Zeitschrift: Schweizerische mineralogische und petrographische Mitteilungen = Bulletin suisse de minéralogie et pétrographie

Band: 34 (1954)

Heft: 1

Artikel: An appliance for making crystal models in wood

Autor: Parker, Robert L. / Strebel, O.

DOI: https://doi.org/10.5169/seals-27135

An appliance for making crystal models in wood

By *Robert L. Parker* and *O. Strebel* (Zurich)

Introduction

Wood models are an indispensable aid to teaching crystallography, but as very numerous types are required and the supplies necessary for large classes of students considerable, their purchase in sufficient number is apt to prove an expensive item. Trials at making series of such models were accordingly undertaken by the authors in the Mineralogical Institute of the Swiss Federal Institute of Technology. The present paper contains a short account of the methods adopted which may be of interest to other teaching institutes. The authors desire to record their thanks to the late Professor P. NIGGLI for his encouragement and liberality in placing the resources of the Institute at their disposal. His only stipulation was that the finished article must in every respect be equal to those available commercially. This, the authors consider, has been achieved.

The original plan was to adapt for use on wood the well known GOLDSCHMIDT apparatus for cutting plaster of Paris models. Detailed plans for such a changeover have been given by CHARLES PALACHE and LYMAN W. LEWIS (American Mineralogist 12 (1927) 154—156), and it was proposed to proceed on the lines indicated in that paper. However, various considerations lead the authors to put this scheme aside and to proceed with the construction of an appliance conceived on different lines. The result as shown in Fig. 1 was planned to make the construction of doubly terminated models as accurate and simple as possible. Technical details (see last paragraph) were finally designed by O. STREBEL who constructed the machine in the workshop of the Institute.

General description

As seen in the photograph (Fig. 1) the appliance consists of three essential parts: 1. a vertical rotating disc carrying a sheet of emery paper;

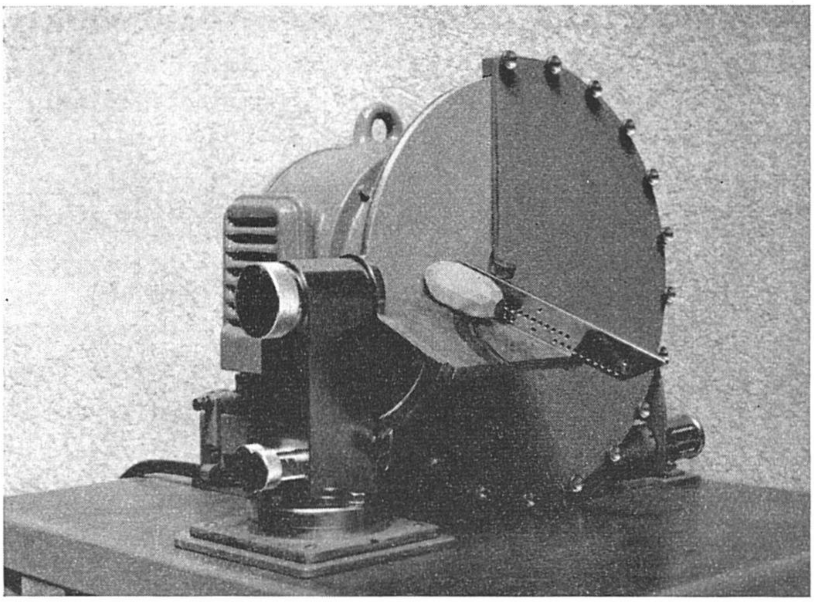

Figure 1. General view of the appliance for grinding crystal models in wood.

2. a tilting stage and 3. a limb which can be rotated about an axis perpendicular to the plane of the stage. Scales are provided for reading the amount of tilt given to the stage and the rotation of the limb. When the stage is horizontal (i. e. perpendicular to the disc) and when the limb stands at right angles to the disc, the reading on each of the scales is 90°. The models are made from blocks of pear wood whose original shape is that of a cube or parallelepiped. It rests on the stage on one of its faces (the "supporting" plane S) and makes contact with the limb along another of its faces (the "guiding" plane G). Gentle hand-pressure of the block

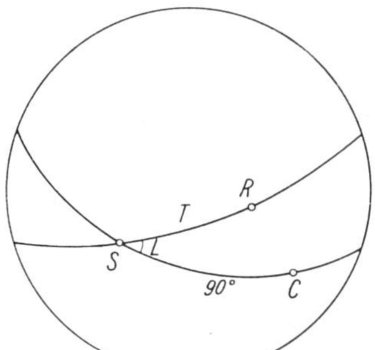

Figure 2. Stereogram showing the general relations between the supporting plane (S), the guiding plane (G = C in the figure), and the face (R) which is to be ground.

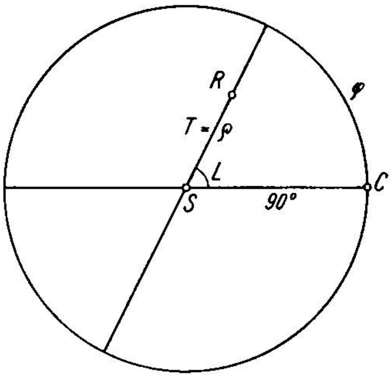

Figure 3. Stereogram showing the relations between S, G (= C in the figures) and R when S is (001) of an orthorhombic crystal.

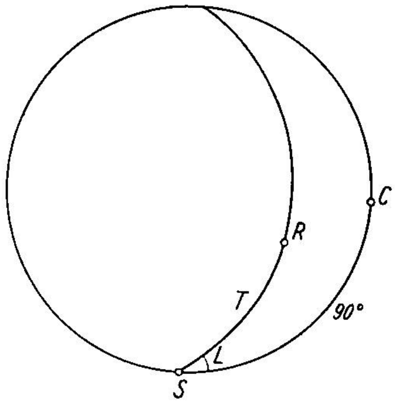

Figure 4. Stereogram showing the relations between S, G, and R when S is (100) of an orthorhombic crystal.

against the disc causes the latter to grind a face R whose orientation in respect to S and G depends on T and L which are the angles of stage-tilt and limb-inclination respectively: Of these angles T is the interfacial angle between S and R, while L is the angle between the zones [SR] and [SG]. When the original shape of the block has been modified by the addition of new faces (R_1, R_2, R_3...) these can also be used as supporting or guiding planes. It is always advantageous to select as such planes the largest surface elements available as this ensures firm and accurate guidance of the block during grinding.

The relationships between the faces S, G, and R are shown in the stereographic projection[1]) Fig. 2. Conditions will obviously be much simplified if S and G correspond to two main reference planes of the crystal and quite especially so when the crystal's axial cross is rectangular. Thus fig. 3 shows the relations obtaining when S = (001) and G = (010) of an orthorhombic crystal. L then assumes the value of φ and T that of ρ of the face R. In Fig. 4 the case is shown that S = (100) and G = (010) of an orthorhombic crystal. It can easily be verified that L now assumes the value $(90 - \eta_0)$ and T that of $(90 - \xi)$ in which η_0 ξ have the significance given to them by V. GOLDSCHMIDT in his "Winkeltabellen". Alternatively L may be identified with $(90 - \varphi_1)$ and T with $\rho_1 = A$ in which φ_1, ρ_1 and A are used as in the latest edition of DANA's Handbook.

The fashioning of models of crystals for which angle tables are available can, therefore, largely be based on angular values provided by these

[1]) The circlets in the figures refer to points on the lower half of the sphere of projection.

tables. When the required data are not thus forthcoming, sufficiently accurate values of L and T can be extracted from a carefully prepared stereographic plot permitting angles to be read with a precision of about a quarter of a degree. A criterion for the adequacy of the degree of accuracy of the angles used is provided by the development of edges between tautozonal faces which should, of course, be parallel.

The case frequently arises that when some plane is to be used as S (the supporting plane) no plane perpendicular to S is available to act as the guiding plane G. This, however, is immaterial; for experience has shown that so long as the S face is not too small, any one of its edges placed firmly against the limb provides a perfectly satisfactory guide (Fig. 5a). This is even the case when an "overhanging" plane (Fig. 5b)

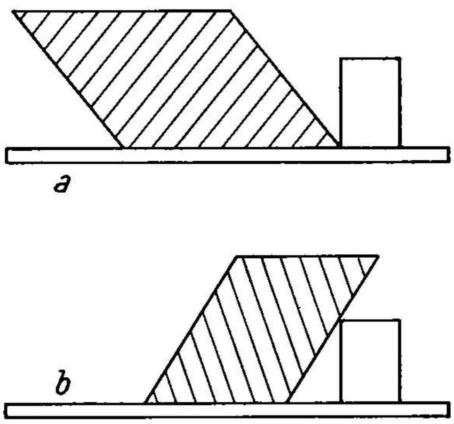

Figure 5a and b. Diagram showing that edges of the supporting plane can be used as guides during grinding.

prevents the edge being brought into actual contact with the limb and guidance is provided by a line parallel to the edge. In either case the edge represents the zone [SG] required for determining the angle L as defined above.

Practical Example

As an example of practical procedure the construction of a simple octahedron out of a normally oriented cube may be considered. The four faces meeting in one corner of the octahedron can immediately be ground by successively using each of four tautozonal cube faces as S faces and an adjoining one (in the same zone) as G. The values to be set will be $L = 45°$ and $T = 54° 44'$. Fig. 6a shows the appearance of the model at the com-

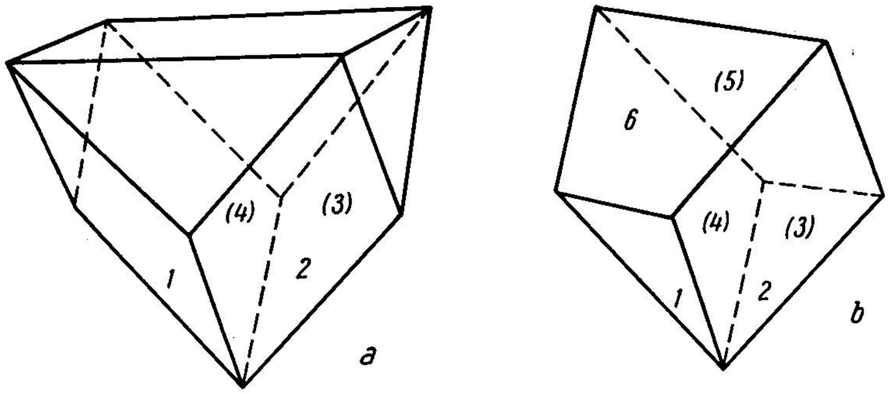

Figure 6a and b. First and second stage in the development of an octahedron out of a cube-shaped block.

pletion of this stage. By reversing the S faces two further faces of the octahedron can now be ground with the same values of L and T. Fig. 6b shows this phase of the development. As the cube faces have entirely disappeared those of the octahedron must now be used as S and G. The last two to be ground (5 and 6 in Fig. 6b) are the most convenient ones to use for this purpose and by using 5 and then 6 as S and in each case the edge [5/6] as G the two missing faces of the octahedron may now be added. The angles to be set are $L = 60°$ and $T = 70° 32'$. A careful watch must be kept on the size of the faces as they are ground so that grinding may be discontinued as soon as the face has "grown" sufficiently to pass through a previously determined and precisely marked point on the block. This is quite essential if the model is to be an ideal one (i. e. devoid of any irregularities in the sizes of corresponding faces). The overall size of the models can be chosen at will and can be made quite large if desired. A length of about 5—6 cms for models of prismatic habit is one well suited to general requirements.

Technical Details

The main constructional details of the machine are contained in Fig. 7, a, b, c which shows its front and side elevations and ground plan respectively. They may be referred to as follows: The aluminium disc (1) on which the emery paper is glued[2]) is attached at (2) to the shaft of an 0.5 H. P. electromotor rotating at 1350 revs per min. It is for the most part contained in an iron case narrower on the left than on the right where

[2]) The glue employed is easily soluble in acetone.

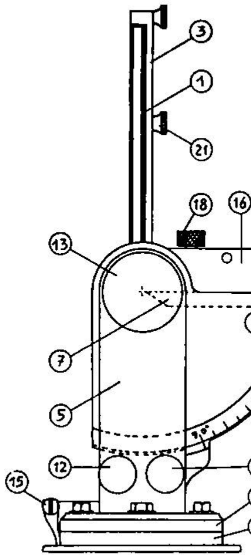

Fig. 7b

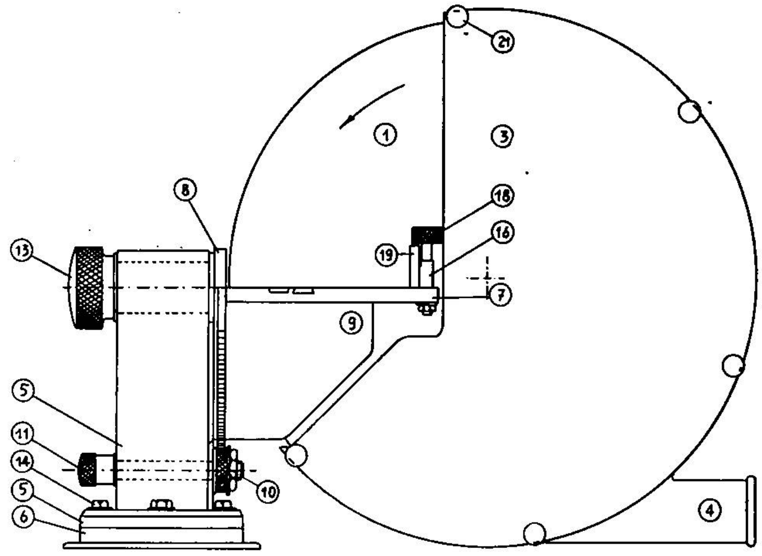

Fig. 7a

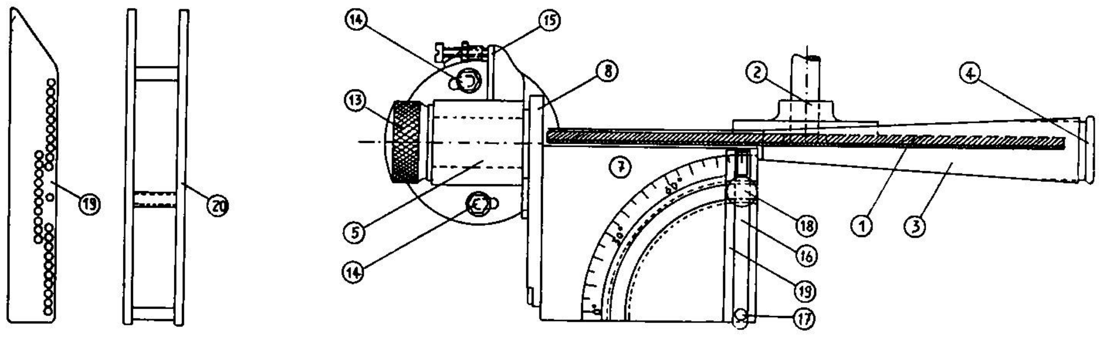

Fig. 7c

Figure 7a, b, and c. Front and side elevations and ground plan of the machine. For the explanations of the numbers see text.

it opens into a nozzle (4) to which a vacuum-cleaner[3]) can be attached. The latter effectively removes the very fine sawdust arising during grinding. The front part of the case is attached to the back by the nuts (21) as shown in the drawing and can be quickly removed when it is desired to replace one disc by another, e. g. by one carrying a finer or coarser grade of emery paper. The types of emery paper best adapted to the

[3]) The authors are indebted to the Electrolux Vacuum Cleaner Co. who contributed the suction unit of one of their machines for use in the present connection.

present purposes were found to be grades 80, 120, 150, and 180 of the so-called Ruby paper manufactured by the S. I. A. abrasives factory at Frauenfeld.

The stage is carried by an axis passing through the column (5) and consists of the stage proper (7), a flange (8) and the sub-stage support (9). The latter was introduced to give rigidity to the stage as a whole. All these parts are made of iron and securely welded together. (8) carries the scale on which the tilt of the stage can be read and the tilting is effected by the small rubber friction-wheel (10) which presses against (8) and can be turned and accurately set by the knob (11) on the left of the column. A second knob (12) immediately behind serves to clamp the stage at any desired setting of the scale, while a rotation of the larger knob (13) securely locks the whole stage in its inclined position and thus prevents any change in angle during the grinding process. The column as a whole can be rotated on a fixed base (6) when the nuts (14) are loosened. As it is only desired to swing the stage away a short distance from the disc when changing the latter, each of the four nuts (14) fit into slots which restrict the movement of the column. A fine screw attached to the fixed base and in contact with the column at (15) serves in the first place to adjust the axis of the stage in a position exactly parallel to the disc. When the screw is once set its end serves as a fixed-point to which the column can be returned after having been swung away from the disc. The setting of the screw has occasionally to be checked for accuracy.

The limb (16) rotates about its axis (17) and can be arrested in any position by the screw (18). The L values (see above) are read on a scale let into the stage. As any rotation of the limb moves its end away from the disc, an accessory limb (19) provided with a number of holes can be screwed to the main limb in any desired position and provides secure guidance for the block of wood right up to its contact with the disc. It is desirable to use the emery paper over the entire breadth of the disc. To make this possible, several double limbs (20) of various widths were made and can, like the simple accessory limb, be screwed to the main limb in any position. They allow the block to be brought into contact with any part of the disc and thus render changes of paper unnecessary before the entire surface has been worn down.

The column, stage and accessory limbs were finally chromiumplated while the disc-case was sprayed with a coat of paint. The main limb and scales are in brass.

Received: January 25th. 1954