

## **SYMMETRO-GRAPHY**

Section Editor: Dénes Nagy, Institute of Applied Physics,  
University of Tsukuba, Tsukuba Science City 305, Japan;  
Fax: 81-298-53-5205; E-mail: nagy@bk.tsukuba.ac.jp

### **BIBLIOGRAPHY**

#### **BIBLIOGRAPHY OF TEXTBOOKS AND MONOGRAPHS RECOMMENDED FOR INTERDISCIPLINARY COURSES ON SYMMETRY AT THE UNIVERSITY LEVEL**

##### **Part 2**

Interdisciplinary textbooks and monographs on symmetry are listed in Part 1 (this volume, No. 2, pp. 211-219). Here we consider more specialized monographs with some interdisciplinary outlook (Section 3) and books on dissymmetry, broken symmetry, asymmetry (Section 4).

##### **Introductory notes: Principles of selection**

It is difficult to make strict rules for selecting books of interdisciplinary interest. Sometimes works referring to a concrete discipline still have an interdisciplinary importance. For example, a book on crystallographic symmetry groups is useful not only for crystallographers, but for all people interested in solid state physics, crystalphysics, crystalchemistry, and materials science. As a general principle: we consider those books that have some interest outside the main discipline of the author. Thus, we do not list books on, let us say, symmetries in particle physics or orbital symmetry in chemistry, because these ones are rarely used by people who do not work in those fields.

##### **3 More specialized monographs with some interdisciplinary outlook**

###### *3.1 History of science, philosophy, psychology*

Altmann, S. L. (1992) *Icons and Symmetries*, Oxford: Clarendon Press and New York: Oxford University Press, xii + 104 pp. [History of mathematics and physics].

Burckhardt, J. J. (1988) *Die Symmetrie der Kristalle: Von René-Just Haüy zur kristallographischen Schule in Zürich*, [The Symmetry of Crystals: From René-Just Haüy to the Crystallographic School in Zurich, in German], Basel: Birkhäuser, 195 pp.

Hommel, H. (1987) *Symmetrie im Spiegel der Antike*, [Symmetry as Reflected in the Antiquity, in German], Sitzungsberichte der Heidelberger Akademie der Wissenschaften, Philosophisch-Historische Klasse, Jahrgang 1986, Bericht 5, Hiedelberg: Winter, 59 pp.

Leyton, M. (1992) *Symmetry, Causality, Mind*, Cambridge, Mass.: MIT Press, x + 630 pp.

Piersa, H. (1990) *Symetria i jej funkcje poznawcze w fizyce*, [Symmetry and its Cognitive Functions in Physics, in Polish], Lublin, Poland: Wydawnictwo KUL [Katolicki Uniwersytet Lubelski], 257 pp.

Scholz, E. (1989) *Symmetrie, Gruppe, Dualität: Zur Beziehung zwischen theoretischer Mathematik und Anwendungen in Kristallographie und Baustatik des 19. Jahrhunderts*, [Symmetry, Group, Duality: On the Connection between Theoretical Mathematics and Applications in Crystallography and Structural Design of the 19th Century, in German], Basel: Birkhäuser and Berlin: Deutscher Verlag der Wissenschaften, 406 pp.

Sodnomgombo, D. and Khvan, M. P. (1981) *Filosofiya i simmetriya*, [Philosophy and Symmetry, in Russian], Ulan Bator, Mongolia: Gosizdat, 206 pp.

Urmantsev, Yu. A. (1974) *Simmetriya prirody i priroda simmetrii (Filosofskie i estestvennonauchnye aspekty)*, [Symmetry of Nature and the Nature of Symmetry (Philosophical and Scientific Aspects), in Russian], Moskva: Mysl', 229 pp. [Philosophy, Biology, System approach].

Van Fraassen, B. C. (1989) *Laws and Symmetry*, Oxford: Oxford University Press, xv + 395 pp.; French trans., *Lois et symétrie*, Mathesis [Series], Paris: Vrin, in prep. [Philosophy, Physics].

Yaglom [Iaglom], I. M. (1988) *Felix Klein and Sophus Lie: Evolution of the Idea of Symmetry in the Nineteenth Century*, Boston: Birkhäuser, vii + 237 pp. [History of mathematics and physics].

Also see the old books in Section 2.1.1, as well as many works in Section 4 on the philosophical aspects of symmetry and asymmetry.

### 3.2 Exact sciences (mathematics, crystallography, physics, and chemistry)

#### 3.2.1 Structure of matter (atomic or molecular level), applications of group theory

Baggott, J. E. (in prep.) *Perfect Symmetry: The Accidental Discovery of a New Form of Carbon*, Oxford: Oxford University Press. [Buckminsterfullerene].

Bernal, I., Hamilton, W. C., and Ricci, J. S. (1972) *Symmetry: A Stereoscopic Guide for Chemists*, San Francisco: Freeman, viii + 180 pp.

Bhagavantam, S. (1966) *Crystal Symmetry and Physical Properties*, London: Academic Press, x + 230 pp.

Dmitriev, I. S. (1976) *Simmetriya v mire molekul*, [in Russian], Leningrad [Sankt-Peterburg]: Khimiya; 124 pp.; Rev. English trans., *Symmetry in the World of Molecules*, Moscow: Mir, 1979, 147 pp.; German trans., *Symmetrie in der Welt der Moleküle*, Leipzig: Deutscher Verlag für Grundstoffindustrie, 1987, 146 pp.

Fedorov, E. S. (1949) *Simmetriya i struktura kristallov: Osnovnye raboty*, [Symmetry and Structure of Crystals: Basic Works, in Russian], Ed. by A. V. Shubnikov and I. I. Shafranovskii, Klassiki nauki [Series], Moskva: Izdatel'stvo Akademii Nauk SSSR, 630 pp.; English trans., *Symmetry of Crystals*, ACA Monograph, No. 7, New York: American Crystallographic Association, 1971, x + 315 pp. [Basic works of late 19th century, including the discovery of the 230 crystallographic space groups].

Fujita, S. (1991) *Symmetry and Combinatorial Enumeration in Chemistry*, Berlin: Springer, ix + 368 pp.

Hochstrasser, R. M. (1966) *Molecular Aspects of Symmetry*, New York: Benjamin, xiii + 355 pp.; Russian trans., Khokhshtasser, R., *Molekulyarnye aspekty simmetrii*, Moskva: Mir, 1968, 384 pp.

Jaffé, H. H. and Orchin, M. (1965) *Symmetry in Chemistry*, New York: Wiley, x + 191 pp.; Reprint, Huntington, N.Y.: Krieger, 1977, x + 193 pp.; German trans., *Symmetrie in der Chemie: Anwendung der Gruppentheorie auf chemische Probleme*, Heidelberg: Hüthig and Stuttgart: UTB (Uni-Taschenbücher), 1973, 186 pp.; Japanese trans., *Gunron nyuumon: Kagaku ni okeru taishou*, Tokyo: Toukyou Kagaku Doujin, 1966, 191 pp.; Reprint ed., *ibid.*, 191 pp.; Russian trans., Dzhafe, G. and Orchin, M., *Simmetriya v khimii*, Moskva: Mir, 1976.

Kettle, S. F. A. (1985) *Symmetry and Structure*, Chichester, England: Wiley, x + 330 pp.; Paperback ed., *ibid.*, 1989; 2nd ed., *Symmetry and Structure: Readable Group Theory for Chemists*, in prep.; German trans., *Symmetrie und Struktur: Eine Einführung in die Gruppentheorie*, Teubner Studienbücher, Stuttgart: Teubner, in prep.

Ladd, M. F. C. (1989) *Symmetry in Molecules and Crystals*, Chichester, England: Ellis Horwood and New York: Halsted Press, 274 pp.

Loeb, A. L. (1971) *Color and Symmetry*, Wiley Monographs in Crystallography, New York: Wiley, xiii + 179 pp.; Reprint, Huntington, N.Y.: Krieger, 1978, xiii + 179 pp.

Ludwig, W. and Falter, C. (1988) *Symmetries in Physics: Group Theory Applied to Physical Problems*, Springer Series in Solid-State Sciences, Vol. 64, Berlin: Springer, xi + 461 pp.

Mead, C. A. (1974) *Symmetry and Chirality*, Topics in Current Chemistry, Vol. 49, Berlin: Springer, iv + 88 pp.

Schonland, D. S. (1965) *Molecular Symmetry: An Introduction to Group Theory and its Uses in Chemistry*, London: Van Nostrand, xii + 298 pp.; French trans., *La Symétrie moléculaire*, Paris: Gauthiers-Villars, 1971.

Senechal, M. (1990) *Crystalline Symmetries: An Informal Mathematical Introduction*, Bristol: Hilger, xii + 137 pp.

Shubnikov, A. V. (1951) *Simmetriya i antisimmetriya konechnykh figur*, [Symmetry and Antisymmetry of Finite Figures, in Russian], Moskva: Izdatel'stvo Akademii Nauk SSSR, 172 pp.; English trans. [together with some other works], Shubnikov, A. V., Belov, N. V., et al., *Colored Symmetry*, Ed. by W. T. Holser, New York: Macmillan and Oxford: Pergamon Press, 1964, xxv + 263 pp. [Antisymmetry = 2-colored or black-and-white symmetry].

Steinborn, D. (1993) *Symmetrie und Struktur in der Chemie*, [Symmetry and Structure in Chemistry, in German], Weinheim, Germany: VCH, xv + 435 pp.

Vainshtein, B. K. (1979) *Sovremennaya kristallografiya*, Tom 1: *Simmetriya kristallov, Metody strukturnoi kristallografii*, Moskva: Nauka, 383 pp.; English trans., *Modern Crystallography 1: Symmetry of Crystals, Methods of Structural Crystallography*, Springer Series in Solid-State Sciences, Vol. 15, Berlin: Springer, 1981, xvii + 399 pp.; 2nd enlarged ed., *ibid.*, in prep.

Zheludev, I. S. (1976) *Simmetriya i ee prilozheniya*, [Symmetry and its Applications, in Russian], Moskva: Atomizdat, 286 pp.; 2nd enlarged ed., Moskva: Energoizdat, 1983, 303 pp.; Japanese trans. of the 1st ed., *Taishousei to sono ouyou*, Tokyo: Koudansha, 1979, 303 pp.

A list of additional books, which are slightly less interdisciplinary, is available upon request.

### 3.2.2 Other mathematics and/or physics

Arai, A. (1993) *Taishousei no suri*, [Mathematics of Symmetry, in Japanese], Tokyo: Nihon Hyouronsha, 221 pp.

Bunch, B. (1989) *Reality's Mirror: Exploring the Mathematics of Symmetry*, New York: Wiley, xi + 286 pp.; Japanese trans., *Jitsuzai no kagami: Shinmetorii no sekai*, Tokyo: Seidosha, in prep.

Elliott, J. P. and Dawber P. G. (1979) *Symmetry in Physics*, Vol. 1, *Principles and Simple Applications*, Vol. 2, *Further Applications*, London: Macmillan, xix + xviii + 557 pp. [Vol. 1, pp. 1-280; Vol. 2, pp. 281-557]; Russian trans., Élliott, D. and Dober, P., *Simmetriya v fizike*, Tom 1, *Osnovnye printsipy i prostye prilozheniya*, Tom 2, *Dal'neishie prilozheniya*, Moskva: Mir, 1983, 364 + 410 pp.

Genz, H. (in prep.) *Principles of Symmetry in Physics*, Berlin: Springer.

Harter, W. G. (1993) *Principles of Symmetry, Dynamics, and Spectroscopy*, New York: Wiley, xxii + 846 pp.

Holden, A. (1971) *Shapes, Space, and Symmetry*, New York: Columbia University Press, viii + 200 pp.; Reprint, New York: Dover, 1991, 200 pp. [Polyhedra].

Holod, P. I. and Klimyk, A. U. (1992) *Matematychni osnovy teorii symetrii*, [Mathematical Foundations of Theory of Symmetry, in Ukrainian], Kiyiv [Kiev]: Naukova dumka, 366 pp.

Kompaneets, A. S. (1978) *Simmetriya v mikro- i makromire*, [Symmetry in the Micro- and the Macro-Worlds, in Russian], Moskva: Nauka, 207 pp.

Morita, M. (1980) *Taishousei genri: Busshitsu to uchuu o shihaisuru migi to hidari*, [Symmetry Theory: Matter and Universe Ruled by Right and Left, in Japanese], Tokyo: Koudansha, 228 pp.

Schmutzer, E. (1972) *Symmetrien und Erhaltungssätze der Physik*, [Symmetries and Conservation Laws of Physics, in German], Braunschweig: Vieweg and Berlin: Akademie-Verlag, 165 pp.; Russian trans., Shmuttser, É., *Simmetrii i zakony sokhraneniya v fizike*, Moskva: Mir, 1974, 159 pp.

Schottenloher, M. (1993) *Geometrie und Symmetrie in der Physik*, [Geometry and Symmetry in Physics, in German], Wiesbaden: Vieweg, to appear.

Wigner, E. P. (1967) *Symmetries and Reflections*, Bloomington, Ind.: Indiana University Press, viii + 280 pp.; Many reprints; German, Hungarian, Russian trans. [Physics, Philosophy].

Yale, P. B. (1968) *Geometry and Symmetry*, Holden-Day Series in Mathematics, San Francisco: Holden-Day, xi + 288 pp.; Reprint, New York: Dover, 1988.

Zee, A. (1986) *Fearful Symmetry: The Search for Beauty in Modern Physics*, New York: Macmillan, xiv + 322 pp.; Reprint, New York: Collier Books, 1989, xiv + 322 pp.; Japanese trans., *Uchuu no dezain genri: Pariti, geeji, kuouku*, Tokyo: Hakuyousha, 1989, 438 pp.; German trans., *Magische Symmetrie: Die Ästhetik in der modernen Physik*, Frankfurt am Main: Insel, 1993, 360 pp.

Also see the books in Sections 4.1 and 4.3 on broken symmetry and asymmetry in physics, as well as Petukhov (1981) in 3.3 on biomechanics. A list of additional books, which are slightly less interdisciplinary, is available upon request.

### 3.3 Descriptive sciences (biology, mineralogy, geology) and technical applications

Bobrowski, L. (1987) *Dyskryminacja symetryczna w rozpoznawaniu obrazów: Teoria, algorytmy, zastosowania w komputerowym wspomaganiu diagnostyki medycznej*, [Symmetric Discrimination in Recognition of Images: Theory, Algorithms, Application in Computer-Assisted Medical Diagnostics, in Polish], Wrocław: Ossolineum, 170 pp.

Charnov, E. L. (1993) *Life History of Invariants: Some Explorations of Symmetry in Evolutionary Ecology*, Oxford: Oxford University Press, xv + 167 pp.

De Michele, V. (1972) *Crystals: Symmetry in the Mineral Kingdom*, London: Orbis Books, 80 pp.

Dubrov, A. P. (1980) *Simmetriya funktsional'nykh protsessov*, [Symmetry of Functional Processes, in Russian], Moskva: Znanie, 64 pp. [Biology, Biophysics - with some challenging ideas].

Dubrov, A. P. (1989) *Symmetry of Biorhythms and Reactivity*, New York: Gordon and Breach, ix + 268 pp. [Biology, Biophysics - with some challenging ideas].

Jacobsohn-Lask, L. (1924) *Die Kreuzung der Nervenbahnen und die bilaterale Symmetrie des tierischen Körpers*, [The Crossing of Neural Pathways and the Bilateral Symmetry of the Animal Body, in German], Abhandlungen aus der Neurologie, Psychiatrie, Psychologie und ihren Grenzgebieten, Heft 26, Berlin: Karger, 125 pp.

Makagonov, E. P. (1991) *Simmetriya srostkov mineralnykh individov*, [Symmetry of Systems of Single Minerals, in Russian], Moskva: Nauka, 193 pp.

Malakhov, A. A. (1965) *L<sub>5</sub>-simmetriya zhizni*, [L<sub>5</sub>-Symmetry of Life, in Russian], Sverdlovsk: SredneUral'skoe knizhnoe izdatel'stvo, 60 pp. [L<sub>5</sub>-symmetry = 5-fold rotational symmetry].

Petukhov, S. V. (1981) *Biomekhanika, bionika i simmetriya*, [Biomechanics, Bionics, and Symmetry, in Russian], Moskva: Nauka, 238 pp.

Shafranovskii, I. I. and Plotnikov, L. M. (1975) *Simmetriya v geologii*, [Symmetry in Geology, in Russian], Leningrad [Sankt-Peterburg]: Nedra, 144 pp.

Sukhanov, V. B. (1968) *Obshchaya sistema simmetrichnoi lokomotsii nazemnykh pozvonochnykh i osobennosti peredvizheniya nizshikh tetrapod*, [in Russian], Leningrad [Sankt-Peterburg]: Nauka, 227 pp.; English trans., *General System of Symmetrical Locomotion of Terrestrial Vertebrates and Some Features of Movement of Lower Tetrapods*, New Delhi: Amerind, [Published for the Smithsonian Institution and the National Science Foundation, Washington, D.C.], 1974, vii + 274 pp.

Sulima, Yu. G. (1970) *Biosimmetricheskie i bioritmicheskie yavleniya i priznaki u sel'skokozyaistvennykh rastenii*, [Biosymmetrical and Biorhythmical Phenomena and Characteristics of Agricultural Plants, in Russian], Kishinev, Moldavia [Moldova]: Izdatel'stvo Akademii Nauk Moldavskoi SSR, 148 pp.

Ufimtsev, G. F. (1991) *Gornye poiasa kontinentov i simmetriya rel'efa zemli*, [Mountain Belts of Continents and Symmetry of the Relief of the Earth, in Russian], Novosibirsk: Nauka, 168 pp.

Yushkin [Iushkin], N. P., Shafranovskii, I. I., and Yanulov [Anulov], K. P. (1987) *Zakony simmetrii v mineralogii*, [Laws of Symmetry in Mineralogy, in Russian], Leningrad [Sankt-Peterburg]: Nauka, 333 pp.

Also see the books in Section 4.2 on asymmetry in biology, as well as Tímár (1979) in 3.4.3 on human proportions.

### 3.4 Art and the humanities

#### 3.4.1 Anthropology

Lucich, P. (1987) *Genealogical Symmetry: Rational Foundations of Australian Kinship*, Armidale, New South Wales: Light Stone Publications, xxxi + 684 pp.

Witherspoon, G. and Peterson, G. (in prep.) *Dynamic Symmetry and Holistic Asymmetry in Navajo and Western Art and Cosmology*, American Indian Studies, Vol. 5, New York: Lang.

Also see the books in Sections 2.2.2 and 2.2.3 on pattern analysis. In connection with physical anthropology, cf., Tímár (1979) in 3.4.3 and Schneider (1973) in 4.2.

#### 3.4.2 Architecture and design

Baglivo, J. A. and Graver, J. E. (1983) *Incidence and Symmetry in Design and Architecture*, Cambridge, England: Cambridge University Press, xi + 306 pp.

Bairati, C. (1952) *La simmetria dinamica: Scienza ed arte nell'architettura classica*, [Dynamic Symmetry: Science and Art in Classical Architecture, in Italian], Milano: Editrice Politecnica Tamburini, 100 pp.

Hambidge, J. (1926) *The Elements of Dynamic Symmetry*, New Haven, Conn.: Yale University Press and New York: Brentano, xx + 140 pp.; Reprint, New Haven, Conn.: Yale University Press, 1948, xvii + 133 pp.; Reprint, New York: Dover, 1967, xvii + 133 pp. [Dynamic symmetry = a system of proportions based on square roots of integers; there are further books on this topic by Hambidge].

Kalayan, H. (1988) *The Architectural Information through Symmetry*, Amman: Department of Antiquities, The Hashimite Kingdom of Jordan, 89 pp.

Kambartel, W. (1972) *Symmetrie und Schönheit: Über mögliche Voraussetzungen des neueren Kunstbewusstseins in der Architekturtheorie Claude Perraults*, [Symmetry and Beauty: On Possible Prerequisites of the New Artistic Consciousness in the Theory of Architecture of Claude Perrault, in German], München: Fink, 179 pp.

Kask, T. (1971) *Symmetrie und Regelmässigkeit: Französische Architektur im "Grand Siècle"*, [Symmetry and Regularity: French Architecture in the "Grand Siècle", in German], Basel: Birkhäuser, 157 pp.

Meunié, L. (1968) *L'Architecture et la géométrie: Symétries et rythmes harmoniques*, [Architecture and Geometry: Symmetries and Harmonic Rhythms, in French], Paris: Vincent, Fréal, 93 pp.

Ressa A. (1990) *Chiese barocche in Piemonte: Nella evoluzione delle figure planimetriche a simmetria centrale*, [Baroque Churches in Piemonte: On the Development of the Layout-Figures in Central Symmetry, in Italian], Roma: Quasar, 210 pp.

Smolina, N. I. (1990) *Traditsii simmetrii v arkhitekture*, [Traditions of Symmetry in Architecture, in Russian], Moskva: Stroizdat, 343 pp.

Szambien, W. (1986) *Symétrie, goût, caractère: Théorie et terminologie de l'architecture à l'âge classique, 1550-1800*, [Symmetry, Taste, Character: Theory and Terminology of Architecture in the Age of Classicism, 1550-1800, in French], Paris: Picard, 232 pp.

### 3.4.3 Painting

Funck-Hellet, C. (1950) *Composition et nombre d'or dans les oeuvres peintes de la Renaissance: Proportion, symétrie, symbolisme*, [Composition and Golden Number in the Painted Works of the Renaissance: Proportion, Symmetry, Symbolism, in French], Paris: Vincent, Fréal, 111 pp. [Some of the analyses are wayward].

Scheibler, I. (1960) *Die symmetrische Bildform in der frühgriechischen Flächenkunst*, [Symmetric Picture-Form in the Early Greek Art of Surface-Decoration, in German], Kallmünz, Germany: Lassleben, 131 pp.

Timár, L. (1979) *Albrecht Dürer: Della simmetria dei corpi humani*, [in English], Budapest: Chemical Works of Gedeon Richter, 64 pp.; Hungarian version, *ibid.*, 1979. [On Dürer's book on human proportions].

Also see MacGillavry (1965) and Schattschneider (1990) in Section 2.2.3 on the graphic art of M. C. Escher, Witherspoon and Peterson (in prep.) in 3.4.1 on Navaho painting and its modern adaptation.

### 3.4.4 Music

Karakulov, B. I. (1989) *Symmetriya muzykalnoi sistemy: O melodii*, [Symmetry of the Musical System: On the Melody, in Russian], Alma-Ata, Kazakhskoi SSR [Kazakhstan]: Nauka, 129 pp.

Lendvai, E. (1993) *Symmetries of Music: An Introduction to Semantics of Music*, Compiled and ed. by M. Szabó and M. Mohay, Kecskemét, Hungary: Kodály Institute, 155 pp.; German and Hungarian trans., in prep.

Massenkeil, G. (1962) *Untersuchungen zum Problem der Symmetrie in der Instrumentalmusik W. A. Mozarts*, [Studies on the Problem of Symmetry in the Instrumental Music of W. A. Mozart, in German], Stuttgart: Franz Steiner, vii + 145 pp., 106 examples of notes.

Melchert, H. (in prep.) *Symmetrie: Form im Rezitativ der Bachschen Matthäuspassion*, [Symmetry: Form in the Recitative of Bach's "St. Matthew Passion", in German], Ed. by R. Schaal, Veröffentlichungen zur Musikforschung, No. 17, Wilhelmshaven, Germany: Noetzel.

Schröder, H. (1902) *Symmetrische Umkehrung in der Musik: Ein Beitrag zur Harmonie- und Kompositionslehre, mit Hinweis auf die hier technisch notwendige Wiedereinführung antiker Tonarten im Style moderner Harmonik*, [Symmetrical Inversion in Music: A Contribution to the Study of Harmony- and Composition-

Theory with a Reference to the Here Technically Necessary Reintroduction of Ancient Keys in the Style of Modern Harmony, in German], Publikationen der Internationalen Musikgesellschaft, Beihefte, Heft 8, Leipzig: Breitkopf und Härtel, 128 pp.; Reprint, Walluf, Germany: Sändig.

Werker, W. (1922) *Studien über die Symmetrie im Bau der Fugen und die motivische Zusammengehörigkeit der Präludien und Fugen des "Wohltemperierten Klaviers" von Johann Sebastian Bach*, [Studies on the Structural Symmetry in the Fugues and the Motivic Relationship between the Preludes and Fugues in Johann Sebastian Bach's "The Well-Tempered Clavier", in German], Leipzig: Breitkopf und Härtel, vii + 356 pp.; Reprint, Walluf, Germany: Sändig, 1969.

### 3.4.5 Literature

Etkind, E. G. (1988) *Simmetricheskie kompozitsii u Pushkina*, [Symmetrical Compositions of Pushkin, in Russian], Parizh [Paris]: Institut d'études slaves, 84 pp.

Fedynyshynets, V. (1989) *Symetriya poezii: Khudozhnie oformlennyya avtora*, [Symmetry of Poetry: Artistic Presentation of the Author, in Ukrainian], Uzhhorod, Ukraine: Karpaty, 93 pp.

Greenberg, M. (1986) *Corneille, Classicism, and the Ruses of Symmetry*, Cambridge, England: Cambridge University Press, xv + 189 pp.

Knight, W. F. J. (1939) *Accentual Symmetry in Vergil*, Oxford: Blackwell, x + 107 pp.; Reprint, New York: Garland, 1979, x + 107 pp.

Montgomery, R. L., Jr. (1961) *Symmetry and Sense: The Poetry of Sir Philip Sidney*, New York: Greenwood Press, vii + 134 pp.; Reprint, *ibid.*, 1969, vii + 134 pp.

Spillner, B. (1971) *Symmetrisches und asymmetrisches Prinzip in der Syntax Marcel Prousts*, [Symmetric and Asymmetric Principle in the Syntax of Marcel Proust, in German], Frankfurt am Main: Hain, xii + 223 pp.

Also see the books in Section 4.4 on broken symmetry and asymmetry in linguistics, literature, and semiotics.

## 4 Interdisciplinary books on dissymmetry, broken symmetry, asymmetry, including asymmetry of brain and asymmetry of time

Note the differences between these concepts:

- (1) dissymmetry is the lack of some elements of symmetry (cf., Pasteur's molecular dissymmetry) or the small deviation from the perfect symmetry (cf., P. Curie's principle of dissymmetry),
  - (2) broken symmetry is the occasional violation of an existing or suspected symmetry (cf., Lee and Yang's broken symmetry in particle physics),
  - (3) asymmetry is the total lack of symmetry.
- (In connection with antisymmetry, or black-and-white symmetry, in crystallography, cf., Shubnikov (1951) in Section 3.2.1).

#### 4.1 General

Akopyan, I. D. (1980) *Simmetriya i asimmetriya v poznanii*, [Symmetry and Asymmetry in Cognition, in Russian], Erevan, Armenia: Izdatel'stvo Akademii Nauk Armyanskoi SSR, 132 pp.

Caglioti, G. (1983) *Simmetrie infrante nella scienza e nell'arte*, [Broken Symmetries in Science and Art, in Italian], Milano: CLUP, 182 pp.; German trans., *Symmetriebrechung und Wahrnehmung: Beispiele aus der Erfahrungswelt*, [Symmetry-Breaking and Perception: Examples from the Empirical World, in German], [With a preface by H. Haken], Braunschweig: Vieweg, 1990, x + 200 pp.; English trans., *The Dynamics of Ambiguity*, Berlin: Springer, 1992, xx + 170 pp.; Russian and Japanese trans., in prep.

Caillois, R. (1973) *La Dissymétrie*, [Dissymmetry, in French], Paris: Gallimard, 96 pp.; Japanese trans., *Hantaishou*, Tokyo: Shisakusha, 1991, 152 pp.

Gardner, M. (1964) *The Ambidextrous Universe*, New York: Basic Books, x + 294 pp.; Reprint, London: Penguin Books, 1967, 272 pp.; Reprint, London: Pelican Books, 1970, 276 pp.; 2nd rev. ed., *The Ambidextrous Universe: Mirror Asymmetry and Time-Reversed Worlds*, New York: Scribner, 1979, 293 pp.; 3rd rev. ed., *The New Ambidextrous Universe: Symmetry and Asymmetry from Mirror Reflections to Superstrings*, New York: Freeman, 1990, xiv + 392 pp.; German, French, Italian, Japanese, Lithuanian, Polish, Russian trans. of various eds.

Mayer-Kuckuk, T. (1989) *Der gebrochene Spiegel: Symmetrie, Symmetriebrechung und Ordnung in der Natur*, [The Broken Mirror: Symmetry, Symmetry-Breaking, and Order in Nature, in German], Basel: Birkhäuser, 264 pp.

Shubnikov, A. V. (1961) *Problema dissimmetrii material'nykh ob'ektov*, [The Problem of Dissymmetry of Material Objects, in Russian], Moskva: Izdatel'stvo Akademii Nauk SSSR, 55 pp.

Sonin, A. S. (1987) *Postizhenie sovershenstva: Simmetriya, asimmetriya, dissimmetriya, antisimmetriya*, [Comprehension of Perfectness: Symmetry, Asymmetry, Dissymmetry, Antisymmetry, in Russian], Moskva: Znanie, 203 pp.

Also see Witherspoon and Peterson (in prep.) in 3.4.1 on symmetry and asymmetry in Navaho art and cosmology.

#### 4.2 Chemistry and biology, including asymmetry of brain

Bentley, R. (1969-70) *Molecular Asymmetry in Biology*, Vols. 1-2, New York: Academic Press, xii + 322 + xiii + 566 pp.

Bianki, V. L. (1985) *Asimmetriya mozga zhivotnykh*, [Asymmetry of the Brain of Animals, in Russian], Leningrad [Sankt-Peterburg]: Nauka, 295 pp.

Bradshaw, J. L. and Nettleton, N. C. (1983) *Human Cerebral Asymmetry*, Englewood Cliffs, N.J.: Prentice-Hall, xvi + 335 pp.

Bragina, N. N. and Dobrokhotova, T. A. (1981) *Funktsional'nye asimmetrii cheloveka*, [Functional Asymmetries of the Human, in Russian], Moskva: Meditsina, 288 pp.; 2nd rev. ed., *ibid.*, 1988, 237 pp.

Bryden, M. P. (1982) *Laterality: Functional Asymmetry in the Intact Brain*, New York: Academic Press, xiii + 319 pp.

Depenchuk, N. P. (1963) *Simmetriya i asimmetriya v zhivoi prirode*, [Symmetry and Asymmetry in Living Nature, in Russian], Kiev: Izdatel'stvo Akademii Nauk Ukrainskoi SSR, 174 pp.

Galaktionov, S. G. (1978) *Asimmetriya biologicheskikh molekul*, [Asymmetry of Biological Molecules, in Russian], Minsk, Bielorussia [Belarus]: Vysheishaya shkola, 175 pp.

Hellige, J. B. (1993) *Hemispheric Asymmetry: What's Right and What's Left*, Cambridge, Mass.: Harvard University Press, xiii + 396 pp.

Kizel', V. A. (1985) *Fizicheskie prichiny dissimmetrii zhivykh sistem*, [Physical Causes of Dissymmetry of Living Systems, in Russian], Moskva: Nauka, 118 pp.

Kuroda, R. (1992) *Seimei sekai no hitaishousei: Shizen wa naze anbaransu ga suki ka*, [Asymmetry of the Living World: Why Does Nature Like Imbalance?, in Japanese], Tokyo: Chuouo Kouronsha, 216 pp.

Neville, A. C. (1976) *Animal Asymmetry*, The Institute of Biology's Studies in Biology, No. 67, London: Arnold, 60 pp.

Saito, Y. (1979) *Inorganic Molecular Dissymmetry*, Inorganic Chemistry Concepts, Vol. 4, Berlin: Springer, ix + 167 pp.

Schneider, L. A. (1973) *Asymmetrie griechischer Köpfe vom 5. Jahrhundert bis zum Hellenismus*, [Asymmetry of Greek Heads from the 5th Century [B.C.] to the Hellenism, in German], Stuttgart: Franz Steiner, viii + 168 pp.

Vartanian, G. A. and Klementev, B. I. (1991) *Khimicheskaya simmetriya i asimmetriya mozga*, [Chemical Symmetry and Asymmetry of the Brain, in Russian], Leningrad [Sankt-Peterburg]: Nauka, 150 pp.

Also see Ivanov (1978) in 4.4 on the asymmetry of brain.

#### 4.3 Physics, including asymmetry of time

Boccaro, N. (1976) *Symétries brisées: Théorie des transitions avec paramètre d'ordre*, [Broken Symmetries: Theory of Transitions with Parameter of Order, in French], Actualités scientifiques et industrielles, Vol. 1378, Paris: Hermann, 274 pp.

Davies, P. C. W. (1974) *The Physics of Time Asymmetry*, Berkeley: University of California Press, xviii + 214 pp.; Paperback ed., *ibid.*, 1977, xviii + 214 pp.; Japanese trans., *Jikan no butsurigaku: Sono hitaishousei*, Tokyo: Baifuukan, 1979, xiv + 219 pp.; Reprint ed., *ibid.*, 1982, xiv + 219 pp.

Forster, D. (1975) *Hydrodynamic Fluctuations, Broken Symmetry, and Correlation Functions*, Frontiers in Physics, Vol. 47, Reading, Mass.: Benjamin, xix + 326 pp.; Reprint, Redwood City, Calif.: Addison-Wesley, 1989, xxiv + 326 pp.

Genz, H. and Decker, R. (1991) *Symmetrie und Symmetriebrechung in der Physik*, [Symmetry and Symmetry-Breaking in Physics, in German], Braunschweig: Vieweg, 376 pp.

Horwich, P. (1987) *Asymmetries in Time: Problems in the Philosophy of Science*, Cambridge, Mass.: MIT Press, xiii + 218 pp.; Japanese trans., *Jikan ni muki wa aruka*, Tokyo: Maruzen, 1992, viii + 355 pp.

Lautman, A. (1946) *Symétrie et dissymétrie en mathématiques et physique: La Problème du temps*, [Symmetry and Dissymmetry in Mathematics and Physics: The Problem of Time, in French], *Actualités scientifiques et industrielles*, No. 1012: *Essais philosophiques*, No. 3, Paris: Hermann, 50 pp.

Lee, T. D. (1988) *Symmetries, Asymmetries, and the World of Particles*, Seattle, Wash.: University of Washington Press, xii + 66 pp.

#### 4.4 Linguistics, literature, semiotics

Andrews, E. (1990) *Markedness Theory: The Union of Asymmetry and Semiosis in Language*, Sound and Meaning: The Roman Jakobson Series in Linguistics and Poetics, Durham, N.C.: Duke University Press, viii + 220 pp.

Fido, F. (1988) *Il regime delle simmetrie imperfette: Studi sul "Decameron"*, [The Rule of Imperfect Symmetries: Study of the "Decameron", in Italian], Milano: Angeli, 151 pp.

Freund, J. (1991) *Broken Symmetries: A Study of Agency in Shakespeare's Plays*, Worcester Polytechnic Institute Studies in Science, Technology, and Culture, Vol. 8, New York: Lang, xvii + 214 pp.

Ivanov, V. V. (1978) *Chetnoe i nechetnoe: Asimmetriya mozga i znakovykh sistem*, [Even and Odd: The Asymmetry of Brain and Sign-Systems, in Russian], Moskva: Sovetskoe radio, 184 pp.; German trans., *Gerade und Ungerade: Die Asymmetrie des Gehirns und der Zeichensysteme*, Stuttgart: Hirzel, 1983, 221 pp.; Hungarian trans., *Páros és páratlan: Aszimmetria az agyban és a jelrendszerben*, Budapest: Kozmosz, 1986, 263 pp.

Shapiro, M. (1976) *Asymmetry: An Inquiry into the Linguistic Structure of Poetry*, North-Holland Linguistic Series, Vol. 26, Amsterdam: North-Holland, xiv + 231 pp.