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X-ray studies on polycrystalline gypsum

SIR C V RAMAN and A JAYARAMAN
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1. Introduction

Gypsum is one of the most important of the commoner minerals and the different forms in which it is found and their structural characters are therefore matters of considerable interest. Brauns' *Das Mineralreich*[1] and Hintze's *Handbuch der Mineralogie*[2] contain illustrated accounts of the subject. We are concerned in this paper with the polycrystalline forms of gypsum. Of these the best known is the white and semi-opaque material known as alabaster. Mineralogists recognise another form which they designate as "fibrous gypsum". As the name indicates, this form is an aggregate of parallel fibres or rods. Hintze mentions that when the fibres in such gypsum are very fine, their direction is parallel to the mineralogical *c*-axis, while if the material consists of coarser fibres, their direction may depart to a greater or less extent therefrom.

In a recent paper in these *Proceedings*,[3] it has been shown that we must recognize *three* polycrystalline forms of gypsum with specific characters which are readily distinguishable from each other. The first is *alabaster* which is an aggregate of small crystals more or less randomly orientated: the second is *satin-spar* which is a truly fibrous variety of gypsum in which the fibres lie along the mineralogical *c*-axis, while the third form has been designated as *fascicular gypsum* and is an aggregate of rods more or less exactly parallel to the *b*-axis which is also the symmetry axis of the crystal-structure. This third form is readily distinguished from the other two by its external appearance. It exhibits optical phenomena of great beauty and interest which have been fully described and explained in the paper referred to above. In the present communication, we report the results of X-ray studies undertaken to confirm and reinforce the conclusions already reached in that paper from the optical evidence. We have thought it desirable to carry out such an investigation for the reason that the third form of gypsum is of common occurrence and it would seem that those who have noticed it have mistaken it for the second or fibrous species. Our X-ray studies show clearly that the direction of the rods in fascicular gypsum is along the *b*-axis, while in the truly fibrous forms it is along the *c*-axis. Further, while the X-ray patterns

plate cut from the latter with its faces transverse to the fibre direction was normally irradiated by an X-ray beam in a flat-film camera, the record appeared both spotty and irregular, thus indicating a departure from the regularity of orientation shown by the material detached from its outer surface.

4. Fascicular gypsum

As already stated, this material exhibits highly characteristic external features which enable it to be readily identified. It may be readily split into slabs or sheets of any thickness, but the surfaces thus exposed do not exhibit the smoothness and optical perfection characteristic of the cleavage of selenite and are more appropriately described as planes of parting. The most distinctive feature of the mineral is that the edges of the blocks or slabs are not smooth but exhibit parallel ridges. The inference suggested by the external appearance of the material is that it is an aggregate of rods in parallel setting, their direction coinciding approximately with the *b* or the symmetry axis of gypsum.

Figure 5 in plate II is an X-ray pattern recorded with cylindrical camera and CuK_α radiation. The specimen examined was a rod detached from the material and set with its length parallel to the axis of the camera. It was kept stationary during the exposure. The pattern exhibits irregularly disposed spots. The configuration of the latter indicated that the length of the rod was not quite parallel to the *b*-axis, but was slightly inclined to the latter. The rod was turned through $3\frac{1}{2}°$ from the previous position, but nevertheless the pattern then obtained did not exhibit the characteristic features of a rotation diagram. However, when the specimen was oscillated through 30° each way, a record was obtained which is reproduced in figure 6 in plate II and clearly exhibits layer lines. These are much closer to each other than those appearing in figure 4 in the same plate. Measurements indicated that the oscillation axis coincided with the *b* or symmetry axis of gypsum.

Figure 3 in plate I shows an X-ray diagram obtained with a flat film camera and the MO radiation, the beam being parallel to the length of the rods. It will be seen from the pattern that the X-ray reflections recorded appear as patches located roughly on short arcs of circles. The picture indicates that while the rods consist of individual crystals having their *b*-axes parallel, the variations of orientation of the other two crystallographic axes are insufficient in magnitude to give a complete pattern of circular rings. The inferences regarding the nature of the material indicated both by the longitudinal and transverse X-ray photographs thus support each other. The X-ray results are also in agreement with the conclusions already drawn from the optical investigations and described in the earlier paper.

5. Summary

X-ray diffraction patterns have been recorded and are reproduced in the paper showing clearly the existence of *three* polycrystalline forms of gypsum with specific structural characters which are readily distinguishable from each other: (a) alabaster; (b) satin-spar, which is a truly fibrous material with the fibres orientated along the mineralogical *c*-axis; and (c) fascicular gypsum which is an aggregate of rods having their *b*-axes or crystallographic symmetry axes parallel to each other and the two other axes showing only a limited range of variation, and hence not fibrous in the proper sense of the word.

6. References

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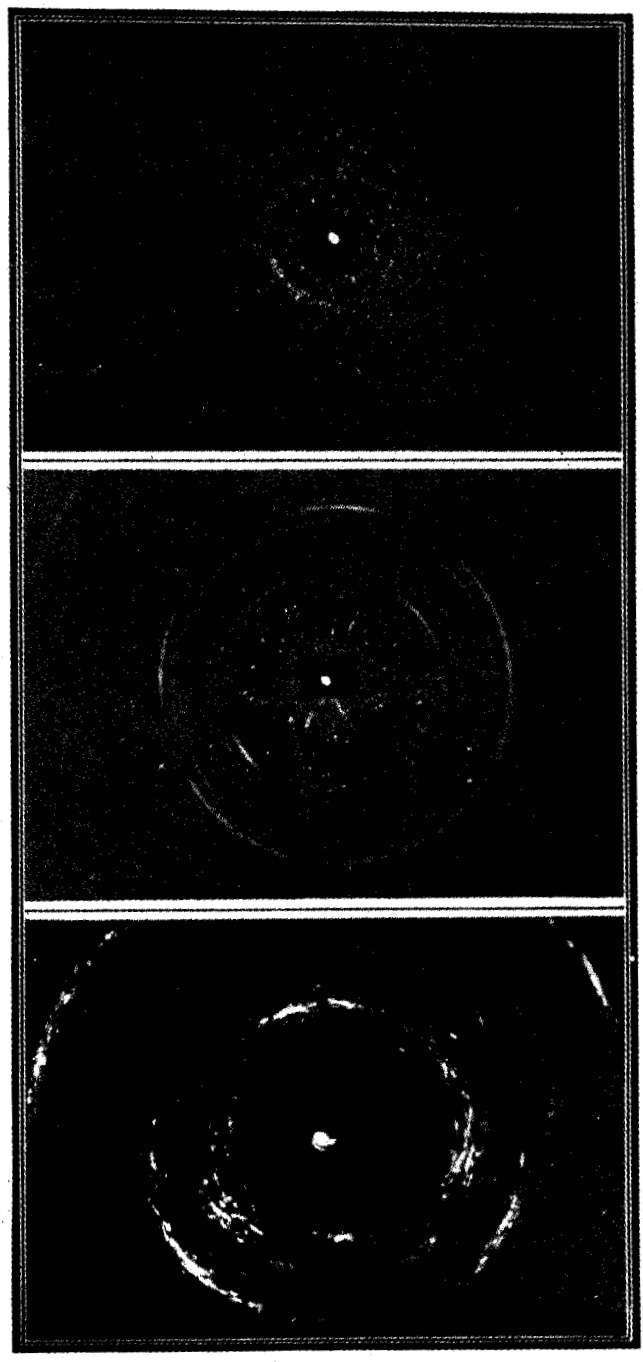
2. Hintze Carl, *Handbuch der Mineralogie*, Erster Band. Dritte Abteilung, Zweite Halfte, Walter De Gruyter and Co., 1930, 4274–4323.
3. Raman C V and Ramdas A K, *Proc. Indian Acad. Sci.*, 1954, **39A**, 153.



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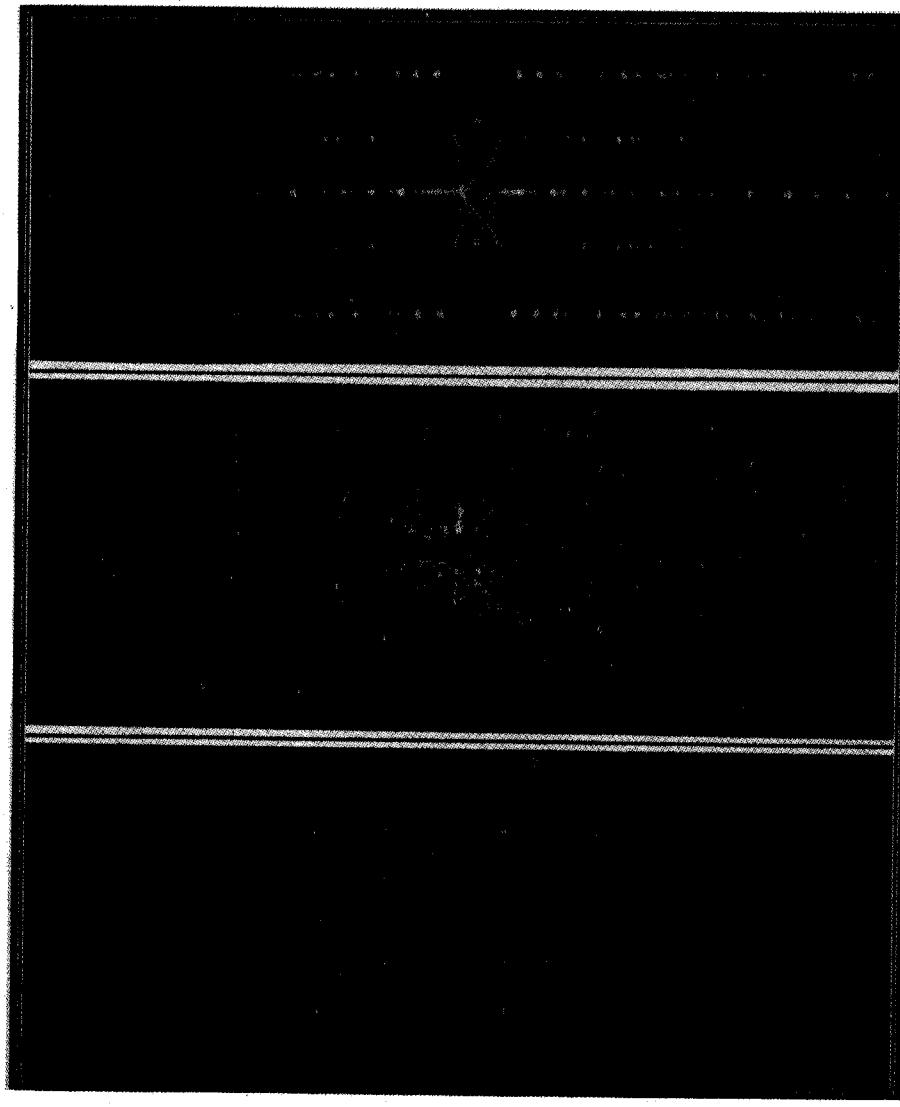
(2)

(3)

Figures 1–3

Plate I



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(6)

Figures 4–6

Plate II