ON SOME CRYSTALS OF TOPAZ FROM MONGOLIA AND NORTH
AND CENTRAL CHINA

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The crystallographical study of the newly found crystals of topaz was
started by W. H. Wong and continued and completed by S. W. Wang under
the supervision of the former. The angular measurements have been taken
with a horizontal reflecting goniometer. This paper is to record the origin
and occurrence of the crystals with the circumstances of their discovery and
to give a description of their crystalline forms. As far as our knowledge goes,
these are the first crystals of topaz described from China.

Occurrence of the Crystals.

The crystals under study are numbered according to the order in
which they came to the collection of the Geological Survey. The
crystallographic description in the next section will follow the same order.

No. 1. is a large crystal presented to the Geological Survey Museum
in 1919 by late Mr. T. S. Kiang (江根毅) of the Department of Mines of the
Ministry of Agriculture and Commerce. The specimen is come from north of
Urga in Mongolia and was obtained from a Chinese miner who has worked in
the Mongolor gold mines in the Iro valley. This region is known to be of
Archean gneiss, and it is very likely that the topaz is derived from pegmatitic
veins in the gneissic formation.

No. 2. is a beautifully transparent crystal rich in faces, yellow in
color, presented to the Geological Survey by a Belgian Missionary Father
Vleeschower at Tatung, north Shansi, through the intermediary of Father
Teilhard de Chardin and Dr. C. C. Young (楊如健) both working for the Survey
in their travelling in Shansi and Shensi in 1929. The crystal is said to come
from the district of Hunyuan (呂梁), S. E. of Tatung.

* Summary read at the 7th Annual Meeting, March 1930. Manuscript received 15,
  August, 1930.
** Director of the Geological Survey, Research Professor of the China Foundation.
No. 3. and No. 4. Through the help of Father Vleeschower, the Geological Survey asked another missionary Father Jong residing at Hunyuan to send out local people to make a search for all crystals at the Survey's expenses in order to try out the chances of getting other possible minerals and ascertain the exact origin of topaz if more crystals could be obtained. As result of this search a good amount of different minerals was sent to the Survey at the end of 1929 from which we immediately recognized two more crystals of topaz from Mu-chang-wang; a locality 85-90 li S. W. of Hunyuan (漵縣), close to the border of the district of Fanchi. These two crystals shall be respectively called No. 3 and No. 4. No. 3 is similar to the No. 2 in crystalline faces so that their common origin is probable although unlike No. 2, No. 3 is entirely uncolored. No. 4 is also colorless with the same strong luster and beautiful transparency as No. 3, but the crystalline faces are so unequally developed as to render the orthorhombic symmetry hardly recognizable as will be described later. The crystals of Topaz were mixed with crystals of quartz which were associated themselves with fluorite. This mineralogical association and some rock fragments included in the collection sent to the Survey all seem to confirm their origin in pegmatitic or quartz veins in the Archean gneiss.

No. 5. As we know that the topaz crystals are not distinguished from the quartz crystals by local collectors, a thorough investigation of all the quartz crystals may possibly lead to further discovery of topaz crystals. With this object in view, S. W. Wang made a succession of visits for the Geological Survey at various precious stone shops or eyeglass making shops in Peking, examining all the quartz crystals which are available in their hands. From one of these shops, one more crystal of topaz was found in 1930. This crystal is stated to come from Tunghai (東海) or as called formerly Haichou (海州) in N. E. Kiangsu. This statement is very probably true as Haichou has been well known for its production of rock crystals and from C. C. Liu (劉季辰) who has done the geological mapping of Kiangsu province, we know that the Archean metamorphics are there prevailing.

From the above it becomes clear that topaz is pretty widely distributed in China. We have already specimens from three large regions: namely, Mongolia, Northern China and Central China. The crystals of topaz are usually confounded with quartz crystals by the native people: but the difference is not entirely unnoticed since in the stone shops in Peking where we obtained our specimen No. 5, the topaz was called octagonal shuisheng (八角水晶)
while the ordinary quartz crystals are named hexagonal shuiching (六角水晶).
Another local name for Topaz is Pinto shuiching (平頭水晶) or flat topped quartz to differentiate it from sharp topped crystals of true quartz.

Neither was topaz unknown as one of the gem stones in China. It is called Huang-pao-shih (黃寶石) or yellow yaku (黃雅姑) or Yaku.* "Yaku" is apparently a foreign term which Laufer identified with the Arabian term "Yakut". The Ming History stated that Yaku of various colors, red, blue or yellow, is produced from Ceylon. From these evidences, it seems probable that the topaz in the Chinese market of precious stones was of foreign origin while the same mineral from our own territory was not given its due value.

DESCRIPTONS OF THE CRYSTALS**

No. 1. Crystal from Mongolia.

This is a pretty large crystal unfortunately half broken as shown in fig. 1. It is almost 50 mm in height and 55 mm in width. The following faces are recognized using the Miller and Dana’s symbols.

Prisms: Unit prism m: all the four faces (1\(\overline{1}0\)), (\(\overline{1}1\)0), (1\(\overline{1}0\)) and (1\(\overline{1}0\)) are present. The complete faces are about 10 mm wide.

![Fig. 1.](image)

Brachyprism l: Two faces (1\(\overline{2}0\)) and (1\(\overline{2}0\)) are each about 30 mm wide, being the best developed faces. The face (1\(\overline{2}0\)) is the most brilliant while the (1\(\overline{2}0\)) is striated.

Domes: One brachydome l is present. The face (02\(\overline{2}\)) is well developed while the (02\(\overline{2}\)) is much less perfect. The face (02\(\overline{2}\)) is bright but

* H. T. Chang: Lapidarium Sinicum.
** The number of the figures in the plate as well as in the text corresponds to the number of crystals as mentioned above.
rather unequal with small corrosion figures. The face (110) is much corroded so that the angle (110) (120) is difficult to measure.

The goniometric measurements are as follows:

\[
\begin{align*}
\text{11'} & & \text{120} & & \text{120} & & 87^{\circ} 0' \\
\text{ml} & & \text{110} & & \text{120} & & 17^{\circ} 48' \\
\text{tt'} & & \text{021} & & \text{021} & & 85^{\circ} 50' (?)
\end{align*}
\]

Specific gravity: 3.52

No. 9. Crystal from Hunyuan, Shansi.

This crystal is 30 mm in height and about 20 mm in width measured along the intersection of the brachydomes. Almost all faces have strong and brilliant luster, from vitreous to adamantine. It is thoroughly transparent with a tea yellow color. (fig. 2.)

Prisms: Also two prisms are developed, the unit prism m and the brachy prism l, the latter being much wider than the former. All the faces of the unit prism are only 1 to 3 mm wide while the brachyprismatic faces (120) are all about 12 mm wide.

Domes: There are two brachydomes f (02x) and y (04y), the former being better developed than the latter. The intersection of the two faces (02x) and (02y) does not make a sharp edge, but there seems to be a very narrow strip of a plane which is the basal pinacoid c (00z).

There is also one macrodome d (021) represented by a very small facet grouped with the equally small pyramidal faces.

Pyramids: Two macro-pyramids are present o (221) and u (111) which have the same width and are very small.
The following are the angles measured:

- $II'$, $(220) \angle (120)$: $86^\circ 54'$
- $lm$, $(120) \angle (110)$: $18^\circ 44'4''$
- $mm''$, $(110) \angle (110)$: $55^\circ 46'$
- $ff'$, $(021) \angle (021)$: $87^\circ 27'2''$
- $yy'$, $(041) \angle (041)$: $124^\circ 35'$
- $dd'$, $(201) \angle (201)$: $122^\circ 13'$
- $mo$, $(110) \angle (221)$: $26^\circ 15'$
- $mu$, $(110) \angle (111)$: $44^\circ 44'$
- $oo''$, $(221) \angle (221)$: $49^\circ 30'$
- $oo'$, $(221) \angle (221)$: $105^\circ 1'$
- $uu''$, $(111) \angle (111)$: $39^\circ 10'$
- $uu'$, $(111) \angle (111)$: $78^\circ 13'$
- $dd'$, $(201) \angle (\overline{2}01)$: $122^\circ 13'$

Specific gravity: 3.54

No. 3. Crystal from Hunyuan, Shansi.

This is the crystal richest in faces. The whole crystal has a length of 34 mm. and a width of about 20 mm. It is colorless and transparent. The main faces have a brilliant vitreous to adamantine luster (fig. 3).

Prisms: We have here the usual prismatic faces. The unit prism $(1\overline{1}0)$ and the brachy prism $1\overline{1}0$, the latter is comparatively, as usual, more developed, both with very strong luster.

Pinacoid: The basal pinacoid $c$ $(001)$ is here well represented by a face 6 mm wide and even more brilliant than the two prisms. The surface,
the middle, which fact would suggest the presence of two flat macrodome faces approaching so much the horizontal as to make almost one plane. The basal cleavage face has not the same appearance. Indeed the goniometrical measurement seems to confirm a small angle of a little over one degree between the macrodome faces.

**Domes:** There are three brachydomes. The best developed is y (041) with very brilliant faces, the brachydome f (021) is situated between y (041) and another flatter dome and becomes only a narrow band, but the faces are also brilliant. Above f (021) comes a third dome with dull faces. Its symbol is x or (043). All the three brachydomes are the same as found in the Japanese Topaz as figured by Dana in his text book of mineralogy with the difference however that the dome y is here better developed than f. The brachydome x (043) is rather an uncommon form.

**Pyramids:** The pyramidal faces all belong to macropyramids as in the crystal No. 2. They are developed here only on one side. Another particularity is that three forms (instead of two) can be identified with the four faces. The pyramid 0 (221) and t (223) are only represented by one face each while the unit pyramid u (111) has all its two faces present. Owing to the unsymmetrical development of 0 (221) and t (223) on the right and left, the two faces (111) and (111) of the unit pyramid are apparently separated at different levels. This seems to be a special feature due to the hemihedrism.

There are thus in this single crystal 2 prisms, 1 pinacoid, 3 domes and 3 pyramids, altogether 9 crystalline forms.

The measured angles are as follows:

- \( \Pi' \), (120) \& (210) 87° 2′
- \( \Pi'' \), (220) \& (110) 18° 46½′
- \( \Pi''' \), (110) \& (110) 56° 1′
- \( \Pi'''' \), (042) \& (042) 22° 32½′
- \( \Pi'''''' \), (021) \& (021) 87° 41½′
- \( \Pi'''''''' \), (043) \& (043) 65° 6′
- \( \Pi''''''''' \), (001) \& (043) 32° 23½′
- \( \Pi'''''''''' \), (001) \& (021) 43° 52′
- \( \Pi''''''''''' \), (001) \& (041) 62° 23½′
- \( \Pi'''''''''''' \), (110) \& (221) 26° 19½′
- \( \Pi'''''''''''''' \), (110) \& (111) 44° 37′
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\[\begin{align*}
m1 &:\ \{(110)\ \Delta (223)\} &\quad 55^\circ 29' \\
uu &:\ \{(111)\ \Delta (1\bar{1}1)\} &\quad 39^\circ 6' \\
o &:\ \{(221)\ \Delta (111)\} &\quad 18^\circ 17' \\
c &:\ \{(001)\ \Delta (1\bar{1}1)\} &\quad 45^\circ 30' \\
ci &:\ \{(001)\ \Delta (223)\} &\quad 34^\circ 20' \\
c &:\ \{(001)\ \Delta (211)\} &\quad 64^\circ 19'
\end{align*}\]

Specific gravity: 3.56

No. 4. Crystal from Hunyuan, Shansi.

This is a most curious crystal of which the exact crystallographic form is difficult to understand at the first sight. To give better idea of this unusual crystalline form, three figures are printed, viz: one front view (fig. 4 a), one back view (fig. 4 b) and one orthographic projection (fig. 4 c). One can hardly find its orthorhombic symmetry without goniometric measurement. The crystal is pure, colorless, entirely transparent with strong luster just as the crystal No. 3. Unlike the three crystals described above which are all truncated at the lower portion and terminated more or less perfectly by the basal cleavage, this has one face at least of the lower part still preserved, and the basal cleavage is not very distinct. The following is a brief description of the different faces.

Prisms: As usual two prisms m (110) and l (120) are present. On the front view the two faces (2\(\bar{1}2\)o) and (110) are so obliquely cut by the brachydome f (021) and they are so different in aspect, (110) very brilliant and (1\(\bar{1}\)0) very dull, as to make it not easy to see their equivalency. The face (120) is very reduced into a small triangular facet intercalated between the prism (110) and the dome (041). On the other hand, the face (2\(\bar{1}2\)o) is well developed but much corroded so as to look dull as the (1\(\bar{1}\)0). On the other side—the back side—both (120) and (1\(\bar{2}\)2o) are well developed and brilliant, but none of the unit prism
faces (r00) or (t00) is present. On the whole the vertical zone is largely
constituted by the three faces (r20), (t20) and (t20) of the brachyprism and
the two faces (t10) and (t30) of the unit prism.

Domes: Two domes f (o21) and y (o41) are here present. The face f
(o21) is so large as to measure 33 mm long and 25 mm broad while its
correspondent (o21) is much smaller, less than 10 mm, and much corroded. Of
the other brachydomes, only the face y (o41) is present without any symmetric
correspondent on the other side.

Pyramids: There are here three pyramidal forms. The unit pyramid u
has one face at the front view (t31), but has no symmetric correspondent on
the back side. Another pyramid is represented by the face (221) and (221),
the other two (221) and (221) being entirely absent.

The nature of another pyramidal face has appeared rather puzzling to
the first examination. It is a face in the lower portion of the crystal in the
same zone as (t10) and (221). It is also in contact with the face (t10). As
the face is corroded and uneven it is difficult to obtain exact goniometric
measurements. The approximate angle measured is about 40° with the face (r10)
and about 62° with the face (t10). These two measurements agree fairly well to
give a ratio of indices approaching r: r: 0.35. The nearest ratio in simple members
is 7: 7: 6. Referring to its actual position, the face corresponds thus to (770).
This seems to be a new face not known before with the Topaz crystals.

The dull faces (r10), (r30), (221), (311), (021) and (770) are all grouped
together on one side while all the other faces are brilliant. The reason of this
difference is perhaps to be found in the corroding action of the mineralized
solution or gas after the crystallization of topaz affecting only the one side
of the crystal exposed to the active agent.

The following are the angles measured:

<table>
<thead>
<tr>
<th>Plane</th>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>/2.  (120)</td>
<td>(120) 87° 40′</td>
</tr>
<tr>
<td>mm  (110)</td>
<td>(110) 53° 32′</td>
</tr>
<tr>
<td>im  (120)</td>
<td>(110) 17° 45′</td>
</tr>
<tr>
<td>/4. (021)</td>
<td>(021) 85° 12′</td>
</tr>
<tr>
<td>hy  (021)</td>
<td>(041) 18° 38′</td>
</tr>
<tr>
<td>mo  (110)</td>
<td>(220) 26° 54′</td>
</tr>
<tr>
<td>m°u  (110)</td>
<td>(110) 44° 23′</td>
</tr>
<tr>
<td>q°m  (770)</td>
<td>(110) 40° 1′</td>
</tr>
<tr>
<td>q°m  (770)</td>
<td>(110) 62° 38′</td>
</tr>
</tbody>
</table>
Specific gravity: 3.55

No. 6. Crystal from Haichou, Kiangsu.

This crystal has a height of 45 mm and a width of 25 mm. It is uncolored and transparent but the faces are not all so brilliant as with the the Shansi crystals. There are the usual forms (fig. 5):

Fig. 5

Prisms: m (110) and l (120) almost equally developed.

Domes: y (041) and f (021) the latter is much corroded.

Pyramid: 0 (221) is well developed. There seems to be another one above that but its exact nature is difficult to ascertain owing to the corrosion.

The following are the angles measured:

\[
\begin{align*}
\text{lI}', \quad (120) & \Delta (120) \quad 86^\circ 46' \\
\text{lm}, \quad (120) & \Delta (110) \quad 18^\circ 41' \\
\text{mm}', (110) & \Delta (110) \quad 56^\circ 1' \\
\text{yy}', (041) & \Delta (041) \quad 124^\circ 28' \\
\text{moo}', (110) & \Delta (221) \quad 26^\circ 2' \\
\text{ooc}', (221) & \Delta (221) \quad 49^\circ 35' \\
\text{ooc}', (221) & \Delta (221) \quad 105^\circ 8'
\end{align*}
\]

Specific gravity 3.56
To summarize the five crystals of Topaz described above we may have a table (see also fig. 6) as follows:

<table>
<thead>
<tr>
<th>Crystals</th>
<th>Prisms</th>
<th>Domes</th>
<th>Pyramids</th>
<th>Pinacoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>m (110), l (120) f (021)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 2</td>
<td>m (110), l (120) f (021), y (041), u (111), o (221) c (001) d (001)</td>
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</tr>
<tr>
<td>No. 3</td>
<td>m (110), l (120) y (041), f (021), u (111), o (221), c (001) x (043), i (223)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>m (110), l (120) f (021), y (041) u (111), o (222), q (776)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 5</td>
<td>m (110), l (120) y (041), f (021) o (221)</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Fig. 6 Stereographic projection showing all the faces of the five Topaz crystals.

A comparison between the angles measured and the angles calculated shows a maximum difference of 23° 46' and a minimum difference of 20°. This is given in detail in the following table.
We have thus eleven crystalline forms in the five crystals of topaz.

The following table summarizes the various forms which have been mentioned with some better known foreign minerals.
<table>
<thead>
<tr>
<th>Author</th>
<th>Region</th>
<th>Prisms</th>
<th>Domes</th>
<th>Pyramids</th>
<th>Pinacoids</th>
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<td>Des Cloiseaux</td>
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<td>(110),(120)</td>
<td>(041),(201)</td>
<td>(111),(221)</td>
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<td>Bretagne</td>
<td>(110),(120)</td>
<td>(021),(041)</td>
<td>(111),(221)</td>
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<td>(012),(111)</td>
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<td>S.W. Africa</td>
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<td>New Caledonia</td>
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<td>(011),(101)</td>
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<td>(021),(041)</td>
<td>(111),(221)</td>
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<td>Utah</td>
<td>(110),(120)</td>
<td>(021),(041)</td>
<td>(111),(223)</td>
<td>(010)</td>
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<td>Dana.</td>
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<td>(021),(041)</td>
<td>(221),(441)</td>
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<td>Wong and</td>
<td>China</td>
<td>(110),(120)</td>
<td>(021),(041)</td>
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<td>Wang.</td>
<td></td>
<td></td>
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<td>(002)</td>
</tr>
</tbody>
</table>

By comparing the crystalline forms observed in the Chinese Topaz with those known from other countries, the following conclusions may be retained:

1. The crystalline forms m (110), l (120), f (021), y (041), u (111), o (221), i (223) common in Chinese crystals are also the common faces in the topaz of other regions. The predominance of l (120) in the prismatic zone and the development of f (021) or y (041) as the prominent brachydomes are also but the common habit of this mineral as already known.
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2. The macrodome d (201) is rather common in foreign topaz, but is found only once in the five crystals here studied.

3. The brachydome x (043) present in our crystal No. 3 is not a very common form. It is however present also and even predominant in the topaz crystals from South Baldface mountain as described by Marland P. Billings.

4. The unequal development of our crystal No. 4 constitutes quite a special habit unknown before with crystals from other countries. It bears besides a new pyramidal face (775) which has not been found, as far as our knowledge goes, from foreign topaz.