Oszkár Papp, Szaniszló Bérczi, Tibor Tarnai, György Kampis. Information: György Darvas, refer to the Board of ISIS-Symmetry.

1993

January 27-29, 1993 - Wako (Tokyo), Japan
The World of Scientific Art. Information: Yasunari Watanabe, Riken: The Institute of Physical and Chemical Research, Wako, Saitama 351-01, Japan; Phone: 81-484-62-1111, ext. 3343; Fax: 81-484-62-4645.

January 28-30, 1993 – Frankfurt am Main, F. R. Germany
Evolutionäre Symmetrietheorie: Selbstorganisation und dynamische Systeme, [Evolutionary Symmetry Theory: Self-Organization and Dynamical Systems, in German]. Information: Werner Hahn, refer to the Board of ISIS-Symmetry; Peter Weibel, Institut für neue Medien, Staatliche Hochschule für bildende Künste (Städelschule), Hanauer Landstr. 204-206, D-W-6000 Frankfurt am Main, F. R. Germany; Phone: 49-69-445-036; Fax: 49-69-439-201.

February 25-26, 1993 – Suva, Fiji ISIS-Symmetry
Symmetry and Structure: Dialogue among Disciplines. Keynote speaker: Andreas Dress, University of Bielefeld, F.R. Germany. Information: John Hosack and Dénes Nagy, Department of Mathematics, University of the South Pacific, P.O. Box 1168, Suva, Fiji; Fax: 679-301-305; E-mail: j.hosack@usp.ac.fj.

February 27-28, 1993 – Bristol, U.K.
Art and Science: Two or Three Cultures? Information: Interalia, 49 Bristol Hill, Brislington, Bristol BS4 5AA, U.K.; Phone: 44-272-720-704; Fax: 44-0272-776-390.

June 7-11, 1993 – Albany, New York, U.S.A.
Art and Mathematics Conference (AM93). Information: Nathaniel A. Friedman, Department of Mathematics, State University of New York at Albany, 1400 Washington Avenue, Albany, NY 12222; Phone: 1-518-442-4621; Fax: 1-518-442-4731; E-mail: am93@bst.albany.edu.

June 10-July 11, 1993 – Budapest, Hungary ISIS-Symmetry
Ars (Dis)Symmetrica '93. An exhibition emphasizing the relationship of art and science. Location: Víztorony Gallery, Margaret Isle, Budapest. Information: László Beke and György Darvas, refer to the Board of ISIS-Symmetry.

June 14-July 14, 1993 – Chicago, Illinois, U.S.A.
Golden Mean Exhibition and Symposium. Symposium: June 17, 1993. The exhibition will travel to other locations. Information: Beverly Russel, 1 Coffey Lane, New Paltz, NY 12561, U.S.A.; Phone: 1-914-255-9357; Fax: 1-914-255-4681.

June 14-18, 1993 – Linz, Austria
Ars Electronica 93: Genetic Art – Artificial Life, Festival for Art, Technology, and Society. Information: Ars Electronica, Brucknerhaus Linz, Untere Donaulände 7, A-4010 Linz, Austria; Fax: 43-732-7612-350; E-mail: schoeber@jk.uni-linz.ac.at .

July 10-16, 1993 – Mittersill, Austria
Künste und Bildung zwischen Ost und West – polyästhetische Erziehung und europäische Integration / Arts and Education between East and West – Polyesthetic Education and European Integration. Information: Wolfgang Roscher, Hochschule für Musik und darstellende Kunst "Mozarteum", Mirabellplatz 1, A-5020 Salzburg, Austria; Phone: 43-662-88-908 ext. 611; Fax: 43-662-872-436.

July 14, 1993 – Kensington (Sydney), New South Wales, Australia
Building Bridges between Art and Science. One-day seminar. Information: Liz Ashburn, College of Fine Arts, University of New South Wales, Kensington, N.S.W. 2033, Australia; Phone: 61-2-339-9559; Fax: 61-2-339-9056.

August 18-21, 1993 – Toronto, Ontario, Canada
Seventh Biennial Meeting of the International Society for the Study of Human Ideas on Ultimate Reality and Meaning. Information: Tibor Horvath, Regis College, 15 St. Mary Street, Toronto, Ont., Canada M4Y 2R5; Phone: 1-416-922-2476 or 1-416-922-5474 (leave message); Fax: 1-416-922-2898.

August 22-29, 1993 – Zaragoza, Spain
19th International Congress of History of Science (ICHS). There are some symmetry-related sections: Ethnomathematics, ethnoscience and the recovery of world history of science (Chairs: Ubiratan D'Ambrosio and Paulus Gerdes, refer to the Board of ISIS-Symmetry), Arts and mathematical sciences (Chairs: Kirsti Andersen and Eberhard Knobloch), Physics: (Chairs: Antonio Beltran, Luis Boya and Manuel J. Valera). Information: Congress Office, Facultad de Ciencias, Ciudad Universitaria, E-50009 Zaragoza, Spain; Phone: 34-76-357-180; Fax: 34-76-565-852; E-mail: ichs@cc.unizar.es .

September 11-October 9, 1993 – North Bethesda, Maryland, U.S.A.
Kaleidoscope Renaissance: Fifth National Kaleidoscope Exhibitions. Special Scope Saturdays: meet the artists (September 11), demonstrations by Cozy Baker (September 18), Pat Kehs (September 25), Kay Winkler and Charles Karadimos (October 2), and Marvin Hardy (October 9). Location: Strathmore Hall Arts Center, 10701 Rockville Pike, North Bethesda, MD 20852; Phone: 1-301-530-0540. Information: Cozy Baker, Brewster Society, 100 Severn Ave., Suite 605, Annapolis, MD 21403, U.S.A.; Phone: 1-301-365-1855.

October 11-16, 1993 – Belgrade, Yugoslavia
Regional Symmetry Conference. Information: Fulbright Alumni Association, Palmoticeva 22/I, 11000 Belgrade, Yugoslavia; Phone: 38-11-334-524; Fax: 38-11-344-513; or Slavik Jablan, refer to the Board of ISIS-Symmetry.

October 28-31, 1993 – Chicago, Illinois, U.S.A.
Science and Art: Creativity, Motivation, and the Joy of Learning. Information: Linda Marquardt, Chicago Academy of Sciences, 2001 North Clark Street, Chicago, IL 60614, U.S.A.; Phone: 1-312-549-3077.

November 3-7, 1993 – Minneapolis, Minnesota, U.S.A.
Fourth International Symposium on Electronic Art (FISEA). Information: Roman Verostko, Minneapolis College of Art and Design, 2501 Stevens Avenue South, Minneapolis, MN 55404, U.S.A.; Phone: 1-612-874-3754; Fax: 1-612-874-732; E-mail: fisea93@msc.net.

November 27, 1993 – Bristol, U.K.
Growth and Form: Art and Science Conference. Information: Interalia, 49 Bristol Hill, Brislington, Bristol BS4 5AA, U.K.; Phone: 44-272-720-704; Fax: 44-0272-776-390.

1994

January 20-22, 1994 – Lisbon, Portugal
Art and Science Looking into the 3rd Millennium. Information: Fundação Calouste Gulbenkian, P-1093 Lisboa Codex, Portugal; Phone: 351-1-793-5131; Fax: 351-1-795-5206.

March 5-15, 1994 – Arizona, U.S.A.
XVth International Humanitas Congress. Information: Peter Horwath, Department of Foreign Languages, Arizona State University, Tempe, AZ 85287-0202, U.S.A.; Phone: 1-602-965-6382 or 1-602-965-6281; Fax: 1-602-965-0135.

March 27-29, 1994 – Renvyle (near Letterfrack), Ireland
Foams Euroconference. Information: Denis Weaire, Physics Department, Trinity College, Dublin, Ireland; E-mail: dweaire@vax1.tcd.ie.

June 12-18, 1994 – Berkeley, California, U.S.A.
Semiotics Around the World: Synthesis in Diversity, Fifth Congress of the International Association for Semiotic Studies (IASS). Solomon Marcus (refer to the Board of ISIS-Symmetry) is one of the Vice-Presidents of IASS. Information: Irmengard Rauch, 2036 Columbus Parkway #347, Benicia, CA 94510, U.S.A.; Phone and Fax: 1-707-746-7480; E-mail: irauch@garnet.berkeley.edu.

June 21-25, 1994 – Linz, Austria
Ars Electronica 94: Intelligent Environments – Festival for Art, Technology, and Society. Information: Ars Electronica, Brucknerhaus Linz, Untere Donaulände 7, A-4010 Linz, Austria; Fax: 43-732-7612-350; E-mail: schoeber@jk.uni-linz.ac.at.

June 27-July 2, 1994 – Bydgoszcz, Poland

Convex and Discrete Geometry. Information: Marek Lassak, Instytut Matematyki i Fizyki ATR, ul. Kaliskiego 7, PL 85-791 Bydgoszcz, Poland; E-mail: lassak@pltmk11.bitnet.

July 25-27, 1994 – Blumenau, Brazil

History and Pedagogy of Mathematics (HPM): An International Conference. Information: Ubiratan D'Ambrosio, Board member of ISIS-Symmetry, New address: Rua Peixoto Gomide 1772, ap. 83, 01409 Sao Paulo, S.P. Brazil; Phone and Fax: 55-11-280-0266.

August 3-11, 1994 – Zürich, Switzerland

International Congress of Mathematicians (ICM 94). There are some symmetry-related sections, including Nos. 4. Geometry, 7. Lie groups and representations, 17. Applications of mathematics in the sciences, 18. Teaching and popularization of mathematics, 19. History of mathematics. Information: ICM 94, ETH Zentrum, CH-8092 Zürich, Switzerland.

August 15-20, 1994 – Salzburg, Austria

Kunst und Religion: Weltmusik und Weltreligionen – Klänge und Texte, Kulte und Kulturen / Arts and Religion: Music and Religions of the World – Sound and Word, Cults and Cultures. Information: Wolfgang Roscher, Hochschule für Musik und darstellende Kunst "Mozarteum", Mirabellplatz 1, A-5020 Salzburg, Austria; Phone: 43-662-88-908 ext. 611; Fax: 43-662-872-436.

August 21-27, 1994 – Bielefeld, F. R. Germany

ISIS-Symmetry

Structural and Dynamical Symmetry in Complex Systems. This research symposium will be co-organized by ISIS-Symmetry. Information: Andreas Dress and Dénes Nagy, refer to the Board of ISIS-Symmetry.

August 28-September 2, 1994 – Leipzig, F. R. Germany

15th European Crystallographic Meeting (ECM-15). Information: P. Paufler, Institut für Kristallographie, Universität Leipzig, Scharnhorsstr. 20, D-O-7030 Leipzig, F. R. Germany.

November 21-25, 1994 – Tsukuba Science City, Japan

ISIS-Symmetry

Katachi U Symmetry. *Katachi* is the principal Japanese word expressing form, shape, pattern, while *U* refers to union. The symposium will be organized in cooperation with ISIS-Symmetry and five Japanese societies or groups. Information: Tohru Ogawa, Institute of Applied Physics, University of Tsukuba, Tsukuba Science City, Ibaraki-ken, Japan 305; Phone and Fax: 81-298-53-5028.

November 29-December 2, 1994 – Ohtsu (near Kyoto), Japan

Origami Science and Scientific Origami. Information: Koryo Miura, refer to the Board of ISIS-Symmetry; Mailing address: 3-9-7 Tsurukawa, Machida, Tokyo, Japan 195; Fax: 81-427-35-6946.

OBITUARY

ANDREW DUFF-COOPER

1947 - 1991

After studying Sociology and Philosophy at the University of Kent, Andrew Duff-Cooper enrolled at the University of Oxford to study Social Anthropology under the guidance of Professor Rodney Needham. He there took a special interest in the work of Andrew Lang, whom he continued to admire for many years. A year at the University of Leiden completed his preparations for fieldwork in Indonesia which extended from 1979 to 1981. In the course of writing his doctoral Thesis, he was awarded both an Emslie Horniman Scholarship and a Radcliffe-Brown Scholarship by the Royal Anthropological Institute.

His doctoral fieldwork, which came to concentrate on a community of Balinese on the island of Lombok, shaped his interest in the social principles underlying cognitive classification and ritual symbolization. His more than sixty articles published over the following years combined a pointedly holistic ethnographic approach with an analytical interest in the functioning of symbolic classifications as ideologies. This interest led to an increasingly focused concern with the notions of hierarchy and symmetry.

In 1985, Andrew Duff-Cooper became a Research Fellow of the Japan Society for the Promotion of Science and began to teach in Tokyo, first at Keio and later at Seitoku University. Field research in the Amami Islands of Japan's Southwestern Archipelago contributed to a number of publications concerned with contemporary Japanese culture.

Beside this new interest, he found time to act as coorganizer of the 1989 conference of the Traditional Cosmology Society on Contests and to edit its proceedings. In the autumn of 1990, Andrew was able, finally, to return to his place of first fieldwork on Lombok and to engage in further research. His insistence to do so against a variety of hindrances was characteristic of the man he was: undeterrable, inquisitive, and devoted to his work.

Andrew Duff-Cooper died on 4th August 1991. Those who knew him as a friend will mourn his genial company, his love of argument, and his generosity and tact. His colleagues will be glad to know that a full bibliography, as well as posthumous work, will be published in *JASO*, the Journal of the Anthropological Society of Oxford, and by the University of Kent.

Gerd Baumann

Contributions to *SYMMETRY: CULTURE AND SCIENCE* are welcomed from the broadest international circles and from representatives of all scholarly and artistic fields where symmetry considerations play an important role. The papers should have an interdisciplinary character, dealing with symmetry in a concrete (not only metaphorical!) sense, as discussed in 'Aims and Scope' on p. 336. The quarterly has a special interest in how distant fields of art, science, and technology may influence each other in the framework of symmetry (symmetrology). The papers should be addressed to a broad non-specialist public in a form which would encourage the dialogue between disciplines.

Manuscripts may be submitted directly to the editors, or through members of the Board of ISIS-Symmetry.

Contributors should note the following:

- All papers and notes are published in English and they should be submitted in that language. The quarterly reviews and annotates, however, non-English publications as well.
- In the case of complicated scientific concepts or theories, the intuitive approach is recommended, thereby minimizing the technical details. New associations and speculative remarks can be included, but their tentative nature should be emphasized. The use of well-known quotations and illustrations should be limited, while rarely mentioned sources, new connections, and hidden dimensions are welcomed.
- The papers should be submitted either by electronic mail to both editors, or on computer diskettes (5 1/4" or 3.5") to György Darvas as text files (IBM PC compatible or Apple Macintosh); that is, conventional characters should be used (ASCII) without italics or other formatting commands. Of course typewritten texts will not be rejected, but the preparation of these items takes longer. For any method of submission (e-mail, diskette, or typescript), four hard-copies of the text are also required, where all the necessary editing is marked in red (inserting non-ASCII characters, underlining words to be italicized, etc.). Three hard-copies, including the master copy and the original illustrations, should be forwarded to György Darvas, while the fourth copy should be sent to Dénes Nagy. No manuscripts, diskettes, or figures will be returned, unless by special arrangement.
- The papers are accepted for publication on the understanding that the copyright is assigned to ISIS-Symmetry. The Society, however, aiming to encourage the cooperation, will allow all reasonable requests to photocopy articles or to reuse published materials. Each author will receive a complimentary copy of the issue where his/her article appeared.
- Papers should begin with the title, the proposed running head (abbreviated form of the title of less than 35 characters), the proposed section of the quarterly where the article should appear (see the list in the note 'Aims and Scope'), the name of the author(s), the mailing address (office or home), the electronic mail address (if any), and an abstract of between 10 and 15 lines. A recent black-and-white photo, the biographic data, and the list of symmetry-related publications of (each) author should be enclosed; see the sample at the end.
- Only black-and-white, camera-ready illustrations (photos or drawings) can be used. The required (approximate) location of the figures and tables should be indicated in the main text by typing their numbers and captions (Figure 1: [text], Figure 2: [text], Table 1: [text], etc.), as new paragraphs. The figures, which will be slightly reduced in printing, should be enclosed on separate sheets. The tables may be given inside the text or enclosed separately.
- It is the author's responsibility to obtain written permission to reproduce copyright materials.
- Either the British or the American spelling may be used, but the same convention should be followed throughout the paper. *The Chicago Manual of Style* is recommended in case of any stylistic problem.
- Subtitles (numbered as 1, 2, 3, etc.) and subsidiary subtitles (1.1, 1.1.1, 1.1.2, 1.2, etc.) can be used, without over-organizing the text. Footnotes should be avoided; parenthetical inserts within the text are preferred.
- The use of references is recommended. The citations in the text should give the name, year, and, if necessary, page, chapter, or other number(s) in one of the following forms: ... Weyl (1952, pp. 10-12) has shown...; or ... as shown by some authors (Coxeter et al., 1986, p. 9; Shubnikov and Koptsik 1974, chap. 2; Smith, 1981a, chaps. 3-4; Smith, 1981b, sec. 2.12; Smith, forthcoming). The full bibliographic description of the references should be collected at the end of the paper in alphabetical order by authors' names; see the sample. This section should be entitled *References*.

Sample of heading (Apologies for the strange names and addresses)**SYMMETRY IN AFRICAN ORNAMENTAL ART
BLACK-AND-WHITE PATTERNS IN CENTRAL AFRICA****Running head:** Symmetry in African Art**Section:** Symmetry: Culture & Science

Susanne Z. Dissymmetrist and Warren M. Symmetrist
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Abstract

The ornamental art of Africa is famous ...

Sample of references

In the following, note punctuation, capitalization, the use of square brackets (and the remarks in parentheses). There is always a period at the very end of a bibliographic entry (but never at other places, except in abbreviations). Brackets are used to enclose supplementary data. Those parts which should be italicized — titles of books, names of journals, etc. — should be underlined in red on the hard-copies. In the case of non-English publications both the original and the translated titles should be given (cf., *Dissymmetrist*, 1990).

Asymmetrist, A. Z. (or corporate author) (1981) *Book Title: Subtitle, Series Title, No. 27, 2nd ed.*, City (only the first one): Publisher, vii + 619 pp.; (further data can be added, e.g.) 3rd ed., 2 vols., *ibid.*, 1985, viii + 444 + 484 pp. with 2 computer diskettes; Reprint, *ibid.*, 1988; German trans., *German Title, 2 vols.*, City: Publisher, 1990, 986 pp.; Hungarian trans.

Asymmetrist, A. Z., Dissymmetrist, S. Z., and Symmetrist, W. M. (1980-81) Article or e-mail article title: Subtitle, Parts 1-2, *Journal Name Without Abbreviation*, [E-Journal or Discussion Group address: journal@node (if applicable)], B22 (volume number), No. 6 (issue number if each one restarts pagination), 110-119 (page numbers); B23, No. 1, 117-132 and 148 (for e-journals any appropriate data).

Dissymmetrist, S. Z. (1989a) Chapter, article, symposium paper, or abstract title, [Abstract (if applicable)], In: Editorologist, A.B. and Editorologist, C.D., eds., *Book, Special Issue, Proceedings, or Abstract Volume Title*, [Special Issue (or) Symposium organized by the Dissymmetry Society, University of Symmetry, San Symmetrino, Calif., December 11-22, 1971 (those data which are not available from the title, if applicable)], Vol. 2, City: Publisher, 19-20 (for special issues the data of the journal).

Dissymmetrist, S. Z. (1989b) *Dissertation Title*, [Ph.D. Dissertation], City: Institution, 248 pp. (Exhibition Catalogs, Manuscripts, Master's Theses, Mimeographs, Patents, Preprints, Working Papers, etc. in a similar way; Audiocassettes, Audiotapes, Compact Disks, Computer Diskettes, Computer Software, Films, Microfiches, Microfilms, Slides, Sound Disks, Videocassettes, etc. with necessary modifications, adding the appropriate technical data).

Dissymmetrist, S. Z., ed. (1990) *Dissimetriya v nauke* (title in original, or transliterated, form), [Dissymmetry in science, in Russian with German summary], Trans. from English by Antisymmetrist, B. W., etc.

Phyllotaxist, F. B. (1899/1972) *Title of the 1972 Edition*, [Reprint, or Translation, of the 1899 ed.], etc.

[Symmetrist, W. M.] (1989) Review of *Title of the Reviewed Work*, by S. Z. Dissymmetrist, etc. (if the review has an additional title, then it should appear first; if the authorship of a work is not revealed in the publication, but known from other sources, the name should be enclosed in brackets).

In the case of lists of publications, or bibliographies submitted to *Symmetro-graphy*, the same convention should be used. The items may be annotated, beginning in a new paragraph. The annotation, a maximum of five lines, should emphasize those symmetry-related aspects and conclusions of the work which are not obvious from the title. For books, the list of (important) reviews, can also be added.

Sample of biographic entry

Name: Warren M. Symmetrist, Educator, mathematician, (b. Boston, Mass., U.S.A., 1938).

Address: Department of Dissymmetry, University of Symmetry, 69 Harmony Street, San Symmetrino, Calif. 69869, U.S.A. **E-mail:** symmetrist@symmetry.edu

Fields of interest: Geometry, mathematical crystallography (also ornamental arts, anthropology — non-professional interests in parentheses).

Awards: Symmetry Award, 1987; Dissymmetry Medal, 1989.

Publications and/or Exhibitions: List all the symmetry-related publications/exhibitions in chronological order, following the conventions of the references and annotations. Please mark the most important publications, not more than five items, by asterisks. This shorter list will be published together with the article, while the full list will be included in the computerized data bank of ISIS-Symmetry.

There are many interdisciplinary periodicals and symposia in various fields of art, science, and technology, but broad interdisciplinary forums for the connections between distant fields are very rare. Consequently, the interdisciplinary papers are dispersed in very different journals and proceedings. This fact makes the cooperation of the authors difficult, and even affects the ability to locate their papers.

In our 'split culture', there is an obvious need for interdisciplinary journals that have the basic goal of building bridges ('symmetries') between various fields of the arts and sciences. Because of the variety of topics available, the concrete, but general, concept of symmetry was selected as the focus of the journal, since it has roots in both science and art.

SYMMETRY: CULTURE AND SCIENCE is the quarterly of the *INTERNATIONAL SOCIETY FOR THE INTERDISCIPLINARY STUDY OF SYMMETRY* (abbreviation: *ISIS-Symmetry*, shorter name: *Symmetry Society*). *ISIS-Symmetry* was founded during the symposium *Symmetry of Structure (First Interdisciplinary Symmetry Symposium and Exhibition)*, Budapest, August 13-19, 1989. The focus of *ISIS-Symmetry* is not only on the concept of symmetry, but also its associates (asymmetry, dissymmetry, antisymmetry, etc.) and related concepts (proportion, rhythm, invariance, etc.) in an interdisciplinary and intercultural context. We may refer to this broad approach to the concept as *symmetrology*. The suffix *-logy* can be associated not only with knowledge of concrete fields (cf., biology, geology, philology, psychology, sociology, etc.) and discourse or treatise (cf., methodology, chronology, etc.), but also with the Greek terminology of proportion (cf., *logos, analogia*, and their Latin translations *ratio, proportio*).

The basic goals of the *Society* are

- (1) to bring together artists and scientists, educators and students devoted to, or interested in, the research and understanding of the concept and application of symmetry (asymmetry, dissymmetry);
- (2) to provide regular information to the general public about events in symmetrology;
- (3) to ensure a regular forum (including the organization of symposia, and the publication of a periodical) for all those interested in symmetrology.

The *Society* organizes the triennial *Interdisciplinary Symmetry Symposium and Exhibition* (starting with the symposium of 1989) and other workshops, meetings, and exhibitions. The forums of the *Society* are *informal* ones, which do not substitute for the disciplinary conferences, only supplement them with a broader perspective.

The Quarterly - a non-commercial scholarly journal, as well as the forum of *ISIS-Symmetry* - publishes original papers on symmetry and related questions which present new results or new connections between known results. The papers are addressed to a broad non-specialist public, without becoming too general, and have an interdisciplinary character in one of the following senses:

- (1) they describe concrete interdisciplinary 'bridges' between different fields of art, science, and technology using the concept of symmetry;
- (2) they survey the importance of symmetry in a concrete field with an emphasis on possible 'bridges' to other fields.

The Quarterly also has a special interest in historic and educational questions, as well as in symmetry-related recreations, games, and computer programs.

The regular sections of the Quarterly:

- **Symmetry: Culture & Science** (papers classified as humanities, but also connected with scientific questions)
- **Symmetry: Science & Culture** (papers classified as science, but also connected with the humanities)
- **Symmetry In Education** (articles on the theory and practice of education, reports on interdisciplinary projects)
- **Mosaic of Symmetry** (short papers within a discipline, but appealing to broader interest)
- **SFS: Symmetric Forum of the Society** (calendar of events, announcements of *ISIS-Symmetry*, news from members, announcements of projects and publications)
- **Symmetrography** (biblio/disco/software/ludo/historio-graphies, reviews of books and papers, notes on anniversaries)
- **Reflections: Letters to the Editors** (comments on papers, letters of general interest)

Additional non-regular sections:

- **Symmetrospective: A Historic View** (survey articles, recollections, reprints or English translations of basic papers)
- **Symmetry: A Special Focus on ...** (round table discussions or survey articles with comments on topics of special interest)
- **Symmetry: An Interview with ...** (discussions with scholars and artists, also introducing the Honorary Members of *ISIS-Symmetry*)
- **Symmetry: The Interface of Art & Science** (works of both artistic and scientific interest)
- **Recreational Symmetry** (problems, puzzles, games, computer programs, descriptions of scientific toys; for example, tilings, polyhedra, and origami)

Both the lack of seasonal references and the centrosymmetric spine design emphasize the international character of the *Society*; to accept one or another convention would be a 'symmetry violation'. In the first part of the abbreviation *ISIS-Symmetry* all the letters are capitalized, while the centrosymmetric image *ISIS!* on the spine is flanked by 'Symmetry' from both directions. This convention emphasizes that *ISIS-Symmetry* and its quarterly have no direct connection with other organizations or journals which also use the word *Isis* or *ISIS*. There are more than twenty identical acronyms and more than ten such periodicals, many of which have already ceased to exist, representing various fields, including the history of science, mythology, natural philosophy, and oriental studies. *ISIS-Symmetry* has, however, some interest in the symmetry-related questions of many of these fields.

continued from inside front cover

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Bruno Gruber (Symposia *Symmetries in Science*)

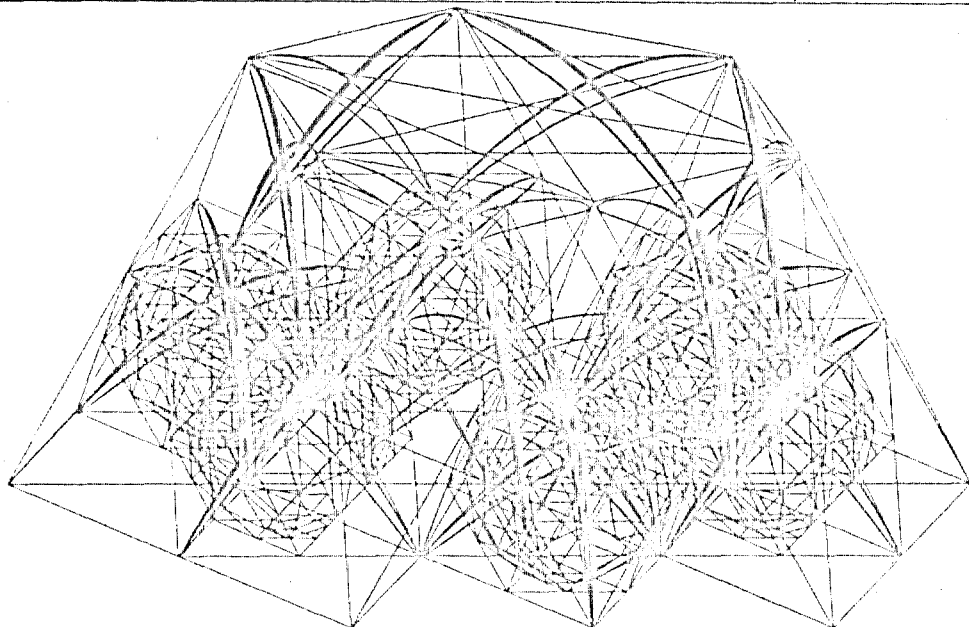
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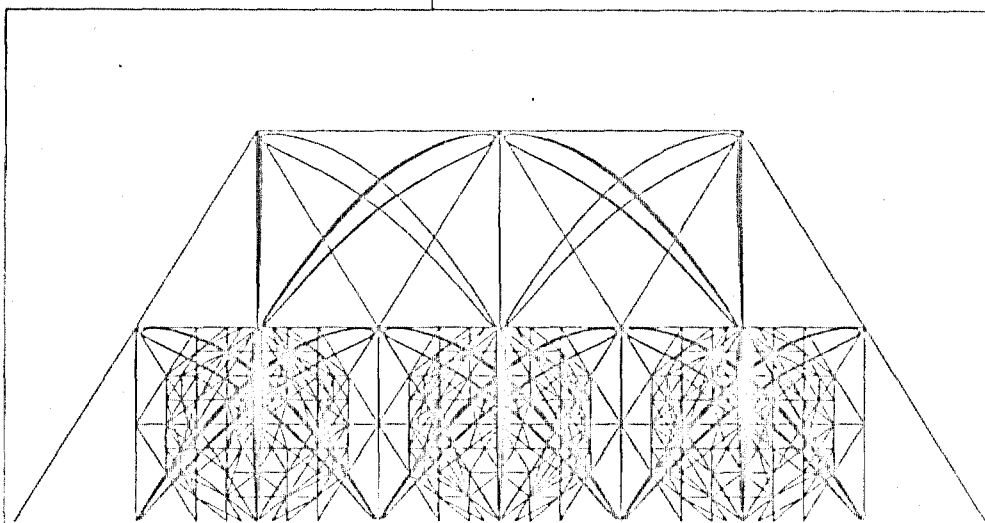
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Large synergetical structure on hexagonal figure
Perspective

Symmetry



Large synergetical structure on hexagonal figure
Side view