my own two favourites being the beautifully concise picture he portrays (SP38) of 'The Structure of Water', and his magical introduction (SP123) to 'The Hemoglobin Molecule'. The first was presented ats a Royal Society meeting in November, 1957; and J. D. Bernal's comment upon in – in view of the prominence Pauling gave to the centred pentagonal dodecahedron – was that 'this extremely elegant and ingenious theory of water structure, from its very nature, would not be the structure of a liquid at ordinary temperatures ... it may well, however, be the structure of vitreous water at low temperatures'. 'The Hemoglobin Molecule in Health and Disease' (SP123) summarizes a talk he gave to an audience of scientists and non-scientists at the *American Philosophical Society* in Philadelphia, April 1951. The opening paragraph again grips one: 'Hemoglobin is one of the most interesting chemical substances in the world – to me it is the most interesting of all. Each of us carries around with him his own supply, amounting to a pound or two, approximately one per cent of the body weight. This supply is in the red corpuscles of the blood. Hemoglobin is the pigment of the blood: it has a beautiful red colour in arterial blood, and a purple colour in venous blood. It is hemoglobin that gives a pink flush to our skin; we are pale when there is a deficiency of hemoglobin in the skin, either because of a general deficiency of the substance in the body, an anaemia, or because blood is driven from the skin to the interior of the body by the contraction of the blood vessels in the skin'. Was there ever a more enticing opening to a popular lecture?

Third, the Selection contains many papers on some unrelated subjects that, together with orthomolecular medicine, occupied much of Pauling's research time in the later years of his long and fertile life. One of these was his effort to model the atomic nucleus as a close-packed cluster of spherons (α-particles) and to account for nuclear properties, including fission (SP77), with this model. This was largely ignored by physicists, as was his model of superconductivity (SP78, SP79), based on the resonating valence bond theory of metals (SP31). As the editors rightly state (p. 459), in the controversy over quasicrystals, discovered by Shechtman *et al.*, Pauling took on, ironically, the role of the conservative, defending (SP80, SP81) classic crystallographic thinking against the radical ideas of the quasicrystal advocates who ultimately carried the day. Even to the last, he had the knack of choosing a gripping title and writing a tantalizing summary, as evidenced by the *Physical Review Letters* paper (SP81), written in his 86th year, entitled 'So-called Icosahedral and Decagonal Quasicrystals are Twins of an 820-Atom Cubic Crystal'.

I commend this Selection unreservedly.

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Sir John Meurig Thomas is a recent winner of the Linus Pauling Gold Medal.

On quaternions and octonions: their geometry, arithmetic and symmetry. By John H. Conway and Derek A. Smith. Natick, MA: A. K. Peters Ltd, 2003. Price USD 29.00. ISBN 1-56881-134-9

This book consists of three chapters of increasing length, dealing with complex numbers, quaternions and octonions, respectively. I shall concentrate my review on the first two chapters, where the connection with concepts familiar to crystallographers is made.

In the introductory chapter on complex numbers, the authors show that the complex units correspond to rotations in two-dimensional space and they determine the finite subgroups of the special and general orthogonal group in two dimensions. Then they discuss definitions of complex integers with unique factorization into products of primes, the simplest of which, Gaussian and Eisenstein integers, correspond to the square and hexagonal lattice, respectively. Finally, they reproduce Polya's famous illustration of the 17 types of two-dimensional space groups. Instead of the usual symbols for these groups, 'orbifold symbols' are given, of which only a summary definition appears in the book.

Whereas for complex numbers the terms norm, unit and complex conjugate are defined, they are taken for granted in the case of quaternions. It is shown that there exists a 2-to-1 homomorphism from the group of unit quaternions to the group SO_3 of rotations in 3-dimensional space. The finite subgroups of SO_3 are derived using spherical trigonometry, similar to that done in the book *Geometric Symmetry* by Lockwood & Macmillan (Cambridge University Press, 1978). The transition to the finite subgroups of the group of unit quaternions is mentioned only briefly. More space is devoted to the derivation and listing of the finite subgroups of the general orthogonal group GO_3. These are the well known (generally non-crystallographic) point groups listed also in Volume A of *International Tables for Crystallography*. Various kinds of symbols are used to denote these point groups, one resembles the Schoenflies notation whereas the orbifold symbols resemble the Hermann–Mauguin notation.

It is then shown that a 2-to-1 homomorphism exists between ordered pairs of unit quaternions and SO_4. Names characterizing the finite subgroups of SO_4 are introduced; in the case of polyhedral groups, also modified Coxeter symbols are given. The authors claim that they have for the first time given unique names to all finite subgroups of SO_4. They explain the various types of chirality shown by subgroups of SO_4. Finally, Hurwitz and Lipschitz integral quaternions are defined and their factorization into products of primes is discussed.

The book has been written by two mathematicians. A great advantage is that it is written in a style that makes it easily accessible also to other scientists. The main messages are clearly stated, not buried under technical details. The book is carefully written; I noted only few misprints: In Figure 2.1, z_0^3 and zz_0^2 are shown instead of z_0^2 and zz_0; the orbifold symbols 3*2 and *332 are exchanged in Table 3.1; the alternative symbols for 2*12 and 2*30 have wrong subscripts in Table 3.2: $\bar{v}qv$ should be replaced by $\bar{q}vq$ in the title of the Appendix on page 40.

The authors do not state for what readership they have written the book. Although it cannot serve as a basic text for crystallographers, I enjoyed reading it and added Hermann–Mauguin symbols to many tables and figures. Looking at the title of the book, I had hoped that it might also discuss the use of quaternions to derive the coincidence misorientations of cubic lattices, which is not the case. Instead it gives the17 types of two-dimensional space groups and the finite subgroups of GO_3, which seem to me less closely related to quaternions.

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