Tumbledown Mountain talc deposit, Allamoore District, Culberson County, Texas

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TUMBLEDOWN MOUNTAIN TALC DEPOSIT, ALLAMOORE DISTRICT, CULBERSON COUNTY, TEXAS

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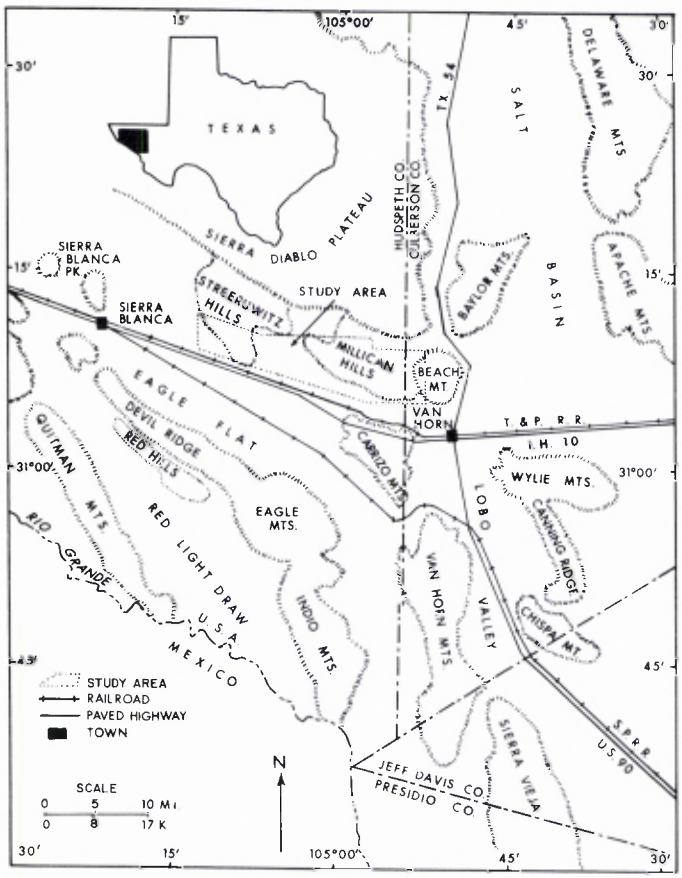
INTRODUCTION

The Tumbledown Mountain deposit is the easternmost exposure of talc-bearing Precambrian rocks of the Allamoore district of Culberson and Hudspeth Counties, Texas (figs. 1 and 2). The district, which is one of the more important talc-producing areas in the United States, is about 30 km long and 25 km wide. Talc was first commercially mined in 1952; 192,492 short tons were mined in 1974 (Hawkins and Girard, 1977). Five companies operating in the district mine moderate- to large-sized deposits by open-pit methods. Some high-grade deposits were selectively mined underground during the 1960's. Talc reserves are estimated in the tens of millions of tons.

All talc-bearing rocks of the district are restricted to the talcose phyllite horizon within the Precambrian Allamoore Formation. Talc deposits vary in size from talcose streaks to zones up to 200 m wide and 1.6 km long. Most are moderately to steeply dipping lensoid or tabular bodies. Others, along with adjacent carbonate and mafic metaigneous rocks, have been strongly deformed or isoclinally folded.



(Modified from Wylie, 1970)

Figure 1. Generalized physiographic map of Trans-Pecos Texas, showing location of Allamoore district.

Some of the finest exposures of the Allamoore Formation are revealed in the synclinal structure that lies on the Hazel Formation at Tumbledown Mountain. A "surface of movement" (King, *in* King and Flawn, 1953) separates the Allamoore thrust sheet from the underlying Hazel Formation; another within the Allamoore subdivides it. This section is tectonically thickened due to duplication by faulting. The syncline is bounded on the south and east by later high-angle faults and is overlain unconformably to the east by the Bliss(?) Sandstone (Lower Ordovician).

This paper is a progress report based on a partially completed study of the stratigraphy, structure and mineral deposits of the talc district. A subsequent paper will give further details. The reader interested in more detail regarding the regional geology will find the following publications helpful: Hawkins and Girard (1977), King (1965), King and Flawn (1953), Reid (1974), Rohrbacher (1973), and Sample and Gould (1945). Additional information concerning talc may be found in Roe (1975), Wells (1976) and Clarke (1979).

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TUMBLEDOWN MOUNTAIN STRATIGRAPHIC SECTION

General Remarks

Tumbledown Mountain, a high western spur of Beach Mountain about 12 km northwest of Van Horn, Texas, provides excellent exposures of the Allamoore Formation. About 570 m of Allamoore occur in a synclinal structure, which rests on the Hazel Formation and is bounded by later high-angle faults (figs. 1 through 4). Figure 5 presents geologic cross-sections through Tumbledown Mountain. Table 1 gives the stratigraphic column for Tumbledown Mountain. (*See also* King, this guidebook.)

Allamoore Formation

The oldest rocks exposed on Tumbledown Mountain are those of the Precambrian Allamoore Formation; however, due to probable thrusting they are exposed near the summit (figs. 4 and 5). Neither the top nor the base of the Allamoore is preserved. Table 2 gives the stratigraphic section of the Allamoore Formation on Tumbledown Mountain. A "surface of movement" within the Allamoore subdivides it into at least two parts. The Allamoore at this locale consists of basal amygdaloidal basalt flows and volcaniclastic material, which are overlain by interbedded light and dark gray talcose phyllite and silicified black limestone. Light orangish-brown to dark gray, finely crystalline, partially silicified limestone

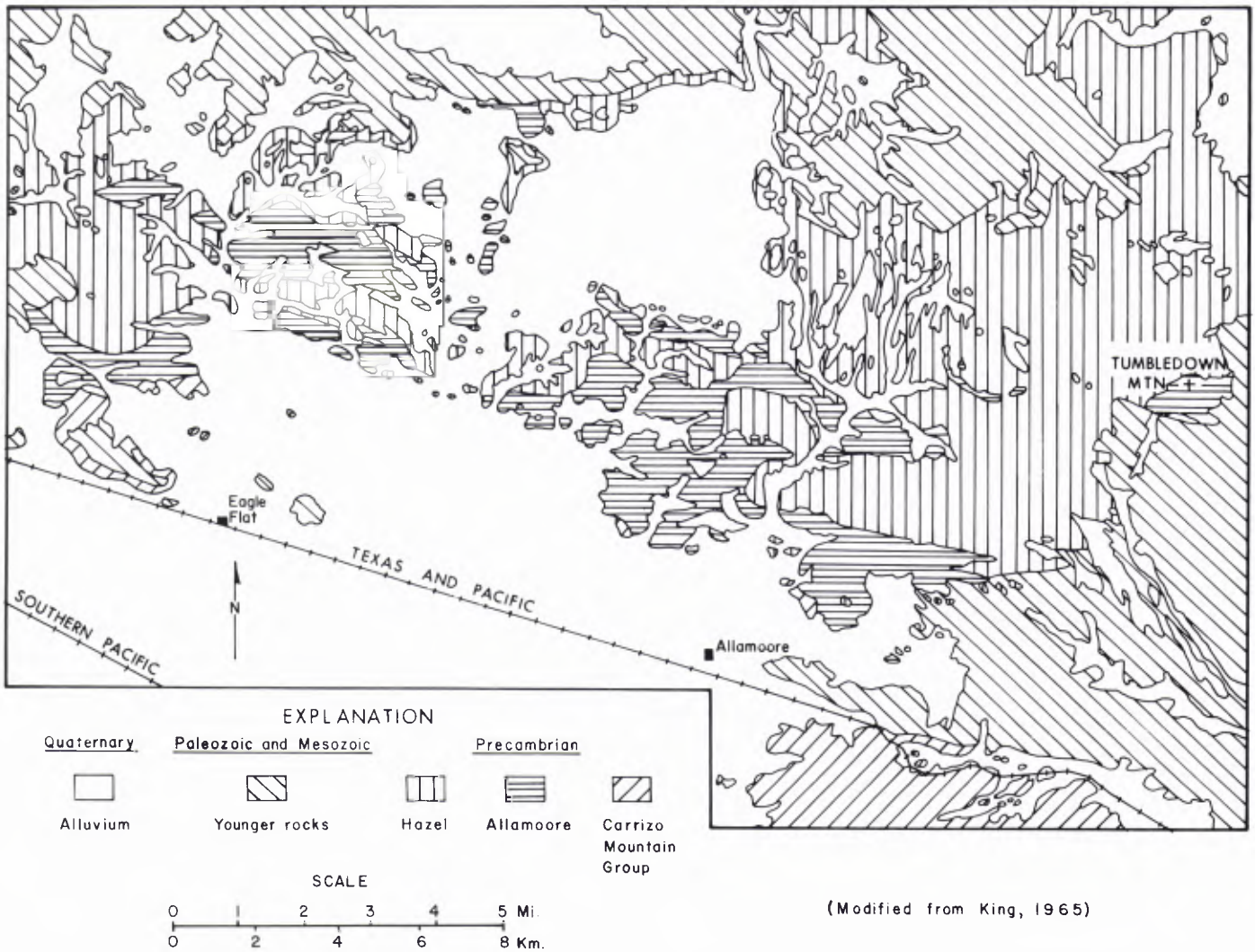

Figure 2. Generalized geologic map of the Allamoore district. Carrizo Mountain Group—metasedimentary and metaigneous rocks; Allamoore—limestone, volcanic and volcaniclastic rocks, and phyllite; Hazel—red siltstone and coarse conglomerate; Paleozoic and Mesozoic—mostly limestones with some shales and sandstones, as well as a few Tertiary intrusions; Quaternary—unconsolidated alluvial deposits.

and dolomite constitute the bulk of the uppermost Allamoore. Water-laid basaltic tuff is also present. These carbonate rocks contain abundant chert ribs and are thinly laminated to massively bedded. Crinkled, dome-like structures resembling *Cryptozoon* or stromatoporoids are common. Evidence indicating that the chert ribs were formed during diagenesis and were brittle before deformation of the Allamoore is the characteristic fracturing and flow deformation of limestone between the chert fragments.

Hazel Formation

The Hazel Formation, of Precambrian age, consists of red, laminated siltstone and fine-grained sandstone interbedded with and underlain by conglomerate of coarse angular fragments derived from the Allamoore Formation. Locally, one finds interbedded pink limestones. Reid (1974) states that the Hazel Formation was deposited by an alluvial fan system draining a southern source area. Reid (1974) believes that the Hazel and Allamoore Formations were originally interbedded and constituted a single formation. King (*in* King and Flawn, 1953) states that both were tectonically mixed in a complex structure of folds and thrust faults. In most places, the Allamoore is overlain by the Hazel, but because of thrusting the Allamoore is topographically higher at this locale (Table 1 and figs. 3 through 5).

Van Horn Sandstone

The Van Horn Sandstone, of Precambrian (?) age, normally unconformably overlies the Allamoore and Hazel Formations (Table 1). "The Van Horn Sandstone is characteristically a coarse, red, arkosic sandstone in thick or massive beds, and containing occasional scattered pebbles. No fossils are known. The sandstones are interbedded with and are underlain by thin to thick beds of conglomerate . . . Sandstones project in great rounded ledges, largely barren of vegetation, and on the faces of escarpments rise in picturesque towers, prows and battlements" (King *in* King and Flawn, 1953).

Bliss(?) Sandstone

The Bliss(?) Sandstone, of Ordovician age, unconformably overlies the Van Horn Sandstone (Table 1 and fig. 5). The basal meter or so of the Bliss(?) is a rounded vein-quartz pebble conglomerate, whereas the majority of the formation is white or light brown quartzose sandstone in beds a few centimeters to ep cm

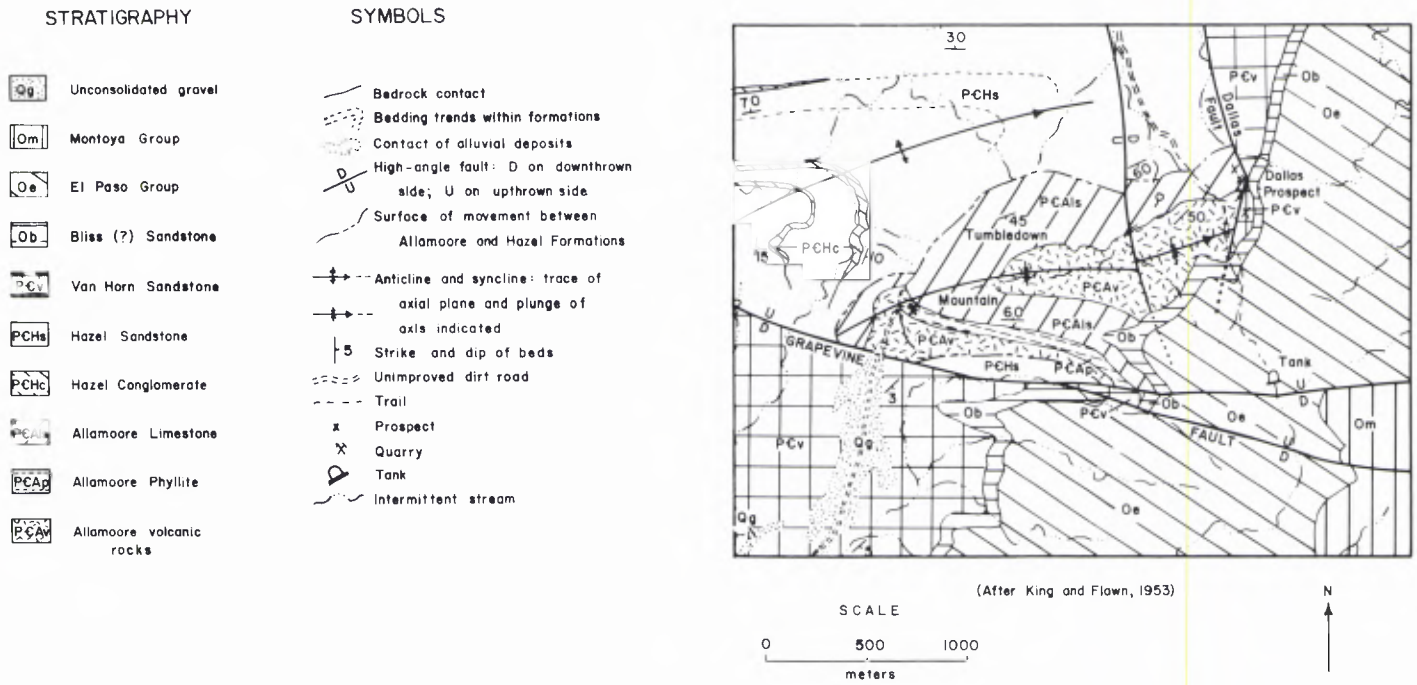

Figure 3. Geologic map of Tumbledown Mountain, Culberson County, Texas.

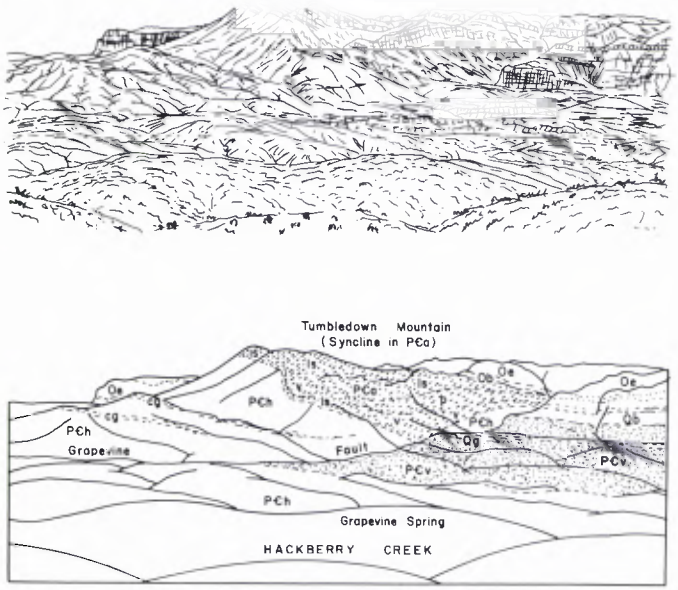

Figure 4. Top. Panoramic view of west face of Tumbledown Mountain. Geologic features of panorama are summarized in lower sketch. P€a–Allamoore Formation, with units of limestone (ls), volcanic rocks (v) and phyllite (p); P€h–Hazel Formation with conglomerate (cg); P€v–Van Horn Sandstone; Ob–Bliss(?) Sandstone; Oe–limestone of the El Paso Group; Qg–unconsolidated gravel (after King, in King and Flawn, 1953).

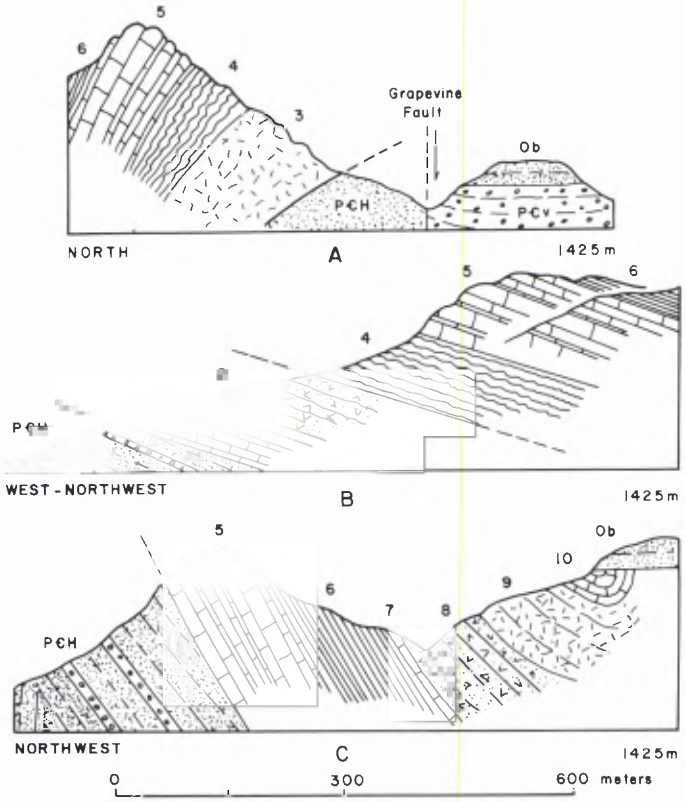

Figure 5. Geologic cross-sections through the Allamoore Formation on Tumbledown Mountain. A, South side of mountain; B, west end of mountain; C, north side of mountain. Numbers refer to units in section as given in Table 2. P€H–Hazel Formation; P€v–Van Horn Sandstone; Ob–Bliss(?) Sandstone. Note "surface of movement" between the Allamoore and Hazel Formations, and that between beds 2 and 3 of B (after King, in King and Flawn, 1953).

Table 1. Stratigraphic column for Tumbledown Mountain, Culberson County, Texas.

AGE	ROCK UNIT
Quaternary	Unconsolidated sand and gravel
	Unconformity
Ordovician	Montoya Group El Paso Group Bliss (?) Sandstone
	Unconformity
Precambrian (?)	Van Horn Sandstone
	Unconformity
Precambrian	Hazel Formation Unconformity Allamoore Formation

thick. The beds are commonly laminated, cross-bedded and ripple-marked. Vertical worm tubes (*Scolithus*) are common.

El Paso and Montoya Groups

Limestone of the El Paso Group succeeds the Bliss(?) Sandstone on Beach Mountain (Table 1, figs. 3 and 4). It is about 335 m thick and consists of calcitic and dolomitic limestone; several thick beds of calcareous or dolomitic sandstone occur in the lower part. Fossils indicate that it is of Early Ordovician (Beekmantown) age and equivalent to several formations of the Ellenburger Group of central Texas.

On the summit of Beach Mountain, to the southeast of Tumbledown Mountain (fig. 3), the El Paso Group is overlain by massive dolomitic and cherty limestone belonging to the Montoya Group, of Late Ordovician (Cincinnatian) age.

Quaternary Gravels

Unconsolidated deposits, of probable Pleistocene age (Table 1), at Tumbledown Mountain consist of material derived from the exposed older rocks of the area. These deposits have been dissected by modern drainage systems. Currently forming deposits are composed of fragments of the older exposed rocks and are restricted to modern drainage systems.

TUMBLEDOWN MOUNTAIN TALC DEPOSIT

General Remarks

Talc-bearing rocks on Tumbledown Mountain are restricted to the phyllite unit of the Allamoore Formation. Tectonic emplacement of the Allamoore on the Hazel resulted in thickening of the Allamoore by partial duplication along a "surface of movement" within the Allamoore (figs. 3 thru 5). Deformation of the Allamoore due to thrusting is illustrated by the synclinal structure of the Allamoore and intense folding and shearing within the phyllite unit.

Lithology and Structure

Exposures of interbedded dark and light gray talcose phyllite and black, silicified limestone and chert can be seen in gullies and cuts along the southern side of Tumbledown Mountain. In these, alternating light and dark gray talc laminae (< 1 cm thick) parallel the gross bedding of the syncline; foliation is parallel to lamination. Laminae (< 1 cm) of white limestone and black, silicified limestone and chert are commonly intercalated with the talc. Beds of black, usually silicified, limestone and chert of 3 cm to 40 cm thickness can also be observed in these exposures.

Evidence of more intense deformation may be seen in the faces of the mine. Here, one can see highly sheared and folded phyllite and interbedded black, silicified limestone and chert. Foliation developed parallel to lamination, and glide along laminae produced open and tight chevron, ptygmatic and recumbent folds within the phyllite. A strongly marked slaty cleavage roughly parallels the axial planes of these minor folds. The more brittle and thicker silicified limestone and chert beds are deformed into moderately tight to open folds; commonly, the beds are fragmented and now form boudinage structure. The more plastic phyllite was deformed by flowage around and between the limestone and chert fragments. Tension gashes, now filled with white coarsely crystalline quartz, occur in the thicker limestone and chert beds perpendicular to bedding.

Axial plane cleavage of the minor folds, as viewed in the mine faces, roughly parallel the axis of the large synclinal structure. A few second-generation folds, roughly perpendicular to the first generation, have been observed in the mine. The orientation of the folds indicates that the principal direction of thrust of the Allamoore was from southeast to northwest, with secondary movement from southwest to northeast.

MINING AND MILLING OPERATIONS

All current talc production in the Allamoore district is by open-pit methods utilizing tracked and rubber-tired mine vehicles, and medium to large haulage trucks. During the 1960's, high-grade talc was selectively mined underground with rail-mounted equipment.

At Tumbledown Mountain, limestone overburden and subgrade talcose phyllite are bulldozed downslope from the mine. Explosives detonated in small-diameter holes, drilled by an air-driven track-mounted drill rig, break the massive limestone beds into manageable blocks. The interbedded phyllite and limestone are broken by rippers mounted at the rear of bulldozers. Once ripped, the material is pushed over the edge of the bench. The accumulated material is loaded onto medium-sized (10 to 25 mton) trucks by rubber-tired front-end loaders with about 1.5 to 2 m^3 capacity buckets. The smaller trucks carry their loads directly to the processing plant, while the larger ones dump their loads at a stockpile located on a flat area about 3 km from the mine. The stockpiled talc is transported by the smaller dump trucks and semi-trailers.

Processing Methods

Most of the talc produced in the Allamoore district is processed as described below; high-grade talc is handled differently. It is reduced to the desired fineness by passing it through a primary jaw or cone crusher to produce a uniform particle size, and then through a secondary rod mill or cone crusher. Screening of the product gives different size fractions, which are further processed to remove impurities before sale for use in the paper, paint and cosmetic industries.

The low-grade talc is normally passed through a primary jaw or cone crusher and then hand-sorted to remove gangue limestone and chert. The sorted material is further reduced to about 3 cm particle size by secondary rod mills or cone crushers; screening and remilling of larger fragments insures uniformity of size. The screened material is fed into a gas-fired rotary kiln for calcining. Carbon dioxide, carbon and water are driven off during calcining

Table 2. Stratigraphic section of Allamoore Formation on Tumbledown Mountain (after King, in King and Flawn, 1953).

	Estimated thickness (in meters)
Bliss (?) Sandstone at top of section	
Unconformity	
Allamoore Formation	
(10) Brown, thinly laminated limestone, with siliceous bands, forming massive ledges. Exposed only in small patches in core of syncline, beneath Bliss (?) Sandstone	30.5
(9) Dark greenish or reddish, amygdaloidal igneous rock, probably a lava flow or flows, in part interbedded with underlying sandstone	61
(8) Medium- to coarse-grained, maroon-red sandstone, in part filled with dark grains a few millimeters across, perhaps igneous detritals. The sandstone is well laminated, the gritty beds alternating with the finer grained beds. The sandstone is darker and less reddish on freshly broken surfaces	91.5
(7) Very massive, jagged-surfaced brown limestone, perhaps dolomitic. Forms top of resistant beds of mountain, the beds above being carved into a canoe-shaped basin between the enclosing limestone ridges	9
(6) Siliceous beds, strikingly banded by light buff siliceous layers, and red-brown sandy-calcareous layers, the respective layers being a few millimeters to 15 cm thick. Some bedding surfaces show faint small-scale ripple-marks.	61
(5) Main limestone body of the mountain. Pale gray or pale brown limestone, with some dark gray or blue-gray limestone, the latter thinly laminated and possibly bituminous. Chert is common in many beds but particularly in the more massive layers. Some of the chert bands in the massive layers follow a series of zig-zags, the points of which are hardly rounded; these seem not to be due to crumpling and may be original in the deposit, and perhaps caused by organic growth. At one place the top bed consists of massive pink limestone with some laminated structure that resembles *Cryptozoon*, whose upper surface rises into knobs and points that are overlapped by the succeeding siliceous beds of member (6)	76
(4) Blue-black, fissile phyllite, sericitic and graphitic, with some blue-black hornstone and gray calcareous layers. Bare exposures at southwest end of mountain show intensely contorted bedding caused by prominent slaty cleavage. Exposed only on south and southwest sides of mountain; pinches out between member (5) and underlying Hazel Formation on north	30.5
(3) Greenstone, either an intrusive or a massive flow. Dense, fine-grained, tough rock, blue-black where fresh, dark olive-green where weathered; some fragments in float are amygdaloidal. Crops out only on south side of mountain	61
Surface of movement	
(2) Reddish sandstones of pyroclastic origin, with some interbedded lava. The member is identical in appearance to bed (8) and quite different from bed (3), which it overlaps in places	76
(1) Lower limestone, similar to bed (5); exposed only on lower western slopes of mountain	15 - 46
Surface of movement	
Hazel Formation at base of section; overlain by bed (3) on south side of mountain; by bed (1) on west end; and by bed (5) on north side.	

and the characteristic properties of talc are destroyed. The resultant product is hard, white to light gray, artificial diopside-like substance used in the ceramic industry.

Talc Grades and Uses

Baseline grade of talc throughout the district is set at approximately 30 percent, by volume, carbonate material; higher carbonate content produces a subgrade uneconomical talc-carbonate deposit. The various grades of talc and their respective market prices are directly related to the amount of impurities present and the particle size of the product. Impurities include limestone, silica, carbonaceous material and any other substance that affects the hardness and color of the talc. High-grade talc, very light colored highly pure masses, commands high market prices and is relatively rare in the district. The more abundant low-grade talc is not actually sold as a talc, but rather as an artificial diopside-like compound, which is used in the ceramic industry. Production costs, market prices and tonnage figures for reserves and mined material are not released by the operating companies. However, market prices can be determined by referring to *Engineering and Mining Journal* and *Industrial Minerals*.

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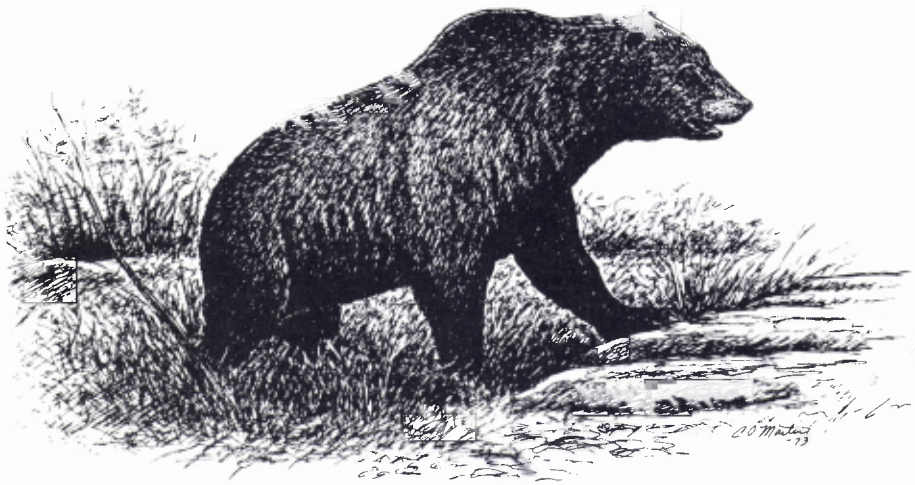

Grizzly bear, *Ursus arctos*.