

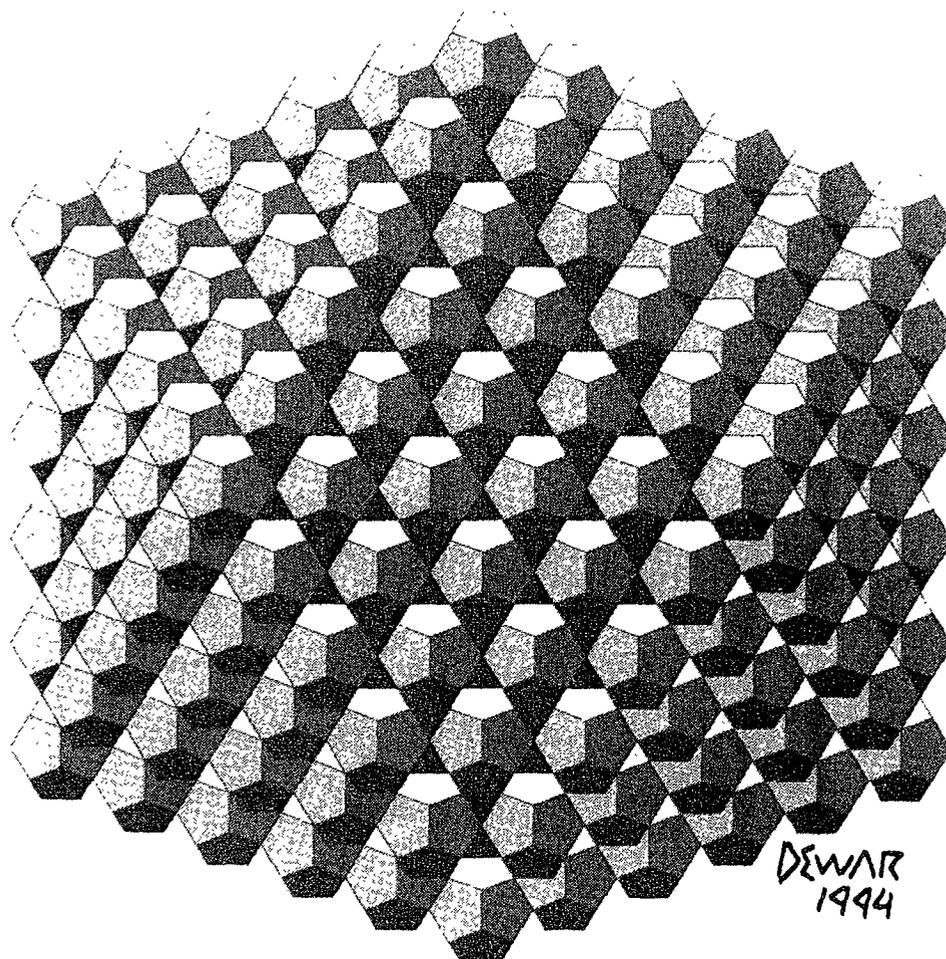
# Symmetry: Culture and Science

Symmetry:  
Natural and Artificial, 3

The Quarterly of the  
International Society for the  
Interdisciplinary Study of Symmetry  
(ISIS-Symmetry)

Editors:  
György Darvas and Dénes Nagy

Volume 6, Number 3, 1995



Third Interdisciplinary Symmetry Congress and Exhibition  
Washington, D.C., U.S.A. August 14 - 20, 1995

## SNOW CRYSTALS - NATURAL AND ARTIFICIAL

**Ivar Olovsson**

Institute of Chemistry, University of Uppsala  
Box 531, S-751 21 Uppsala, Sweden

Have you visited the storehouse of the snow  
or seen the arsenal where hail is stored?  
(Job 38:22)

Snow crystals have fascinated man from time immemorial and many attempts have been made to classify them according to their shape and to find under what conditions the various types of crystals are formed. Both amateurs and researchers have devoted themselves with great interest to the field. Here we notice in particular the farmer W.A. Bentley from Vermont in the United States who during the years 1885 - 1931 produced over five thousand pictures of snow crystals which he photographed through a microscope.

The snow crystals have originated from very small ice crystals, less than 0.1 mm, formed high up in the atmosphere. During their flight down to the ground they have passed through atmospheric layers of different temperature and humidity and the shape depends on these meteorological conditions.

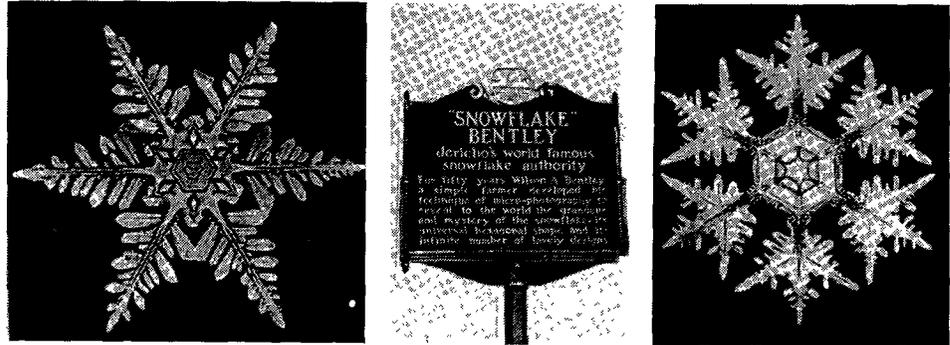
If an ice crystal grows under ideal conditions its outer shape will show a perfect sixfold symmetry, reflecting the inner molecular arrangement which has a hexagonal symmetry. However, in general the conditions are not ideal and the shape may be more or less regular. But independent of such deviations, the angle between the dominating crystal faces is always the same, 60 degrees.

*Natural snow crystals.* Bentley's pictures inspired many researchers, among others the Japanese Ukichiro Nakaya. He was originally a nuclear physicist, but when he got a job in Sapporo in 1932, there were no facilities for nuclear research and therefore he turned his interest towards a material which was abundant in Sapporo, namely *snow*. He started to study snow crystals in the mountains around Sapporo and he found many previously unknown crystal forms and noticed that regular crystals were not at all as common as irregular ones.

*Artificial snow crystals.* Nakaya's field studies could not answer the question why snow crystals occur in so many different forms. In order to investigate the exact meteorological conditions for the formation of snow crystals of a particular shape Nakaya built a specially equipped low-temperature laboratory where temperature and humidity could be varied. Nobody had earlier produced artificial snow crystals and it took some time before he found a good method. He could then grow quite perfect crystals; it took about 30-60 minutes before a snow crystal with a well developed dendritic shape was formed. Due to the second world war, it took a long time before Nakaya's work could be published. The original text and many pictures were destroyed when the printing-house was bombed.

The very successful snow research at the university in Sapporo was continued by Teisaku Kobayashi, among others, and the conditions for the growth of a particular form could be established. With the help of Nakaya's and Kobayashi's diagrams it is accordingly possible to draw conclusions about the atmospheric conditions in the air it has passed through during its

ends of needles. This is just what happens to a real snow crystal as it passes through different layers on its way down. The final crystal is thus unique to its special growth history. By studying the shape of the snow crystal it is accordingly possible to draw conclusions about the temperature and humidity in the different layers of the atmosphere. The snow crystal tells its own history and is - with Nakaya's famous words - "a letter sent from heaven". It is then interesting to note that the earliest known pictures of snow crystals were drawn 1555 just by a minister of the Lord, the archbishop in Uppsala, Olaus Magnus.



W. A. BENTLEY PHOTOGRAPHING SNOW CRYSTALS