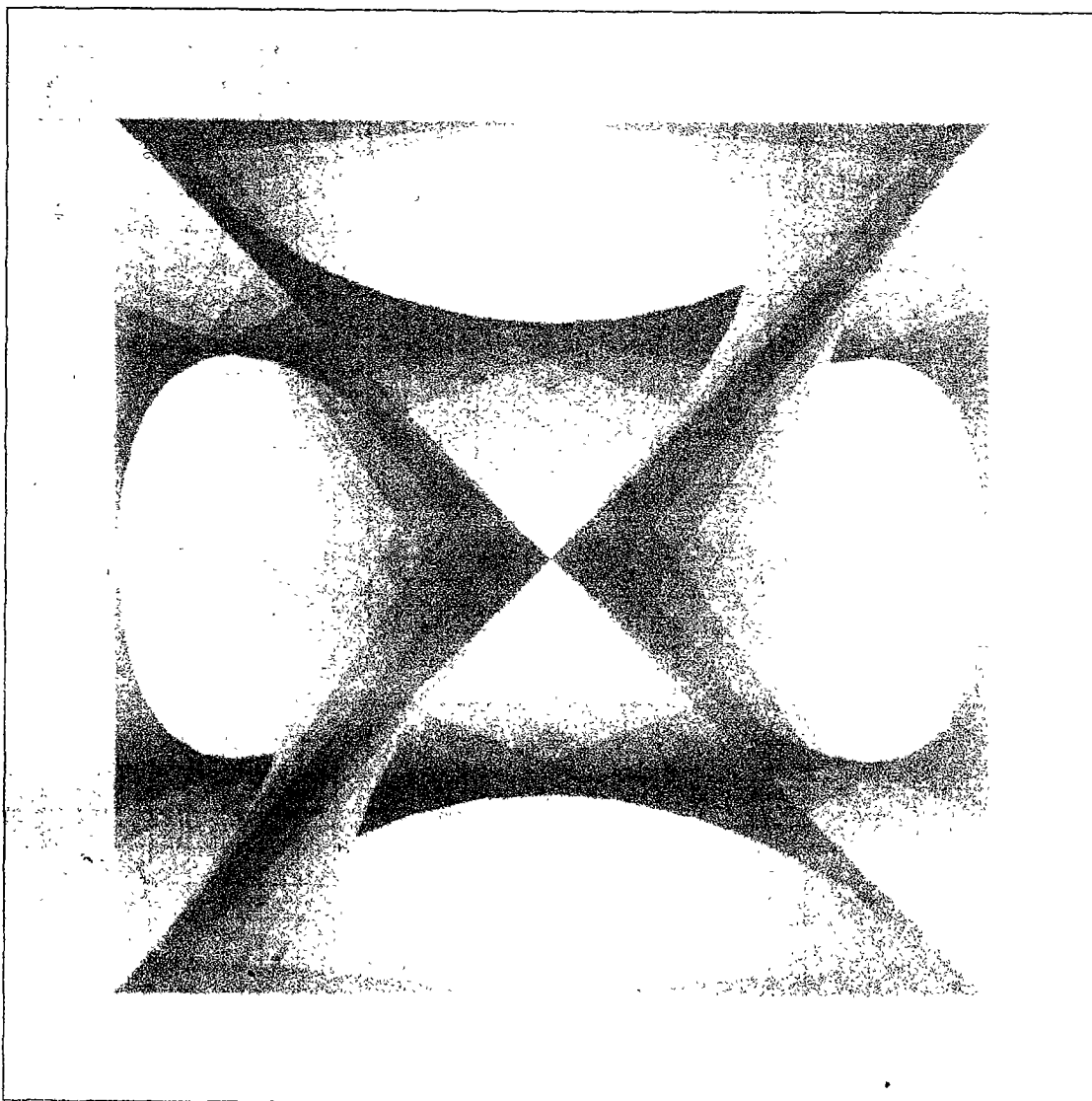


# Symmetry: Culture and Science

The Quarterly of the  
International Society for the  
Interdisciplinary Study of Symmetry  
(ISIS-Symmetry)

Volume 8, Number 3-4, 1997



*INTERNATIONAL SOCIETY FOR THE  
INTERDISCIPLINARY STUDY OF SYMMETRY  
(ISIS-SYMMETRY)*

*President*

**Dénes Nagy**, Institute of Applied Physics,  
University of Tsukuba, Tsukuba Science City  
305, Japan; nagy@bukko.bk.tsukuba.ac.jp  
[Geometry, Crystallography, History of  
Science and Technology, Linguistics]

*Chairman of the Advisory Board*

**Arthur L. Loeb**, Carpenter Center for the  
Visual Arts, Harvard University, Cambridge,  
MA 02138, U.S.A.;  
mharpenn@husc.harvard.edu [Visual Arts,  
Choreography, Music, Crystallography]

*Honorary Presidents*

**Konstantin V. Frolov**, Russian Academy of  
Sciences, Mechanical Engineering Research  
Institute, ul. Griboedova 4, 101830 Moscow,  
Russia [Mechanical Engineering]

and

**Yuval Ne'eman**, R. and B. Sackler Faculty of  
Exact Sciences, Tel-Aviv University, Tel-Aviv,  
Israel 69978; matilda@novelty.tau.ac.il,  
and Center for Particle Physics, University  
of Texas, Austin, TX 78712, U.S.A. [Particle  
Physics]

*Secretary General*

**György Darvas**, Symmetrion – The Institute  
for Advanced Symmetry Studies,  
and Institute for Research Organisation of the  
Hungarian Academy of Sciences, Nádor u. 18,  
P.O. Box 994, Budapest, H-1245 Hungary;  
h492dar@ella.hu [Philosophy of Science,  
Theoretical Physics]

*Secretaries*

**Martha Pardavi-Ihorvath**, Department of  
Electrical Engineering and Computer Science,  
The George Washington University,  
Washington, D.C. 20052, U.S.A.;  
pardavi@seas.gwu.edu [Materials Science]

and

**Janusz Rebielak**, Department of Architecture,  
Faculty of Building Structures, Technical  
University of Wrocław, ul. B. Prusa 53/55,  
PL-50-317 Wrocław, Poland;  
janusz@novell.arch.pwr.wroc.pl  
[Architecture, Building Engineering]

*Members of the Board*

**Fred L. Bookstein**, Center for Human Growth  
and Development, University of Michigan,  
300 North Ingalls Building, Ann Arbor,  
Michigan 48109-0406, U.S.A.;  
fred@brainmap.med.umich.edu [Biology,  
Statistics]

**Siglind Bruhn**, Department of Musicology and  
Institute for the Humanities, University of  
Michigan; 1308 Broadway, Ann Arbor,  
MI 48105, U.S.A.; siglind@umich.edu [Music,  
Semiotics, Literature]

**Betty Collings**, 1991 Hillside Drive, Columbus,  
OH 43221, U.S.A.; ted+@osu.edu [Sculpture]

**Liz Edwards**, Visual Arts Program, Academy  
of the Arts, Queensland University of  
Technology, P.O. Box 362, Redhill, Brisbane,  
QLD 4059, Australia; e.edwards@qut.edu.au  
[Fine Art, History of Art]

**Ruslan I. Kostov**, Faculty of Geology and  
Prospecting, University of Mining and Geology  
“St. Ivan Rilski”, Sofia 1100, Bulgaria;  
rikostov@cserv.mgu.bg [Geology,  
Mineralogy, History of Science]

**Sergei V. Petukhov**, Mechanical Engineering  
Research Institute, Russian Academy of  
Sciences, ul. Griboedova 4, 101830 Moscow,  
Russia; pet@sam.imash.ras.ru [Mechanical  
Engineering, Biomechanics]

*Information Network Advisor*

**Mihály Szoboszlai**, Faculty of Architecture,  
Technical University of Budapest, Műegyetem  
rkp. 3, Budapest, H-1111 Hungary;  
szoboszlai@arch.bme.hu [Architecture,  
Geometry, Computer Aided Architectural  
Design]

*Associate Editor*

(of *Symmetry: Culture and Science*)

**John Hosack**, Department of Mathematics  
and Computing Science, University of the  
South Pacific, P.O. Box 1168, Suva, Fiji;  
j.hosack@usp.ac.fj [Mathematical Analysis,  
Philosophy]

# Symmetry: Culture and Science

Founding editors: G. Darvas and D. Nagy

The Quarterly of the  
International Society for the  
Interdisciplinary Study of Symmetry  
(ISIS-Symmetry)

Temporarily edited by the *curatory* of the International Symmetry Foundation  
Published by the *International Symmetry Foundation*

Volume 8, Numbers 3-4, 225-432, 1997

## CONTENTS

### *SYMMETROSPECTIVE: A HISTORIC VIEW*

- **The birth of the tunnel diode and the semiconductor superlattice, Leo Esaki** 227

### *SYMMETRY: SCIENCE & ART*

- **Symmetry in theory - Mathematics and aesthetics, Peter Hilton, Jean Pedersen** 239
- **Perfect precise colourings, John F. Rigby** 265
- **Digital evolutions for regular polyhedra, Daniela Bertol** 289
- **Tetralectics - An approach to post-modern logic, Richárd Hargittai, Ödön Farkas, László Ropolyi, Gábor Veress, György Vankó** 295

### *SYMMETRY: ART & SCIENCE*

- **Reflections on rotations, John G. Harries** 315
- **Bishops of opposite colours: The idea of symmetry and the symmetry of ideas, David Jenkins** 333

### *SYMMETRY IN EDUCATION*

- **Escher's world: Learning symmetry through mathematics and art, David Williamson Shaffer** 369
- **Mathematical symmetry: A mathematics course of the imagination, Raymond F. Tennant** 394
- **Seeing through symmetry - As seen through its labs, Laurence I. Gould** 401

### *SYMMETRY AND RECREATION*

- **Symmetry in practice - Recreational constructions, Peter Hilton, Jean Pedersen** 409

*SYMMETRY: CULTURE AND SCIENCE* is edited by the Board of the International Society for the Interdisciplinary Study of Symmetry (ISIS-Symmetry), and published by the International Symmetry Foundation. The views expressed are those of individual authors, and not necessarily shared by the Society or the editors.

Curatory of the *International Symmetry Foundation*:

Szanişzló Bérczi (head), János F. Böhm, György Darvas, Sándor Kabai

Any correspondence should be addressed to the  
*International Symmetry Foundation*

c/o Symmetrion

P.O. Box 994, Budapest, H-1245 Hungary

Phone: 36-1-331-8326 Fax: 36-1-331-3161

E-mail: sym@freemail.hu, bercziszani@ludens.elte.hu, h492dar@ella.hu,

*Assistant Editor*: Csaba Mezei

Subscription:

Annual membership fee of the Society:

*Benefactors*, US\$780.00;

*Ordinary Members*, US\$78.00 (includes the subscription to the quarterly),

*Student Members*, US\$63.00 (includes the subscription to the quarterly);

*Institutional Members*, please contact the Secretary General.

Annual subscription rate for *non-members*: US\$100.00.

Make checks payable to *ISIS-Symmetry* and mail to G. Darvas, Secretary General, or transfer to the following account number: ISIS-Symmetry, International Symmetry Foundation, 10300002-50400004-21004015, Hungarian Foreign Trade Bank, Budapest, Szt. István tér 11, H-1821 Hungary; Swift MKKB HU HB.

© ISIS-Symmetry. No part of this publication may be reproduced without written permission from the Society.

ISSN 0865-4824

Cover layout: Günter Schmitz;

Images on the cover:

Student works from the Basic Design Studio of William S. Huff,  
(Department of Architecture, SUNY at Buffalo, N.Y.)

on the front cover: *Square with saddle curves* by Richard Rice, *UB-1994*;

on the back cover: two *Spirals* by Robert Skolnik, *CMU-1965*;

Ambigram on the back cover: Douglas R. Hofstadter