

Errata for WEYL's *Symmetry*

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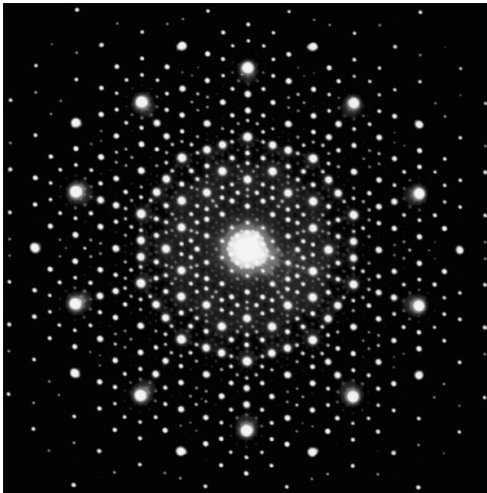
p. 20: *“The net result is that in all physics nothing has shown up indicating an intrinsic difference of left and right.”*

Four years after the book was published, physicists discovered a fundamental left-right asymmetry, of which there is a wonderful discussion in Feynman's *Lectures on Physics*, vol. I, ch. 52. More recent experiments seem to indicate that charge, reflection and time symmetry all go together.

p. 25: *“It seems difficult to devise physical laws in which they are not intrinsically alike; but the negative counterpart of the positively charged proton still remains to be discovered.”*

This was discovered three years after the book's publication and is now called the 'antiproton'. For a description of its physical properties, see the chapter of Feynman's *Lectures* cited above.

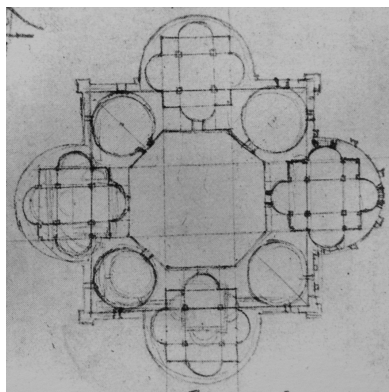
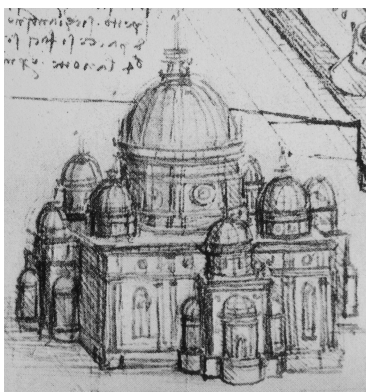
p. 63: *“While pentagonal symmetry is frequent in the organic world, one does not find it among the most perfectly symmetrical creations of inorganic nature, among the crystals.”*



Crystallographers have since discovered crystals with, amongst other properties, five-fold symmetry of sorts, called ‘quasicrystals’. The figure on the first page shows a Laue diagram of an aluminium-nickel-cobalt quasicrystal (compare the diagrams on p. 124 of the book).

p. 66: “Leonardo da Vinci engaged in systematically determining the possible symmetries of a central building and how to attach chapels and niches without destroying the symmetry of the nucleus.”

I have examined several books on Leonardo’s architectural work and found no trace of a systematic examination of central symmetry, nor even of a building design which has a cyclic symmetry group. The figures below show a view and plan of a church design from one of Leonardo’s notebooks.

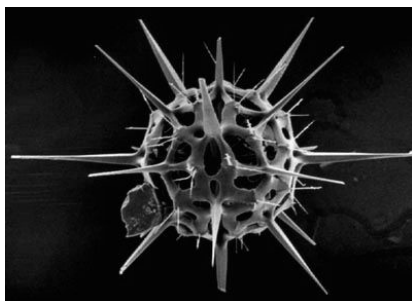


p. 75: “Here is a page from Haeckel’s *Challenger* monograph showing the skeletons of several Radiolarians.”

D’Arcy Thompson wrote¹: “As to Haeckel, I wouldn’t trust him round the corner, and I have the gravest doubt whether his pentagonal dodecahedron and various others ever existed outside his fertile fancy. I believe I may safely say that no type-specimens of these exist in the British

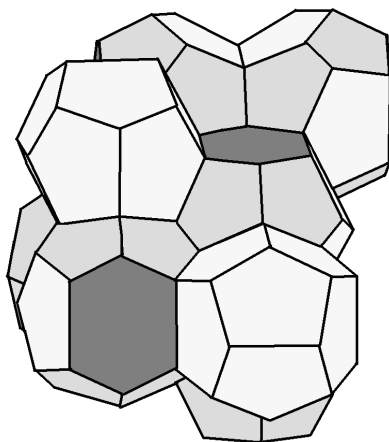
¹ In a letter quoted in H. S. M. Coxeter’s review of *Symmetry* in the *American Mathematical Monthly* (1953), 60 (2): p. 136-139.

Museum, or anywhere else.” Here is a photograph of a radiolarian.



p. 93: “*I am inclined to believe that Lord Kelvin’s configuration gives the absolute minimum; but so far as I know, this has never been proved.*”

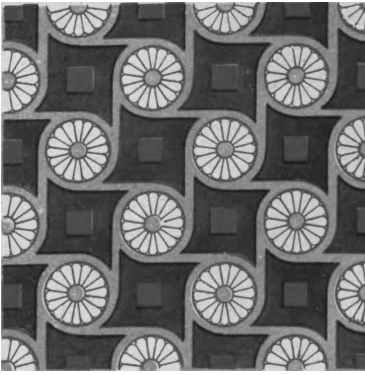
In fact, a better configuration was discovered by Weaire & Phelan in 1994. It uses two types of cells, with 12 and 14 sides. It is not known whether it is optimal.



p. 103: “*Examples for all 17 groups of symmetry are found among the decorative patterns of antiquity, in particular among the Egyptian ornaments.*”

Only 12 of the 17 symmetry groups can be found in extant ancient Egyptian decorations¹, with the five groups that preserve hexagonal lattices missing. Two example patterns are shown below (and see fig. 65 of the book).

¹ B. Grünbaum, ‘The Emperor’s New Clothes’, *Mathematical Intelligencer* 6(4) p.47



p. 104: “Strangely enough the proof was carried out only as late as 1924 by George Pólya, now teaching at Stanford.”

Actually the proof was first given by E. S. Fedorov in 1891¹, though Pólya discovered the result independently. Moreover, Pólya did not actually give a proof in his 1924 article, but merely stated the result.

p. 104: “Galois’ ideas, which for several decades remained a book with seven seals but later exerted a more and more profound influence upon the whole development of mathematics, are contained in a farewell letter written to a friend on the eve of his death, which he met in a silly duel at the age of twenty-one.”

This letter was only a sketch of various results Galois had obtained. His most important work was a memoir² on the solvability of algebraic equations which he had been submitting versions of to the *Académie des Sciences* every year for three years previous to his death, and which was finally published by Liouville in his journal in 1846. Also, Galois died at twenty.

Image sources: Quasicrystal – Abe et al., *Nature Materials* (2004), 3: p. 759-767; Leonardo’s sketches – Paris manuscript B, ff. 18 v & 19 r; Radiolarian – *Encyclopedia of Life* (col.org); Weaire-Phelan structure – Tom Ruen, *Wikipedia*; Egyptian patterns – Owen Jones, *The Grammar of Ornament*.

¹ ‘Symmetry in the plane’, *Proceedings of the Imperial St. Petersburg Mineralogical Society*, 28 (2), p. 345-390.

² Translated into English in Appendix 1 of H. M. Edwards, *Galois Theory* (1984).