

RECREATIONAL SYMMETRY

This is a non-regular section for symmetry-related problems and puzzles (symmetry-enigmas), as well as games, computer programs, descriptions of scientific toys, and other topics which are connected with both recreation and education.

FLEXING POLYHEDRA

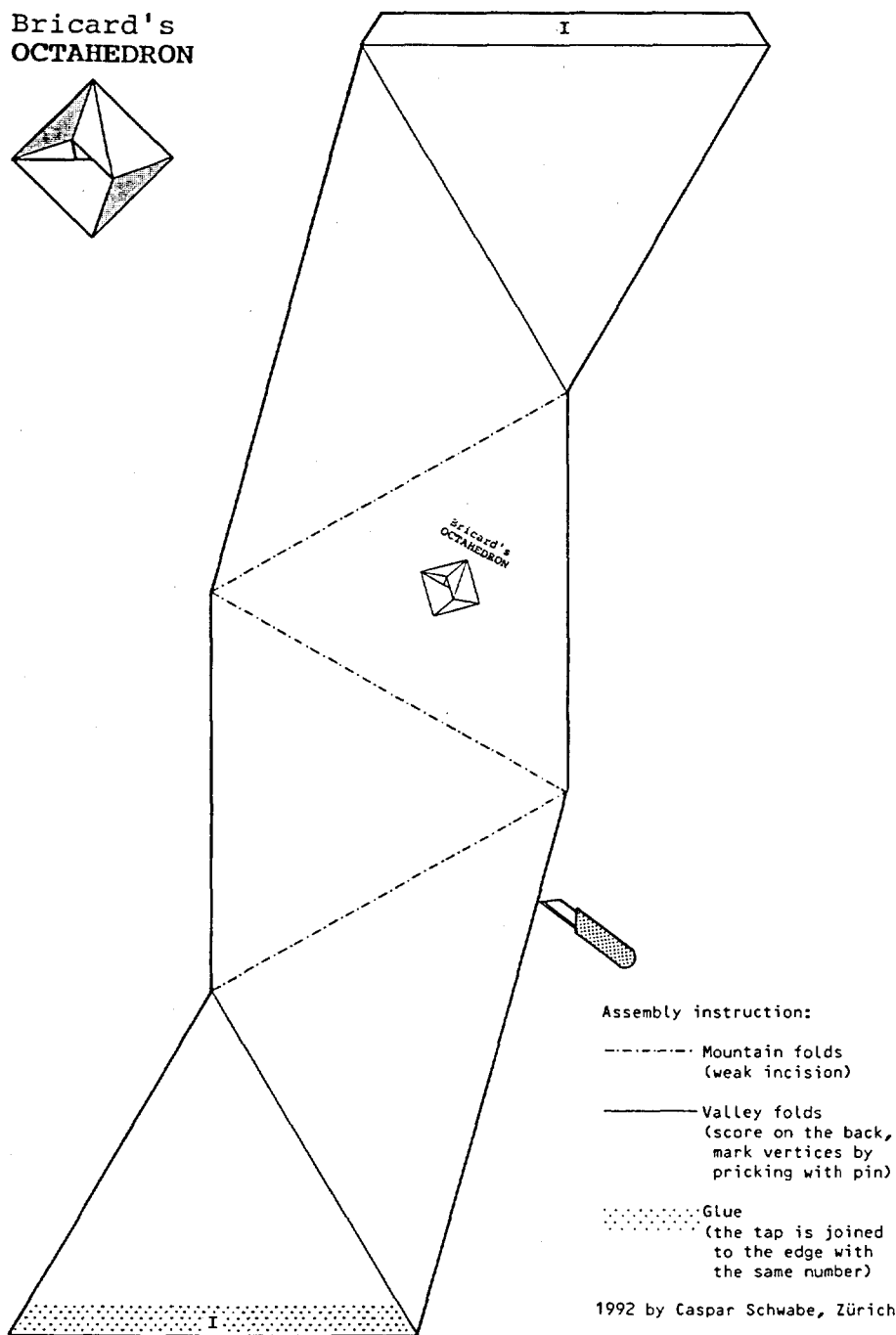
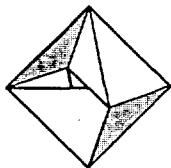
Nets by Caspar Schwabe

On the following four sheets you will find the nets of the four flexing polyhedra illustrated in C. Schwabe's abstract on pp. 168-169 of this issue.

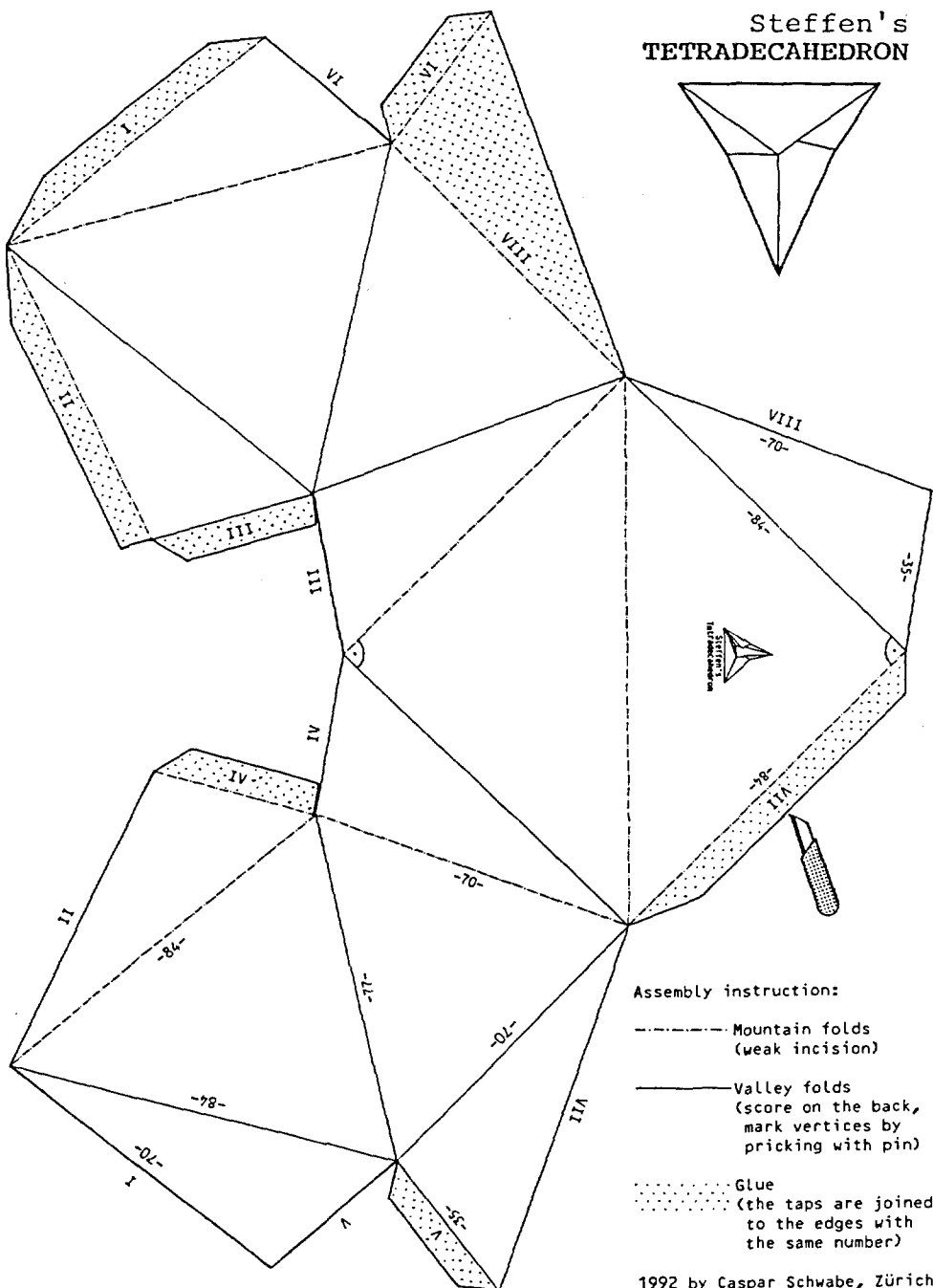
Before cutting out the sheets, please enlarge them by Xerox to 175 per cent on A3 paper size, if you wish colored paper of about 170 grams per m².

The nets are the courtesy of Caspar Schwabe.

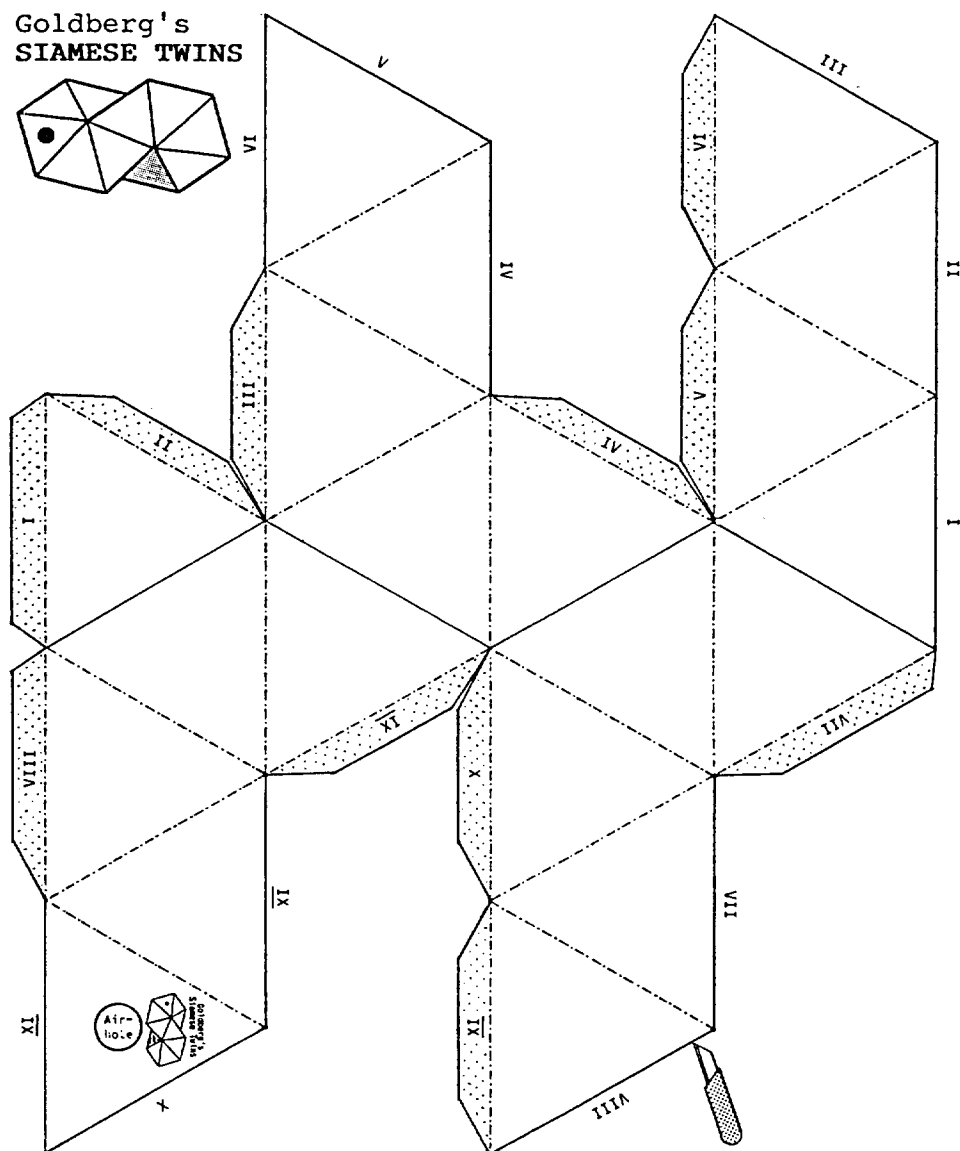
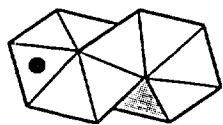
Bricard's OCTAHEDRON



Steffen's TETRADECAHEDRON



Goldberg's SIAMESE TWINS



Assembly instruction:

- Mountain folds (weak incision)
- Valley folds (score on the back, mark vertices by pricking with pin)
- Glue (the taps are joined to the edges with the same number)



Peter Klein (left) plays on Caspar Schwabe's 'accordion'; it is a flexible polyhedron (see on the opposite page) that actually provides music by pressing out the air through a whistle. Vojtěch Kopský (right) enjoys the performance. Luckily his umbrella was not required

Photo: Caspar Schwabe



Shutaro Mukai with Caspar Schwabe's *quadricorn*.

Photo: Caspar Schwabe

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. 224. The quarterly has a special interest in how distant fields of art, science, and technology may influence each other in the framework of symmetry (symmetryology). 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; parenthetic 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

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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) *Dissymmetriya 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 *Symmetry-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 disciplinary 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 *symmetryology*. 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 symmetryology;
- (3) to ensure a regular forum (including the organization of symposia, and the publication of a periodical) for all those interested in symmetryology.

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)
- **Symmetry-graphy** (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.

Germany, F.R.: Andreas Dress, Fakultät für Mathematik, Universität Bielefeld, D-4800 Bielefeld 1, Postfach 8640, F.R. Germany [Geometry, Mathematization of Science]

Theo Hahn, Institut für Kristallographie, Rheinisch-Westfälische Technische Hochschule, D-5110 Aachen, F.R. Germany [Mineralogy, Crystallography]

Hungary: György Darvas (see above, Executive Secretary)

Italy: Giuseppe Caglioti, Istituto di Ingegneria Nucleare - CESNEF, Politecnico di Milano, Via Ponzio 34/3, I-20133 Milano, Italy [Nuclear Physics, Visual Psychology]

Poland: Janusz Rebielak, Instytut Architektury i Urbanistyki, Politechnika Wrocławska (Institute of Architecture and Town Planning, Technical University of Wrocław), ul. B. Prusa 53-55, PL 50-317 Wrocław Poland [Architecture, Geometry, and Structural Engineering]

Portugal: José Lima-de-Faria, Centro de Cristalografia e Mineralogia, Instituto de Investigação Científica Tropical, Alameda D. Afonso Henriques 41, 4.ª Esq., P-1000 Lisboa, Portugal [Crystallography, Mineralogy, History of Science]

Romania: Solomon Marcus, Facultatea de Matematica, Universitatea din Bucuresti (Faculty of Mathematics, University of Bucharest), Str. Academiei 14, R-70109 Bucuresti (Bucharest), Romania [Mathematical Analysis, Mathematical Linguistics and Poetics, Mathematical Semiotics of Natural and Social Sciences]

Russia: Vladimir A. Koptsik, Fizicheskii fakul'tet, Moskovskii gosudarstvennyi universitet (Physical Faculty, Moscow State University) 117234 Moskva, Russia [Crystalphysics]

Scandinavia: Ture Wester, Skivlaboratoriet, Bærende Konstruktioner, Kongelige Danske Kunstakademi - Arkitektsskole (Laboratory for Plate Structures, Department of Structural Science, Royal Danish Academy - School of Architecture), Peder Skramsgade 1, DK-1054 København K (Copenhagen), Denmark [Polyhedral Structures, Biomechanics]

Switzerland: Caspar Schwabe, Ars Geometrica Rämistrasse 5, CH-8024 Zürich, Switzerland [Ars Geometrica]

U.K.: Mary Harris, Maths in Work Project, Institute of Education University of London, 20 Bedford Way, London WC1H 0AL, England [Geometry, Ethnomathematics, Textile Design]

Anthony Hill, 24 Charlotte Street, London W1, England [Visual Arts, Mathematics and Art]

Yugoslavia: Slavik V. Jablan, Matematički institut (Mathematical Institute), Knez Mihailova 35, pp. 367, YU-11001 Beograd (Belgrade), Yugoslavia [Geometry, Ornamental Art, Anthropology]

Chairpersons of

Art and Science Exhibitions: László Beke, Magyar Nemzeti Galéria (Hungarian National Gallery), Budapest, Budavári Palota, H-1014 Hungary

Itsuo Sakane, Faculty of Environmental Information, Keio University at Shonan Fujisawa Campus, 5322 Endoh, Fujisawa 252, Japan

Cognitive Science: Douglas R. Hofstadter, Center for Research on Concepts and Cognition, Indiana University, Bloomington, Indiana 47408, U.S.A.

Computing and Applied Mathematics: Sergei P. Kurdyumov, Institut prikladnoi matematiki im. M.V. Keldyshe RAN (M.V. Keldysh Institute of Applied Mathematics, Russian Academy of Sciences), SU-125047 Moskva, Miusskaya pl. 4, Russia

Education: Peter Klein, FB Erziehungswissenschaft, Universität Hamburg, Von-Melle-Park 8, D-2000 Hamburg 13, F.R. Germany

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Project Chairpersons:

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Art and Biology: Werner Hahn, Waldweg 8, D-3554 Gladenbach, F.R. Germany

Evolution of the Universe: Jan Mozrzymski, Instytut Fizyki, Uniwersytet Wrocławski (Institute of Theoretical Physics, University of Wrocław), ul. Cybulskiego 36, PL 50-205 Wrocław, Poland

Higher-Dimensional Graphics: Koji Miyazaki, Department of Graphics, College of Liberal Arts, Kyoto University, Yoshida, Sakyo-ku, Kyoto 606, Japan

Knowledge Representation by Metastructures: Ted Goranson, Sirius Incorporated, 1976 Mendenhall Drive, Virginia Beach, VA 23457-1227, U.S.A.

Pattern Mathematics: Bert Zaslow, Department of Chemistry, Arizona State University, Tempe, AZ 85287-1604, U.S.A.

Polyhedral Transformations: Haresh Lalvani, School of Architecture, Pratt Institute, 200 Willoughby Avenue, Brooklyn, NY 11205, U.S.A.

Proportion and Harmony in Arts: S. K. Heninger, Jr. Department of English, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3520, U.S.A.

Shape Grammar: George Stiny, Graduate School of Architecture and Urban Planning, University of California Los Angeles, Los Angeles, CA 90024-1467, U.S.A.

Space Structures: Koryo Miura, Spacecraft Engineering Research Division, Institute of Space and Astronautical Science, Yoshinodai, Sagami-hara, Kanagawa 229, Japan

Tibor Tarnai, Technical University of Budapest, Department of Civil Engineering Mechanics, Budapest, Műegyetem rkp. 3, H-1111 Hungary

Liaison Persons

Andra Akers (International Synergy Institute)

Stephen G. Davies (Journal *Tetrahedron: Asymmetry*)

Bruno Gruber (Symposia *Symmetries in Science*)

Alajos Kálmán (International Union of Crystallography)

Roger F. Mallina (Journal *Leonardo* and International Society for the Arts, Sciences, and Technology)

Tohru Ogawa and **Ryuji Takaki** (Journal *Forma* and Society for Science on Form)

Dennis Sharp (Comité International des Critiques d'Architecture)

Erzsébet Tusa (INTART Society)

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