The formation and structure of both the icosahedral and decagonal quasicrystals are shown to be closely related to the structure of the crystalline phase. A number of icosahedral quasicrystals have been found in Ti-Ni, Ti-Fe, V-Ni-Si and Hf-Ni-Si systems and the equilibrium phases in these systems contain more than 50% icosahedrons in their crystallographic structures. Moreover, the orientation relationship between the icosahedral phase and the respective crystalline phase is determined by the orientation of the icosahedron in the 112. The transformation of the Al-Cr icosahedral phase (a35) to Al6 Cr2 (2/m) has been analyzed from the group-subgroup point of view. Fivefold and threefold twins were found around the [101] and [145] digerstics respectively which in turn are parallel to the 5 and 3 axes, respectively, of the icosahedral phase. In other words, the icosahedron serves as the bridge between the structure of the icosahedral phase at one end and the crystalline phase at the other. III. The structures of the decagonal quasicrystal of Al-Mn (Mn-Cr, Mn-Fe-Co, Mn-Fe-Ni, Mn-Fe-Co) have been studied by Ihase and it was shown that the one dimensional periodicity of this 2D quasicrystal is closely related to one of the unitcell dimensions of the crystalline plane.

20.X-5 QUASICRYSTALINE AND RELATED CRYSTALLINE STRUCTURES. By K.S. Kim, Beijing Laboratory of Electron Microscopy, Chinese Academy of Sciences, P.O. Box 2724, Beijing, P.R. China.

The definitions of scientific concepts change with time, reflecting the current state of knowledge. This is as it should be. Crystal symmetry became popular when Hauy (1800) stated his law of symmetry (similar edges, and apices, of the crystal polyhedron are similarly truncated); the truncations were rational faces of a new form, visualized as a whole and represented by the Hauy-Lévy form symbol. --Weiss (1816) and Mohr (1825) introduced analytic geometry in crystallography (origin 0 anywhere inside the crystal) and devised a face symbol (the Weiss coefficients, precursors and reciprocals of the Miller indices). --Bravais (1849) re-enumerated the 32 crystal classes (Hessel (1830), whose paper was to remain unread until Schöncke discovered it in 1881), but his main achievement is his work on lattices (translation groups): 7 point symmetries in lattices, whence the 7 Bravais systems; 14 lattice modes. Whereas Weiss and Mohr were justified in distinguishing hexagonal from trigonal on the basis of the order of the principal axis, observed on the morphology, Bravais was able to discriminate between lattices, hexagonal and rhombohedral, not only theoretically but also empirically (law of Bravais). Bravais' space consists in an infinite set of points (nodes); one of them is taken as O. New definitions of elements of symmetry use lattice language: an axis is a row line, a mirror is a net plane. --Jordan's paper (1867) ushered in group theory for crystallographers. The group elements are the symmetry operations; the whole group is the symmetry element. By using screw axes, Schöncke (1879) found 66 (one too many) space groups of motions; by adding the glide planes Schöncke (1881) and Findenegg (1881) discovered the 172 more by Barlow (1894), found the remaining 165 space groups. --Various generalizations of symmetry (antisymmetry or black-white, color symmetry, etc) were made in the twentieth century, introducing new elements and operations.


Several proposals for the use of other space-group symbols than those of Schoenflies have been published. One of them is the 'Hermann-Mauguin' or 'International' symbol. The Schoenflies symbols are essentially symbols for the group, an index to distinguish the different space-group types belonging to that point-group type. The Hermann-Mauguin symbols are genuine space-group symbols (from which the corresponding point-group symbols may be derived by a simple procedure).

The constituents of each Hermann-Mauguin symbol represent a set of generators of the space group. In the selection of generators, glide reflections are preferred to screw rotations. Rototranslations and inversion are used only if unavoidable. This choice together with an appropriate nomenclature makes possible to do without the relative positions of the geometric symmetry elements in most cases. From the short Hermann-Mauguin symbol the 'general positions' of the space-group type can be calculated easily. The structure of the symbols allows, moreover, the concise derivation of all space-group types, provided the 32 crystal classes and the 14 Bravais types of lattices are supposed to be known.