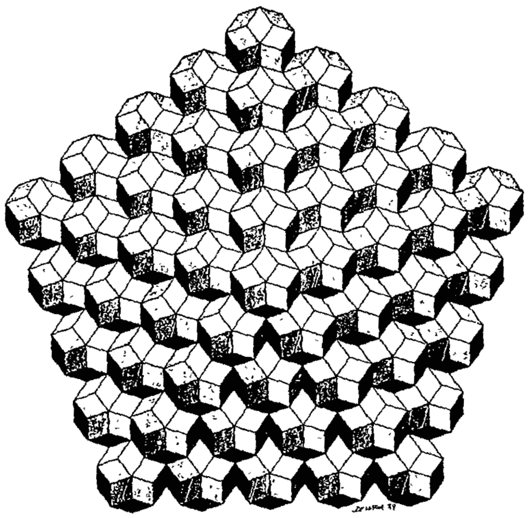
Symmetry of STRUCTURE

an interdisciplinary Symposium

Abstracts

II.



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Ideal and real crystal forms.

The theory of crystal forms is based on concepts of simple forms , i.e. initial, or ideal, and derivative, or false (distorted) ones.

An ideal simple form represents a combination of faces linked by elements of crystal symmetry. The faces should be identical in shape and size (I). The 47 ideal simple forms can be simulated by wellknown educational models. For the majonty of real crystals these forms appear only to be the "quasi-ideal" ones, more or less corresponding to geometric models. For all elements of proper symmetry of a crystal, the complete conservation can be provided in media with sphere symmetry of $\infty/\infty m$ (in the case of thorough and uniform influx of the feeding material to a growing polyhedre). Anyway, such conservation is obtained when all corresponding crystal and medium elements are coincident. The 146 symmetry variations of simple forms (2) are derived from 47 initial geometrical figures after registrating their crystallograohic symmetry. Their models are constructed by means of addition to edges of 5 edge arrow with symmetry of 1,2, m , $1m$, $2mm$ (fig. 1,2 (3). To establish the latter ones on real crystals there should be taken into account face striations, etch figures, etc.

Distorted crystal forms with different dimensions of simular faces are the most widely distributed in nature.

According to P.Curie's idea of symmetry, visually on the crystal there remain only its proper symmetry elements, which coincide with ones of the parent medium (4).

In natural environment there dominate media with point symmetry ∞m of cone (gravitation field). Parallel with the cone symmetry, which gives rise to " pyramidal" forms, the symmetry of plane dyhedre is considered to be a most widely spread. This "dome" symmetry, m , enters the subgroup of the cone symmetry, common for ererything that grows in no-vertical way or moves straightforwardly along the earth surface (4). Description and simulation of distorted forms can be realized using the concept of false simple forms. The latter ones are derived from initial simple ideal forms by means of their symmetry reduction. By this, face numbers and angle magnitudes remain constant, but face and edge dimensions are changed. Such configurations are described as combinations of compound false forms or " subforms". For example, a distorted cube will form " tetragonal prism with pinacoid " or three "pinacoid" combinations. According to Mokievski's idea, derivation and simulation of simple false forms can be perforned using either different colouring of faces of the 47 simple forms (5) or stereographic projects (fig.3). Their total sum will be 430.

Assuming, that the 146 symmetry variations of simple ideal forms are initial, we can obtain the 1263 ones for false forms (6) by sequential reduction of their symmetry (from $m3m$ and $6/mmm$ to 1). Thus, we can distinguish 4 gradations of simple crystallographic forms: two of them being initial ideal (47; 146) and the other two being derivative, or false, (430,1263) ones.

It is interesting to underline the similarity of the abovementioned ratios of 4 sum values to three ones:

146 : 47 = 3,1

1263 : 430 = 2,9

430 : 146 = 3,0

One is struck by the affinity of values 146, 430, 1263 with products:

$47 \times 3 = 141$; $47 \times 3^2 = 423$; $47 \times 3^3 = 1269$.

Respectively, the ratios of false simple forms to their ideal prototypes approach the value 9:

430 : 47 = 9,4; 1263 : 146 = 8,7.

The solution of the abovementioned ratios requires further investigations. Here, a certain role may belong to the analogy (parallelism) between the sequence of form distortions perfomed by Fiodorov's extensions and dislocations, on the one hand, and the classic hierarchy of category is represented by single system, the intermidiate one by three systems (one extension), and the lowest one also by three systems (extensions and dislocations). All said above confirms the presence of many mysteries that still cover a great part of, one would think, such a clear and trivial field as the simple crystal form theory.

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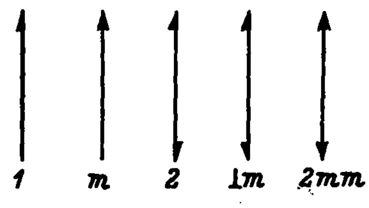
Figures.

Fig. 1 Five types of finite edge symmetry.

Fig. 2. Faces of 5 cube symmetry variations.

Fig. 3 the 9 combinations of false subforms derived from a cube.



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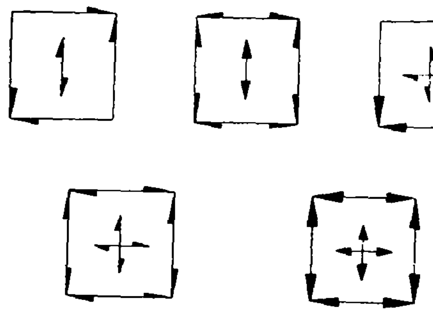

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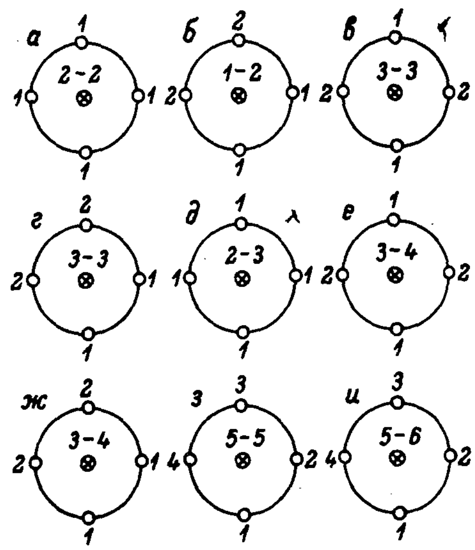

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