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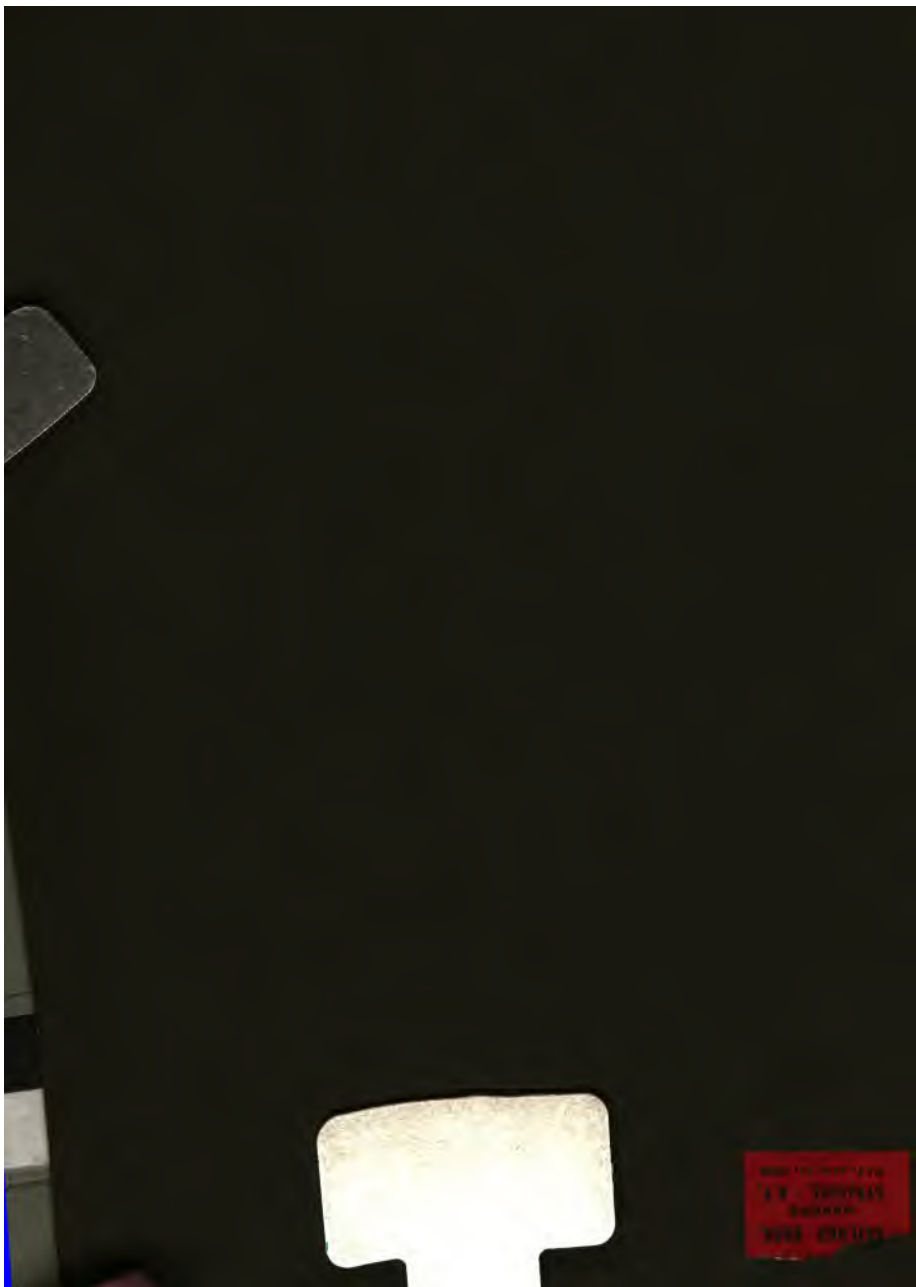
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TABLES FOR THE DETERMINATION

OF THE

COMMON MINERALS  
AND ROCKS

BY

W. A. TARR

Assistant Professor of Geology and Mineralogy  
University of Missouri

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# INTRODUCTION

A mineral may be defined as any inorganic substance found in nature that has a definite chemical composition. Minerals usually have a definite crystalline structure, also, but this is not essential, as is shown in the case of limonite, bauxite, and psilomelane. The tables include all the very common minerals and also a number that are less abundant, altho some of them may be very important as the source of some of the metals, such as galena, sphalerite, stibnite, hematite, etc.

It is possible to determine the names of the various minerals by the use of their physical properties. The most important properties are streak, color, luster, hardness, cleavage, fracture, structure, specific gravity, and more rarely, odor, taste, feel, and magnetism. It is always necessary to make these determinations upon a fresh specimen, because minerals are changed by the action of water, gases, temperature, etc. But by using care, the minerals which are similar in some properties but different in others, can be separated.

The streak of a mineral is the color of its powder. This may be obtained by rubbing it upon a streak plate or by scratching or breaking up a fragment and noting the color. Fresh material must be used. The streak is the first property determined.

The color of a mineral may always be the same, or it may range thru various shades of one color, or the same mineral may have several different colors.

Luster is defined as the appearance of the surface in reflected light. Minerals are divided into two groups on the basis of their luster, viz., metallic and non-metallic. Minerals with a metallic luster reflect light like a metal. There are various lusters in the non-metallic group, common ones being vitreous, greasy, earthy, waxy, adamantine, resinous, etc. These are defined in the glossary.

Hardness is the resistance a mineral offers to scratching. Use a good knife (a good knife blade usually has a hardness of about 5.5) or compare the mineral to another of known hardness. This is done by seeing which one in the known scale will scratch it. The common scale of hardness is as follows: 1—talc, 2—gypsum, 3—calcite, 4—fluorite, 5—apatite, 6—orthoclase, 7—quartz, 8—topaz, 9—corundum, 10—diamond. Fibrous or finely granular minerals usually appear softer than the individual fibers or grains really are. Use the same pressure for all the minerals. In the group where the streak is white or light gray, the minerals are grouped according to their hardness.

Cleavage is the property of minerals to break or split easily along certain planes in the mineral. These planes are parallel to each other and are also parallel to some possible crystal face. Thus a mineral with cubic cleavage splits parallel to the cube faces, etc. There are various degrees of cleavage which may be called perfect, imperfect, good, fair, or poor.

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Fracture is that character of the surface obtained when a mineral is broken in any direction other than that parallel to the cleavage. There are several fractures as follows: conchoidal, uneven, splintery, hackly, smooth, and earthy.

The various ways in which minerals can occur are known as structures. The great majority of minerals do not show crystal forms but occur in masses or aggregates. Various terms are in use to define these forms, the following being the most important; bladed, botryoidal, columnar, compact, crested, fibrous, foliated, lamellar, prismatic, mammillary, and stalactitic.

The specific gravity of a mineral is its weight compared to that of an equal volume of water. This can be roughly determined by the use of the Jolly specific gravity balance, or on any balance.

Some minerals have a distinct odor after they have been moistened or rubbed. Kaolin has an earthy odor after moistening by breathing upon it; pyrite gives off a sulfurous odor on being struck, etc.

Those minerals which are soluble in water can be tasted. Salt or halite is a very common example of these.

Various minerals feel smooth, soapy, clayey, or rough to the touch.

A few minerals are attracted by a magnet, and one variety of magnetite acts as a lodestone or magnet itself.

For further definitions see the glossary.

Do not expect to find every property listed in the tables perfectly developed on each mineral. Such a case would be unusual, altho in most cases there will be a sufficient number of physical properties to determine the mineral easily.

## GLOSSARY

Adamantine luster—like that of the diamond.

Basal cleavage—splits parallel to the end or base of a crystal.

Bladed—elongated or flattened, like the blade of a knife.

Botryoidal—closely united spherical masses, resembling a bunch of grapes.

Cleavage—a property of minerals to break or split easily in certain directions, yielding approximately smooth surfaces.

Columnar—long thick fibers.

Compact—closely united.

Conchoidal—the breaking of a mineral with a rounded or curved surface like the interior of a shell.

Concretion—rounded masses formed about a center.

Crested—flat, parallel crystals with their edges projecting as ridges.

Crystal—Xl—a substance bounded entirely or nearly so, by natural plane faces.

Earthy—looks like clay, dull.

Effervescence—the mineral dissolves, giving off a gas as bubbles.

Fibrous—consists of slender fibers or threads.

Foliated—in plates or leaves that separate easily.

Fracture—any surface obtained when a mineral is broken not parallel to the cleavage.

Hackly—rough surface covered with sharp points.

Iridescence—usually a thin film on the surface of a mineral which produces a play of colors.

Lamella—small, thin plates or layers, curved or straight.  
 Luster—the manner in which a surface reflects light.  
 Magnetic—attracted by a magnet.  
 Metallic luster—reflecting light like a metal.  
 Prismatic—a crystal elongated parallel to the vertical axis.  
 Resinous luster—having the appearance of resin.  
 Stalactites—cylindrical masses, resembling icicles.  
 Rhombohedral—shaped like a rhomb.  
 Sectile—capable of having slices cut off.  
 Tarnish—a thin, colored film on the surface of a mineral. It differs from the color of the mineral.  
 Vitreous luster—reflects light like glass.  
 Waxy luster—reflects light like wax, or looks like wax.  
 Xls—crystals.

### KEY TO THE TABLE

1. Streak Black or nearly so, to Steel Gray.  
 Color: Dark Gray or Black. Page 6.  
 Brass Yellow or Bronze to Purplish. Page 6.
2. Streak Red or Brownish Red. Page 6-8.  
 Color: Red or Brown. Page 7.  
 Dark Gray or Black. Page 8.
3. Streak Yellow or Yellowish Brown.  
 Color: Yellow. Page 8.  
 Brown or Black. Page 8.  
 Yellowish Green. Page 10.
4. Streak Blue or Green.  
 Color: Blue or Green. Page 10.  
 Dark Green or Black. Page 10.
5. Streak Uncolored—White or Light Gray.  
 Transmits light on thin edges.  
 Hardness—1-2.5. Can scratch with the finger nail. Page 10-12.  
 Hardness—2.5-5.5 or 6. Will not scratch glass. Pages 12-14.  
 Hardness—5.5 to 6 or over. Will scratch glass. Pages 14-18.

## STREAK DARK GRAY TO BLACK

H	Color	Streak	Cleavage or Fracture	Luster	G
COLOR: DARK GRAY TO BLACK					
1-2.5	Steel gray to black	Darker than color	Basal, perfect	Metallic dull	2.2
2	Dark lead gray	Gray, black	Prismatic, gives long, shiny faces	Metallic	4.5
2.5	Dark lead gray	Dark gray to black	Cubic, perfect	Metallic	7.5
2.5-3	Dark lead gray	Lead gray	C—good but rarely seen F—conchoidal to uneven	Metallic	5.5 5.8
5-6	Grayish black; dull black	Brownish to black	F—conchoidal	Submetallic	2.2 4.7
5.5	Iron black	Iron black	F—uneven	Metallic	5.2

### COLOR: BRASS YELLOW TO BRONZE TO PURPLISH

3	Purplish, copper brown, horse-flesh brown.	Grayish black	F—uneven	Metallic	4.9 5.4
3.5 4	Deep brass yellow	Greenish black	F—uneven to conchoidal	Metallic	4.2
3.5	Bronze yellow	Grayish black	F—uneven	Metallic	4.6
4.5	Bronze brown				
6 6.5	Pale brass yellow	Greenish black	F—uneven	Metallic	5
6	Whitish brass yellow	Black	F—uneven	Metallic	4.9

## STREAK RED OR BROWNISH RED OR BROWN

### COLOR: RED OR BROWN

1.5 3	Reddish to brown	Reddish bwn.	F—earthy	Earthy, dull	2.5
1-4	Brownish red to cherry red	Dark red, cherry-red	F—earthy	Earthy, dull	2.5-5
2.5 3	Copper red	Copper red	F—hackly	Metallic	8.8



## STREAK DARK GRAY TO BLACK

Structure	Other Properties	Name and Composition
<b>COLOR: DARK GRAY TO BLACK</b>		
Foliated, laminated, scaly, earthy	Feels greasy; marks paper; sectile; scales flexible, inelastic	Graphite, Carbon
Prisms, often bent; bladed	Brittle; sometimes iridescent; tarnished	Stibnite, $Sb_2S_3$
Cubes and granular masses	Sectile to brittle; often found with sphalerite	Galena, $PbS$
Xls rare. Massive or as grains.	Often has a bluish tarnish. Associated with pyrite, chalcopyrite, etc.	Chalcoite, $CuS$
Massive rounded masses; kidney shaped	Tough to brittle; often found with limonite	Psilomelane, $MnO_2 \cdot H_2O$ , etc.
Octahedrons, massive, granular to compact	Brittle; strongly magnetic	Magnetite, $Fe_3O_4$

## COLOR: BRASS YELLOW TO BRONZE TO PURPLISH

Compact; massive	Usually has many colors, but purple predominates; brittle	Bornite, $Cu_5FeS_4$
Massive; compact; rarely in four-sided crystals	Softer than pyrite, may have a tarnish; brittle	Chalcopyrite, $CuFeS_2$
Massive, granular	Slightly magnetic; surface often tarnished bronze-brown	Pyrrhotite, $Fe_7S_8$
Cubes, pyritohedrons, massive, granular	Very common. Found everywhere. Cubes are striated. Brittle	Pyrite, $FeS_2$
Arrow shaped Xls, may have curved faces, stalactites	Never in the form of cubes; white on fresh surface	Marcasite, $FeS_2$

## STREAK RED OR BROWNISH RED OR BROWN

### COLOR: RED OR BROWN

Clay like masses with small round concretions	Distinguished from clay by the concretions. Clayey odor	Bauxite, $Al_2O_3 \cdot 2H_2O$
Compact, granular, earthy, nodules, etc. Powder	Red ochre, looks like red clay, which it may be	Hematite, $Fe_2O_3$
Hackly masses, sheets, wires, and crystals	Malleable; often with a dark tarnish; sometimes greenish tarnish	Copper, $Cu$

## STREAK RED, OR BROWNISH RED OR BROWN

H	Color	Streak	Cleavage or Fracture	Luster	G
COLOR: RED OR BROWN					
3.5 4	Brown, dark reddish bwn., red, deep red	Reddish bwn.	C—perfect. 12-sided forms	Resinous, vitreous	4
4.5 5	Red to reddish brown	Pale reddish brown	C—basal fair F—conchoidal uneven	Vitreous, to greasy	3.1

### COLOR: DARK GRAY OR BLACK

2.5 6.5	Dark steel gray to iron black	Brownish-red	C—Micaceous (if present)	Metallic, brilliant	4.4 5.3
3.5 4	Brownish black	Dark brown	C—perfect. 12-sided forms	Resinous, submetallic	4
5-6	Dull black	Very dark brown	F—conchoidal	Submetallic, dull	3.7 4.7
6-7	Black	Dark brown	C—poor	Submet. to metallic	7

## STREAK YELLOW, YELLOWISH BROWN TO BROWNISH

### COLOR: YELLOW

1.5 2.5	Sulphur yellow, honey yellow, straw yellow	Pale yellow	C—poor F—conchoidal	Resinous, vitreous	2
1.5 4	Yellow	Yellowish brown	C—None F—earthy	Earthy to dull. Silky	3.6
3.5 4	Brownish yellow to yellow	Pale yellow	C—12 sided, perfect F—uneven	Resinous	4

### COLOR: BROWN OR BLACK

1.5 3	Brown or black	Browns or yellow	F—earthy	Earthy to dull	2.5
1.5 4	Brown or black	Brownish yellows	F—earthy	Earthy to dull	3.6
3.5 4	Brown to brownish black	Brownish yellow	C—12 sided perfect F—uneven	Resinous	4
3.5 4	Various shades of brown	Pale yellow, ylw-brwn.	C—rhombohedral, perfect	Vitreous	3.8
6-7	Black, red-brown, yellow-brown	Pale ylw. gray-bwn.	F—uneven	Submetallic	6.8 7.1

## STREAK RED, OR BROWNISH RED OR BROWN

Structure	Other Properties	Name and Composition
COLOR: RED OR BROWN		
Granular masses and crystals with rounded faces	Distinguished by its resinous luster, often with galena	Sphalerite, ZnS
Prismatic Xls usually. Massive, granular.	Xls have a fused appearance.	Apatite (CaF) Ca <sub>4</sub> (PO <sub>4</sub> ) <sub>6</sub>

### COLOR: DARK GRAY TO BLACK

Foliated, platy, micaceous, massive granular	Bright sparkling plates or scales. Specular hematite	Hematite, Fe <sub>2</sub> O <sub>3</sub>
Massive, granular and in crystals	May occur with galena, pyrite and chalcopyrite. See above	Sphalerite, ZnS
Massive, granular, compact, kidney shaped	Tough to brittle. Note dull luster and fracture	Psilomelane, MuO <sub>2</sub> H <sub>2</sub> O, etc.
Massive, as grains like sand, pebbles	Usually as grains and pebbles. Very hard and heavy	Cassiterite, SnO <sub>2</sub>

## STREAK YELLOW, YELLOWISH BROWN TO BROWNISH

### COLOR: YELLOW

Massive, in crystals and as crusts	Can be ignited with a match and burns with a blue flame	Sulfur, S
Earthy masses and nodules. Radiating	Yellow ochre. Looks like clay; and often is clay	Limonite, 2Fe <sub>2</sub> O <sub>3</sub> 3H <sub>2</sub> O
Massive, cleavable masses, crystals	Brittle. Often found with galena and chalcopyrite	Sphalerite, ZnS

### COLOR: BROWN OR BLACK

Clay like masses contain concretions	Has a clay odor, often is hard. See above	Bauxite, Al <sub>2</sub> O <sub>3</sub> 2H <sub>2</sub> O
Massive, earthy Radiating nodules	Brown ochre. See above	Limonite, 2Fe <sub>2</sub> O <sub>3</sub> 3H <sub>2</sub> O
Massive, cleavable masses, crystals	Very common color	Sphalerite, ZnS
Rhombohedral, cleavage masses, crystals	The cleavage or crystal faces are often curved. Brittle.	Siderite, FeCO <sub>3</sub>
Grains, pebbles with concentric structure	Note the hardness and the gravity. Stream tin.	Cassiterite, SnO <sub>2</sub>

## STREAK YELLOW, YELLOWISH BROWN TO BROWNISH

H	Color	Streak	Cleavage & Fracture	Luster	G
COLOR: YELLOWISH GREEN					
6-7	Yellowish green, olive green, nearly black	Pale yellow to white	C—basal, perfect F—uneven	Vitreous	3.3

## STREAK BLUE OR GREEN

COLOR: BLUE OR GREEN					
1-2	Dull green, often dark	Greenish whitish	F—earthy	Dull	2.2
1.5 2.5	Grass green to dark green	Pale green gryish grn.	C—basal, perfect	Pearly, dull vitreous	2.8
2-4	Bluish green to greenish blue	Pale green Pale blue	F—uneven to conchoidal	Vitreous, earthy	2 2.3
3.5 4	Bright green, dark green, emerald green	Emerald green	F—uneven, splintery	Vitreous, silky, dull	4
3.5 4	Azure blue	Smalt blue	F—uneven	Vitreous, velvety	3.8
4-6	Light to dark green	Greenish wht. to white.	C—prismatic	Vitreous, silky	2.9 3.2
5-6	Blackish green to leek green	Greenish-gray pale green	C—prismatic, perfect F—uneven	Vitreous submet,	3.2 3.6
5-6	Dark shades of green	Greenish gray yellowish	C—prismatic, perfect F—uneven	Vitreous, silky	2.9 3.3

## COLOR: DARK GREEN TO BLACK

5-6	Greenish black, pitch blk., brwn-black	Gray, green, brwn-gray	Angle between the faces 124°	Vitreous, silky	2.9 3.3
5-6	Greenish black, pitch-black, to brownish blk.	Greenish-gray to gray	C—Prismatic, good angle between the faces 87°	Vitreous to dull	3.2 3.5

## STREAK UNCOLORED. WHITE OR LIGHT GRAY

HARDNESS 1—2.5. CAN SCRATCH WITH FINGER NAIL

1 1.5	Green, white, gray	White	C—basal, perfect F—uneven to splintery	Silky to greasy, silky metallic	1-2.5
1-2.5	Light to olive-green, yellowish-green.	White	—fibrous	Pearly to greasy	2.6 2.8

## STREAK YELLOW, YELLOWISH BROWN TO BROWNISH

Structure	Other Properties	Name and Composition
<b>COLOR: YELLOWISH GREEN</b>		
Slender, striated prisms, massive, fibrous, etc.	Translucent to opaque. Has a peculiar green color	Epidote, Hydrous Ca, Al, Fe, silicate

## STREAK BLUE OR GREEN

<b>COLOR: BLUE OR GREEN</b>		
Grains or granular massives. Earthy.	Common in green sands. Also as grains in limestones and marls.	Glauconite, Hydrous silicate of K and Fe.
In foliated scaly, granular, earthy masses	Tough to brittle. Flexible but not elastic like the micas.	Chlorite, H <sub>2</sub> O, Mg, Al, silicate
Massive, opal-like masses	Brittle. Adheres to the tongue. Usually found with copper ores.	Chrysocolla, CuSiO <sub>3</sub> 2H <sub>2</sub> O
Fibrous, banded, stactitic, botryoidal, masses	Often as a stain on rocks. May be interlayered with azurite. Effervesces with HCl.	Malachite, CuCO <sub>3</sub> Cu(OH) <sub>2</sub>
Crystals, fibrous, banded, acicular	Usually found with malachite. Like malachite.	Azurite, 2CuCO <sub>3</sub> Cu(OH) <sub>2</sub>
Long slender crystals, radiating, fibrous	124° is the angle between the cleavage faces	Actinolite, Ca(MgFe) <sub>3</sub> (SiO <sub>3</sub> ) <sub>4</sub>
Short, thick Xls., 8 sided, granular	Distinguished from hornblende by the 87° angle between faces	Augite, Ca, Mg, Fe, Al, silicate
Long slender Xls, fibrous, blades, granular	Distinguished by its 6 sided Xls and 124° angle between faces	Hornblende Ca, Mg, Fe, Al, silicate

## COLOR: DARK GREEN OR BLACK

Long slender prisms, 124° between cleavage faces	Common. Determined by the angle between faces as given above	Hornblende, Ca, Mg, Fe, Al, SiO <sub>2</sub>
Short thick, 8 sided Xls. Angle 87°	Brittle. Determined by its cleavage angle and 8 sides	Augite, Ca, Mg, Fe Al, silicate

## TRANSMIT LIGHT ON THIN EDGES

Foliated, fibrous, compact masses	Seetle. Greasy or soapy feel. Inelastic plates. Soapstone when finely granular	Talc, H <sub>2</sub> Mg <sub>3</sub> Si <sub>4</sub> O <sub>13</sub>
Fibrous, rarely massive	Fibers flexible and easily separated. Feels smooth. Beautiful fibers.	Asbestos (chrysotile) H <sub>3</sub> Mg <sub>3</sub> Si <sub>2</sub> O <sub>5</sub>

## STREAK UNCOLORED OR WHITE OR LIGHT GRAY

H	Color	Streak	Cleavage & Fracture	Luster	G
HARDNESS 1-2.5. CAN SCRATCH WITH FINGER NAIL					
1-2	Dull green, often dark	White	F—earthy	Dull	2.2
1-2.5	White, gray, pink and red	White	C—basal, perfect F—conchoidal	Pearly, vitreous, silky dull	2.2 2.4
1.5 2.5	Yellow	White	F—uneven to conchoidal	Vitreous to greasy	2
1.5 2.5	White, yellow, brown, gray	White	F—earthy	Earthy to dull	2.6
1.5 3	Reddish, brownish, yellow, white	White or the same as color	F—earthy	Earthy to dull	2.5
2 2.5	White, gray, yellow, brown	White	C—perfect, into thin sheets	Pearly to vitreous	2.7 3
2-2.5	Black, brown, green	White, gray,	C—perfect, into thin sheets	Pearly to vitreous	2.7 3.1
2-2.5	Dark to grass green	Gray, white, green	C—perfect, as very fine scales	Pearly, vitreous, dull	2.8
2.5 3	White, red, blue, green, gray, etc.	White	C—cubic, perfect F—Conchoidal	Vitreous	2.2
2.5 5	Light and dark green, honey-yellow, white	White	F—uneven to conchoidal, splintery	Waxy, greasy, dull	2.5
HARDNESS 2.5 to 6.5 or 6. WILL NOT STRATCH GLASS					
2.5 3	White, red, blue, green, gray,	White	C—cubic, perfect F—conchoidal	Vitreous	2.2
2.5 5	Light and dark green, honey-yellow, white	White	F—uneven to conchoidal, splintery	Waxy, greasy dull	2.5
2.5 3.5	White, yellowish, gray pinkish, brown	White	C—basal and prismatic, good F—uneven	Vitreous, pearly	4.5
3	White, pink yellow, red, brown, gray, green	White	C—perfect, cleaves into rhombohedrons, even in very small fragments	Vitreous, pearly, dull	2.7

## TRANSMIT LIGHT ON THIN EDGES

Structure	Other Properties	Name and Composition
Grains or granular massive. Earthy	Common in green sands. Also as grains in limestones and marls.	Glauconite, Hydrrous silicate of K and Fe.
Tabular, transparent Xls, massive, granular, fibrous	3 varieties of gypsum. Cleaves into thin sheets not flexible or elastic—selenite. Fibrous—satin-spar. Granular massive—alabaster	Gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
Crystals, crusts, massive	Brittle. Catches fire easily and burns with a blue flame	Sulfur, S
Massive, compact masses, earthy, soapy, friable	Clay odor when breathed upon. Adheres to the tongue. Plastic, greasy.	Kaolin, $\text{H}_4\text{Al}_2\text{Si}_2\text{O}_9$
Massive with pea-shaped concretions	Clay odor, distinguished from kaolin by the pea-shaped masses.	Bauxite, $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
In plates or books. Sometimes large. As scales	Tough and transparent. Flexible and elastic. Splits easily.	Muscovite, $\text{H}_3\text{KA}_3(\text{SiO}_3)_3$
In plates or books, scales, micaceous	Tough. Dark colored even in the thinnest sheets. Splits easily. Flexible and elastic	Biotite, Silicate of H, K, Al, Mg, & Fe
Micaceous scaly masses, lusterous	Tough to brittle. Flexible, but not elastic like the micas	Chlorite, $\text{H}_2\text{O}, \text{Mg}, \text{Al}$ Silicate
Massive granular masses. Xls.	Tough. Salty taste, soluble in water	Halite (Common Salt) NaCl
Massive, compact, fibrous	Tough, brittle; smooth, greasy feel	Serpentine, $\text{H}_4\text{Mg}_3\text{Si}_2\text{O}_{10}$
<b>WILL NOT SCRATCH GLASS</b>		
Massive granular masses. Xls.	Brittle. Salty taste. Soluble in water	Halite (Common Salt), NaCl
Massive, compact, fibrous	Tough, brittle; smooth, greasy feel.	
Tabular, prismatic Xls. Crested or divergent groups. Compact, lamellar	Brittle. Easily determined by its high specific gravity and cleavage. Often found in limestones	Barite (Heavy Spar) $\text{BaSO}_4$
Long, sharp Xls and short Xls. Rhombohedrons, massive granular, cleavable masses. Found in cavities in many kinds of rocks	Perfect cleavage into rhombs, easy effervescence with hydrochloric acid make it easy to determine. Transparent to opaque. There are many varieties of calcite	Calcite, $\text{CaCO}_3$

## STREAK UNCOLORED, WHITE OR LIGHT GRAY

H	Color	Streak	Cleavage & Fracture	Luster	G
HARDNESS—2.5 to 5.5 or 6. WILL NOT SCRATCH GLASS					
3-3.5	White, grayish, bluish-gray, gray, reddish	White	C—perfect in two directions, fair in the third F—uneven	Vitreous to pearly	2.9-3
3.5	Gray, yellowish, brown, white, etc.	White or gray	C—good into rhombohedrons with slightly curved faces	Vitreous pearly dull	2.9
3.5 4	Pink, gray, white, brown	White to gray	C—into rhombohedrons F—conchoidal	Vitreous, pearly,	3.8
3.5 4	Honey-yellow yellowish brown, reddish	White to yellowish	C—perfect into sided forms if complete. Not usual	Greasy, resinous submetallic	3.9 4.2
4	White, yellow, green, pink, purple	White	C—readily into octahedrons or an 8 sided forms	Vitreous	3
3.5 4.5	White, gray, brown	White	C—rhombohedral perfect F—conchoidal when massive	Dull to earthy, rarely vitreous	3 3.1
4.5 5.5	White to gray	White to gray	C—prismatic at an angle of 124°.	Vitreous to silky	2.9 3.2
4.5 5	Green, brown, red, white, gray, etc.	Usually white	C—basal fair F—conchoidal—uneven	Vitreous to greasy	3.1
4-7	Blue, white, bluish gray, reddish and green	White	C—perfect in two directions producing bladed forms F—fibrous	Vitreous, pearly	3.6
HARDNESS Above 5.5 or 6. WILL SCRATCH GLASS					
5-6	Usually dark green or black but may be light green or white	Lighter than the color	C—has perfect cleavage giving an angle of 124° F—uneven	Vitreous to silky	2.9 3.3
5-6	Color usually like the above mineral but lighter	Lighter than the color	C—good, giving an angle of 87° F—uneven	Vitreous to dull bronzy	3.2 3.5



## TRANSMIT LIGHT ON THIN EDGES

Structure	Other Properties	Name and Composition
<b>WILL NOT SCRATCH GLASS</b>		
Granular, massive, lamellar or fibrous	Brittle. Looks like marble or sugar. Not so heavy as barite. Acid has no effect.	Anhydrite, $\text{CaSO}_4$
Cleavable masses, Xls have curved faces	Brittle. Nearly always some shade of brown. Sp. Gr. Dissolves slowly in hot HCl.	Siderite, $\text{FeCO}_3$
Usually has crystal faces which are curved. Granular masses.	Has curved faces and does not effervesce in cold hydrochloric acid unless in a powder	Dolomite, $\text{CaMg}(\text{CO}_3)_2$
Granular, cleavable masses, Xls	Resinous luster and good cleavage	Sphalerite, $\text{ZnS}$
Very common as cubic Xls, granular; cleaves easily	Transparent to translucent. Easily determined by octahedral cleavage and hardness	Fluorite, $\text{CaF}_2$
Massive, rarely crystalline. As disseminated grains	Conchoidal F, prominent and characteristic.	Magnesite, $\text{MgCO}_3$
Prismatic Xls, usually. Massive, granular	Cleavage faces at an angle of $124^\circ$	Actinolite, $\text{Ca}(\text{MgFe})_2$
Bladed Xls, often radiating, fibrous	Xls have a fused appearance	Apatite, $(\text{CaF})\text{Ca}_4(\text{PO}_4)_3$
As long blade-like Xls.	Often has bluish spots in the Xls	Cyanite, $\text{Al}_2\text{SiO}_5$

### NOT SCRATCHED WITH A GOOD KNIFE AS A RULE

Long, slender crystals. Bladed, fibrous, columnar	May be softer, due to alteration. Six sided crystals. Cleavage angles $124^\circ$ . Luster brighter than augite, cleavage also better	Hornblende (several varieties). Silicate of Ca, Mg, Fe, Al
Short thick Xls. Compact masses, etc.	Recognized by the shape of the Xls. Cleavage faces at angle of $87^\circ$ . 8 sided Xls.	Augite. Silicate of Ca, Mg, Fe, Al

## STREAK UNCOLORED. WHITE OR LIGHT GRAY

H	Color	Streak	Cleavage & Fracture	Luster	G
HARDNESS ABOVE 5.5 or 6. WILL SCRATCH GLASS.					
5-6	White, light gray to light green, also pink	White	C—perfect at an angle of 124° F—uneven.	Vitreous to silky	2.9 3.1
5-6	White to light or rarely dark green, grayish	White to gray to greenish	C—good in two directions at an angle of nearly 90° F—uneven to conchoidal	Vitreous often dull, rarely pearly	3.2 3.6
5-6	Light to dark green	White to gray	C—prismatic at an angle of 124°	Vitreous to silky	2.9 3.2
4-7	Blue, white, bluish gray, reddish and green	White	C—perfect in two directions producing bladed forms. F—fibrous	Vitreous, pearly	3.6
5.5-6	White, gray, greenish colorless	White	C—poor F—conchoidal to uneven	Vitreous to greasy	2.55 2.65
5.5	White, to gray	White	C—poor F—conchoidal	Vitreous to greasy	2.5
5.5 6	Blue, gray white, greenish, yellowish	White	C—not distinct; if present, dodecahedral F—conchoidal to uneven	Vitreous greasy	2.14 2.30
6	White, pink, red, yellow, green, gray, black	White	C—perfect in two directions at 90° F—uneven, splintery	Vitreous, pearly	2.6
6 6.5	White, yellowish, green	White	C—good in two directions F—uneven	Vitreous, pearly	2.55
6	Gray, often dark, grayish white	White-	C—perfect in 2 directions, nearly 90° F—uneven	Vitreous, glassy	2.7
6-6.5	White, gray, colorless	White to white	C—perfect in 2 directions, nearly 90° F—uneven	Vitreous, pearly glassy	2.6
6-7	Yellowish green, dark green	Grayish, etc.	C—basal, fair, not common F—uneven	Vitreous,	3.3
6.5 7	Various shades of green	White	F—uneven to subconchoidal	Vitreous, glassy	3.2
6.5 7.5	Red, brown, yellow, pink, etc. black	Usually colored light	F—uneven to conchoidal	Vitreous, Rarely resinous	3.4 4.3

## TRANSMIT LIGHT ON THIN EDGES

Structure	Other Properties	Name and Composition
NOT SCRATCHED WITH A GOOD KNIFE AS A RULE		
Xls, usually long bladed or short and stout. In long thin Xls in aggregates, rarely fibrous.	Note good cleavage at 124°, silky luster, and form of Xls	Tremolite, $\text{CaMg}_2(\text{SiO}_3)_4$
Usually short thick prisms, nearly square or 8-sided, may be granular, rarely fibrous.	Shape of Xls and cleavage angles aid in its determination	Diopside, $\text{CaMg}(\text{SiO}_3)_2$
Bladed Xls, often radiating, fibrous.	Cleavage faces at an angle of 124°	Actinolite, $\text{Ca}(\text{MgFe})_2(\text{SiO}_3)_4$
As long blade-like Xls.	Often has bluish spots in the Xls	Cyanite, $\text{Al}_2\text{SiO}_5$
Usually massive or as embedded grains. Xls thick and 6-sided.	Note greasy luster and poor cleavage. Never with quartz, may be with sodalite, feldspar, etc.	Nephelite, $(\text{NaK})\text{AlSi}_3\text{O}_8$
Rounded grains, often with crystal faces.	Brittle. In well developed Xls or rounded grains in igneous rocks	Leucite, $\text{KAl}(\text{SiO}_3)_2$
Xls are 12-sided forms. More commonly massive or as grains.	If blue, readily recognized, otherwise told by its associates, nephelite and leucite. Never with quartz	Sodalite, Na, Al, Silicate with some chlorine.
Xls, short and thick. Granular and massive	Brittle. Two cleavages at about 90°. Commonly associated with quartz in granite. Very common feldspar	Orthoclase, $\text{KAlSi}_3\text{O}_8$
Xls fine. Cleavable to granular masses	Only the green varieties can be distinguished from orthoclase	Microcline, $\text{KAlSi}_3\text{O}_8$
Large, cleavable masses	Brittle. Often shows fine play of colors, greens, reds, blues, etc. Striated on one cleavage face	Labradorite, $\text{CaAl}_2\text{Si}_2\text{O}_8$ and $\text{NaAlSi}_3\text{O}_8$
Cleavable masses. May show fine twinning lines on one face. Massive	Often twinned so as to show striations on the cleavage faces	Albite, $\text{NaAlSi}_3\text{O}_8$
Long slender Xls, fibrous. Massive. Xls may be striated	Recognized by its peculiar yellow green color. Very characteristic	Epidote, Complex silicate of Ca, Mg, Fe, Al
Rounded green grains. Massive, granular	Brittle. Usually in basaltic rocks. Note its hardness and color	Olivine, $(\text{MgFe})_2\text{SiO}_4$
Usually as crystals, 12 to 24 sides. May be as rounded grains. Massive	Brittle. Opaque to translucent. H. and color and shape aid in determining it	Garnet, Silicate of Ca, Mg, Al, Fe

## STREAK UNCOLORED. WHITE OR LIGHT GRAY

H	Color	Streak	Cleavage & Fracture	Luster	G
HARDNESS Above 7 WILL SCRATCH GLASS					
THE FOLLOWING ARE ALL VARIETIES OF QUARTZ. NO CLEAVAGE					
7	Colorless	White	F—conchoidal to uneven	Vitreous to greasy	2.6
7	Pink	White	F—conchoidal to uneven	Vitreous to greasy	2.6
7	White and milky	White	F—conchoidal to uneven	Vitreous to greasy	2.6
7	Purple and amethystine	White	F—conchoidal to uneven	Vitreous to greasy	2.6
7	White, gray, etc.	White	F—marked conchoidal to uneven	Waxy to vitreous, dull	2.6
7	Banded, red, white, pink, brown, green, etc.	White	F—marked conchoidal to uneven	Dull to waxy to vitreous	2.6
7	Red, yellow, brown	White	F—marked conchoidal	Dull, waxy	2.6
7	Dark gray to black	White	F—marked conchoidal	Dull, waxy	2.6
7	White or light gray	White	F—marked conchoidal	Dull, waxy	2.6
7	Dark brown to nearly black	Non-colored to grayish	C—fair in one direction	Sub-vitreous to dull or resinous	3.65 3.77
7-7.5	Dark brown to green, red, pink, etc.	White	C—not good F—uneven to subconchoidal	Vitreous,	4.4 4.8
7.5-8	Green, yellow, blue, pink, etc.	White	F—conchoidal to uneven	Vitreous,	2.6 2.8
9	Gray, bluish, brown and many other colors	None	C—fair in 3 or 4 directions F—conchoidal	Vitreous to dull	3.9 4.1

## TRANSMIT LIGHT ON THIN EDGES

**Structure                      Other Properties                      Name and Composition**  
**CANNOT BE SCRATCHED BY A KNIFE**

THE FOLLOWING ARE ALL VARIETIES OF QUARTZ. NO CLEAVAGE

Usually as perfect six-sided crystals	Brittle. No cleavage. Use hardness and luster (vitreous to greasy) and F.	Rock Crystal, $\text{SiO}_2$
Usually as perfect six-sided crystals Also massive	Brittle. No cleavage. Use hardness and luster (vitreous to greasy) and F.	Rose Quartz, $\text{SiO}_2$
Massive and crystals	Brittle. No cleavage. Use hardness and luster (vitreous to greasy) and F.	Milky Quartz, $\text{SiO}_2$
Crystals, 6 sided. Massive	Brittle. No cleavage. Use hardness and luster (vitreous to greasy) and F. and color	Amethyst, $\text{SiO}_2$
Always massive	Tough. Determined by luster, fracture and toughness. Translucent	Chalcedony, $\text{SiO}_2$
Always massive and banded	Tough. Determined by luster, fracture and toughness. Translucent. Agate bands colored	Agate and Onyx, $\text{SiO}_2$
Massive and as nodules	Tough. Determined by the luster, fracture, toughness and color. Opaque	Jasper, $\text{SiO}_2$
Massive and as nodules	Tough. Determined by the luster, fracture, toughness and color. Opaque	Flint, $\text{SiO}_2$
Massive and as nodules	Tough. Determined by the luster, fracture, toughness and color. Opaque	Chert, $\text{SiO}_2$
Prismatic Xls. Twins, + or X shaped	Readily determined by hardness, flat Xls, and twins	Staurolite, Hydrous Fe Al silicate
Crystals, 6 sided or triangular in outline	Brittle. Xls are striated vertically. Note triangular outline if in Xls	Tourmaline, Very complex silicate
Crystals, 6 sided, columnar	Brittle. Translucent to transparent. Long Xls striated vertically. Very hard	Beryl, $\text{Be}_3\text{Al}_2(\text{SiO}_3)_6$
Usually in short 6 sided Xls. Barrel shaped	Tough to brittle. Easily determined by being harder than all other minerals	Corundum, $\text{Al}_2\text{O}_3$

## INTRODUCTION TO ROCK TABLE

A rock may be defined as any material forming an essential part of the earth's crust. A rock is usually regarded as a hard substance and the term is generally applied to such materials, but it also embraces such soft materials as clay, mud, sand, etc. There are three great groups of rocks: **igneous** rocks, those that result from the solidification of molten material; **sedimentary** rocks, those which are deposited by water, air, and ice; **metamorphic** rocks, those produced from either of the first two by the various metamorphic processes which change the original materials either wholly or in part. The majority of the rocks found under the head of massive rocks in division III of the table are igneous rocks; divisions I and II contain the majority of the sedimentary rocks; while metamorphic rocks occur in all three of the major divisions.

The following table is designed so that the student will use the physical properties to separate the various kinds of rocks and thus lead up to the rock name. This has a tendency to prevent the use of pre-conceived ideas as to the name (which are only too often erroneous) and to cause the student to observe the real differences.

It is only attempted to bring the more common rocks into the various divisions in such a way that they may be readily separated. In using the table first determine the hardness of the rock and this will rate it in division I or II or III. Care must be exercised in this determination altho the lines between the groups are not very close. Choose a fresh portion of the rock, especially if the surface is decayed and note whether the specimen is really scratched or whether some of the minerals are merely broken. In the case of the schists and gneisses the mica is apt to be merely scratched off the specimen. Having decided on which division it is in, it should be noted whether it is in group A (massive rocks) or group B (banded rocks). Under these groups the various rocks are arranged approximately according to their hardness. This arrangement cannot be followed in Division III because the rocks are all very similar in hardness. Instead, the massive group, which is by far the largest group, is divided into sub-groups based on the size of the grains or minerals. The size of the grains and their relations to each other is what is known as texture. Once a specimen is located in a group the application of the specific tests given will soon separate the various rocks and give the proper name.

The tables do not attempt to bring together the rocks which belong to the same petrographic class. The primary object is to get a name for and learn something about the composition and physical properties of the rock.

The materials of the sandstones and conglomerates are usually cemented together or consolidated by pressure. The cements may be calcium carbonate (calcite), silica, clay, or the iron oxides, usually hematite, but also limonite. It should be noted that shales often are calcareous or they may contain some sand and sometimes considerable of the iron oxides. Limestones often contain clay or sand and this should be noted.

Note.—Acetic acid can be used in testing for calcium carbonate, but not for dolomite. Use hydrochloric acid for the latter. When using hydrochloric acid do not put more than a small drop on the rock, always putting it on a fresh surface.

## GLOSSARY

**Massive**—uniform in color and size of grains in all directions.

**Banded**—shows lines or bands of different color or different mineral composition, or bedding planes.

**Foliated**—in bands which are more or less curved.

**Porphyry**—a rock which contains some crystals that are larger than the remainder, although the latter may be large enough to determine. The larger crystals are called **PHENOCRYSTS**. When the phenocryst is determinable its name may be used as a partial name for the rock, thus, if hornblende were the phenocryst, the rock name would be hornblende granite, or hornblende felsite, etc.

**Groundmass**—the fine-grained part of the rock in which the phenocrysts are embedded.

## KEY TO TABLE

- I. The specimen can be scratched with the finger nail.  
Hardness less than 2.5 or 3.
  - A. Massive. Pages 21-22.
  - B. Banded. Page 22.
- II. Rocks that cannot be scratched with the finger nail, but can be scratched with a knife blade. A good knife has a hardness of about 5.5.
  - A. Massive. Pages 22-23.
  - B. Banded. Page 23.
- III. All rocks that are harder than a knife blade.
  - A. Massive (1)
    1. Grained rocks. The grains over 1-16 of an inch, or determinable. Pages 23-24.
    2. Fine-grained rocks. The grains less than 1-16 of an inch, Pages 24-25.
    3. Glassy rocks. Page 25.
  - B. Banded rocks. Page 25.

(1) Most of the rocks in this group may be porphyritic, that is, they may contain some mineral or minerals larger than those in the ground mass.

### I. ROCKS THAT CAN BE SCRATCHED WITH THE FINGER NAIL. A. MASSIVE.

1. Soft, friable, earthy masses, usually white, yellow, or gray. Effervesces with cold hydrochloric acid. **CHALK**. If it has a clayey odor when breathed upon and sticks to the tongue it is called **MARL**.
2. Soft, crumbly, clayey odor, sticks to tongue, sticky and plastic when wet, smooth, greasy feel when rubbed for sometime between the fingers. White, gray, yellowish, and various other colors. Breaks irregularly. **CLAY**.
3. White to gray, crumbly, no odor, not plastic, does not effervesce. **DIATOMACEOUS EARTH**.
4. White, yellow, red, grained masses. No odor, no effervescence. Sometimes fibrous or may be in transparent plates. **GYPNUM**.
5. Similar to 2, but harder and has compact, dull appearance. May effervesce. Breaks into chips. **SHALE**. (See B-2.)
6. Grained; white, red, gray, blue; has salty taste—soluble in water. **ROCK SALT**.
7. Friable, crumbles easily, not scratched. Colors: white, red, brown, green, yellow, etc. Grains merely broken apart and not scratched, composed of rounded or angular grains of quartz and sometimes feldspar. May effervesce. **SANDSTONE**. (See 11-A-6 and 7.)

8. Soft; white, gray; no odor usually, but may have; composed of various sized angular materials, such as broken minerals, rocks, pumice, etc. Porous and light, usually. TUFF.
9. White, sharp, brittle, very porous, the openings are often very large; crushed with the nail. Does not effervesce. SILICEOUS SINTER.
10. Gray or green of various shades, often dark, the light colored ones often showing a shining surface; shows no cleavage; has smooth to gritty feel; and consists of talc, some chlorite, and other materials. SOAPSTONE.

**B. BANDED ROCKS.** Show bedding planes or are foliated.

1. Dense; gray, white, blue, yellow, and other colors: may be finely laminated, otherwise like 2 (above). CLAY.
2. A dense rock, may be coarsely or finely laminated, otherwise like A-5 (above). SHALE.
3. Greenish; greasy feeling in foliated masses; easily cleaves into leaves that bend but do not spring back. The leaves may be small and may be mixed with other minerals. TALC-SCHIST.
4. Green to dark green, very fine grained, dense, smooth feel, shining luster, may have crystals of other minerals. CHLORITE-SCHIST.
5. Very friable and crumbles easily in the fingers. Banded. SANDSTONE. (See A-7)
6. Banded; composed mainly of mica; shiny luster on two sides of the rock; thin layers. Black, white, gray, brown, and green. Rarely so soft. MICA-SCHIST. (See II-B-6)

**II. ROCKS HARDER THAN FINGER NAIL AND SCRATCHED WITH KNIFE.**

**A. MASSIVE.** Do not show bands or bedding planes.

1. Has salty taste. (See I-A-6) ROCK SALT.
2. Dense, dull in appearance, clayey odor. Shell like fracture. Same as I-A-5. SHALE.
3. White, gray, pink, yellow, etc.; grained. No effervescence or odor. (See I-A-4) GYPSUM.
4. Dense to granular; shell-like to smooth fracture; usually easily scratched with knife, H-3; color: white, blue, gray, black, red, etc. Effervesces briskly with cold hydrochloric acid, may contain fossils. LIMESTONE.  
When impure may have clayey odor; then called argillaceous limestone; when grained it is called MARBLE.
5. Similar to the above, except harder, about 4; heavier, and does not effervesce with cold acid unless in fine powder. Will effervesce along a scratch. May be porous. DOLOMITE.
6. Porous, brittle, does not effervesce. (See I-A-9)  
SILICEOUS SINTER.
7. Grains rounded or angular, more or less cemented, with calcite, iron, clay, or silica; may effervesce; may crumble; grains mainly of quartz. Color white, red, brown, gray, etc. SANDSTONE. Same as I-A-7.



8. Similar to 6, only contains feldspar and mica. **ARKOSE.**
  9. Composed of rounded pieces of rocks and minerals more or less firmly cemented together with clay, calcareous material, or even fine sand. Colors vary, usually depending on materials of same; grays, brown, reds, etc. The materials are larger than peas. May effervesce. **CONGLOMERATE.**  
Sometimes the fragments are angular, it is then called a **BRECCIA.**
  10. Angular pieces of various igneous rocks and minerals in more or less fine, ash-like material. Color: white, gray. May look like a felsite. Rarely has clayey odor. **TUFF.**
  11. Yellowish green, dull to waxy luster, dense, smooth to splintery fracture. Hardness 2.5-5 may be harder if quartz is present. Smooth to greasy feel. **SERPENTINE** and **SERPENTINE ROCK.**
- B. BANDED ROCKS OF ABOVE HARDNESS.** Several of the above rocks show some kind of banding.
1. Dull, dense, splits off in chips, shell like fracture, banded, clayey odor, no effervescence. **SHALE.** (See I-A-5)
  2. Effervesces easily with acid. H-3. See 3 above. The bands may be very fine. **LIMESTONE.**
  3. Effervesces only along scratch, harder and heavier than 2. See 4 above—**DOLOMITE.**
  4. Composed of grains of quartz, see 6 above. The bands may be due to different colors or mineral grains. **SANDSTONE.** Composed of grains of feldspar or mica, **ARKOSE.** See 7.
  5. Dense; dull to shiny luster cleaves into thin plates which ring when struck; splintery fracture on the ends; gray, black, green, red, etc. **SLATE.**  
As the mica becomes larger and more abundant the slate becomes **PHYLLITE.**
  8. Contains much mica, some quartz also, cleaves irregularly. Color black, gray, white. The scales of mica **peel off easily.** May contain crystals of garnet, or other minerals. **No feldspar.** **MICA SCHIST.**
  7. Very dark green, usually black, shiny luster, minerals generally long and fibrous. Hardly scratched with knife. Has appearance of a mass of needles. **HORNBLÉNDE SCHIST.**
- III. ROCKS WHICH CANNOT BE SCRATCHED WITH A KNIFE BLADE OR CAN BE SCRATCHED WITH DIFFICULTY.**
- A. MASSIVE ROCKS.**
1. **GRAINED, THE GRAINS OR MINERALS EASILY DISTINGUISHED, OVER 1-16 INCH.**
    - (a) Composed of feldspar and quartz, with or without other minerals. Color: white, gray, pink, red, or green. **GRANITE.**  
There are the following varieties:
      1. Quartz, feldspar, and biotite. **BIOTITE GRANITE,** also called **TRUE GRANITE.**
      2. Quartz, feldspar, muscovite, and biotite. **MUSCOVITE-BIOTITE GRANITE.**
      3. Very coarse-grained granite, crystals one inch or more in size. **PEGMATITE.**
      4. Medium-grained granite with large porphyritic crystals. **PORPHYRITIC GRANITE,**

5. Fine-grained granite with phenocrysts, or a dense rock composed of more than 50% of quartz and feldspar as phenocrysts. **GRANITE PORPHYRY.**
  6. Quartz, feldspar, mica, and hornblende or tourmaline, etc. The last gives the rock its name, as **HORNBLLENDE GRANITE, TOURMALINE GRANITE,** etc.
- (b) Composed of feldspar with little or no quartz. Color: white, gray, shades of red. **SYENITE.**
    1. Contains feldspar and nephelite. **NEPHELITE SYENITE.**
    2. Contains dark feldspar, which may show twinning lines, or a play of colors, as blues, reds, greens, etc. The rock is usually dark gray. **ANORTHOSITE.**
    3. Contains feldspar, hornblende, or mica. **HORNBLLENDE or MICA SYENITE.**
    4. Fine-grained syenite with phenocrysts, or a dense rock with more than 50% of feldspar as phenocrysts. **SYENITE PORPHYRY.**
  - (c) Rocks composed of hornblende and feldspar, or some mica. Color usually light gray. Heavy. **DIORITES.**
    1. May be called **MICA DIORITE** if mica is abundant.
    3. Fine-grained with phenocrysts. **DIORITE PORPHYRY.**
  - (d) Composed of a pyroxene and feldspar (usually dark). Color: usually very dark. Heavy. **GABBRO.**
    1. Composed of feldspar, pyroxene, and olivine. **OLIVINE GABBRO.**
    2. Composed of feldspar, pyroxene, and mica. **MICA GABBRO.**
    3. Large crystals in dark, crystalline groundmass. **GABBRO PORPHYRY.** Not common.
  - (e) Composed of less than 50% of feldspar and some undeterminable ferromagnesian mineral. **DOLERITE.**
    1. Phenocrysts of feldspar, hornblende, or pyroxene in a groundmass of feldspar and some undeterminable ferromagnesian mineral. **DOLERITE PORPHYRY.**
  - (f) (1) Composed of pyroxene and olivine. **PERIDOTITE.**  
 (2) Composed of pyroxene. **PYROXENITE.**  
 (3) Composed of hornblende. **HORNBLLENDE.**
  - (g) This group is more or less light colored, usually some shade of gray, green, or black.
    1. Epidote and quartz or some feldspar. **EPIDOTE ROCK.**
    2. Garnet and either ferromagnesian minerals or possibly feldspar and quartz. **GARNET ROCK.**
  - (h) Very hard and tough; minerals; all quartz; vitreous to dull luster; rounded grains may be seen cemented together; breaks through the quartz grains and not around them as in sandstone; may be banded. **QUARTZITE.**
2. **FINE-GRAINED, DENSE ROCKS, THE MINERALS LESS THAN 1-16 INCH AND NOT RECOGNIZABLE.** If a porphyry, the phenocrysts must make up less than 50% of the rock.
- (a) Light colored rocks; white, red, brown, yellow, light gray, and light green. Break with more or less splintery edges. **FELSITE.**
    1. Same but with phenocrysts (less than 50% of rock) set in a dense groundmass. The phenocrysts may be of any mineral and may give the name to the rock. **FELSITE-PORPHYRY or LEUCOPHYRE.**  
 May also say **QUARTZ-FELSITE-PORPHYRY,** etc.

- (b) Dark colored rocks; dark gray, dark green, black. **BASALT.** May be porous and slaggy looking. Holes are rounded or elongated. **Scoriaceous basalt.**
  - 1. Same with phenocrysts (often olivine). **BASALT-PORPHYRY.**
- (c) Like (h) above—**QUARTZITE.**
- (d) Dense, dark gray to nearly black, tough, has splintery to conchoidal fracture. **HORNSTONE.**

### 3. ROCKS COMPOSED WHOLLY OR IN PART OF GLASS.

- 1. Black, red, brownish, greenish, vitreous, conchoidal fracture. **OBSIDIAN.**
- 2. Resinous, oily or greasy luster, dull, fracture less shell-like than obsidian, generally light colored. **PITCHSTONE.**
- 3. A glassy rock full of tubular openings, usually white, and very light and porous. Often has a satiny luster. Brittle. **PUMICE.**
- 4. Either 1 or 2 may contain phenocrysts; then called a **VITROPHYRE** or **OBSIDIAN-PORPHYRY.**

### B. BANDED OR FOLIATED ROCKS. These rocks may sometimes be very much crumpled and folded.

- 1. Composed of mica with some quartz, garnets, and other minerals. Mica may be biotite or muscovite. The mica can be scratched easily. Colors vary widely. Very shiny on the cleavage faces. Layers usually thin. **MICA-SCHIST.**
- 2. Similar to above but with excess quartz, 50% or more. **QUARTZ-MICA-SCHIST.**
- 3. Dark rock; greenish to black; consisting of long, slender crystals of hornblende. Often has fibrous appearance or radiating appearance on the surface. Bands not readily seen. **HORNBLLENDE-SCHIST**
- 4. Banded rock; gneissic or foliated; usually rather coarse bands; white, red, gray, green, as rule light in color; composed of feldspar with several minerals. Several varieties are known. **GNEISS.**  
Thus if it has the mineral composition of a granite it is called **granite-gneiss**; of a syenite, **syenite-gneiss**, etc. Or, it may contain garnets, then called **GARNET-GNEISS**, etc.

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