SYMMETRO-GRAPHY

SYMMETRY:
A BIBLIOGRAPHY OF INTERDISCIPLINARY BOOKS

University-textbooks, scholarly monographs, popular-scientific works

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This bibliography includes
- about 600 books, plus their additional editions, close to 1,000 items (collections of papers by different authors, abstracts and proceedings of meetings, booklets shorter than 50 pages, and manuscripts are not considered),
- on symmetry (they refer to this term or its derivatives, including antisymmetry, asymmetry, dissymmetry, directly in their titles),
- in 25 languages (Bulgarian, Catalan, Chinese, Czech, Danish, Dutch, English, French, German, Greek, Hungarian, Italian, Japanese, Lithuanian, Norwegian, Polish, Portuguese, Rumanian, Russian, Serbo-Croatian, Slovakian, Spanish, Swedish, Turkish, Ukrainian),
- from all of the continents’ (from Brazil to Mongolia, from Mexico to Australia, from Norway to Mozambique),
- with the full bibliographic description of each book (Bulgarian, Chinese, Greek, Japanese, Russian, and Ukrainian names and titles are romanized), and
- with translations of all book-titles that have no English versions.

The books are classified according to a system that was developed for this purpose. Since the "linear" classification of interdisciplinary books is impossible, there are cross-references among sections.

INTRODUCTION

As it is emphasized in the heading, all of the listed books are on symmetry (antisymmetry, asymmetry, dissymmetry, and other derivatives): they refer to this fact directly in their titles. Since the expression symmetry became an international word, its adapted versions, with minor phonetic changes, are available in many languages. In the case of Far Eastern books those are considered that use
- the Chinese term duichên (modern Mandarin reading, Pinyin [sound assembly] system of romanization; which is tui ch'eng according to the earlier Wade-Giles romanization) . . . or

2 Its adopted Korean version tae-ch'ing (McCune-Reischauer system of romanization).
3 Its adopted Japanese version taishou (revised Hepburn system of romanization).
- the Japanese *shinmetorii* (the adopted international word, which development has no Chinese or Korean equivalent).

The cited Chinese term, which is written in two characters, is related to objects facing each other to form a pair (bilateral symmetry), but its meaning can be extended to the case of rotational symmetry. Still, it is more specific than the Western "symmetry". Perhaps this observation also contributed to the fact that in modern Japanese both terms are used: *taishou* (adopted from China and written in Sino-Japanese kanji characters) and *shinmetorii* (adopted from Western languages and written in the katakana phonetic syllabary).

Note the following important conventions:

(1) Books without reference to symmetry (or its derivatives) in the title → not listed.

Unfortunately there are many books of this category which deal with symmetry-related topics. Obviously, the exclusion of these books has some disadvantages, but
- it was necessary to limit the scopes of this bibliography,
- there are some good bibliographies on polyhedra, proportions, rhythm, tilings and patterns, respectively, which are available for further reference.

Bibliography of bibliographies (or comprehensive lists of references) of some symmetry-related fields

(a) Polyhedra

(b) Proportions in art and nature
- Also see the additions to this bibliography in the following book:

(c) Rhythm

(d) Tilings and patterns

(2) In the case of translated books:
- There are books where the original titles refer to symmetry (or its derivatives), but the translated versions do not → in this case we still list the bibliographic data of the translated versions.
- There are books where the original titles do not refer to symmetry (or its derivatives), but the translated versions introduce this term → in this case we do not list the book and its translated versions.

In short, our decision is based on the author's original intention, not on the later view of the translators.
BIBLIOGRAPHY

(3) Items shorter than 50 pages are also excluded. We plan, however, to publish further bibliographies on
symmetry and related topics, covering not only university-textbooks, scholarly monographs, and popular-
scientific books, but also collections of essays, proceedings, and other works.

International aspects

It is interesting to note that many references in this bibliography are not yet available in major computer
catalogs, data banks, and electronic bookstores: they frequently miss older items and books written in
languages that are not widely spoken at their centers. We think, however, that these works are also important.
Often they include tables and illustrations that are easy to understand without reading the actual language.
A beautiful example is Kumagai and Sawada textbook Moyou to shinmetorii (Ornamental Patterns and
Symmetry, in Japanese) in Section 1.1.3. In addition to this, the data of translated books
- may help the international cooperation among interested scholars and instructors,
- may provide useful information to lecturers and students who visit particular countries and would like to
  refer to locally available works,
- may orient publishers and translators.

We observed in various cases that translators of books did not revise the list of references, just adopted it. This
method led to such comic cases where, for example, an English book on symmetry (translated from German)
refers not to the original version of papers and books in English, but to their later German translations. Should
the reader learn German to follow the references? I also believe that even publishers did not realize some
basic data on translated books that are available in our bibliography. The lack of information led to
duplicating or even triplicating the same work. I have no different explanation of the surprising fact that
Hermann Weyl's book Symmetry (Princeton, 1952) has
- three different Spanish translations: (1) Buenos Aires, 1958; (2) Barcelona, 1974; (3) Madrid, 1990.
- three different Chinese translations (with see slightly different titles!): (1) Beijing [Peking], 1986; (2) Taibei
  [Taipei, Taiwan], (3) Shanghai.

These are not reprint editions of the same translation, but different interpretations of the book.
If a book has more than one translation, we list these in a chronological order (according to the first editions in
the corresponding languages).

In those cases where the translated titles significantly differ from the original ones (or new subtitles are
added), those “modified” titles are also translated into English. For example, Pagels' book Perfect Symmetry:
1991 became in Japanese Toki no hajimari e no tabi: Taishousei no butsuri [Journey to the Beginning of
Time: The Physics of Symmetry], while, as a further twist, the second edition was translated as Hoshi kara
ginga e: Heesheru no niwa [From the Stars to the Milky Way: Herschel's Garden]. There is no similar
“problem” with the Italian and Portuguese translations of the same book. They follow more or less the original
title and therefore these titles are not translated into English.

Concerning translated books, we give the possible “new” (transliterated) names of authors in those cases
where these are important to locate the book in the corresponding language territory, e.g.,
- Sheikov, a Bulgarian author (in English transliterated form) became
- Scheikov in the German translation of his book,
- Sejkov in the Hungarian version.

Luckily there is no similar problem in Japan: most library catalogs list the Japanese translations of foreign
books under the original names of authors.

The translation of terms is often a very difficult task. In some cases we added alternative expressions
<interrupting the translated titles> or brief notes [in brackets at the end]. The related problems led to two case
studies and related hypertext essays:
- objectology or object-design as possible English equivalents of the Japanese monogaku,
- futaisou as a possible Japanese equivalent of dissymmetry (lack of some elements of symmetry).

Some conventions used in this bibliography:

To keep the bibliography shorter, we adopted the following conventions:

- If a book is published in a series whose title is important to find some extra information about it, we give the series title after the actual title of the book (note that the title of the book is italicized, while the series title is not).
- For place of publication, only the first one is given, followed by the name of the state or country if any difficulty may occur in locating the corresponding city [and maybe some additional information in brackets, e.g., the new names of some places in the former U.S.S.R.].
- The names of publishers are given in short form, e.g., we have Springer instead of Springer Verlag. We use, however, the full names of publishers where the sort forms may lead to ambiguities, e.g., we should make clear that a book is published either by the Academy of Science of the U.S.S.R. (Akademiya Nauk SSSR) or by the Publishing House of the same institution (Izdatel'ство Akademii Nauk SSSR).
- In the case of parallel editions, we refer to both publishers.
- Reprint, paperback, and new editions are also listed; these are marked by asterisk (*).
- Translations are listed in new paragraphs; these are marked by dash (-).
- In some cases there are brief notes after the books [in brackets].
- We use the conventional transliteration of Cyrillic words [sometimes giving alternative versions of names in brackets].
- In the case of the transliteration of Japanese names and titles, we use the system preferred by most wordprocessors and some computerized data banks where, e.g., instead お and う, we have おう and うう (without diacritical symbols!), respectively. We do not introduce, however, this style in case of "Tokyo", because this city is known in this form, while the linguistically correct "Toukyou" would be very strange for most readers. We use some standard abbreviations: ed. (edition or editor), eds. (editions), ibid. (ibidem, in the same place), pp. (pages), trans. (translation).

A request:
Of course this bibliography is not complete. We kindly ask our readers to report any missing item.

1 INTERDISCIPLINARY TEXTBOOKS AND TEACHING MATERIALS

The border line between textbooks and scholarly monographs is not always clear. We list here such books where there are some indications that the works are written (partly or fully) with educational purposes: these are texts, guides, problem-books, or other teaching materials. Since this intention is not always clear from the titles of books, we pay a special attention to subtitles, series titles, the detailed data of the publishers, and even remarks in the prefaces. In the case of some non-English books, not only the titles, but also other bibliographic data are translated into English. In the case of names of institutions I try to give the official translation (with remarks that give further information or alternative translations that are closer to the original). Occasionally, there are notes that explain the intention of the author [these are in brackets at end of the item].
1.1 Interdisciplinary works in a broad sense

1.1.1 General introductions

- Science-technology and arts-humanities:

Bérczi, S. (1990) *Szimmetria és struktúrápítás*, [Symmetry and Structure-Building, in Hungarian], Egyetemi jegyzet [University Text], Budapest: Tankönyvkiadó, 260 pp. [Published for a course at the Eötvös Loránd University, Budapest].


- Many fields of science:


- Philosophy of science:

There are some related booklets, but these are shorter than our limit of 50 pages. See, e.g.,


Also see:

* Khakimov (1986) on systems and symmetry → Section 1.2.6

1.1.2 Specific scientific fields (with an outlook to arts)


Also see:

* Povde~ko (1970) on technology and design → Section 1.2.7,

* MacGillavry on Escher → Section 2.2.3

1.1.3 Arts and design (with an outlook to science)

Huff, W. S. (1967-77) *Symmetry: An Appreciation of its Presence in Man’s Consciousness*, Parts 2-6, Designed by T. Gonda, Pittsburgh: [Privately Published], 93 pp. in various pageings. [This series of booklets was distributed in Northern America for those universities that have design programs; Part 1 is not published; the order of publishing: Part 4, 1967; Part 6, 1970; Part 5, 1971; Part 2, 1975; Part 3, 1977].


1.1.4 Philosophy (see the Philosophy of science)
1.2 More specialized works of a given field (with some interdisciplinary outlook)

1.2.1 Mathematics

Some works on mathematical education and teaching aids on elementary mathematics are considered, but kept in the subsection 1.2.1.1.


* 2nd printing, corrected, ibid., 1987.


Also see:

* Graduate textbooks → Section 1.3.

1.2.1.1 Mathematical education, elementary mathematics


There are many related booklets which are shorter than our limit of 50 pages. Illustrating the broad international interest in symmetry, we refer here to two items that was published in Fiji, a South Pacific island.
country (population ca. 750,000), and Kiribati, a country of tropical islands and atolls (population ca. 70,000),
respectively:
* Symmetry, Pupils' Pamphlet A18, [Suva, Fiji]: University of the South Pacific, 30 pp.

1.2.2 Crystallography
* Zeszyt 3: Symetria w morfologii krystalatów, grupy punktowe, [Booklet 3: Symmetry in the Morphology of Crystals, Point Groups, in Polish],
* Zeszyt 4: Symetria w budowie wewnętrznej ciał krystalicznych, grupy przestrzenne, [Symmetry in the Internal Structure of Crystalline Materials, Space Groups, in Polish], Katowice [Poland]: Uniwersytet Śląski [University of Silesia], 48 + 51 pp. [The subtitles of Booklets 1, 2, and 3 do not refer to symmetry].
* [1] *Klasyczna symetria, [Classical Symmetry, in Russian],
* [2] *Obobshchennaya symetria, [Generalized Symmetry, in Russian],
* [3] *Antisymentria, [Anti-Symmetry <Black-and-White Symmetry>, in Russian],
* [4] *Tablicy dlia samostoyatel'nykh zanyatii studentov pri izucheni symmetry Kristallov: Fedorovskie gruppy kubicheskoi singonii, [Tables for Individual Work of Students for the Study of Symmetry of Crystals: Fedorov Groups <Space Groups> of the Cubic System, in Russian],* Leningrad [now Sankt-Peterburg]; Leningradski gosudarstvenny universitet [Leningrad <St. Petersburg> State University], 85 + 73 + 78 + 34 pp. [In the case of [1] the order of authors is different: Frank-Kamenetski, Dubov, Shafranovskii].
Loub, J. (1987) *Kristallová struktura, symetrie a rentgenová difrakce: Učebno pro poslucháče fakulty přírodovedecke, [Crystal Structure, Symmetry and X-Ray Diffraction: Intended for Students of the Faculty of Natural Science <Faculty of Science>, in Czech],* Praha [Prague]: Státní pedagogické nakladatelství (SPN), 142 pp. [Published for Charles University].
1.2.3 Physics (other than crystallography)


Also see:
* Engineering, technology → Section 1.2.7,
* Graduate textbooks → Section 1.3

1.2.4 Chemistry (other than crystallography)


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Note. Dorain (1965), Jaffé and Orchin (1965), and Kettle (1985), see above, were not published originally as textbooks. However, their German translations are in series of university textbooks.

1.2.4.1 Chemical reactions (orbital theory)

There are some guides, programmed texts, and problem books on orbital symmetry, which is useful to predict and explain certain types of reactions in inorganic chemistry. However, this topic is more specialized and we keep all of the related books together in Section 3.2.1.2.

See there especially, Bellamy (1974), Entwistle (1972), Gilchrist and Storr (1972), Lehr and Marchand (1972), Orchin and Jaffé (1971b), and Sunjic (1979).
1.2.5 Biology

Also
* Grodzicki (1988) on spectroscopy — Section 1.2.4.
* Khakimov (1986) on symmetry in nature — Section 1.2.6.

1.2.6 Earth sciences
Khakimov, E. M. (1986) Sistemo-symmetriinyi analiz ob'ektov prirody (Posobie po spetskursu), [Systemo-Symmetric Analysis of Objects of Nature (Textbook for a Special Topic Course), in Russian], Kazan' [Russia]: Chelyabinskii gosudarstvennyi pedagogicheskii institut [Chelyabinsk State Teacher-Training Institute <College>], 95 pp. [Published for students of geology-geographical disciplines, also recommended for students of biology and chemistry (cf., preface, p. 4), and those who are interested in the philosophical questions of science (cf., annotation, p. 2)].

1.2.7 Engineering, technology


1.2.8 Arts and the Humanities


1.3 Graduate textbooks: Mathematics and/or physics


* Paparback ed., ibid.

2 INTERDISCIPLINARY MONOGRAPHS AND POPULAR-SCIENTIFIC BOOKS

2.1 General works with systematic surveys

2.1.1 Pioneering works published until 1952 (when three books appeared independently by Jaskowski, Weyl, and Wolf and Kuhn)

These books have significant historic importance. In addition to these, all of them have materials that are still current. Students may survey them in seminar reports.


Shubnikov, A. V. (1940) Symmetriya (Zakony simmetrii i ih primenenie v nauke, tekhnike i prikladnom iskusstve), [Symmetry (The Laws of Symmetry and Their Application in Science, Technology, and Applied Art), in Russian], Moskva: Izdatel'stvo Akademii Nauk SSSR, 176 pp. [Cf., Shubnikov and Koptsik (1972) In Section 2.1.2, which is published as the 2nd enlarged ed. of this; however, the volume of that book is about twice larger than this one, and thus we suggest to consider it as a separate item].


- Reprint ed., In: Vulf, Yu. [sic] V., Izbrannye raboty po kristallofizike i kristallografii, [Selected Works on Crystalphysics and Crystallography, in Russian], Moskva: Gosudarstvennoe izdatel'stvo tehnicheskoj literature, 1952, 242-330. [Note that the author's first name was used in two different versions: Georgii and Yuri].


- Reprint and paperback eds., ibid., 168 pp.
- Japanese reprint ed., Shinmetorii, ibid., 1970, ii + 165 pp. [The earlier subtitle is not used; H. Touxama's commentary is revised, pp. 159-165]
- Japanese reprint eds. of the latter, ibid.
* French reprint eds., ibid.
* Russian trans., Volf, G., *Simmetriya*, Ed. by B. A. Rozenfel’d, Moskva: Nauka, 1968, 190 pp. [With a commentary by the editor, pp. 168-173, and two additional articles in Russian: "Weyl and the concept of symmetry" by I. M. Yaglom [Agolom], pp. 5-32, and "Weyl and the methodological problems of science" by B. V. Birjukov, pp. 174-190; the cover design is based on M. C. Escher’s Lizards].

Also see the following pre-1952 books:
* Shepard (1948) on pattern analysis — Section 2.2.2,
* Plehn (1911) on colored patterns — Section 2.2.3,
* Veen (1911) on the diamond — Section 3.2.2,
* Danver (1942) on astronomy — Section 3.2.4,
* Jocoboñh-Lask (1924) on biology — Section 3.3.1,
* Hay (1846) on basic design — Section 3.4.2,
* Schröder (1902) and Werkster (1922) on music — Section 3.4.4,
* Anderson (1897) on physical education — Section 3.5,
* Gauze (1940) on asymmetry of the protoplasm — Section 4.2,
* Lautman (1946) on mathematical and physical symmetry and dissymmetry — Section 4.3.

Also see the modern editions of classical works:
* Fedorov (1949), Fedorov (1971) on symmetry groups (collections of late 19th century works in Russian and in English, respectively) — Section 3.2.2,
* García, S. (1681/1991) on architecture — Section 3.4.2,
* Timfr (1979) on Dürer’s book on human proportions — Section 3.4.3.
2.1.2 Works published after 1952


- Spanish trans., Fascinante simetría, [Fascinating Symmetry, in Spanish], Barcelona: Fundación Caja de Pensiones, 1990, 71 pp


* 2nd ed., ibid., 1965, 128 pp [Popular-scientific].


- English trans., *This Amazingly Symmetric World,* Moscow: Mir, 1986, 164 pp


2.2 Works on pattern creation and pattern analysis

2.2.1 Pattern creation


Waller, M. D. (1961) Chladni Figures: A Study in Symmetry, London: Bell, xxii + 163 pp. [Note: Visualization of sound waves - the sand pattern technique of Chladni (1756-1827) produces symmetric patterns on plates vibrated, for example, by a violin bow at their edges].

Also see:
* Herfort and Klotz (1997) → Section 1 1 2

2.2.2 Pattern analysis: comprehensive surveys


* Paperback ed., ibid., 1991

Also see:
* Bérczi (1990) → Section 1.1,
* Huff (1967-77, Parts 2-3), Kumagai and Sawada (1983) → Section 1.1.3,
* Crowe (1986), Rosanes and Rosanes (1993) → Section 1.2.1.1 and 1.1.2.
* Takahashi (1998) → Section 1 2 1,
* Jaskowski (1952), Shubnikov (1940) → Section 2.1.1,
* Shubnikov and Koptsik (1972), Wolf and Wolff (1956), and some other books → Section 2 1.2.
2.2.3 Pattern analysis: special fields


Bérczi, S. (1986-87) *Szimmetria és techné a magyar, avar és hanti disznóbiztonságban*, [Symmetry and techné in the Hungarian, Avar, and Hanti Ornamental Art], in Hungarian, Budapest: Művészeti Kiadó, University of Pázmány Péter Catholic University of Hungary, xxiii + 505 pp.

Universidade Pedagógica, 152 pp.* [Lunda is a region of the Northeastern part of Angola].


* Paperback ed., ibid., 1992


Also see:

* Rull Perez (1987) → Section 1 2.1.1,


3 MORE SPECIALIZED MONOGRAPHS WITH SOME INTERDISCIPLINARY OUTLOOK

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 also for people interested in solid state physics, crystal physics, crystal chemistry, materials science, and, in some cases, even for designers. As a general principle: we consider those books that have some importance outside its primary discipline. Following this
principle, we include books related to mathematical-physical topics (e.g., theoretical mechanics, quantum theory, particle physics) although many of these books have a limited target among a group of mathematicians and physicists. We also list books on symmetries in various artistic fields, because these could be useful for artists of other fields and scholars who would like to illustrate scientific books with artistic examples. We also include books on dynamic symmetry in design, a proportion-system proposed by Jay Hambidge on the basis of his studies on Greek art, because we witnessed that some aspects of this topic are also interesting for mathematics students (despite the fact that it has less value for the originally targeted artists and art historians). We also list some old books of historic importance (cf., Section 2.1.1 and the references there). Indeed, we think that dealing with the history of the subject is relevant and advanced students may prepare related reports. Although we also include books written by historians of science on various aspects of symmetry (see Section 3.1), we suggest combining these with the original sources.

What types of books are not included? It is not easy to give strict rules, but here are some general conventions. We do not list books that use the term symmetry or its derivatives

- (1) as a metaphorical expression, e.g.,
- (2) as an attribute in a specialized term of a discipline that are rarely used outside a particular field (e.g., symmetric space, symmetric logic).

Note that there are cases where a similar term has great importance in two or more field (e.g., asymmetric synthesis, a chemical process that also attracted the interest of biologists).

3.1 History and philosophy of science, cognitive science, psychology, general education


Slok, J. et al. (1975) *Symmetri i videnskaberne*, [Symmetry and the Sciences, in Danish], Det hæde Selskabs publikationsserie, Ny serie, Hæfte 7-8, Aarhus [Denmark]: Universitetsforlaget : Aarhus, 77 pp. [Philosophy
of science; note: we include this item because the title-page presents it as a book with multiple authors, although it can be also interpreted as a collection of papers.


Also see:

* Khaitmov (1986) on philosophy of science → Section 1.2.6,
* Dienes and Mezard (1971) on logic → Section 1.2.1.1,
* Horwich (1987) on the philosophical problems of asymmetry in time → Section 4.3, and
* the pre-1952 works in the context of history of science → Section 2.1.1,
* the books on the philosophical aspects of symmetry vs. asymmetry → Section 4.1.

3.2 Exact sciences (mathematics, physics, and chemistry, including mathematical crystallography)

3.2.1 General works and popular-scientific books


- Hungarian trans., Wigner, J., *Simmetriák és reflexiók*, Budapest: Gondolat, 1972, 355 pp. [The initial “J” refers to Jenő (Eugene, in English), which was Wigner's original given name in Hungary].


3.2.2 Structure of matter - atomic or molecular level: applications of group theory

Mathematical-crystallographical works on colored symmetry and chemical books on orbital symmetry and the theory of chemical reactions are considered, but kept separately in subsections 3.2.1.1 and 3.2.1.2, respectively.


Also see:
- the books on history and philosophy of mathematics and physics — Section 3.1.


Veen, A. L W. van der (1911) Physikal en kristallografijs onderzoek naar de simmetrie van diamant, [Physical and Crystallographic Investigation into the Symmetry of Diamond, in Dutch], Leiden: Stijhoff, 58 pp. + 3 stereoscopic tables. [The Dutch spelling is archaic: the modern version of "symmetry" is "symmetrie", etc.].


Also see:
* Burckhardt (1988) on the history of crystallography → Section 3.1,
* Scholz, E. (1989) on the history of crystallographic groups → Section 3.1,
* many textbooks → Section 1.3

3.2.1.1 Colored symmetry (a mathematical method for describing physical properties of crystals)


Also see:
* Kumagai and Sawada (1985) → Section 1.1.3,
* Dubov et al. (1984-87, Vol. 3) → Section 1.2.2,
* Zamorzaev and Palistrant (1977) → Section 1.3,
* Jaskowski (1952) → Section 2.1.1,
* Shubnikov and Koptetsik (1972) → Section 2.1.2,
* Jablin (1984), Lockwood and Macmillan (1978), Washburn and Crowe (1988) → Section 2.2.2,
* MacGillavry (1965), Schattschneider (1990) → Section 2.2.3,
* Vainshtein (1979) → Section 3.2.2.

Most of these books also present artistic examples (ornamental art, Escher's drawings, etc.). In connection with a fully artistic approach to color and symmetry, without any reference to crystallographic groups, see
* Plehn (1911) → Section 2.2.3.
3.2.1.2 Orbital symmetry and other symmetry principles in the theory of chemical reactions
- German trans., Lehrprogramm Orbitalsymmetrie, [Study-Program Orbital Symmetry, in German], Weinheim [Germany]: Verlag Chemie, 1974, vi + 107 pp.
Woodward, R. B. and Hoffman, R. (1970) The Conservation of Orbital Symmetry, Weinheim [Germany]: Verlag Chemie, 177 pp. [Later both authors were awarded the Nobel Prize in Chemistry for related works.]

3.2.3 Structure of matter - subatomic level; applications of mathematical methods in quantum theory and particle physics

3.2.4 Astronomy, astrophysics
3.2.5 Other mathematical-physical questions, applied mathematics

3.2.5.1 Geometry and algebra


3.2.5.2 Mathematical analysis, theoretical mechanics, nonlinear mathematics, and related questions


Also see:
* the books on broken symmetry and asymmetry in physics → Sections 4.1 and 4.3,
3.3 Descriptive sciences (life sciences, earth sciences) and mathematical models in economics, medicine, and technology

3.3.1 Life sciences (biology, medicine, and psychology)


Also see:
- * Tifjár (1979) on Dürer's book on human proportions → Section 3.4.3, and
- * the books on asymmetry in biology → Section 4.2.

There is a survey-booklet on symmetry in biology which is shorter than our limit of 50 pages:

3.3.2 Earth sciences (mineralogy and geology)


### 3.3.3 Mathematical models in economics, medicine, and technology


Also see the following books that deal with some aspects of symmetry in technology,
* Povleiko (1970) → Section 1 2 7,
* Grigorovskii (1982) → Section 1.2 7,
* Shubnikov (1940) → Section 2.1 1,
* Rohde (1982) → Section 2.1.2,
* Bérczi (1986-87) → Section 2.2.3.

### 3.4 Art and the humanities

#### 3.4.1 Anthropology


Also see:
* the books on pattern analysis → Sections 2 2 2 and 2.2.3.

In connection with physical anthropology, see:
* Timár (1979) on Dürer's book on human proportions → Section 3.4.3,
* Schneider (1973) on asymmetry of Greek heads in art → Section 3.4.3,
* Chubarov (1994) on symmetry of the face and traditional Chinese medicine → Section 3.3.1,
* Anderson (1897), Mentzer and Friedberg (1983), Starosta (1990) on symmetry and physical education → Sec 3.5.

#### 3.4.2 Architecture and design

Note that books on Hambidge's dynamic symmetry are listed separately in the → subsection 3.4.2.1.

Bibliography:


[Symmetry is "the result of harmonic ratio of numbers"; plane figures the bases of all forms, curvilinear figures; applications: ornamental design, Greek architecture, vases, pottery, etc.-].


Kurokawa, M. (1998) *Hantaishou no monogaku, [Objects -Objectology, Object-Design-] of Antisymmetry<Disymmetry>,* in Japanese, Tokyo: TOTO Shuppan, 162 pp. [The author (p. 54) would like to refer to dissymmetry (the lack of some elements of symmetry), but, unfortunately, adopts the term hantaishou (antisymmetry), which is an alternative expression for black-and-white symmetry. This usage of hantaishou came from the Japanese translation of the book La Dissymétrie by Caillois (1973), see it in Section 4.1 with an additional note on this problem.] [Objectology or Object-Design is our suggested equivalent of Kurokawa’s term monogaku or, in other reading, butsugaku. This term is not a well-established in Japanese; it is coming from mono or butsu = thing, object, -gaku = learning, study, science, (as suffix) -ology. Obviously, the term monogaku is broader than product-design and industrial design since objects of fine art and architecture are also considered. This is the reason that we initiate the new expressions objectology or object-design.

Also see:
Antisymmetry, Shubnikov (1951) → Section 3.2.1 1

Note, Caillois (1973) Japan version, → Section 4 1


Stocklas, K (1986) - see at the beginning of this section: Bibliography.
BIBLIOGRAPHY


Also see:
* Huff, W. S. (1967-77) on basic design → Section 11.3,
* Povileiko, R. P. (1970) on industrial design → Section 1.2.7,
* Horst (1994) on garden art → Section 3.4.3

3.4.2.1 Design with dynamic symmetry (a system of proportions based on square roots of integers)

Note that these books represent a method of proportional analysis of art works that are outdated in some sense, but still provide interesting sources not only for some historians of art, but also for educators of mathematics.


* 2nd printing, ibid., 1931, 161 pp.
* Reprint of the original work in a luxury ed., Found Class Reprints.


3 4.3 Visual art (painting, sculpture, garden art)


Also see:
* MacGillavry (1965) and Schattschneider (1990) on the graphic art of M. C. Escher → Section 2.2.3,
* Wetheerspoon and Peterson (1995) on Navaho painting and its modern adaptation → Section 3.4.1,
* Kurokawa (1998) on dissymmetry in art → Section 3.4.2, and
* the books on dynamic symmetry → Section 3.4.2.1.

3.4.4 Music
Wetzel, 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


Also see:
* Goncharenko (1993) → Section 1.2.8.

3.4.5 Literature and linguistics

Eggers, H. (1956) Symmetrisch und Proportion epischen Erzählens: Studien zur Kunstform Hartmanns von Aue,
[Symmetry and Proportion of Epic Short Stories: Studies of Hartmann von Aue's Artistic Form, in German],

Étkind, E. G. (1988) Symmetricheskoe kompozitsii u Pushkina, [Symmetrical Compositions at Pushkin, in Russian],


Presentation of the Author, in Ukrainian], Uzhhorod [Ukraine]: Karpaty, 93 pp.

University Press, xv + 189 pp.


Press, xiii + 270 pp.

Monografi, 4, Padova, Italy: Unipress, i + 123 pp.

vii + 134 pp.


Schlocker G. (1957) Equilibre et symétrie dans la phrase française moderne, [Equilibrium and Symmetry in Modern

Also see:
* Markova (1996) → Section 1.2.8,
* the books on broken symmetry and asymmetry in linguistics, literature, and semiotics → Section 4.4.

3.5 Recreation, games, and sport

Dana, 102 pp.


Starostu, W. (1990) Symetria i asimetria ruchów w treningu sportowym, [Symmetry and Asymmetry of Motions in
Physical Training, in Polish], Warszawa: Instytut Sportu, 320 pp

and Adults, in Slovakian], Bratislava [Czechoslovakia, now Slovakia]: Slovenske pedagogické nakladatelstvo,
281 pp. + 2 attachments [Board games].

Also see:
* Garrett (1987) on the physics of sailing → Section 3.2.2.

There is a booklet on symmetry in chess which is shorter than our limit of 50 pages:
4 INTERDISCIPLINARY BOOKS ON DISSYMMETRY, BROKEN SYMMETRY, ASYMMETRY (INCLUDING SYMMETRY VS. ASYMMETRY, 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: the lack of some elements of symmetry is necessary to have left- and right-handed molecules) 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 3.2.1.1.).

4.1 General


* Paperback ed., ibid., 1991, xiv + 392 pp
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- Japanese trans., Hantaishou: Hidan to migi no benbushou, [Antisymmetry <Dissymmetry: The Dialectics of Left and Right, in Japanese], Tokyo: Shisakusha, 1991, 152 pp. [The Japanese title Hantaishou (han- = anti-, against, opposite; tashou = symmetry), which is also adopted by Kurokawa (1998), see in Section 3.4.2, is unfortunate: its meaning is closer to the crystallographic term "anisotropy" (black-and-white symmetry), cf., Shubnikov (1951) in Section 3.2.1.1. Since there is no well-established Japanese term for dissymmetry in the given sense, I suggest a new Japanese expression: futaishou.]

* Spanish trans. of the 2nd ed., Izquierda y derecha en el cosmos: Simetría y asimetría frente a la teoría de la inversión del tiempo, [Left and Right in the Cosmos: Symmetry and Asymmetry Facing the Theory of the Inversion of Time, in Spanish], Barcelona: Salvat, 1985, xiii + 309 pp


Tayler, K. (1989) *Symmetry and Antisymmetry*, Cambridge [England]: Haslingfield Press, 111 pp. [Symmetry vs. antisymmetry = continuity vs. discontinuity, convergence vs. divergence, variance vs. invariance, etc. - this is not the usual crystallographc or mathematical meaning of antisymmetry].

Also see:
* Witherspoon and Peterson (1995) on symmetry and asymmetry in Navaho art and cosmology → Section 3.4 1,
* Stocklas (1986) on symmetry and antisymmetry in architecture → Section 3.4 2,
* Kurokawa (1998) on dissymmetry in design → Section 3 4 2,
* Mohr (1987) on fractured symmetry in his art works → Section 3.4 3

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

Brain asymmetry - there are many related books that use other expressions (cerebral dominance, dual brain, hemispheric lateralization, split brain, etc.); in accordance with the principles of this bibliography, such items are not listed (their data are available in the bibliographies of the listed books).

**Bibliography:**

- Cohen, S. (1992) - see at the beginning of this section: → Bibliography.


Also see:
* Hámori (1996) on brain asymmetries → Section 1 2 5,
* Schneider (1973) on asymmetry of Greek heads in art → Section 3 4 3,
* Starosta (1990) on symmetry and asymmetry in physical training → Section 3 5,
* Ivanov (1978) on the asymmetry of brain → Section 4 4.

4.2.1 Asymmetrical synthesis


Richie, R. D. (1933) Asymmetric Synthesis and Asymmetric Induction, London: Oxford University Press Seyden-Penne, J Synthet et catalyse asymetriques,


4.3 Mathematics and physics, including asymmetry of time


D. Nagy


Also see:

* Pagels (1986) on the beginning of time in an astrophysical sense — Section 3.2.1.

4.4 Linguistics, literature, semiotics


Fud 


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: Han, xi + 223 pp.