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**MANUAL FOR  
SNOWFLAKE OBSERVATION, IDENTIFICATION,  
AND REPLICATION**

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MANUAL FOR SNOWFLAKE

OBSERVATION, IDENTIFICATION, AND REPLICATION

by

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Oh! the snow, the beautiful snow,  
Filling the sky and the earth below;...  
Beautiful snow, from the heavens above  
Pure as an angel and fickle as love!

John Whitaker Watson

When you start looking closely at snowflakes, you'll see that they come in many very different shapes. For example, some will be flat, perfectly six-sided plates while others will have intricate fernlike crystalline arms growing out every which way.

What shape a snow crystal grows in depends primarily on the temperature of the cloud where the crystal is growing and on how much water vapor is in the air. Therefore, we can learn quite a bit about a cloud simply by studying the snowflakes that fall from it.

Most of the snow crystals you'll see will fit neatly into one of the twelve categories described on the following five pages and on page 13. The magnification of the photographs of snow crystals reproduced on these pages varies considerably, so the size of the illustration does not reflect the relative size of the snow crystal.

## HEXAGONAL PLATES

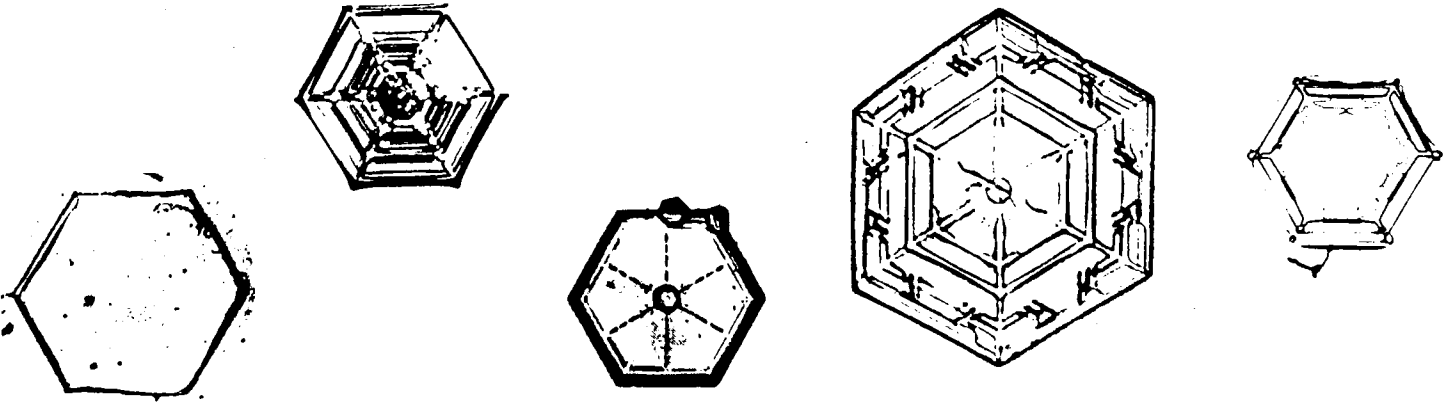


Fig. 1. Depictions of hexagonal plates. (Taken from Hardy *et al.*, 1982; Nakaya, 1954; Pruppacher and Klett, 1978; Wallace, 1977.)

Hexagonal plates are thin, platelike snow crystals the form of which more or less resembles a hexagon or in rare cases, a triangle. Generally all edges or alternate edges of the plate are similar in pattern and length. Hexagonal plates, sometimes simply called plates, may be solid with no internal markings or semisolid containing internal structure due to air inclusions.

## STELLAR CRYSTALS

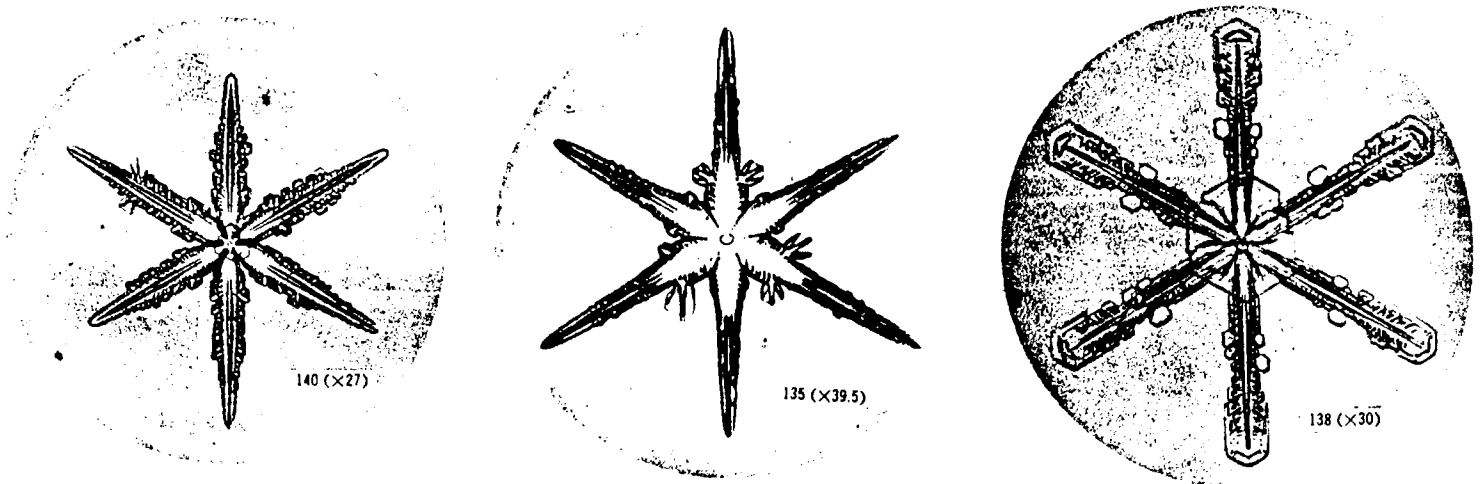


Fig. 2. Depictions of stellar crystals. (Taken from Nakaya, 1954.)

Stellar crystals are thin, flat snow crystals with six arms forming the shape of a star. Occasionally stellars with 3 or 12 arms may be found. These arms may lie in a single plane or in closely spaced parallel planes in which case the arms are interconnected by a very short column.

## DENDRITES

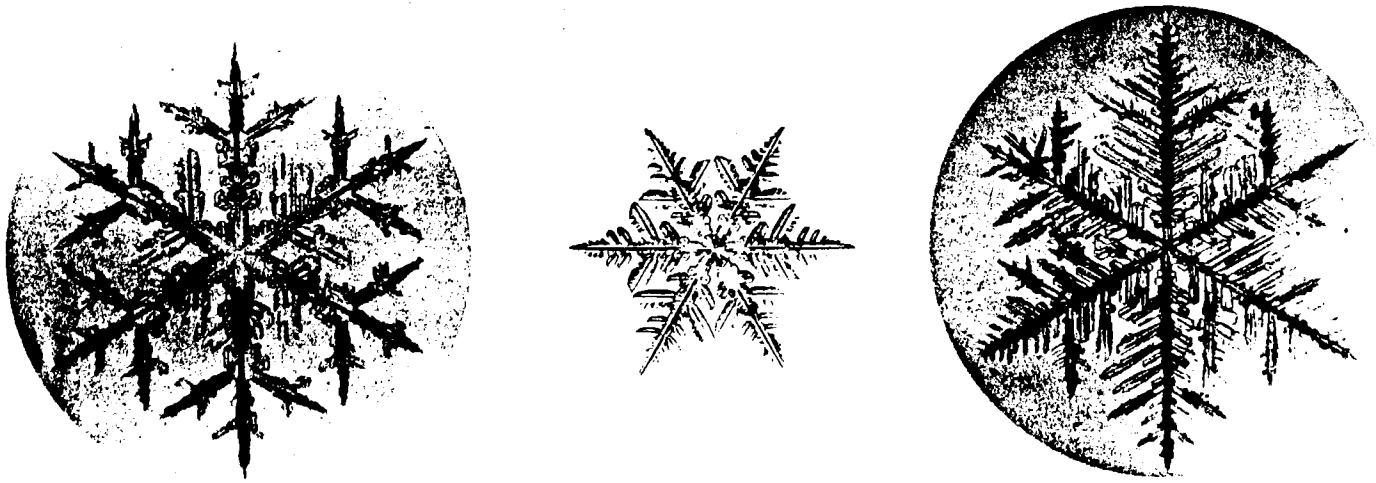


Fig. 3. Depictions of dendrites. (Taken from Nakaya, 1954; Hardy et al., 1982.)

Dendrites, also called plane dendrites, are special forms of stellar crystals in which the six arms have developed intricate fernlike structure.

## SPACIAL DENDRITES

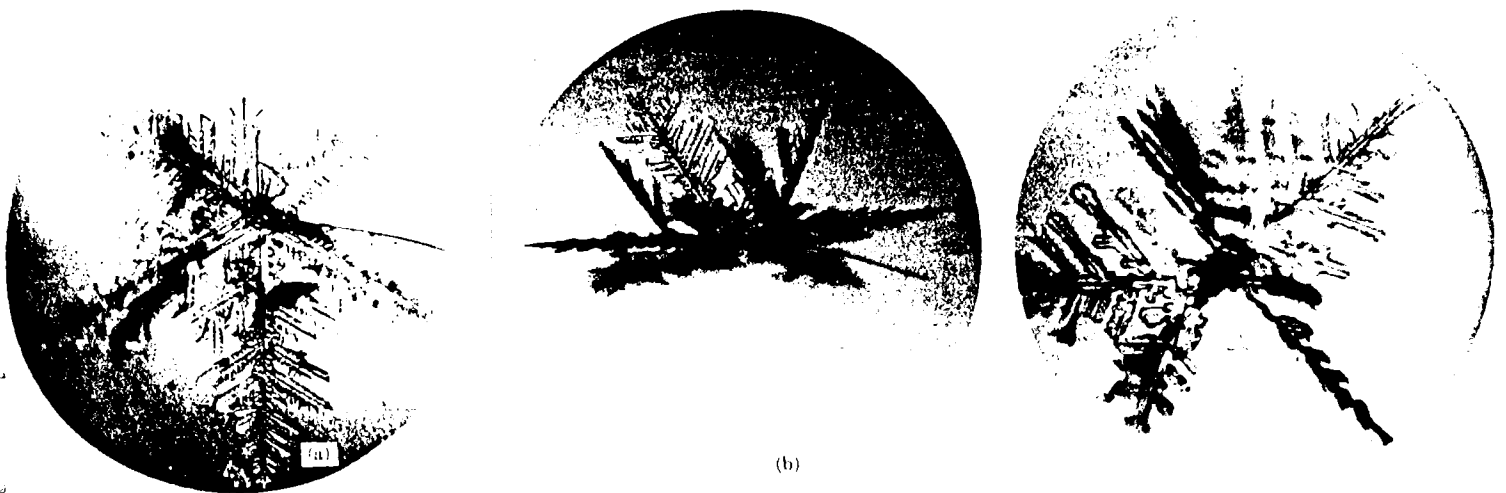
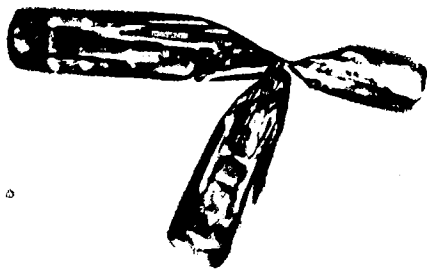


Fig. 4. Depictions of spacial dendrites. (Taken from Nakaya, 1954.)

Spacial dendrites are complex snow crystals with fernlike arms which do not lie in a plane or in parallel planes but extend in many directions from a central nucleus. They exhibit a roughly spherical symmetry.

## COLUMNS



rosette

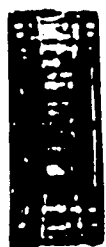


column

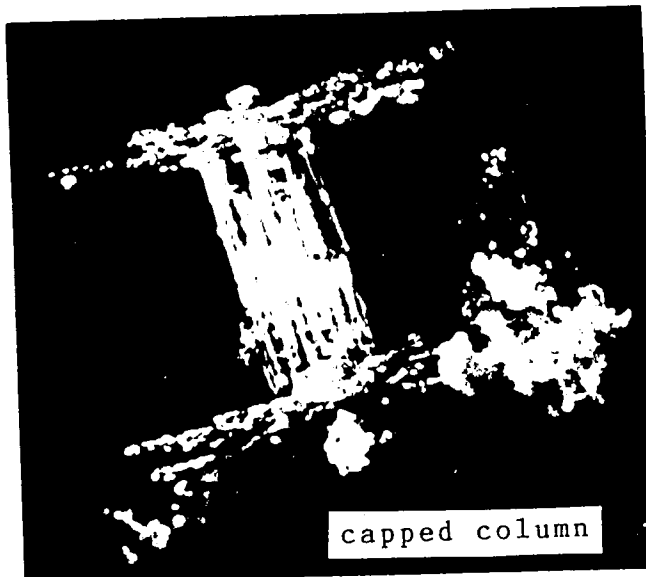


645 (x66.5)

column



column



capped column



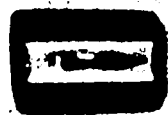
bullet



capped column



attached rosettes



column



rosette

Fig. 5. Depictions of columnar crystals. (Taken from Hardy *et al.*, 1982; LaChapelle, 1969; Nakaya, 1954; Pruppacher and Klett, 1978; Wallace and Hobbs, 1977.)

Columnar crystals are relatively short, six sided columns. They are either solid or hollow. The ends of a column are generally flat, but some may have a pyramid on one end. Columns with pyramids on an end (called bullets) may be attached at the pointed end to other columns and are called rosettes. There are three main types of columns:

- Solid columns
- Hollow columns
- Capped columns

Capped columns have hexagonal plates or stellar crystals on at least one end.

## SECTOR PLATES

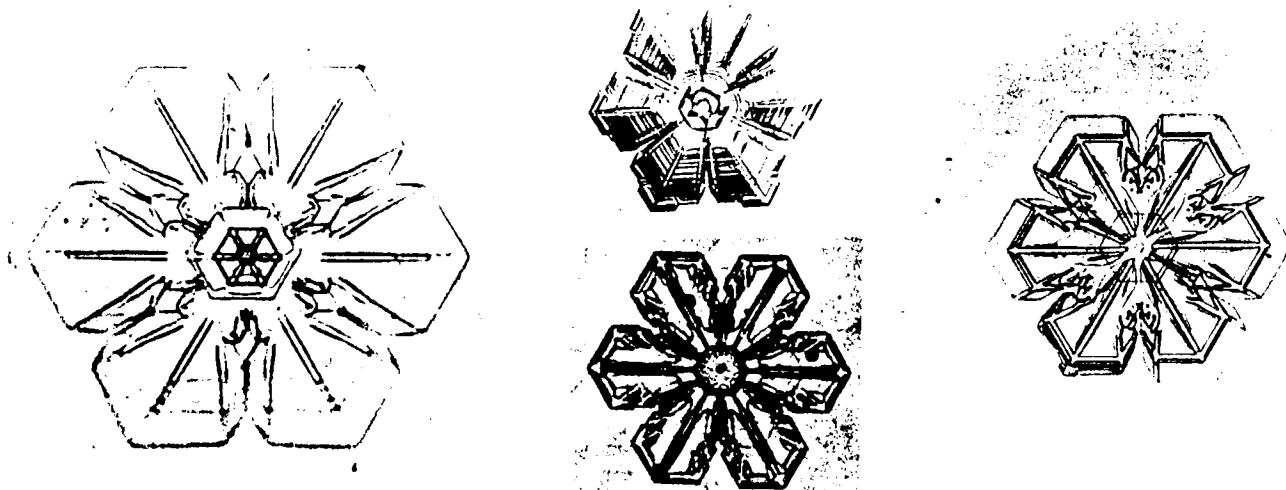


Fig. 6. Depictions of sector plates. (Taken from Hardy *et al.*, 1982; Nakaya, 1954; Pruppacher and Klett, 1978.)

Sector plates are thin, platelike crystals with plates growing in six radiating sectors or sections. They appear as if each arm of a stellar grew out to form a section of plate.

## NEEDLES

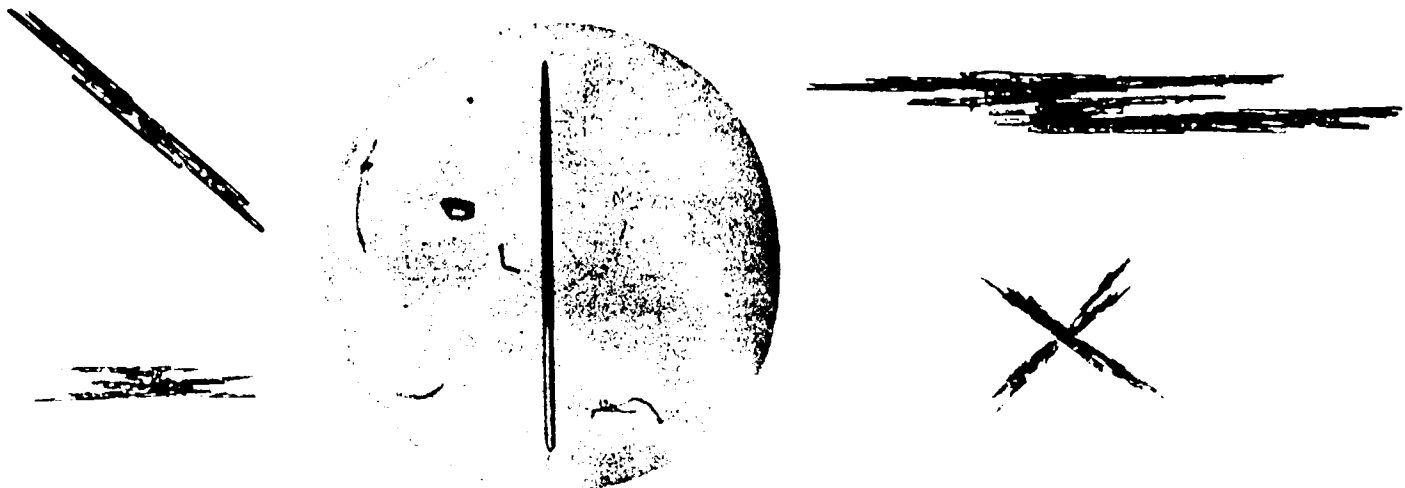


Fig. 7. Depictions of needles. (Taken from Nakaya, 1954; Pruppacher and Klett, 1978; Hardy *et al.*, 1982.)

Needles are very slender, needlelike snow particles of approximately cylindrical form. This class includes hollow bundles of parallel needles and combinations of needles arranged in any of a wide variety of fashions.

## SHEATHS

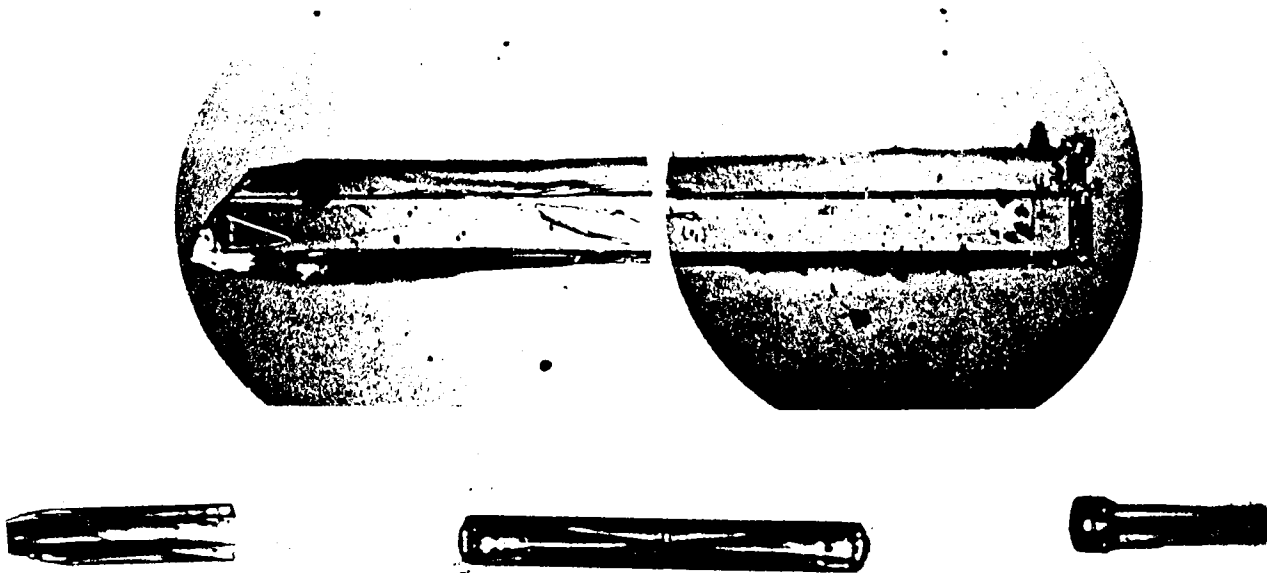


Fig. 8. Depictions of sheaths. (Taken from Nakaya, 1954; Pruppacher and Klett, 1978.)

Sheaths are a type of needle which, as the name implies, are hollow. These are extremely thin, hollow columns.

## IRREGULAR CRYSTALS

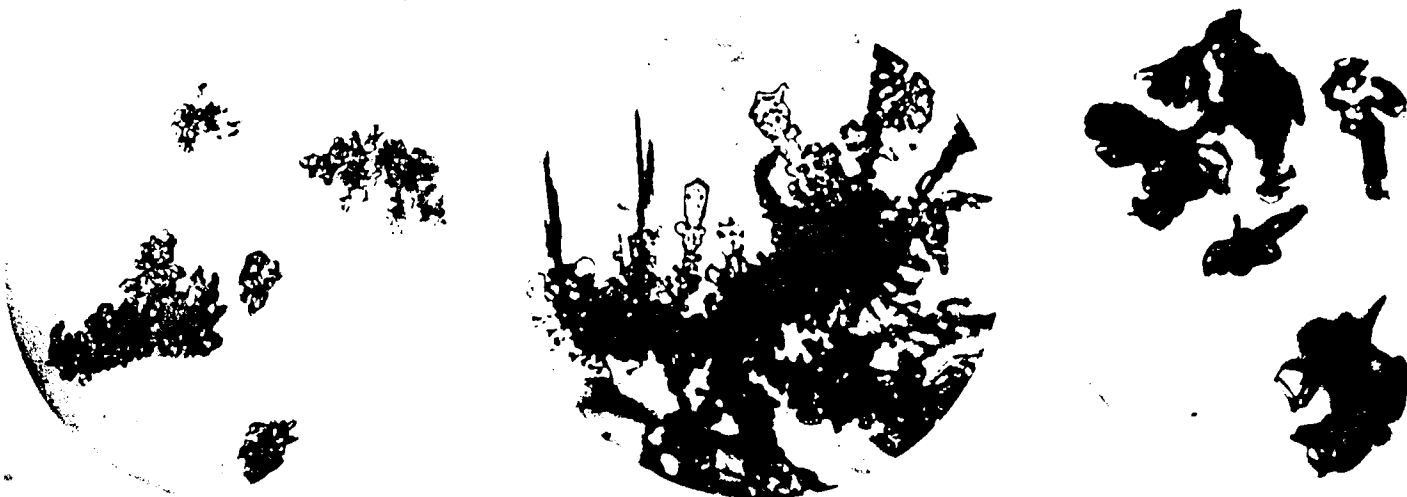


Fig. 9. Depictions of irregular crystals. (Taken from Nakaya, 1954.)

Irregular crystals are snow particles made up of a number of small crystals grown together in a random fashion. Generally the component crystals are so small that the crystalline form of the particle can only be seen with the aid of a magnifying glass or microscope.

You will be able to classify almost all the snow crystals you'll see as one of the eleven types of snow crystals just described or as graupel, which is described on page 13 in the section on riming:

- Hexagonal plates
- Stellar crystals
- Dendrites
- Spacial dendrites
- Solid columns
- Hollow columns
- Capped columns
- Sector plates
- Needles
- Sheaths
- Irregular crystals
- Graupel

Occasionally though, you may come across a crystal that defies these major groupings or you may want to define the snow crystal more precisely. In these cases, you should refer to the following Meteorological Classification of Snow Crystals by Choji Magono and C. W. Lee. Just follow down the outline to the crystal description that seems best. Then use the outline headings (for example, N 1 d refers to a bundle of elementary sheaths) to guide you to the correct sketch of the crystal on the two pages following the outline.

(N) Needle crystal

1. Simple needle
  - a. Elementary needle
  - b. Bundle of elementary needles
  - c. Elementary sheath
  - d. Bundle of elementary sheaths
  - e. Long solid column
2. Combination of needle crystals
  - a. Combination of needles
  - b. Combination of sheaths
  - c. Combination of long solid columns

(C) Columnar crystal

1. Simple column
  - a. Pyramid
  - b. Cup
  - c. Solid bullet
  - d. Hollow bullet
  - e. Solid column
  - f. Hollow column
  - g. Solid thick plate
  - h. Thick plate of skeleton form
  - i. Scroll

2. Combination of columns
  - a. Combination of bullets
  - b. Combination of columns

(P) Plane crystal

1. Regular crystal developed in one plane
  - a. Hexagonal plate
  - b. Crystal with sectorlike branches
  - c. Crystal with broad branches
  - d. Stellar crystal
  - e. Ordinary dendrite crystal
  - f. Fernlike crystal
2. Plane crystal with extensions of different form
  - a. Stellar crystal with plates at ends
  - b. Stellar crystal with sectorlike ends
  - c. Dendritic crystal with plates at ends
  - d. Dendritic crystal with sectorlike ends
  - e. Plate with simple extensions
  - f. Plate with sectorlike extensions
  - g. Plate with dendritic extensions
3. Crystal with irregular number of branches
  - a. Two-branched crystal
  - b. Three-branched crystal
  - c. Four-branched crystal
4. Crystal with 12 branches
  - a. Broad branch crystal with 12 branches
  - b. Dendritic crystal with 12 branches
5. Malformed crystal  
Many varieties
6. Spatial assemblage of plane branches
  - a. Plate with spatial plates
  - b. Plate with spatial dendrites
  - c. Stellar crystal with spatial plates
  - d. Stellar crystal with spatial dendrites
7. Radiating assemblage of plane branches
  - a. Radiating assemblage of plates
  - b. Radiating assemblage of dendrites

(CP) Combination of column and plane crystals

1. Column with plane crystals at both ends
  - a. Column with plates
  - b. Column with dendrites
  - c. Multiple capped column
2. Bullet with plane crystals
  - a. Bullet with plates
  - b. Bullet with dendrites
3. Plane crystal with spatial extensions at ends
  - a. Stellar crystal with needles
  - b. Stellar crystal with columns
  - c. Stellar crystal with scrolls at ends
  - d. Plate with scrolls at ends

- (S) Columnar crystal with extended side planes
  - 1. Side planes
  - 2. Scalelike side planes
  - 3. Combination of side planes, bullets and columns
  
- (R) Rimed crystal (Crystal with cloud droplets attached)
  - 1. Rimed crystal
    - a. Rimed needle crystal
    - b. Rimed columnar crystal
    - c. Rimed plate or sector
    - d. Rimed stellar crystal
  - 2. Densely rimed crystal
    - a. Densely rimed plate or sector
    - b. Densely rimed stellar crystal
    - c. Stellar crystal with rimed spatial branches
  - 3. Graupellike snow
    - a. Graupellike snow of hexagonal type
    - b. Graupellike snow of lump type
    - c. Graupellike snow with nonrimed extensions
  - 4. Graupel
    - a. Hexagonal graupel
    - b. Lump graupel
    - c. Conelike graupel
  
- (I) Irregular snow crystal
  - 1. Ice particle
  - 2. Rimed particle
  - 3. Broken piece from a crystal
    - a. Broken branch
    - b. Rimed broken branch
  - 4. Miscellaneous
  
- (G) Germ of snow crystal (ice crystal)
  - 1. Minute column
  - 2. Germ of skeleton form
  - 3. Minute hexagonal plate
  - 4. Minute stellar crystal
  - 5. Minute assemblage of plates
  - 6. Irregular germ

