

NOTES AND NEWS

CYCLIC PERMUTATION OF CRYSTALLOGRAPHIC AXES

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Except in crystals of most unusual development, the main zone is an axial zone, [001], [100], or [010], of the properly chosen crystal lattice. Normal goniometric procedure leads to a projection and elements on the plane normal to the axis of the main zone; and since, when it is permitted, the main zone is conventionally chosen as the vertical zone [001], a projection and elements in normal position are commonly obtained. In the orthorhombic, monoclinic and triclinic systems there are certain important cases, however, in which the main zone may be [100] or [010]. In such cases normal goniometric procedure leads to a projection and elements in an abnormal position which is conveniently restored to the normal position by systematic cyclic permutation of the crystallographic axes.

In a recent paper (On crystallographic presentation, *Am. Jour. Sci.*, vol. 28, p. 241, 1934) I proposed to name the abnormal positions *inversions* and the word has been used in this sense in subsequent studies (C. Palache: The form relations of the lead oxychlorides, laurionite, paralaurionite and fiedlerite, *Mineral. Mag.*, vol. 28, p. 573, 1934; M. A. Peacock: On pectolite, *Zeit. Krist.*, vol. 90, p. 97, 1935; On wollastonite and parawollastonite, *Am. Jour. Sci.*, in press). I am obliged to Professors A. F. Rogers and J. D. H. Donnay for reminding me that inversion is widely used in the special sense of the symmetry operation due to a center of symmetry. To replace inversion in the new sense Professor Rogers suggests *transposition*; but this word conveys bodily translation without the essential idea of rotation. It seems better to be more explicit and use *permutation* to mean cyclic permutation of the crystallographic axes, giving the three positions, normal position, first permutation, second permutation, corresponding to the normal position, first inversion and second inversion, respectively, of the first paper mentioned (Figs. 5, 6, 7). In German *umstellen* conveys the desired meaning, and *Normalstellung*, *erste Umstellung*, *zweite Umstellung* are appropriate names for the three positions.

Each of these three cyclic positions is obtained from the previous one by two rotations of the primitive parallelepiped: a clockwise rotation about the normal to the axial plane in the position of (010) to bring a new axis vertical; and a clockwise rotation about the new vertical axis to bring a new axial plane into the position of (010). In this way the positive ends of the three axes remain in the first octant (upper-front-right) in all three positions. Since the axes do not change names on rotation,

the axial ratio, the face symbols, and all interfacial angles remain unchanged.

OCCURRENCE OF CLAUDETITE IN IMPERIAL COUNTY, CALIFORNIA

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In the *American Mineralogist*, vol. 19, 1934, Professor Charles Palache describes the crystallography of claudetite, arsenic trioxide, from Imperial County, California, and the United Verde Mine, Arizona. The latter is a product of a mine fire and therefore specimens from the former locality constitute perhaps the best natural crystal occurrence recorded to date. Some claudetite was obtained as a natural oxidation product of arsenical pyrite ores in the San Domingo Mines of Portugal many years ago, but so far as the author is aware the quality of this material did not compare with the present natural occurrence.

During 1932 Mr. R. W. Webb of the University of California at Los Angeles and the writer collected and furnished Mr. Wilke of Palo Alto with the material described by Palache. Because of its rareness and good crystallization it was thought worth while to record more definitely the locality and associations.

The location is about thirty-five miles north of Yuma, Arizona, on the California side of the Colorado River. The exact locality is six miles north of the 4 S ranch and about $1\frac{1}{2}$ miles west from the river on the north side of a broad dry wash. The rocks of the region consist of pre-Cambrian? impure limestones and calcareous schists broken through and extensively covered by Tertiary volcanics.

The deposit which was opened up as a sulphur prospect appears to be related to these eruptives and is an irregular replacement vein along the calcareous crystalline rocks. The vein is composed chiefly of kaolin, gypsum, halloysite, and sulphur. Whitish, powdery sulphur is predominant along the center of the vein. Outward gypsum, kaolin, and halloysite grade into the unaltered rock. A few of the beds show signs of sericitization. Some quartz is present which in many places is thoroughly brecciated. A very fine-grained black tourmaline is also found in veinlets replacing quartz and fine drusy chlorite occurs coating calcite. However, all of this would attract but little attention were it not for the lenses and patches of realgar which are enclosed in sulphur along the center of the vein. The sulphur which immediately surrounds the realgar is often a deep yellow and commonly exhibits a porous boxwork structure. Small orange red veinlets of realgar leading from the massive reddish-brown centers anastomose through the surrounding sulphur boxwork. Away from the realgar centers the sulphur becomes more powdery, lighter colored, and increasingly mixed with clay and gypsum.

The region is an arid one and the permeable nature of the vein has favored its intense oxidation. Thus is accounted for, the claudetite which developed from the realgar. The claudetite occurs crystallized normal to the open seams which cut diagonally through the realgar and into the adjacent sulphur. These seams are open as wide as a quarter of an inch with either wall lined with delicate claudetite crystals averaging two or three millimeters in length. Small but well formed sulphur crystals are also present. Breaking for display of the crystallized linings is greatly facilitated by the open seams. Many, however, are completely clogged with secondary crystallization of sulphur and claudetite.

As evidenced by the realgar and the fine grained black tourmaline the vein belongs to the rather unusual vein group recently termed by Buddington¹ as xenothermal having formed at high temperature and shallow to moderate depth.

¹ Buddington, A. F., High temperature mineral associations: *Econ. Geol.*, vol. 30, p. 210, 1935.