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The Minerals of New Mexico

Lee McGuinness

Mc GUINNESS

MINERALS OF NEW MEXICO

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THE MINERALS OF NEW MEXICO

By

Lee McGuinness

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PREFACE

Inorganic bodies known as minerals make up, either in whole rock-masses or in isolated form, the material of the upper crust of the earth. Through the evidence furnished by the study of meteorites, we also infer that other bodies in the universe are made up of minerals, or at least those portions of them which are represented by meteorites.

Since minerals are, then, important in making up the observable part of the earth, a study of them is of importance in any study of the earth. Because the variety of minerals occurring in New Mexico is large, it will be of interest to all students of nature to consider them in some detail. It is the purpose of the present work to acquaint the reader with the types of minerals found in the State, and to present the amateur and professional collector with both information regarding localities where these minerals may be found, and with criteria for their identification. It is to be hoped that this paper may also be of some use as a very elementary textbook of general mineralogy for the beginner.

The work is divided into the following parts:

I. Introduction: Properties of Minerals.

II. Crystallography.

III. Physical Mineralogy.

IV. Chemical Mineralogy.

V. Origin, Occurrence, and Association of Minerals.

VI. Descriptive Mineralogy of New Mexico Minerals, with Lists of Occurrence in the State.

ACKNOWLEDGEMENTS

This paper was prepared under the direction of Dr. Stuart A. Northrop, head of the department, who also prepared a card catalogue from which the lists of occurrences of New Mexico mineral species were taken. The present writer then wrote the descriptions for the species, using all available authorities to insure completeness and accuracy.

The writer wishes, then, to make acknowledgement to the authors of the various standard works on mineralogy, which were very freely drawn upon in the preparation of the material included in this paper. The two works most often used were "Dana's Textbook of Mineralogy", by William E. Ford, and "The System of Mineralogy of James Dwight Dana", by Edward Salisbury Dana. "The Minerals of Connecticut", by John Frank Schairer, was the inspiration for the present work (see bibliography).

Information incorporated in this thesis, concerning a number of New Mexico species, was obtained by the writer in a problems course in determinative mineralogy by means of chemical and blowpipe methods (Geology 251, 1st semester, 1935-36).

CONTENTS

PART I

PART I

GENERAL MINERALOGY

I. INTRODUCTION: PROPERTIES OF MINERALS.

Definition of a Mineral. According to Dana, a mineral may be defined as a body produced by the processes of inorganic nature, having usually a definite chemical composition and, if formed under favorable conditions, a certain characteristic atomic structure which is expressed in the crystalline form and other physical properties.

A mineral, then, must have a homogeneous nature, even in the smallest fragments, and it must have a chemical composition which is usually definite and capable of being expressed by a chemical formula. If the composition varies, as it does in certain species, it does so within definite limits, and usually according to a definite law.

Further, a mineral usually has a definite atomic structure, which is manifested in the physical properties and especially in the external crystalline form. It is not our purpose to consider in detail the abundant proofs of this definite internal structure; it is enough to say that it has been definitely established in most cases by thorough study of physical and optical characters.

For our purpose, we shall restrict the term mineral to substances originating through natural processes alone, terming those compounds formed in the laboratory or metallurgical furnace as artificial minerals.

Mineral species are, further, usually limited to solid substances, the only exceptions being the liquids mercury and water, both meeting in all respects the conditions established in the definition.

Scope of Mineralogy. Any study of mineralogy necessarily embraces five major divisions:

1. Crystallography.
2. Physical Mineralogy.
3. Chemical Mineralogy.
4. Occurrence of Minerals.
5. Descriptive Mineralogy.

Except for the descriptions of New Mexico species, which are given in considerable detail, only the fundamentals will be treated here. For complete information concerning any of the first four phases, the reader is referred to Dana's "Textbook of Mineralogy".#

Dana, Edward Salisbury. A textbook of mineralogy. 4th ed., revised and enlarged by William E. Ford. New York. John Wiley and sons, inc., 1932. 851p

II. CRYSTALLOGRAPHY.

In any consideration of minerals, a study of crystal form is necessary, because a knowledge of the crystal types of the various species is one of the most important means of identification of minerals without chemical analysis. Further, a study of crystallography is valuable because it is in the external crystalline form of minerals that the interatomic structure is best demonstrated. For these reasons, we may regard some knowledge of crystal types as fundamental in mineralogy.

Definition of a Crystal; Terminology. According to Dana, a crystel is the regular polyhedral form, bounded by smooth surfaces, which is assumed by a chemical compound, under the action of its interatomic forces, when passing, under suitable conditions, from the state of a liquid or gas to that of a solid.

Thus a crystal is the normal form of a mineral species, as of all definite chemical compounds when in the solid state, but conditions permitting complete and perfect development of crystal form are seldom realized in mineral formation. Many mineral species always occur in massive form

[illegible]

In the [illegible]

from [illegible]

Indications [illegible]

Thus [illegible]

(without observable crystals), yet with definite molecular structure; in a few cases the definite internal structure is absent, and the mineral cannot exhibit crystal form even when conditions during formation would be ideal for the development of crystals in a normal mineral.

A definite molecular structure is the essential character of a crystal, and it is manifested in several ways, chief among which is the external form. External form without definite relation to internal structure does not make a crystal of a solid; the external form must be a <u>result</u>, not a <u>cause</u>, of the internal structure. For this reason, any man-made object resembling a crystal, such as a crystal model or a cut gem, is not considered as a crystal.

Further, a replacement of mineral A by mineral B, retaining the form of A, is not a crystal, since the molecular structure of B is not responsible for the external form of the resulting mineral.

The term <u>crystal</u>, then, is reserved to minerals showing natural crystal faces; a cleavage or irregular fragment of a mineral, if with definite internal structure, is said to be <u>crystalline</u>, but not a <u>crystal</u>.

Crystalline minerals without external crystal form are said to be <u>massive</u>. If the structure is shown to be the same in all parallel directions through the mass, the

Pattern-color [illegible]
synchrony in [illegible]
scenes, and [illegible]
such conditions [illegible]
development of [illegible]

[illegible] character of a drama, [illegible] ways, [illegible] form without defining [illegible] rhythm, not [illegible]. [illegible]

Rhythm, [illegible] maintains the [illegible] form-giving [illegible].

[illegible] material or [illegible] [illegible] mineral is described as a single individual; if it varies from grain to grain, the mass is said to be a crystalline aggregate.

If the microscope shows more or less distinct crystalline structure, which cannot be resolved into individuals, the mass is said to be cryptocrystalline. If definite structure is entirely wanting, and the structure is the same in all directions through the mass, the material is said to be amorphous. This state is rare among minerals, more than 98 per cent of which exhibit definite crystalline structure, according to statistical study. (Dana)

Constancy of Interfacial Angles. While crystals often show a considerable variation in the size of like faces, producing what are called distorted forms, the angles of inclination between like faces of crystals of any given species are constant, no matter what the source of the mineral. These angles form an important distinguishing characteristic of any species.

Crystal Habit. The actual forms of the crystals may show considerable variation, especially in certain species, even though the interfacial angles between like faces remain constant. Nevertheless, crystals of a single species generally show tendencies toward certain definite types, this being known as crystal habit. There is, further,

usually a considerable diversity in size of crystals, even in a single species, though some species are characterized by large crystals and others by small crystals. The most perfect development of crystal form is found usually in small specimens.

Symmetry. The faces of a crystal are arranged according to certain definite laws of symmetry, forming a natural basis for division of crystal types into systems and classes. The symmetry of like faces, angles, or corners may be defined in relation to a plane of symmetry, an axis of symmetry, or a center of symmetry. Obviously, the highest grade of symmetry will occur when all three-- plane, axis, and center of symmetry, are present. In contrast, the symmetry of a certain class of one of the systems is of such a low grade that neither plane, axis, nor center of symmetry is represented.

In crystals, symmetry is said to apply as long as the angular positions of opposite faces retain equal relation to the plane, axis, or center of symmetry, even if the faces are unequally developed.

In certain species, the crystals may approximate closely in angle the symmetry of other species of higher symmetry. This is known as pseudo-symmetry. Twin or compound crystals of certain species may simulate a higher

grade of symmetry than that which belongs to the individual crystals. This is also pseudo-symmetry, and the crystals are more specifically referred to as mimetic.

In some cases, crystals belonging to a system of high grade of symmetry may imitate the symmetry of a system of lower grade. This is especially true in the isometric system, where distortion may result in elongated forms resembling those of lower systems.

Crystallographic Axes. In describing a crystal, especially with reference to the position of the faces, it is found convenient to assume certain lines passing through the center of the ideal crystal, as a basis of reference. These are the crystallographic axes. In most cases, these may coincide with axes of symmetry, for the symmetry of the crystal generally determines the position of the crystallographic axes.

It is customary to indicate the crystallographic axes by means of letters, and to orient a crystal in terms of the position of these axes with respect to the observer.

The following paragraphs give the number, arrangement, orientation, and lettering of the crystallographic axes of the six systems of crystals.

In the isometric system, all three crystallographic

axes, which are at right angles to each other, are lettered a, since they are equal and interchangeable. With respect to the observer, the horizontal axis coinciding with the line of sight is a_1, the horizontal axis normal to the line of sight is a_2, and the vertical axis is a_3 (Fig. 1, Plate I).

In the tetragonal system, there are three axes at right angles to each other, two of equal length, and one longer or shorter. They are lettered a_1, a_2, and c, a_1 being the horizontal axis in line with the observer, a_2 the horizontal axis (equal to a_1, and interchangeable with it) normal to the line of sight, and c the vertical axis (Fig. 1, Plate III).

In the hexagonal system, there are four axes, three equal and interchangeable axes in a horizontal plane at angles of 60°, and a vertical axis at right angles to these. These are lettered a_1, a_2, a_3, and c, a_1 and a_3 being the horizontal axes oblique to the observer (a_1 to the left and a_3 to the right in front), a_2 the horizontal axis normal to the line of sight, and c the vertical axis (Fig. 1, Plate V).

In the orthorhombic system, there are three axes at right angles to each other, and unequal in length. Any one of these three may be taken as the vertical or c axis. Of the two horizontal axes, the longer is always taken as the

macro-axis or b axis, normal to the line of sight; while the shorter or brachy-axis is taken as the a axis, coinciding with the line of sight (Fig. 1, Plate VIII).

In the monoclinic system, there are three axes of unequal length, two of which are at right angles, while the third is inclined. Of these, the inclined or clino-axis, sloping down toward the observer, is taken as the a axis. Of the two axes at right angles, the horizontal axis normal to the line of sight (and usually longer) is taken as the ortho-axis or b axis. The remaining axis is vertical, and is taken as the c axis. (Fig. 1, Plate IX)

In the triclinic system, there are three axes of unequal length, and oblique to each other. A triclinic crystal when oriented has one axis in a vertical position, the c axis; one sloping down toward the observer, the a axis; and the remaining axis, more or less normal to the line of sight, is the b axis (Fig. 1, Plate X).

Further, the ends of each axis are referred to as being positive or negative, the usual arrangement being as follows: the positive end of the axis parallel (or nearly so) to the line of sight is the one closer to the observer; the positive end of the horizontal (or nearly so) axis normal to the line of sight is at the right of the observer; and the positive end of the vertical axis is the upper one. In the hexagonal system, the positive and negative signs of the

horizontal axes are arranged alternately, with the positive end of the a_2 axis (normal to the line of sight) at the right of the observer; the positive end of the vertical axis is, as usual, the upper one. These relations are brought out clearly for all the systems in the figures referred to at the ends of the preceding paragraphs.

While the actual lengths of the crystallographic axes vary with the size of the individual crystals, the axial ratio (the relative lengths of the axes) for a single species remains constant. For example, in the mineral zircon, the axial ratio is c = 0.64037; that is, the c axis is 0.64037 times as long as the a axes. One of the horizontal axes is always taken as the basis of reference. In the isometric system, the axes are of equal lengths, so the axial ratio is always unity.

Classification. Theoretically, there are thirty-two possible types of symmetry in crystals built up of like structural units, divided into six systems. In nature, seven classes, one in each system except the hexagonal, and two in that system, include by far the larger number of crystallized minerals, though a dozen other classes are represented, some very rarely. These classes containing the majority of crystal types are the normal classes of the various systems.

The normal class of each system not only includes the majority of natural types of crystals, but members of the normal class also possess the highest grade of symmetry possible in the system. As mentioned above, the hexagonal system is divided into two major divisions, each of which has a normal class, and each of which is sometimes treated as a separate system.

The following discussions of the systems include a definition of the symmetry of the normal or highest class for each system, and a description of the more common and important crystal types. These nearly always fall into the normal class, but wherever there are important types outside the normal class, they are also described briefly.

ISOMETRIC SYSTEM (Regular or Cubic System)

In crystals of the isometric system, there are three crystal axes at right angles to each other and of equal lengths (Fig. 1, Plate I).

In crystals of the normal class, there are three like axial planes, dividing the ideal crystal into identical halves, parallel to the cubic faces, and fixing the crystallographic axes by their intersection. There are six like diagonal planes of symmetry, passing through each opposite pair of cubic edges.

Further, there are three like axes of tetragonal

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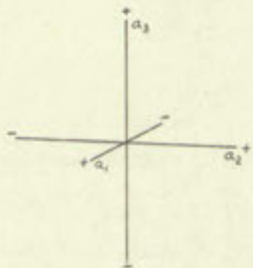
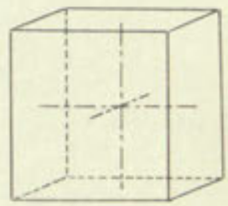
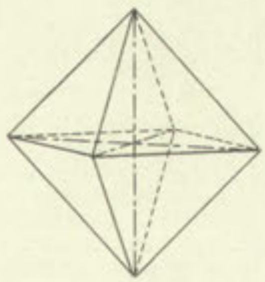
Further, there are three like axes of [illegible]



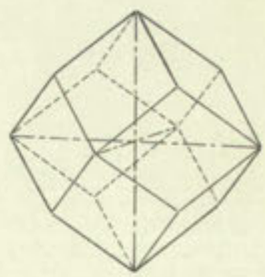
1
Isometric Axes



2
Cube



3
Octahedron



4
Dodecahedron

ISOMETRIC FORMS

symmetry#, coincident with the crystallographic axes and normal to the faces of the cube; four like diagonal axes of trigonal symmetry, normal to the faces of the octahedron; and six like diagonal axes of binary symmetry, normal to the faces of the dodecahedron.

The three simplest types of isometric crystals of the normal class are the cube (Fig. 2, Plate I), the octahedron (Fig. 3, Plate I), and the dodecahedron (Fig. 4, Plate I). The cube is the basal type; the crystallographic axes intersect the centers of the six faces.

If the eight corners of the cube are cut off, forming eight new faces, and if these are enlarged until the cubic faces are obliterated, an octahedron is formed.

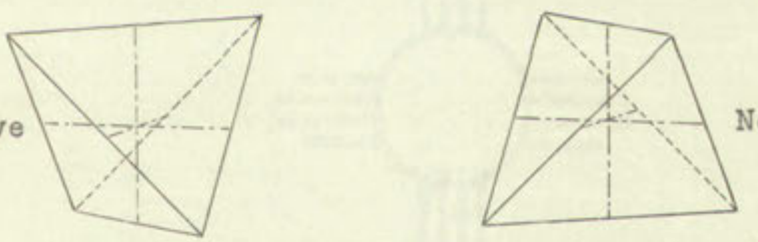
If the twelve edges of the cube are cut off, forming twelve new faces, and if these are enlarged until the cubic faces are obliterated, a dodecahedron is formed. These

---

The terms axis of tetragonal symmetry, axis of trigonal symmetry, axis of binary symmetry, axis of hexagonal symmetry, etc., refer to the fact that a crystal being revolved on one of these axes occupies exactly the same position in space a certain number of times during a complete revolution of 360°, the number depending upon the type of symmetry. For example, a crystal being revolved on an axis of tetragonal symmetry will occupy exactly the same position in space four times during one complete revolution; a crystal revolving on an axis of binary symmetry will occupy exactly the same position twice during one complete revolution, etc.

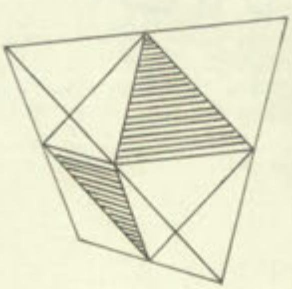
1 2

Pyritohedrons



Positive 3 4 Negative

Tetrahedrons



5

Relation of Octahedron to Tetrahedron

ISOMETRIC FORMS

relations are readily seen by studying the relation of the faces of these two forms to the crystallographic axes in Figs. 3 and 4, Plate I.

These three types alone, or various combinations of them, form most of the crystals of isometric minerals of the normal class.

Two other classes besides the normal class, the pyritohedral and tetrahedral classes, have numerous representatives among isometric minerals.

In the pyritohedral class, the basal type or pyritohedron (Figs. 1 and 2, Plate II) has twelve pentagonal faces, in each of which one edge is longer than the other four similar edges. The type was so named because it is a typical form with the common mineral species pyrite.

In the tetrahedral class, the basal form or tetrahedron (Figs. 3 and 4, Plate II) has four faces, each an equilateral triangle, and meeting the axes at equal distances. It may be formed by enlargement of alternating octahedral faces until the remaining faces are obliterated (Fig. 5, Plate II). Depending on which octahedral faces are enlarged, the resulting tetrahedron is referred to as positive or negative.

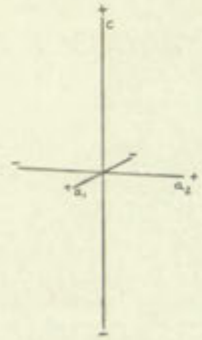
TETRAGONAL SYSTEM

In crystals of the tetragonal system, there are three crystallographic axes at right angles to each other, of which the two horizontal axes are equal in length to each other and interchangeable, while the third or vertical axis is either longer or shorter (Fig. 1, Plate III).

In crystals of the normal class, there is one principal axis of tetragonal symmetry, coinciding with the vertical crystal axis c. There are also four horizontal axes of binary symmetry, two coinciding with the horizontal crystallographic axes, and two diagonal axes bisecting the angles between the first two. There is one principal plane of symmetry, that of the horizontal crystallographic axes, and four vertical planes of symmetry making angles of 45° with each other. The two planes including the horizontal crystallographic axes are called axial planes of symmetry; the other two are diagonal planes of symmetry.

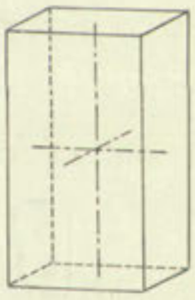
The principal crystal types of the normal class are the square prisms of the first and second order (Figs. 2 and 3, Plate III). The vertical faces are known as prismatic faces or prism faces. The horizontal faces, parallel to the plane of the horizontal axes, are known as the base or basal pinacoid.

These two prisms may occur in combination, in which



1
Tetragonal Axes

2
First Order Prism

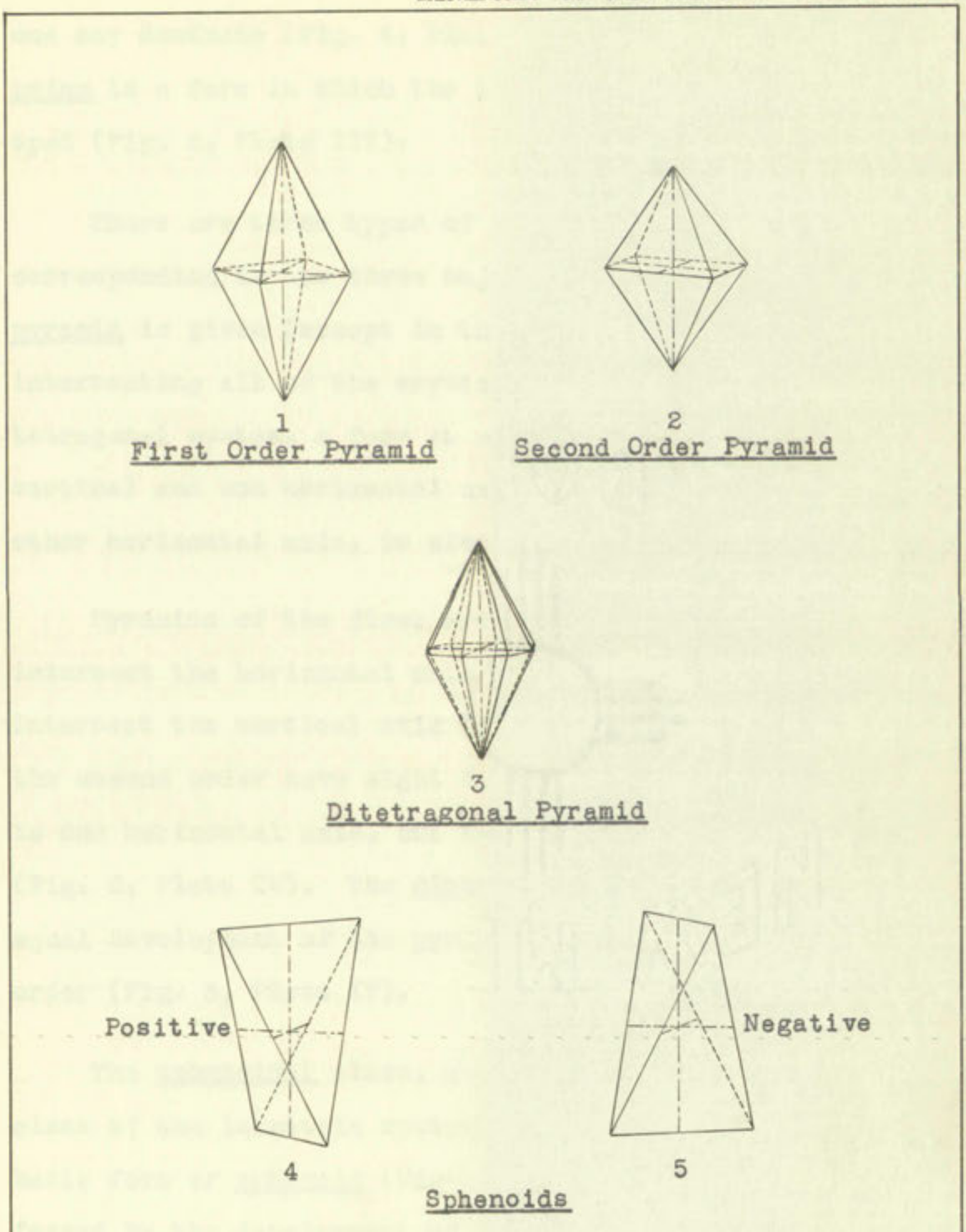


3
Second Order Prism

4
First and Second
Order Prisms

5
Ditetragonal Prism

TETRAGONAL FORMS



TETRAGONAL FORMS

one may dominate (Fig. 4, Plate III). The ditetragonal prism is a form in which the two prisms are equally developed (Fig. 5, Plate III).

There are three types of pyramids in the normal class, corresponding to the three major types of prisms. The term pyramid is given (except in the isometric system) to forms intersecting all of the crystallographic axes. In the tetragonal system, a form in which each face intersects the vertical and one horizontal axis, and is parallel to the other horizontal axis, is also called a pyramid.

Pyramids of the first order have eight faces which intersect the horizontal axis at equal distances, and also intersect the vertical axis (Fig. 1, Plate IV). Pyramids of the second order have eight faces, each of which is parallel to one horizontal axis, but intersects the other two axes (Fig. 2, Plate IV). The ditetragonal pyramid is formed by equal development of the pyramids of the first and second order (Fig. 3, Plate IV).

The sphenoidal class, analogous to the tetrahedral class of the isometric system, is quite important. The basic form or sphenoid (Figs. 4 and 5, Plate IV) may be formed by the development of alternating faces of the first order pyramid. There are two types, positive and negative, depending upon which pyramidal faces are enlarged. The form

[illegible]

[illegible]

spore (Fig. [illegible], Plate [illegible]).

[illegible]

corresponding to [illegible]

[illegible]

[illegible]

[illegible]

vertical and the horizontal [illegible]

other [illegible]

[illegible]

between [illegible]

[illegible]

[illegible]

[illegible]

(Fig. [illegible], Plate [illegible]) [illegible]

[illegible]

order (Fig. [illegible], Plate [illegible]).

[illegible] The [illegible]

[illegible]

resembles a tetrahedron, except that each face is an isosceles instead of an equilateral triangle.

HEXAGONAL SYSTEM

In crystals of the hexagonal system, there are four axes, three equal horizontal axes in a common plane intersecting at angles of 60°, and a fourth, vertical axis, at right angles to them, and longer or shorter (Fig. 1, Plate V).

There are two major sections in this system, each being sometimes treated as a separate system. They are the Hexagonal Division and the Trigonal (or Rhombohedral) Division. In the Hexagonal Division, the vertical crystallographic axis is an axis of hexagonal symmetry; in the Trigonal Division, it is an axis of trigonal symmetry.

There are seven possible classes in the Hexagonal Division. The normal class is by far the most important, but two others are also of importance.

There are five classes in the Trigonal Division. Of these, the rhombohedral class is most important, but three others are important.

[illegible]ssen's calculations, except that [illegible]
isometric instead of a [illegible]

Hexagonal System

In crystals of the hexagonal system there are four axes, three equal horizontal axes [illegible] meeting at angles of 60°, and a fourth, vertical, at right angles to these, and longer or shorter [illegible] V).

There are two major [illegible] sometimes treated as [illegible] Hexagonal Division and the [illegible] Axis. In the Hexagonal Division, [illegible] hexagonal axis is an axis of [illegible] Trigonal Division, it is an axis of [illegible]

There are seven possible classes in [illegible] Division. The normal class is [illegible] but two others are also of [illegible]

There are [illegible] Trigonal Division [illegible] Class, the rhombohedral [illegible] others are important.

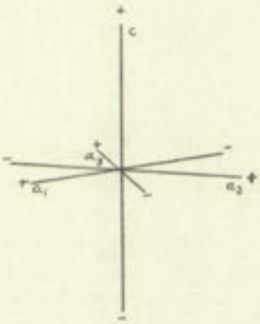
A. Hexagonal Division.

In crystals of the normal class, there is one principal axis of hexagonal symmetry, coinciding with the vertical crystallographic axis; and six horizontal axes of binary symmetry, three of which coincide with the horizontal crystallographic axes, while the other three bisect the angles between them. There is one principal plane of symmetry, the plane of the horizontal crystallographic axes, and six vertical planes of symmetry which intersect the vertical crystallographic axis. Three of these planes include the horizontal crystal axes, and the other three bisect the angles between them.

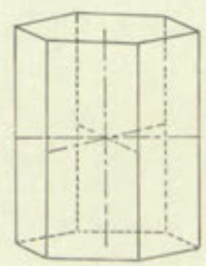
The principal crystal types of the normal class are the hexagonal prisms of the first and second order (Figs. 2 and 3, Plate V). The prisms have six like vertical faces. They are terminated by a horizontal face, the base or basal pinacoid, parallel to the plane of the horizontal crystallographic axes; the prisms may also be terminated by pyramids.

The dihexagonal prism, formed by equal development of first and second order prisms, is also an important type (Fig. 4, Plate V).

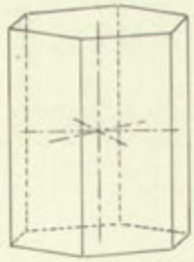
There are three types of pyramids, corresponding to the three major prisms (Figs. 1, 2, and 3, Plate VI).



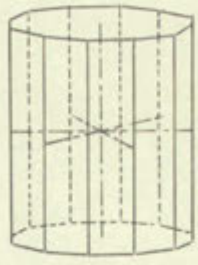
1
Hexagonal Axes



2
First Order Prism

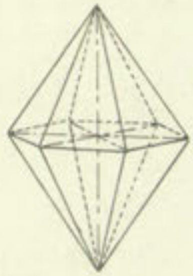


3
Second Order Prism

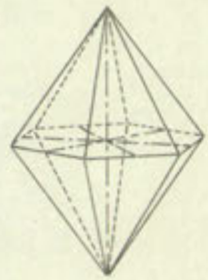


4
Dihexagonal Prism

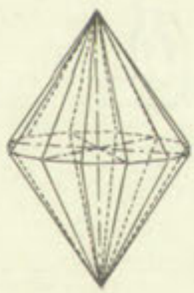
HEXAGONAL FORMS



1
First Order Pyramid

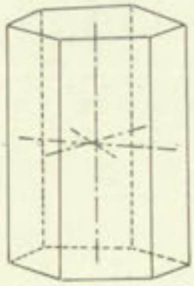


2
Second Order Pyramid

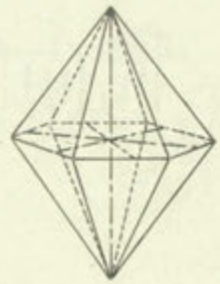


3
Dihexagonal Pyramid

4
Pyramid and Base



5
Third Order Prism



6
Third Order Pyramid

HEXAGONAL FORMS

Combinations of the base with the pyramids are not uncommon (Fig. 4, Plate VI).

These are the most common types of the Hexagonal Division. The two other important classes are the Hemimorphic class; and the Tripyramidal class, in which prisms and pyramids are of the third order (Figs. 5 and 6, Plate VI).

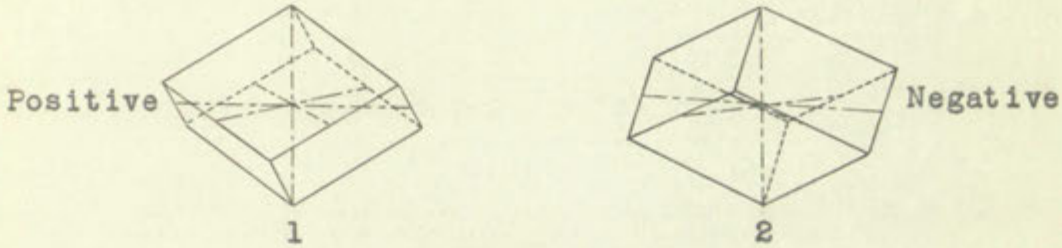
B. Trigonal (Rhombohedral) Division.

In crystals of the rhombohedral class, there is one principal axis of trigonal symmetry, coincident with the vertical crystallographic axis; and three horizontal axes of binary symmetry, parallel to the horizontal crystallographic axes. There are only three planes of symmetry; they are diagonal to the horizontal crystallographic axes and intersect at angles of 60° in the vertical crystallographic axis.

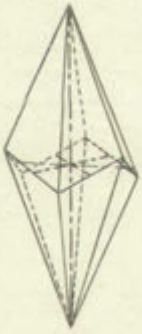
The group is analogous to the tetrahedral class of the isometric system, and to the sphenoidal class of the tetragonal system.

The two important forms, the fundamental types, of the rhombohedral class are the rhombohedron and the scalenohedron (Figs. 1, 2, and 3, Plate VII).

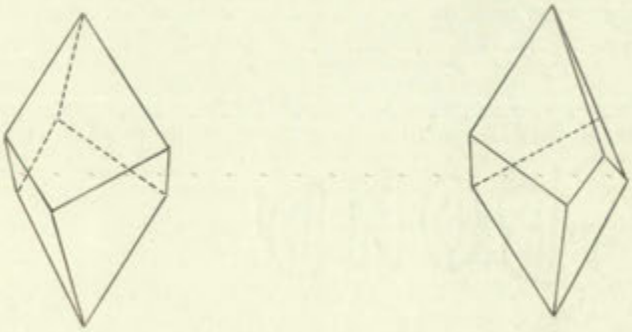
The rhombohedron has six like faces, each a rhomb. There are six like lateral edges forming a zigzag line about the crystal; and six like terminal edges, three above



Rhombohedrons



3
Scalenohedron



4
5
Trigonal Trapezohedrons

HEXAGONAL (RHOMBOHEDRAL) FORMS

and three below, in alternate position. The shape of the rhombohedron varies greatly as the interfacial angles change, so that some types are nearly equidimensional, while others may be flattened.

Rhombohedrons are positive or negative, depending on which alternate sectants the faces fall in. The two complementary forms together embrace all the like faces of the double hexagonal pyramid of the first order of the normal class of the Hexagonal Division, and if they occur equally developed in combination, the form is identical with the pyramid. Usually, there is a slight irregularity in the development, and the better developed rhombohedron is usually taken as the positive one.

The scalenohedron has twelve similar faces, each a scalene triangle. Rouhgly, the form is like that of a double hexagonal pyramid, but there are differences in the angles of the terminal edges, and the lateral edges form a zigzag line around the crystal. It may be thought of as being derived from a dihexagonal pyramid by the development of alternating faces of that form. Scalenohedrons may be either positive or negative also, depending on which alternate faces are developed.

Other forms in this class include the base or basal pinacoid, the prisms, and the pyramids, which are identical in form with those of the normal class of the Hexagonal and three [illegible]. In [illegible]

Rhombohedron varies greatly [illegible]

change, so that some [illegible]

while others may be flattened.

Rhombohedrons are [illegible]

which alternate [illegible]

[illegible] forms together [illegible]

double hexagonal pyramid [illegible]

class of the hexagonal division, [illegible]

developed in combination [illegible]

pyramid. Usually [illegible]

development, and the latter [illegible]

usually shown as the modifi[illegible]

The scalenohedron [illegible]

scalene triangle. [illegible]

double hexagonal pyramid, [illegible]

angles of the [illegible]

zigzag line around the middle [illegible]

being derived from a [illegible]

each of alternating [illegible]

may be taken [illegible]

which alternate [illegible]

Other forms [illegible]

pinacoid, the prism, and the pyramid, [illegible]

in form with those of the [illegible]

Division, and can be distinguished only by the occurrence of rhombohedral faces on other crystals of the same species, or by etching-figures.

There are three other important classes in this division. The first is the rhombohedral-hemimorphic class, in which there are no horizontal axes of symmetry, and no center of symmetry. There are, however, three diagonal planes of symmetry, meeting at angles of 60° in the vertical axis, which is an axis of trigonal symmetry. The class includes the important species tourmaline.

The tri-rhombohedral class has no planes of symmetry, but the vertical axis is an axis of trigonal symmetry, and there is a center of symmetry. The basal types are the positive and negative rhombohedrons of the second order, derived by enlargement of alternating faces of the second order pyramid of the normal class of the Hexagonal Division. Phenacite is the characteristic mineral.

The trapezohedral class is characterized by the absence of planes and center of symmetry, but the vertical axis is one one of trigonal symmetry, and there are three horizontal axes of binary symmetry, coincident with the horizontal crystallographic axes. Quartz is the characteristic mineral here, and the basal form is the trigonal trapezohedron, the faces of which correspond to one-fourth of the faces of the dihexagonal pyramid of the normal class of the Hexagonal

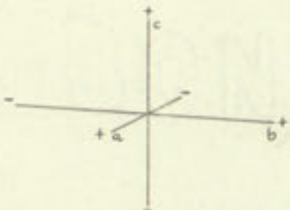
Division (Figs. 4 and 5, Plate VII). There are thus four such trapezohedrons, two positive, and either right- or left-handed; and two negative, and either right- or left-handed, depending on which way they rotate the plane of polarization of light transmitted in the direction of the vertical axis. Right- and left-handed crystals cannot be converted into one another by rotation, but are mirror-images of one another.

<u>ORTHORHOMBIC SYSTEM</u> (Rhombic or Prismatic System)

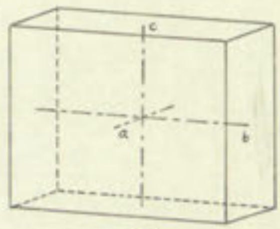
In crystals of the orthorhombic system, there are three axes at right angles to each other, and of unequal lengths (Fig. 1, Plate VIII).

In crystals of the normal class, there are three axes of binary symmetry, coincident with the crystallographic axes. There are also three unlike planes of symmetry at right angles to each other, fixing the crystallographic axes by their intersection.

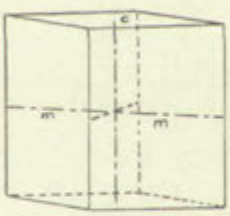
The differences among the isometric, tetragonal, and orthorhombic systems, each of which is characterized by three axes at right angles to each other, are due to the fact that normal isometric crystals are developed equally in the three axial directions; normal tetragonal crystals have a like development only in two directions, those of



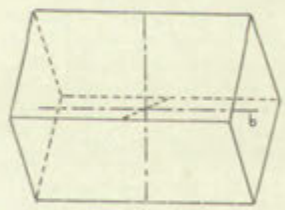
1
Orthorhombic Axes



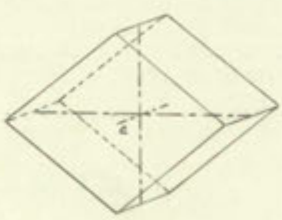
2
Diametral Prism
(Macro-(a), Brachy-(b),
and Basal (c) Pinacoids)



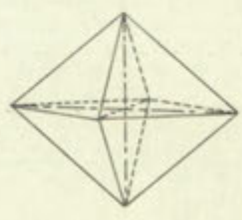
3
Prism (m) and
Basal Pinacoid



4
Macrodome and
Brachypinacoid



5
Brachydome and
Macropinacoid



6
Pyramid

ORTHORHOMBIC FORMS

the horizontal crystal axes; and normal orthorhombic crystals are developed unequally in the three axial directions.

The forms possible in the normal class of the orthorhombic system are the macropinacoid or a-pinacoid, the brachypinacoid or b-pinacoid, the base or c-pinacoid, the prisms, the macrodomes, the brachydomes, and the pyramids.

A pinacoid is a form whose faces are parallel to two axes (parallel to an axial plane). The macropinacoid is parallel to the b and c axes, while cutting the a axis. The brachypinacoid is parallel to the a and c axes, while cutting the b axis. The base or c-pinacoid is parallel to the a and b axes, while cutting the c axis (Fig. 2, Plate VIII).

Each pinacoid is an open form; that is, like faces number only two, and thus cannot enclose a solid body. Together, three pinacoids form the diametral prism, the analogue of the cube of the isometric system (Fig. 2, Plate VIII).

A prism is a form whose faces are parallel to the vertical axis, but intersect the two horizontal axes (Fig. 3, Plate VIII).

A dome, also called a horizontal prism, is a form whose faces are parallel to one horizontal axis, but intersect the vertical and other horizontal axis. The macrodome

A horizontal [illegible]
parts [illegible]

The terms [illegible]

[illegible]

[illegible]

The [illegible]

[illegible]

VIII).

[illegible]

Together, these [illegible]
analogous [illegible]
VIII).

[illegible]

is parallel to the macro- or b axis; the brachydome is parallel to the brachy- or a axis (Figs 4 and 5, Plate VIII).

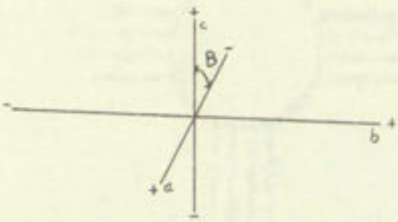
A pyramid is a form whose faces intersect all the axes (Fig. 6, Plate VIII).

Figs. 1-6, Plate VIII, illustrate the various common combinations of forms in the normal class. These, and other combinations of them, make up most of the crystals of orthorhombic minerals.

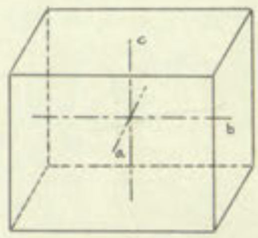
MONOCLINIC SYSTEM (Oblique or Monosymmetric System)

In crystals of the monoclinic system, there are three crystallographic axes of unequal length, two of which are at right angles to each other, while the other is oblique (Fig. 1, Plate IX).

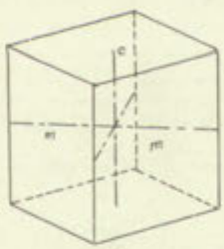
In crystals of the normal class, there is one plane of symmetry and one axis of binary symmetry at right angles to it. The plane of symmetry is always the plane of the a and c axes, and the axis of symmetry coincides with the b axis, normal to this plane. Thus the position of one axis (b) and that of the plane of the a and c axes is fixed by the symmetry, but the a and c axes may occupy different positions in the plane. In crystals of a single species, the angle B between the a and c axes is constant (Fig. 1, Plate



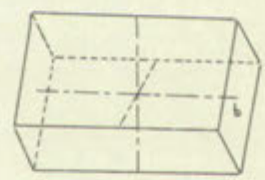
1
Monoclinic Axes



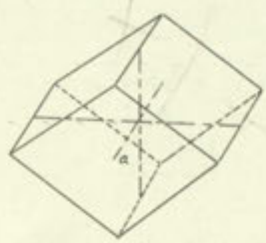
2
Diametral Prism
(Ortho-(a), Clino-(b)
and Basal (c) Pinacoids)



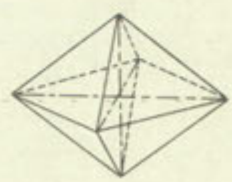
3
Prism (m) and
Basal Pinacoid



4
Orthodomes and
Clinopinacoid



5
Clinodomes and
Orthopinacoid



6
Pyramids

MONOCLINIC FORMS

IX).

The forms possible in the normal class are the <u>ortho-pinacoid</u> or <u>a-pinacoid</u>, the <u>clinopinacoid</u> or <u>b-pinacoid</u>, the <u>base</u> or <u>c-pinacoid</u>, the <u>prisms</u>, the <u>orthodomes</u>, the <u>clino-domes</u>, and the <u>pyramids</u>.

The <u>orthopinacoid</u> includes the two faces parallel to the plane of the ortho-axis <u>b</u> and the vertical axis <u>c</u>. The form is usually designated by the letter <u>a</u>, since it cuts the <u>a</u> axis; thus it is often called the <u>a-face</u> or <u>a-pina-coid</u> (Fig. 2, Plate IX).

The <u>clinopinacoid</u> includes the two faces parallel to the plane of symmetry (the plane of the clino-axis <u>a</u> and the <u>c</u> axis). The face is designated by the letter <u>b</u>, since it cuts the <u>b</u> axis, and the form is called the <u>b-face</u> or <u>b-pinacoid</u> (Fig. 2, Plate IX).

The <u>base</u> or <u>basal pinacoid</u> includes the two terminal faces, above and below, parallel to the plane of axes <u>a</u> and <u>b</u>. The face is designated by the letter <u>c</u>, and is called the <u>c-face</u> or <u>c-pinacoid</u> (Fig. 2, Plate IX). It is inclined to the orthopinacoid <u>a</u>, and the normal angle between faces <u>a</u> and <u>c</u> is the acute axial angle <u>B</u> (Fig. 1, Plate IX).

The <u>diametral prism</u> (Fig. 2, Plate IX), formed by these three pinacoids together, is analogous to the cube of the isometric system. It is bounded by three sets of unlike

faces; it has four similar vertical edges, and four similar edges parallel to the axis a, but the other four edges, parallel to the axis b, are of two sets. The eight solid angles (corners) fall into two sets of four each, the ones above in front being similar to those below behind, and vice versa. These relations may be seen by studying Fig. 2, Plate IX.

The prisms are all of one type, the oblique rhombic prism, consisting each of four faces, cutting the a and b axes while being parallel to the c axis. The unit prism (cutting the a and b axes at unit length) is designated by the letter m. The termination is usually the basal pinacoid (Fig. 3, Plate IX).

The orthodomes consist of four faces parallel to the ortho-axis b, while cutting the other two axes. This form is usually terminated by the clinopinacoid (Fig. 4, Plate IX).

The clinodomes consist of four faces parallel to the clino-axis a, while cutting the other two axes. The ordinary termination is the orthopinacoid (Fig. 5, Plate IX).

The pyramids are really hemipyramids, consisting of four faces only in each form, with two complementary pyramids being necessary to make a closed form, since they replace the solid angles, of which there are two sets. Each face

cuts all three crystallographic axes (Fig. 6, Plate IX).

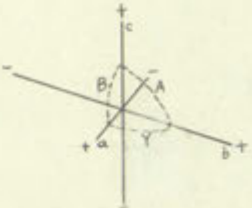
From the symmetry, it can be seen that there are no closed forms in this system. Each form consists of two or four faces. Various combinations of the forms of the normal class make up the majority of crystal types of the system.

TRICLINIC SYSTEM (Anorthic System)

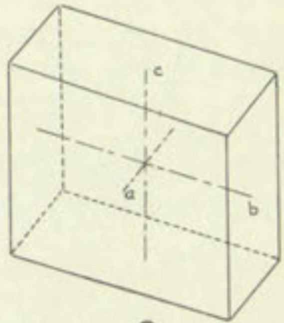
In crystals of the triclinic system, there are three axes of unequal length, all being oblique to one another. The angle between axes b and c is A, that between a and c is B, and that between a and b is Y (Fig. 1, Plate X). There is no necessary relation between the values of A, B, and Y, and any one may be greater or less than 90°.

In crystals of the normal class, there is a center of symmetry, the point of intersection of the three axes, but there is neither plane nor axis of symmetry.

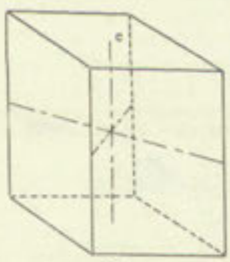
Each of the possible forms consists of two similar faces, parallel to one another and symmetrical with reference to the center of symmetry. The forms are of course open forms. They include the macropinacoid or a-pinacoid, the brachypinacoid or b-pinacoid, the base or c-pinacoid, prisms, macrodomes, brachydomes, and pyramids. In giving the terms macrodome and brachydome, it is assumed that the



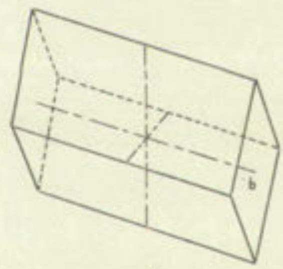
1
Triclinic Axes



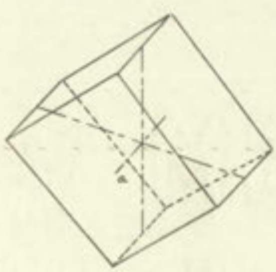
2
Diametral Prism
(Macro-(a), Brachy-(b),
and Basal (c) Pinacoids)



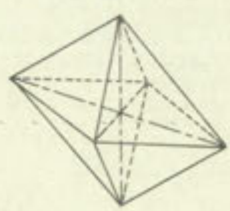
3
Prisms and
Basal Pinacoid



4
Macrodomes and
Brachypinacoid



5
Brachydomes and
Macropinacoid



6
Pyramids

TRICLINIC FORMS

unit length of axis _a_ is less than that of axis _b_. If this is reversed, the terms _brachy-_ and _macro-_ are interchanged.

The _macropinacoid_ or _a-pinacoid_ consists of the two faces parallel to the macro- or _b_ axis and the vertical or _c_ axis, while cutting the _a_ axis (Fig. 2, Plate X).

The _brachypinacoid_ or _b-pinacoid_ consists of the two faces parallel to the brachy- or _a_ axis and the vertical or _c_ axis, while cutting the _b_ axis (Fig. 2, Plate X).

The _base_ or _c-pinacoid_ includes the two faces parallel to the _a_ and _b_ axes, while cutting the _c_ axis (Fig. 2, Plate X).

The _diametral prism_, bounded by the three pinacoids, is also shown in Fig. 2, Plate X. It is the analogue of the cube of the isometric system, and is bounded by three sets of unlike faces. Here like faces, edges, and solid angles include only a given face, edge, or solid angle, and that opposite to it.

The _unit prisms_, of which there are two, consist of two faces each, parallel to the _c_ axis, but cutting the _a_ and _b_ axes at unit length. These two together, with the base, make a common form (Fig. 3, Plate X).

The _macrodomes_, of which there are two, consist of two faces each, parallel to the macro- or _b_ axis, but cutting

the a and c axes. These together, usually with the brachy-pinacoid, make another common form (Fig. 4, Plate X).

The brachydomes include two forms also, each consisting of two faces parallel to the brachy- or a axis, while cutting the b and c axes. These are usually terminated by the macropinacoid (Fig. 5, Plate X).

The pyramids, of which there are four, corresponding to the four sets of solid angles of the diametral prism, cut all three of the axes. The four together make a closed form (Fig. 6, Plate X).

The majority of crystal types of this system are combinations of the above forms of the normal class. Tri-clinic crystals are very difficult to orient, because of their low grade of symmetry, and it is perhaps fortunate that minerals crystallizing in this system are comparitively rare.

<u>Compound or Twin Crystals</u>. Crystals are very seldom found singly, but rather almost always occur in groups. Usually, the relations among individual crystals are irregular, depending upon chance. In some cases, however, the relations of individual crystals to one another are definite, conforming to definite law. If all faces and edges of one crystal are parallel to all faces and edges of another of the same species, they are said to exhibit <u>parallel growth</u> or <u>parallel grouping</u>. If, on the other hand, only a part of their similar faces, edges, etc., are in parallel position, they are said to form a <u>twin crystal</u> or <u>twin group</u>.

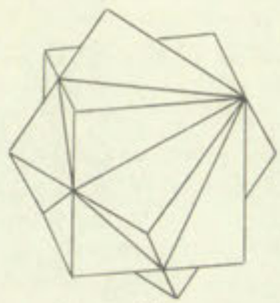
A twin crystal, then, is an intergrowth of two or more individual crystals in such a way that certain similar parts of the two individuals are parallel, while other parts are in reverse position with respect to each other. Sometimes symmetrical examples are found; more often the twinning is demonstrated by the reversed arrangement of some of the faces, in striae on the surface, and in reentrant angles, which are lacking in normal single crystals. A typical example of a twin crystal is a twinned cube of <u>fluorite</u> (Fig. 1, Plate XI).

The component parts of a twin crystal are related to each other, either as mirror-images (as if one were derived from the other by reflection over a common plane), or as if one were derived from the other by a revolution of 180°

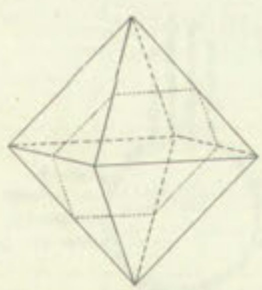
about some axis common to both, or as if both processes took place together. The plane and axis referred to above are the twinning-plane and twinning-axis. These have simple and rational relations to the crystal axes. It is to be observed that no plane of symmetry of an individual crystal can be a twinning-plane in the compound form, since the two halves of a crystal divided by a plane of symmetry are already either mirror-images of one another, or could have been derived by a rotation of 180° by half the crystal, on an axis of symmetry normal to the plane of symmetry. Further, no axis of even symmetry (binary, tetragonal, hexagonal) can be a twinning-axis, since a revolution of 180° by half the crystal on the axis produces exactly the same form as before.

The plane by which the two crystals are united is the composition-plane. In most cases, it coincides with the twinning-plane; if not, it is commonly at right angles to the twinning-plane, that is, parallel to the axis of revolution.

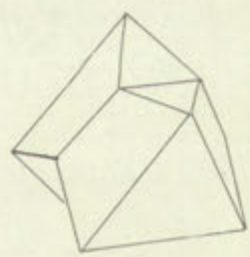
Twin crystals are of two general types: contact-twins, when the two halves are simply united with one another by the composition-plane; and penetration-twins, when the two individuals actually interpenetrate, with a common center which is the center of the axial system for both individuals. This latter case is true in the fluorite twin in Fig. 1,



1
Twinned Cubes
of Fluorite

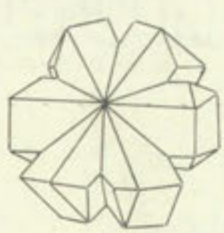


2

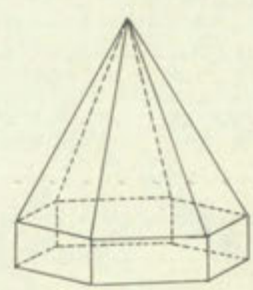


3

Contact-Twinned
Octahedron



4
Staurolite Trilling



5
Hemimorphic Form
Zincite

TWIN CRYSTALS; HEMIMORPHIC FORM

Plate XI. In Fig. 3, same plate, a simple contact-twinned octahedron is shown, derived by a revolution of 180° of half the crystal on the plane indicated by dotted lines in Fig. 2, same plate.

In some cases, extremely thin parallel layers are deposited in crystal growth, each succeeding layer having faces of the kind opposite to those in the preceding layer. This is known as polysynthetic twinning; it leads to fine striations on the plane at right angles to the lamellae. This type of twinning is often observed in the triclinic feldspars.

In certain cases of repeated twinning, the successively reversed individuals are not parallel, and the result is called symmetrical twinning. This type of twinning leads to six-rayed, ten-rayed, etc., twin crystals, known as trillings, fivelings, etc. A trilling of staurolite is shown in Fig. 4, Plate XI.

Holohedral and Hemihedral Forms. A holohedral form is a crystal form which has all the faces having like geometrical positions with respect to the crystallographic axes. Crystals of the normal class in each of the systems are holohedral forms.

A hemihedral form is one belonging to a class of lower symmetry than the normal class, having only one-half of the

faces of the corresponding normal type. Thus the octahedron is a holohedral form of the normal class of the isometric system. The tetrahedron has but half the faces required for normal symmetry; it is a hemihedral form (Figs. 3, 4, and 5, Plate II). The positive and negative tetrahedrons together have all the faces necessary for normal symmetry. This proposition is true for all hemihedral forms: there are two complementary hemihedral forms, positive and negative, which may be considered as derived by enlargement of alternating faces of the normal form. Together, the complementary forms have all the faces required for normal symmetry.

If a form has only one-fourth of the faces necessary for normal symmetry, it is known as a tetartohedral form; four such complementary forms together have all the faces necessary for normal symmetry. Fig. 4 and Fig. 5, Plate VII, show two trigonal trapezohedrons, half of the tetartohedral forms necessary to yield, when combined, the normal dihexagonal pyramid.

Hemimorphic Forms. In hemimorphic forms, one-half of the faces necessary for normal symmetry are present, but in this case the faces present are only those belonging to one extremity of an axis of symmetry and crystallographic axis (Fig. 5, Plate XI). These forms have no center of symmetry, while hemihedral forms do possess a center of symmetry.

Irregularities of Crystals. It has been mentioned previously that ideal crystals are seldom encountered, due to various causes. Most crystals are irregular, and their irregularities may be grouped under four heads: (1) Variation in form and dimensions; (2) Imperfections of surface; (3) Variation of angles; and (4) Internal imperfections and inclusions.

(1) Variation in Form and Dimensions. This type of irregularity is called distortion, and may be regular or symmetrical. The former case is more common. The latter case, while not common, is interesting because symmetrical distortion may produce forms of symmetry different from that of the group to which the crystals belong.

An irregularly distorted quartz crystal, consisting of a prism (m) terminated by positive (r) and negative (z) rhombohedrons, is shown in Fig. 1, Plate XII. A regularly distorted octahedron is shown in Fig. 2, same plate.

(2) Imperfections of Surface. Certain species are characterized by the presence of parallel ridges or furrows on certain crystal faces. These are striae or striations, and the crystal face is said to be striated. This phenomenon may be due to repeated (polysynthetic) twinning, as explained above, or it may be due to alternate occurrence of different faces, due in turn to regular interruption, during growth, of the causes tending to produce a certain face, and

[illegible]

[illegible]

[illegible]

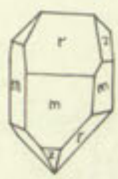
[illegible]

the substitution of causes tending to produce a different face. This is known as oscillatory combination. It is well shown in quartz, in which the prism faces are often striated horizontally, due to alternating combination of the prismatic and rhombohedral faces.

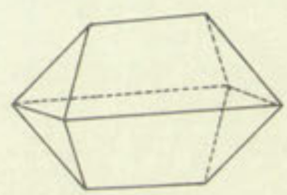
Crystal faces are often irregular, due to various agents, among which are etching by chemical agents or by erosion, or irregularities in crystal growth. There may be minute elevations and depressions caused by oscillatory combination of two or more faces. Oftentimes these minute irregularities are of great importance in revealing the true symmetry of a crystal. Artificial etching is often resorted to in the laboratory to establish the identity of doubtful crystals.

Curved surfaces may result from oscillatory combination on a very fine scale, from independent molecular conditions producing curvature in the lamellae, or from mechanical causes.

(3) Variations in Angle. Most distortions have no effect on the interfacial angles of crystals. Those which produce curved or striated surfaces, however, result in changes of angles. Heat and pressure during formation may result in some changes in angles, as well as producing distortion. The presence of impurities may have a like effect. Pressure during metamorphism may result in change



1
Irregularly Distorted
Quartz Crystal



2
Regularly Distorted
Octahedron

3
Impurities in
Chiastolite

DISTORTION; IMPURITIES

of angles of completed crystals.

Pseudomorphs of a species may vary in angle, due to irregular changes during replacement of the old crystal.

With these somewhat rare exceptions, then, the law of constancy of interfacial angles may be regarded as valid.

There may be a slight difference in the angles of a crystal from those of another crystal of the same species without accidental cause, due to changes in chemical composition. Further, the changes in chemical composition occurring when isomorphous species grade into one another often result in slight but regular changes in interfacial angles.

(4) Internal Imperfections and Inclusions. The perfect transparency of crystals is often affected by disturbances in crystallization, by impurities taken up during crystallization, or by inclusion of foreign matter resulting from a partial chemical alteration. The term inclusion is given to any foreign body enclosed within a crystal, whatever its origin. Inclusions may often be explained by assuming rapid crystallization.

Liquid or gaseous inclusions are often seen, especially in quartz crystals. In some cases, cavities may occur without filling; if regular in form, and conforming to the symmetry of the species, they are called negative crystals.

Solid inclusions vary widely, from purely mechanical admixtures such as sand grains, to separate particles of different minerals, such as magnetite in mica.

Microscopic crystals as inclusions are often of doubtful specific character, and are thus often called microlites. If the minute bodies do not have the regular form of crystals, but are evidently not truly amorphous, they are referred to as crystalloids.

Inclusions are more often regularly than irregularly arranged within the body of the crystal host. A very striking example of this is the regular arrangement of carbonaceous impurities in the variety of andalusite known as chiastolite, as shown in Fig. 3, Plate XII.

Pseudomorphs. While every mineral species is characterized, if crystallized, by a definite external form, crystals are occasionally encountered which have the form, in angles and habit, of a certain species, yet differ entirely in chemical composition. The interior of these crystals is usually granular or waxy, and there is no regular cleavage. Further, optical characters do not conform with those required by the outward symmetry of the crystal.

From these evidences, it is assumed that the material is a different mineral from the original, and has replaced the original, either molecule by molecule, or else by filling a be [illegible] [illegible], from [illegible] [illegible]

admixtures such as [illegible] [illegible] [illegible]

different [illegible] [illegible]

[illegible] Micro-[illegible] [illegible] is an [illegible] [illegible]

fel [illegible] [illegible], [illegible] [illegible]

lite. If the [illegible]

of crystals, [illegible]

are referred to as [illegible]

Mica[illegible] are [illegible] [illegible]

arranged [illegible] [illegible], [illegible]

striking [illegible] [illegible]

[illegible]

as poikilitic, [illegible]

Pseudomorphs. [illegible]

If [illegible], [illegible] [illegible]

occasionally [illegible] [illegible], [illegible]

mould, or a certain [illegible], [illegible]

composition. The latter [illegible] [illegible]

granular or [illegible], [illegible] [illegible]

optical [illegible] [illegible]

[illegible]

These [illegible] [illegible]

a different [illegible]

origin [illegible]

cavity left by the removal of a crystal of the original mineral. These forms are called pseudomorphs.

Crystalline Aggregates: Structure of Minerals. It will be remembered that minerals, while not always occurring in definite crystals, are for the most part at least crystalline in internal structure.

The following terms are used in describing the manner in which crystalline individuals occur in groups. The individual grains, which may be thought of as imperfectly crystallized minerals, are usually included in one of the following three groups: (1) Columns, or fibers, in which case the structure is columnar or fibrous. (2) Thin laminae or lamellae, producing lamellar structure. (3) Grains, producing granular structure.

(1) Columnar and Fibrous Structure. If the elongated individuals are very thin, the structure is fibrous, as in asbestos or satin-spar gypsum. The fibers may or may not be easily separable, and there is a considerable variation in coarseness. Fibrous minerals often have a silky luster.

If the individuals are thick in comparison to those called fibers, the structure is referred to as columnar. If the columns are flattened, the structure is bladed.

If the fibers or columns cross in various directions, forming a net-like appearance, the structure is reticulated.

If they radiate from a center in all directions and produce star-like forms, the structure is referred to as stellated.

If the individuals radiate from a center without producing star-like forms, the structure is simply radiated or divergent.

(2) Lamellar Structure. This type of structure occurs when the mineral consists of flat plates or leaves. The leaves may be straight or bent, and so produce straight lamellar or curved lamellar structure. If the plates are nearly parallel around a common center, the structure is concentric. If the laminae are very thin and separable, the structure is said to be foliaceous or foliated. Since the micas exhibit this structure to such a high degree, the term micaceous is often used.

(3) Granular structure. The individual grains of a mineral possessing granular structure differ a great deal in size in different specimens, and so the structure ranges from coarse granular to fine granular, and, when the individual grains are too small to be observed by the naked eye, to impalpable.

The terms phanero-crystalline and crypto-crystalline are also used to indicate grain size, the former when the grains are large enough, the latter when they are too small,

to be seen by the naked eye.

If granular minerals are easily crumbled by the fingers, they are said to be friable.

Imitative Shapes. A great many minerals occur in the massive state, when they are compact and homogeneous, yet reveal true crystalline structure when examined under the microscope. The following are the standard terms used in describing various structure types of massive minerals.

Reniform: kidney-shaped. The internal structure may be radiated or concentric.

Botryoidal: when the mineral consists of a group of rounded prominences, resembling a bunch of grapes.

Mammillary; resembling botryoidal structure, but with larger prominences.

Globular: spherical or nearly so, with radiated or concentric structure. If attached to a rock, they are referred to as implanted globules.

Nodular: in tuberose shapes, or with irregular projections on the surface.

Amygdaloidal: almond-shaped; the term is often applied to a rock containing almond-shaped nodules.

Coralloidal: consisting of interlaced branchings, like some coral.

Mossy: having the structure or appearance of moss.

Filiform or Capillary: consisting of very long and

slender individuals, ordinarily of successive minute crystals.

Acicular: consisting of slender and rigid individuals, like needles.

Drusy: a surface covered with minute implanted crystals.

Stalactitic: when the mineral occurs in pendent columns, cones, or cylinders. Internal structure may be imperfectly crystalline and granular, or fibrous, with the fibers radiating from a central column.

The term amorphous, as described previously, is used when there is no visible distinct crystalline structure, even under the microscope, and the whole mass is homogeneous. The structure is sometimes called colloidal or jelly-like.

III. PHYSICAL MINERALOGY

Physical characteristics of minerals fall under the following heads:

A. Characters depending upon Cohesion and Elasticity: cleavage, fracture, tenacity, hardness, elasticity, etc.

B. Specific Gravity, or the Density compared with that of water.

C. Characters depending upon Light: color, luster, degree of transparency, special optical properties, etc.

D. Characters depending upon Heat: heat-conductivity, change of form and of optical characters with change of temperature, fusibility, etc.

E. Characters depending upon Electricity and Magnetism.

F. Characters depending upon the reaction of the senses to the mineral: taste, odor, feel, etc.

In the majority of specimens of minerals, definite crystalline form is not developed to a degree high enough to permit ready identification in this way. For this reason, minerals are more often identified by means of their physical

characteristics. It must not be assumed that crystal form and physical characteristics are separate and distinct, for they are closely related. Most physical characters are related to the molecular structure, which in turn is responsible for the crystal form.

All properties of a mineral depend, directly or indirectly, both on the character of the chemical elements making the mineral up, and perhaps more especially on the manner in which the atoms are arranged.

Of the characters listed above, the specific gravity not only indicates the atomic mass of the elements present, but also the state of molecular aggregation. As an example of the first factor, all lead minerals are heavy because lead is heavy. As a demonstration of the latter, the same element may exist in different states of aggregation, leading to different specific gravities, as with diamond and graphite, both pure carbon, yet differing greatly in specific gravity, that of graphite being about 2, while that of diamond is about 3.5.

Specific gravity, and the characters under F, are the only characters which do not vary according to the direction in the crystal. For all other characters, it is true that directions which are crystallographically identical have like physical characters.

The converse proposition, that unlike crystal directions have unlike characters, holds true only in certain cases, those characters which involve the propagation of light and radiant heat, change of volume with temperature change, electric radiation, magnetic induction, etc., being excepted. The proposition does hold true for characters of class A.

Optical properties of crystals are in general agreement with the symmetry, but they do not show all the variations in the symmetry, which are shown by certain other properties. Thus, while all directions are optically similar in isometric crystals (which are thus isotropic), the molecular cohesion is not similar in all directions, as is shown by cleavage in certain directions in some species.

A. Characters Depending upon Cohesion and Elasticity.

The term cohesion refers to the force of attraction between the molecules of a certain body, through which they tend to resist any attempt to separate them, as by breaking or scratching.

Elasticity is the force which tends to return the molecules to their original positions after they have been moved, as by change of shape or volume, under pressure.

Cleavage. Cleavage is the tendency of a crystalline mineral to break in certain definite directions, yielding more or

less smooth surfaces. It shows a minimum of cohesion between the molecules on one side of the cleavage-plane and those on the other.

Planes of cleavage are always planes of crystalline structure, and as such are always parallel to possible crystal faces. The crystal planes have simple relations to the crystallographic axes, and usually are seen as common forms on the crystal in question, though there are important exceptions to this. For example, the mineral calcite, with rhombohedral cleavage, seldom shows rhombohedral faces. In general, however, cleavage takes place in a direction parallel to common crystal faces.

Cleavage is the same in all directions in a crystal which are crystallographically identical. For example, if cleavage exists parallel to one cubic plane in an isometric mineral, it must also exist, with equal development, in the other two cubic planes.

Since cleavage-planes are commonly parallel to some fundamental crystal face, they may often be used in orienting a crystal, when crystal faces are poorly developed.

Cleavage is defined in two ways: according to the direction, as cubic, rhombohedral, prismatic, basal, etc.; and also according to the ease with which it is obtained, and the smoothness of the resulting surface. It is said to be less smooth surfaces. It shows a [illegible] between the molecules on one side of its cleavage-plane and those on the other.

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Since cleavage-planes are commonly parallel to some fundamental crystal face, they may often be used in orienting a crystal, when crystal faces are poorly developed.

Cleavage is defined in [illegible] according to the directions, as cubic, rhombohedral, octahedral, [illegible], etc.; and also according to the ease with which it is obtained, and the smoothness of the resulting [illegible].

<u>perfect</u> or <u>eminent</u> when very easily obtained, affording smooth surfaces, as in <u>calcite</u> and <u>mica</u>. Other grades are spoken of as <u>distinct</u>, <u>indistinct</u> or <u>imperfect</u>, <u>interrupted</u>, <u>in traces</u>, <u>difficult</u>, etc.

In some species, cleavage is better developed in certain varieties of the species than in other varieties of the same species, depending largely on the structure.

The common types of cleavage in the various systems are given below. In all cases, the adjective denoting the type of cleavage is derived from the name of the faces to which it is parallel.

1. <u>Isometric System</u>: <u>cubic</u>, <u>octahedral</u>, and <u>dodecahedral</u>, in order of frequency of occurrence.

2. <u>Tetragonal System</u>: <u>basal</u>, <u>prismatic</u> (parallel to first or second order prisms, or both), and <u>pyramidal</u>.

3. <u>Hexagonal System</u>:

<u>Hexagonal Division</u>: <u>basal</u>, <u>prismatic</u>, and rarely <u>pyramidal</u>.

<u>Rhombohedral Division</u>: <u>basal</u>, <u>prismatic</u>, and <u>rhombohedral</u>.

4. <u>Orthorhombic System</u>: <u>pinacoidal</u> (parallel to one or more of the pinacoids), and <u>prismatic</u> (or <u>domal</u>).

5. <u>Monoclinic System</u>: <u>clinopinacoidal</u>, <u>basal</u>, and

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

prismatic.

6. Triclinic System: since there is much variation possible in selecting the fundamental form, the faces, and thus the cleavage-planes, will vary with the orientation. It is usual practice to orient the fundamental form so that the cleavage is pinacoidal.

Cleavage may be observed under special conditions in some cases, when it is not apparent under casual observation. Sudden changes of temperature, or a sharp blow, may bring out hidden cleavage, not obtainable by simple breaking.

When cleavage is parallel to a closed form (cube, octahedron, etc.), pieces resembling crystals may be broken out of a crystalline individual, but may usually be distinguished from true crystals by the splintery nature of the cleavage faces as compared with crystal faces.

Cleavage-planes may have a pearly or iridescent luster, where thin cleavage plates have partially separated.

Gliding-planes. There are certain planes in most crystals, closely related to cleavage directions, called gliding-planes. Molecular slipping along these planes may take place with the application of pressure, resulting either in a separation into layers in the given direction, or in a revolution of the molecules into a new twinning position,

producing secondary twinning-lamellae.

These secondary twinning-planes are often directions of easy separation, called parting to distinguish it from cleavage. Parting may also occur along gliding-planes. It may occur only on certain planes, those of secondary twinning-lamellae, while cleavage may occur in any plane having the given relation to the crystallographic axes.

Fracture. The term fracture is used to denote the form obtained by breaking a mineral in a direction other than that of cleavage. When the cleavage is perfect in several directions, as in calcite, fracture is not readily obtainable.

Fracture is defined as:

(a) Conchoidal, when the mineral breaks with curved concavities, resembling the interior of a clam shell. It is well illustrated by crystalline quartz. If the depressions are small, the fracture is referred to as small-conchoidal; if only partially distinct, as subconchoidal.

(b) Even, when the fracture surface approximates a plane, though rough and with numerous elevations and depressions.

(c) Uneven, when the surface is entirely irregular, as is true of most minerals.

(d) <u>Hackly</u>, when the elevations are sharp or jagged.

Various other terms, such as <u>earthy</u>, <u>splintery</u>, etc., are also used.

<u>Hardness</u>. The <u>hardness</u> of a mineral is the resistance which a smooth surface offers to abrasion. The <u>degree of hardness</u> is determined by observing the comparative ease or difficulty with which one mineral can be scratched by another material.

There are a great many grades of hardness among minerals, from that of extremely soft minerals, like <u>talc</u>, easily scratched by the finger-nail, to that of <u>diamond</u>, the hardest of known substances. The <u>Mohs scale of hardness</u>, standard for ordinary hardness determinations, consists of ten minerals of progressive degree of hardness. Beginning with the softest, the scale is as follows:

1. Talc.
2. Gypsum.
3. Calcite.
4. Fluorite.
5. Apatite.
6. Orthoclase.
7. Quartz.
8. Topaz.
9. Corundum.
10. Diamond.

This is not an absolute scale; that is, <u>fluorite</u> is not four times as hard as <u>talc</u>, or <u>diamond</u> five times as hard as <u>gypsum</u>. Measured in terms of absolute hardness, the diamond is several thousand times harder than talc. The <u>difference</u>

in hardness between any two adjacent members of the series is roughly equal to that between any two others, however. The scale was so chosen because the minerals, with the exception of course of diamond, are fairly common, and usually occur in convenient form for making tests. A set consisting of the first nine minerals is entirely adequate, since corundum is next to diamond in hardness among the minerals.

The approximate relative hardness of minerals may be determined in the field by comparing the hardness of the mineral with that of ordinary materials, the hardness of some of which, in terms of the Mohs scale, are as follows:

Finger-nail	2.25- 2.5
Copper penny	3.0
Ordinary cutlery steel	5.0
Ordinary window glass	5.5

There is some connection between the hardness of a mineral and its chemical composition, although there are exceptions to the general rule. Usually, however, the following statements hold true:

1. Compounds of the heavy metals, such as silver, copper, mercury, lead, etc., are soft, the hardness being usually less than 2.5- 3.0. Sulphides, arsenides, and oxides of iron, nickel, and cobalt are usually hard.

2. Most sulphides are soft (except as noted above), also most of the carbonates, sulphates, and phosphates.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

3. Hydrous salts are usually soft.

4. The very hard minerals are chiefly oxides and silicates, many of them containing aluminum.

In determining hardness, care should be taken to use fresh, smooth, crystalline surfaces for the determination, as far as possible. Altered surfaces are usually much softer than those of the fresh mineral. Distinguish between crushing of granular minerals and actual scratching. Do not confuse a white ridge, left on a hard mineral by a softer one, with a scratch. It is not necessary to use a large surface for the determination.

Tenacity. The term tenacity as applied to minerals refers to the manner in which they break or are distorted. They may be:

(a) Brittle, when the mineral falls to pieces or powder on the application of pressure, or on being struck with a hammer.

(b) Sectile, when pieces may be cut off with a knife, but the mineral still breaks under a hammer.

(c) Malleable, when pieces may be cut off and flattened under a hammer without breaking.

(d) Flexible, when the mineral will bend without breaking, and remain bent after pressure is removed.

Elasticity. This term expresses the resistance of a solid to being changed in shape or volume with application of pressure, and also the tendency to return to the original shape after the pressure is removed. Every solid material has a _limit of elasticity_. If this limit is passed, the material will not return to its original form after pressure is removed, but will remain permanently bent, due to the establishment of new molecular positions under pressure.

Minerals display a wide range in elasticity, _mica_ being thought of as a highly elastic mineral, while _talc_ is flexible, but not elastic.

B. _Specific Gravity or Relative Density_.

The _specific gravity_ of a mineral is the ratio of its density to that of water at a temperature of 4° Centigrade. This is often expressed as the ratio of the weight of a fragment of the mineral to the weight of a quantity of water equal in volume to the fragment. For example, one cubic inch of a mineral with a specific gravity of 3.0 weighs exactly 3 times as much as one cubic inch of pure water.

While _accurate_ determinations of specific gravity require great care, very close determinations may be made with various simple instruments. In the field, very approximate determinations may be made by "weighing" the mineral in the hand. Experience in the lifting of minerals of known specific gravity will soon enable the collector to guess the

specific gravity of an unknown mineral within one unit.

The average specific gravity of non-metallic minerals (minerals with non-metallic luster) is low, 2.6- 3.0. Non-metallic minerals with specific gravity over 3.5 are relatively heavy, and usually contain a heavy metal, though retaining their non-metallic luster.

The metallic minerals (those with metallic luster) are heavy, the average specific gravity being about 5.0.

Specific gravity is a good identifying characteristic in many cases. It is constant as long as structure and chemical composition in the species remain constant.

C. Characters depending upon Light.

While optical mineralogy is one of the most important fields in the study of minerals, and has furnished most of the evidence in the establishment of the presence of the definite molecular structure which is responsible for many of the other physical characteristics of minerals, it is beyond the scope of the present work to consider the principles of optics. The field is largely one for the specialist, and we shall do no more than mention some of the phenomena in minerals due to the action of light. For a concise discussion of optics as applied to mineral study, the reader is again referred to Dana's "Textbook of Mineralogy."

Specific gravity [illegible]

[illegible]

The average [illegible]
minerals with [illegible]
metallic minerals [illegible]
little heavy, [illegible]
retaining their non-metallic [illegible]

The metallic [illegible]
heavy, the [illegible]

Specific gravity is [illegible]
in many cases. It is [illegible]
chemical composition [illegible]

9. Characters depending [illegible]

While optical [illegible]
fields in the study of minerals, [illegible]
the evidence [illegible]
definite molecular structure [illegible]
of the other physical characters [illegible]
beyond [illegible]
states of [illegible]
[illegible]
phenomena [illegible]
[illegible]
[illegible]

The physical characters of minerals resulting from the action of light, and useful in making determinations, are:

1. Diaphaneity: depending on the relative quantity of light transmitted.

2. Color: depending on the kind of light reflected or transmitted, as determined by selective absorption.

3. Luster: depending on the power and manner of reflecting light.

These three characters are discussed briefly in the following paragraphs.

1. Diaphaneity. The term diaphaneity may be more simply expressed as the degree of transparency. It depends on the amount of light transmitted, or, in other words, the amount absorbed in passing through the substance. Absorption is at a minimum in transparent solids, as ice; at a maximum in opaque substances, as iron. The terms commonly used in expressing the degree of transparency of a given mineral are:

(a) Transparent: when the outline of an object seen through the mineral is perfectly distinct.

(b) Subtransparent or semi-transparent: when objects may be seen through the mineral, but the outline is not distinct.

(c) Translucent: when light is transmitted, but objects are not seen.

(d) Subtranslucent: when only the thin edges of the mineral transmit light.

(c) Opaque: when even thin edges fail to transmit light. This is only a relative term, since any solid object will transmit light of sufficiently thin.

2. Color. Ordinary white light consists of light waves of different wave-lengths, a certain color being produced by the action on the retina of the eye only by waves of a certain length. The color of a mineral depends upon the wave-length of the light reflected to the eye from the surface. Waves which are absorbed by the material do not give color.

The streak of a mineral is the color of its fine powder, usually obtained by rubbing the mineral on an unglazed porcelain tile. Certain minerals, especially metallic minerals, have characteristic streaks which are of value in determining the species.

The fundamental colors used in describing the color of minerals are: white, gray, black, blue, green, yellow, red, and brown. Various combinations of these colors, especially as influenced by luster, are those encountered in minerals. Most of the terms used in the descriptions of the colors of

minerals to follow are self-explanatory.

3. Luster. The luster of minerals depends on the nature of the surface. Variation in the amount of light reflected produces degrees of intensity of luster. Variation in the nature of the reflecting surface produces different kinds of luster.

The recognized degrees of intensity of luster are as follows:

(a) Splendent: reflecting with brilliancy and giving well-defined images.

(b) Shining: producing images by reflection, but not well-defined ones.

(c) Glistening: affording a general reflection, but no image.

(d) Glimmering: affording only an imperfect reflection.

(e) Dull: when there is a total absence of luster.

The recognized kinds of luster are divided into two classes, metallic and non-metallic.

1. Metallic: the luster of the metals, as silver, copper, gold, etc. Minerals are usually not considered as having true metallic luster unless they are opaque.

Imperfect metallic luster is described as sub-metallic.

2. Non-metallic.

(a) Adamantine: the hard and brilliant luster of the diamond. If also sub-metallic, it is referred to as metallic-adamantine.

(b) Vitreous: the luster of broken glass. If imperfect, it is called sub-vitreous. These are the most common luster types among minerals.

(c) Resinous: the luster of yellow resin, typified among minerals by most yellow sphalerite.

(d) Greasy: the luster of oily glass, near resinous luster, but to be distinguished from it.

(e) Pearly: the luster of pearl. If united with sub-metallic, the term metallic-pearly is used.

(f) Silky: the luster of silk, the result of fibrous structure.

The kind and degree of luster often vary with the different crystal faces of a single individual of a species.

Play of Colors. Minerals often display a play of colors or change of color when the mineral is rotated under the light.

Opalescence is a milky reflection from the interior of the crystal.

Iridescence is the exhibition of prismatic colors in the interior or on the exterior of a mineral.

These phenomena are usually due to interference in light rays, caused by the presence of fine cleavage- or twinning lamellae.

Tarnish. A metallic surface is tarnished when its color differs from that of the fresh fracture surface. This is due to a thin film on the surface, derived from decomposition or from foreign sources.

Fluorescence. Certain minerals, notably fluorite, are affected by the action of certain kinds of light waves in such a way as to emit light themselves. If the mineral continues to emit light after the subjection to heat, light, or electric discharge causing the fluorescence, it is said to be phosphorescent.

D. Characters Depending upon Heat. We shall do no more than define the terms used below, since these characters are of little value in ordinary determinations of minerals.

Fusibility. Determination of the approximate relative fusibility of minerals (temperature at which melting or fusing takes place), in the blowpipe laboratory, forms a ready means for assisting in the identification of certain species. There is a wide range of fusibility among the minerals, from those which fuse on the thin edges in a candle

flame, to those infusible in the hottest flame obtainable with a blowpipe. The temperature of fusing is constant in a given species.

Conductivity. In general, crystallized minerals show differences in the rate of conduction of heat in different crystallographic directions, as well as differences in rate in different species. As far as we are concerned here, this characteristic is of little value in identifying minerals.

Expansion. The increase of volume with rise of temperature is a characteristic common to nearly all solids. The amount of expansion with a given rise in temperature varies with the species of mineral, and within crystals of a given species with the crystal direction. Delicate apparatus is required for these determinations, so we shall not consider the subject further here.

Specific Heat. The specific heat of any substance is the amount of heat required to raise the temperature of one gram of the substance one degree Centigrade. The unit of heat is the calorie, the amount of heat necessary to raise the temperature of one gram of pure water one degree Centigrade.

E. Characters Depending upon Electricity and Magnetism.

1. Electricity. These characters furnish little evidence useful in making ordinary mineral determinations, and so will be treated very briefly.

Electrical Conductivity. In general, metallic minerals conduct electricity; non-metallic minerals do not. In all crystals except those of isometric minerals, the conductivity may vary with the crystallographic direction.

Frictional Electricity. All minerals become electrically charged by friction, though some species exhibit this phenomenon in a much higher degree than others. Polished surfaces usually become positively charged by friction; rough surfaces become negatively charged.

Pyroelectricity. The term pyroelectricity refers to the development of positive and negative charges of electricity on different parts of the same crystal when heated. Upon cooling, the positive and negative areas exchange places. Substances not crystallized cannot exhibit pyroelectricity, and the phenomenon is further restricted to non-conductors.

Piezoelectricity. If the volume of a crystal is changed by compression or tension, electric charges result, similar to those accompanying change of volume through heat. This is referred to as piezoelectricity. If compression produces a charge of given sign, tension will produce a charge of opposite sign.

Thermoelectricity. The placing in contact of two unlike metals (or two unlike metallic minerals) usually results in the charging of one positively and the other negatively.

Natural metallic sulphides display a wider range in thermoelectricity than pure metals. The phenomenon, then, is dependent upon chemical composition rather than crystalline form.

2. Magnetism.

Magnetic Minerals. A few minerals in the natural state are capable of being attracted by a steel magnet, and are said to be magnetic. This is especially true for magnetite, the magnetic oxide of iron; pyrrhotite, magnetic sulphide of iron; and some varieties of native platinum.

Some other minerals are slightly magnetic, probably due to admixed magnetite.

If a mineral exhibits not only the property of being attracted by a magnet, but itself shows polarity, it is said to be a natural magnet. Magnetite shows this property in many cases.

All iron minerals are attracted by a sufficiently powerful electromagnet.

F. Characters Depending upon the Action of the Senses.

Taste. Only soluble minerals may have a taste. The various types of taste used for reference are:

(a) Astringent: the taste of vitriol.

(b) Sweetish astringent: the taste of alum.

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Taste. Only soluble minerals may have a taste. The various types of taste used for reference are:

(a) Astringent; the taste of vitriol.

(b) Sweetish astringent; the taste of alum.

(c) Saline: the taste of common salt.

(d) Alkaline: the taste of soda.

(e) Cooling: the taste of saltpeter.

(f) Bitter: the taste of Epsom salts.

(g) Sour: the taste of sulphuric acid.

Odor. Minerals in their dry state do not usually give off odor. By friction, moistening with the breath, or elimination of a volatile ingredient by heat or acids, some minerals give off odors which are designated as:

(a) Alliaceous: the odor of garlic. Most arsenic minerals give off this odor when rubbed or heated.

(b) Horse-radish odor: the odor of decaying horse-radish. Selenium minerals give this odor when heated.

(c) Sulphurous: the odor of burning sulphur, derived by rubbing or heating many sulphides.

(d) Bituminous: the odor of bitumen.

(e) Fetid: the odor of hydrogen sulphide gas (rotten eggs). Derived by friction from some varieties of quartz and limestone.

(f) Argillaceous: the odor of moistened clay, derived by moistening with the breath, friction, or heating.

Feel. In some minerals, the feel is very characteristics. Thus _talc_ has a _greasy_ feel; _sepiolite_ (_meerschaum_) has a _smooth_ feel. Other minerals may have _harsh_ or _meager_ feel. Some hygroscopic minerals (those which take up water rapidly from the air) adhere to the tongue.

In general, very few minerals have physical characters of the above types which are useful in making determinations. Those which do, however, are often very easily identified by means of these characters.

IV. CHEMICAL MINERALOGY.

It has been stated previously that all properties of a mineral depend, either directly or indirectly, upon its chemical composition. For this reason, the determination of the chemical composition plays the most important role in the determination of minerals.

While the present work deals with the identification of minerals mostly by means of their physical characters, the fundamentals of the chemical phase will be treated here. Some knowledge of chemistry is fundamental in mineralogy, just as is some knowledge of crystallography.

Chemical Elements. The science of chemistry recognizes at present ninety-two substances which cannot be decomposed at will. These are the chemical elements.

Atoms and Molecules. The smallest particle of a given element which can play a part in a chemical reaction is the atom. An atom of a given element has a definite and characteristic weight. According to present theory, atoms are composed of positive charges (protons) and negative charges (electrons) of electricity, and the number of charges determines the chemical nature of the atoms, and thus of

the element. The protons have definite mass; the electrons do not supposedly have mass. Each atom supposedly consists of a nucleus of positive charges, surrounded by concentric shells of negative charges; the number of protons is equal to the number of electrons, and this number forms the atomic number of the given element. Thus the characteristics of any given element depend on the atomic number, or the number of protons and electrons, and not on the characters of the protons and electrons, for all are the same.

With rare exceptions, the atom cannot exist alone, but unites with other atoms of the same or different kinds to form the molecule. A molecule is the smallest particle into which a given substance can be divided without changing the chemical nature.

Two or more atoms of the same element may unite with each other to form a molecule of that element; for example, two atoms of oxygen unite to form a molecule of oxygen. Oxygen in the air is in this form. Three atoms of oxygen may unite to form a molecule of ozone, a very unstable form of the element.

Atoms of different elements may unite to form a molecule of a new substance; for example, two atoms of hydrogen unite with one atom of oxygen to form a molecule of water.

Atomic Weight. The relation of the mass of an atom of an

element to that of an atom of oxygen is its atomic weight. The atomic weight of oxygen is taken as exactly 16. With improved means of determination, the atomic weights are continually being redetermined. The present authorized atomic weights are given in a table on a later page.

Symbols and Formulas. The symbol of an element is the initial letter or letters, usually of its Latin name, by which it is represented in noting the chemical composition of a substance in which it plays a part. The formula of a substance is the expression, by means of symbols, of its chemical nature. Since the symbol is taken as indicating one atom of the element, and the formula as indicating one molecule of the substance, the formula also expresses the proportion of each element present. If a small sub-numeral follows the symbol of an element in a formula, it indicates that the given number of atoms of the element are present in one molecule of the chemical compound. For example, the symbol of hydrogen is H, and that of oxygen is O. The formula of water is H_2O, since one molecule of water contains two atoms of hydrogen and one atom of oxygen.

The formula of a compound is the simplest representation of its proportional chemical composition. The molecules of a given compound may consist of the number of atoms indicated by the formula, or of twice, three times, four times, etc., this number. Whether or not the molecule is as simple

as the formula indicates may be determined in the case of volatile substances, but not in the case of non-volatile solid compounds, which means, then, that the true molecular weight of most minerals cannot be determined by means known at present.

Table of the Elements. Of the following elements, only about a dozen play an important part in making up the crust of the earth and the air and water surrounding it. The nine elements making up the bulk of the earth's crust (over 97%) are: oxygen, sulphur, silicon, aluminum, iron, calcium, magnesium, sodium, and potassium. Oxygen is the most abundant element (about 50%). Besides these, hydrogen is present in water, nitrogen in the air, and carbon in organic material.

International Atomic Weights 1933

Name	Symbol	Atomic Number	Atomic Weight
Alabamine	Ab	85	(221)
Actinium	Ac	89	(227)
Aluminum	Al	13	26.97
Antimony (Stibium)	Sb	51	121.76
Argon	A	18	39.944
Arsenic	As	33	74.91
Barium	Ba	56	137.36
Beryllium, Glucinum	Be	4	9.02
Bismuth	Bi	83	209.00
Boron	B	5	10.82
Bromine	Br	35	79.916
Cadmium	Cd	48	112.41
Caesium	Cs	55	132.91
Calcium	Ca	20	40.08
Carbon	C	6	12.00
Cerium	Ce	58	140.13
Chlorine	Cl	17	35.457

; Name	Symbol	Atomic Number	Atomic Weight
Chromium	Cr	24	52.01
Cobalt	Co	27	58.94
Columbium, Niobium	Cb	41	92.91
Copper (Cuprum)	Cu	29	63.57
Dysprosium	Dy	66	162.46
Erbium	Er	68	167.64
Europium	Eu	63	152.0
Fluorine	F	9	19.00
Gadolinium	Gd	64	157.3
Gallium	Ga	31	69.72
Germanium	Ge	32	72.60
Gold (Aurum)	Au	79	197.2
Hafnium	Hf	72	178.6
Helium	He	2	4.002
Holmium	Ho	67	163.5
Hydrogen	H	1	1.0078
Illinium	Il	61	(146)
Indium	In	49	114.76
Iodine	I	53	126.92
Iridium	Ir	77	193.1
Iron (Ferrum)	Fe	26	55.84
Krypton	Kr	36	83.7
Lanthanum	La	57	138.92
Lead (Plumbum)	Pb	82	207.22
Lithium	Li	3	6.940
Lutecium	Lu	71	175.0
Magnesium	Mg	12	24.32
Manganese	Mn	25	54.93
Masurium	Ma	43	....
Mercury (Hydrargyrum)	Hg	80	200.61
Molybdenum	Mo	42	96.0
Neodymium	Nd	60	144.27
Neon	Ne	10	20.183
Nickel	Ni	28	58.69
Niobium, see Columbium			
Nitrogen	N	7	14.008
Osmium	Os	76	191.5
Oxygen	O	8	16.0000
Palladium	Pd	46	106.7
Phosphorus	P	15	31.02
Platinum	Pt	78	195.23
Polonium	Po	84	(210)
Potassium (Kalium)	K	19	39.096
Praseodymium	Pr	59	140.92
Protoactinium	Pa	91	....
Radium	Ra	88	225.97
Radon, Niton	Rn	86	222
Rhenium	Re	75	186.31
Rhodium	Rh	45	102.91
Rubidium	Rb	37	85.44

Name	Symbol	Atomic Number	Atomic Weight
Ruthenium	Ru	44	101.7
Samarium	Sm	62	150.43
Scandium	Sc	21	45.10
Selenium	Se	34	78.96
Silicon	Si	14	28.06
Silver (Argentum)	Ag	47	107.880
Sodium (Natrium)	Na	11	22.997
Strontium	Sr	38	87.63
Sulphur	S	16	32.06
Tantalum	Ta	73	181.4
Tellurium	Te	52	127.61
Terbium	Tb	65	159.2
Thallium	Tl	81	204.39
Thorium	Th	90	232.12
Thulium	Tm	69	169.4
Tin (Stannum)	Sn	50	118.70
Titanium	Ti	22	47.90
Tungsten (Wolframium)	W	74	184.0
Uranium	U	92	238.14
Vanadium	V	23	50.95
Virginium	Vi	87	(224)
Xenon	Xe	54	131.3
Ytterbium	Yb	70	173.04
Yttrium	Y	39	88.92
Zinc	Zn	30	65.38
Zirconium	Zr	40	91.22

For significance of atomic number, see p. 64. Atomic weights in parentheses have not been accurately determined. Names of elements in parentheses are the Latin or Greek names from which the symbol is derived.

Metals and Non-metals. The elements may be divided into two classes, the metals and the non-metals. There are also several elements with characters of both metals and non-metals, called semi-metals.

The true metals possess typical metallic physical characteristics, such as malleability, ductility, opacity, metallic luster, good conduction of heat and electricity, etc. Chemically, they play the part of the positive or basic

element in simple compounds. Typical examples of metals are <u>platinum</u>, <u>gold</u>, <u>iron</u>, <u>sodium</u>, etc.

The non-metals, such as <u>sulphur</u>, <u>carbon</u>, <u>oxygen</u>, <u>chlorine</u>, etc., are, if solid, brittle, often transparent, poor conductors of heat and electricity, etc. Chemically, they act as the negative or acid element in compounds.

The semi-metals or <u>metalloids</u>, such as <u>arsenic</u>, <u>antimony</u>, and <u>bismuth</u>, have most of the physical characteristics of metals, except that they are more or less brittle. They often act as <u>amphoteric</u> substances; that is, they may play the part of either acid or basic elements.

In solution, the elements of simple chemical compounds usually occur as <u>ions</u>, which bear electric charges. The basic elements bear positive charges; the acidic elements bear negative charges. When positive ions of one element and negative ions of another, bearing equal charges, are brought close together, they unite, forming electrically neutral molecules. Thus sodium, a metal, bears a positive charge in solution, indicated thus: Na^+. Chlorine, an acid element, bears in solution a negative charge of equal strength, indicated thus: Cl^-. When the two ions are brought close together, as by concentration or evaporation of the solution, they unite, neutralizing the electric charges, to form a molecule of the salt sodium chloride, NaCl.

Depending upon the character of the solution in which a compound is formed, a semi-metal may act as either a positive or negative element in a compound. Thus arsenic, As, may act as a positive element in one case, forming the compound As_2O_3 with oxygen (which is always negative). In another case, arsenic may act as an acid element, forming for example the compound $FeAs_2$ with the basic element iron.

The Periodic Law. While elements are entirely distinct from one another in physical and chemical properties, certain ones may resemble others in many characters, and so elements as a whole fall into so called isomorphous groups, in each of which all the elements are chemically similar, though not identical. When the elements are arranged according to their atomic numbers, they fall more or less into groups consisting of eight elements each, and the elements in each group have corresponding properties. This is known as the periodic law. The elements are thus arranged in the periodic table, which is largely the work of D. Mendeléeff. The reader is referred to any standard textbook of chemistry for examination of the table.

It is highly interesting to note that, in several instances, gaps were left in the table due to the fact that the elements which should be present had not been isolated and identified. From the position of the missing element in the table, the atomic number, atomic weight, and characters

of the element could be predicted, and this was done in several cases, even to the naming of the element, which had not even been discovered. When the element itself was isolated, it was found to correspond almost exactly to the predicted characters.

Combining Weight. It has been proved that the actual mass of a given element entering into a compound is always proportional either to its atomic weight or to some simple multiple of this; the atomic weight is thus also called the combining weight. It is the weight of the element in grams which will combine with 8 grams of oxygen, or with an equivalent weight of some other element.

In sodium chloride (common salt), NaCl, the masses of sodium and chlorine involved are found by analysis to be 39.4 and 60.6 parts respectively in 100 parts. These numbers are proportional to 23 and 35.4, the atomic weights of sodium and chlorine respectively; it is thus concluded that one atom of each is present in a molecule of the compound, and the formula is, therefore, NaCl.

Molecular Weight. The molecular weight is the weight of the molecule of the given substance, expressed in terms of the oxygen atom as 16. Thus the molecular weight of sodium chloride is $23 + 35.4 = 58.4$; that of water is $2 + 16 = 18$, etc. In gases, the exact molecular weight may be calculated, for 22.4 liters of any gas under standard conditions

(temperature 0° C., pressure 760 mm.) has a weight, in grams, equal to the molecular weight. In solids, where the exact molecular weight cannot be determined, it is taken as the molecular weight derived from the simplest formula giving the true proportions of the elements present. The molecular weight is thus the combined weight of all the atoms present.

Valence. The valence of an element is given by a number representing the capacity of its atoms to combine with the atoms of a unit element like hydrogen or chlorine. Since one atom of sodium combines with one atom of chlorine, sodium has a valence of one; it is univalent. Since most elements will combine directly either with chlorine or hydrogen, their valences may be determined in the same way. If an element will not combine with either of these two, it will usually combine with oxygen. Oxygen has a valence of two, since two atoms of hydrogen are necessary to combine with one atom of oxygen. Knowing this, the valence of the unknown may be determined.

The valence itself is determined by the number of electrons in the outermost ring or shell in the atom. In positive elements, the number of electrons present in the outer shell is equal to the valence; in negative elements, the number of electrons lacking in the outermost shell (the number necessary to give the shell its maximum number) is equal to the valence. The maximum number of electrons

possible, in any element, is two in the first shell (next to the nucleus), eight in the second shell, eight in the third, eighteen in each of the fourth and fifth shells, and thirty-two in the sixth (outermost) shell. Thus sodium, with the atomic number 11, has two electrons in the first shell, eight in the second, and one in the third; it thus has a positive valence of one. Chlorine, with the atomic number 17, has two electrons in the first shell, eight in the second, and seven in the third. Since the maximum for the third or outermost shell is eight, chlorine is lacking one; it thus has a negative valence of one. An element which may be either positive or negative has a definite positive valence when acting as a positive element, and a definite negative valence when acting as a negative element, but the two valences always add up to eight.

The elements seek to give away or to take on electrons so as to arrive at a state where there are no electrons missing in the outer shell; that is, all shells possible in the given element are filled. Thus positive elements, as sodium, with extra electrons in the outer shell, give them up and become positively charged. Negative elements, as chlorine, take on extra electrons to fill the outer shell, and so become negatively charged. Sodium can give up one electron, and so bears a unit positive charge; chlorine can take in an extra electron, and so bears a unit negative charge. Since positive and negative charges attract each

other, the two electrically charged ions come together, and, since their charges are equal, unite to form an electrically neutral molecule.

Many elements may have different valences in different compounds. Thus iron may have a positive valence of two or three, in $FeCl_2$ and $FeCl_3$ respectively. This is due to the fact that an atom of iron may give up two or three electrons, depending upon the nature of the solution in which the compound is formed.

Ionization. Simple chemical compounds in solution always separate to some extent into electrically charged ions. For example, molecules of sodium chloride, when dissolved in water, separate into Na and Cl ions. This is called ionization, and the degree differs highly in different compounds. In general, salts (compounds containing a metal as the positive element and an acid-former as the negative element) are freely ionized in solution. Acids (compounds yielding hydrogen (H^+) ions in solution) and bases (compounds yielding hydroxyl (OH^-) ions in solution) may ionize freely or little, depending on the acid or basic element. The best acid-forming elements are fluorine, chlorine, etc.; the best base-forming elements are the metals caesium, sodium, potassium, lithium, etc.; when best means that the compounds are freely ionized in solution.

Chemical Reaction. Substances in solution frequently react other, the two electrically charged ions come together, and, since their charges are equal, unite to form an electrically neutral molecule.

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Chemical reactions. Substances in solution frequently react with one another, forming new compounds. This is known as chemical reaction. The tendency is always to form new compounds that are either insoluble in the solution and will precipitate out, as is frequently the case in mineral formation, or to form soluble substances that are very little ionized, and so might as well be removed as far as further reaction for them is concerned. Thus the readiness for reaction of any soluble compound depends largely on the degree of ionization.

One of the substances universally obtained in chemical reactions where its elements are present is water, H_2O. Water is very slightly ionized, and so its elements are removed from further possibility of reaction as fast as they come together. This explains why an acid and a base in solution always tend to react with each other to form a salt and water, as is shown in the following equation:
$HCl\ (H^+\ Cl^-) + NaOH\ (Na^+\ OH^-) = NaCl\ (Na^+\ Cl^-) + H_2O\ (HOH)$.
The acid and base, being highly ionized in this case, furnish abundant hydrogen and hydroxyl ions, which immediately join to form unionized water and freely ionized sodium chloride.

A reaction in which elements are removed by precipitation of an insoluble compound is shown by the following equation: $Na^+\ Cl^- + Ag^+\ NO_3^- = \underline{AgCl}\quad Na^+\ NO_3^-$. The silver chloride, AgCl, being quite insoluble, is removed from the with [illegible]

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The [illegible]

mean [illegible]

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solution as fast as the silver and chloride ions come together, leaving freely ionized sodium nitrate, $NaNO_3$, in the solution.

Chemical equations give the quantities of compounds involved in a reaction, and indicate that the weight of all the substances involved is equal before and after the reaction. Thus $23 + 35.4 = 58.4$ grams of sodium chloride reacts with $107.8 + 14 + 48 = 169.8$ grams of silver nitrate, a total of 228.2 grams of substance, to form $107.8 + 35.4 = 143.2$ grams of silver chloride and $23 + 14 + 48 = 85$ grams of sodium nitrate, a total again of 228.2 grams of substance.

Chemical compounds. As stated previously, a chemical compound is a combination of two or more elements united by chemical attraction, and the elements are present either in proportion of their atomic weights or some simple multiple of these. Any substance not satisfying these requirements is a mechanical mixture, not a chemical compound.

The chemical compounds which occur in the form of minerals are divided into various classes. Examples are: oxides, combinations of oxygen with other elements, usually metals; sulphides (selenides, tellurides, arsenides, antimonides, etc), in which sulphur (selenium, tellurium, arsenic, antimony, etc.) is combined with another element in the same capacity as oxygen.

solution as fast as the silver [illegible]
together, leaving [illegible]
the solution.

Chemical equations [illegible]
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of 228.3 grams of substance [illegible]
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is a mechanical mixture, not a chemical compound.

The chemical compounds [illegible]
minerals are divided into [illegible]
<u>oxides</u>, combinations of [illegible]
metals; <u>sulphides</u> [illegible]
[illegible], etc.), in which [illegible]
arsenic, antimony, etc. [illegible]
in the same deposit [illegible]

Other chemical compounds which play a part in mineral formation are classed as acids, bases, and salts. As mentioned previously, acids in solution yield hydrogen ions; bases in solution yield hydroxyl ions; and salts in solution yield both acid and basic ions.

Acids as minerals are not important, with the one important exception of the mineral quartz, SiO_2, which may be considered as dehydrated silicic acid. A few bases occur as minerals, such as brucite, $Mg(OH)_2$.

Most minerals are classed as salts. The common types of salts, together with examples of minerals, are:

Chlorides, salts of hydrochloric acid, HCl: halite, $NaCl$; pyrargyrite, $AgCl$, etc.

Nitrates, salts of nitric acid, HNO_3: niter, KNO_3; soda niter, $NaNO_3$, etc.

Carbonates, salts of carbonic acid, H_2CO_3: calcite, $CaCO_3$; magnesite, $MgCO_3$, etc.

Sulphates, salts of sulphuric acid, H_2SO_4: gypsum, $CaSO_4 \cdot 2H_2O$; barite, $BaSO_4$, etc.

Phosphates, salts of phosphoric acid, H_3PO_4: rock phosphate, $Ca_3(PO_4)_2$, etc.

Silicates, salts of the various silicic acids, the most important of which are metasilicic acid, H_2SiO_3, a salt of such [illegible]

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Important [illegible]

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Important [illegible]

which is rhodonite ($MnSiO_3$); and orthosilicic acid, H_4SiO_4, a salt of which is tephroite (Mn_2SiO_4).

Normal, Acid, and Basic Salts. A normal salt is a neutral salt, in which all the hydrogen of the acid has been replaced by metallic or other positive ions. Thus K_2SO_4 is the normal potassium salt of sulphuric acid.

In acid potassium sulphate, $KHSO_4$, only half the hydrogen of the acid has been replaced by the positive element potassium; it is an acid salt.

A basic salt is one in which the basic bonds of the compound are not all satisfied by the acid. Thus the mineral malachite, with the formula $CuCO_3.Cu(OH)_2$, is a basic salt.

Most minerals are not simple salts, but are more or less complex double salts containing several metallic elements.

Water of Crystallization. Many minerals contain the elements of water in actual combination in the molecule of the mineral, and give up the water when heated, usually to a high temperature. Thus calcium hydroxide, $Ca(OH)_2$, gives off water when heated and becomes unslaked lime, thus:
$Ca(OH)_2 + heat = CaO + H_2O$.

In some minerals, water is present which readily comes

off when the mineral is heated to a moderately high temperature. The water here is not an integral part of the molecule. It is called water of crystallization, and is indicated as such in the formula, as in gypsum, $CaSO_4.2H_2O$. The water may be necessary as far as the physical characters of the mineral are concerned. Gypsum which has lost its water of crystallization becomes an entirely different mineral, anhydrite, $CaSO_4$. Chemically, the two minerals are alike in solution, explaining the previous statement that the water of crystallization is not an integral part of the molecule.

Isomorphism. Minerals which have analogous composition and closely related crystal form are said to be isomorphous. These minerals may be put into isomorphous groups, and the members of a group frequently grade into one another as the variable chemical element is replaced by another. One such group is the Aragonite Group, consisting of the minerals aragonite, $CaCO_3$, witherite, $BaCO_3$, strontianite, $SrCO_3$, and cerussite, $PbCO_3$.

Chemical Examination of Minerals. It has been stated already that, since the chemical composition of a mineral is its fundamental and important character, the determination of the chemical composition is the ultimate step in mineral identification, and must be resorted to when all other methods of determination have failed.

[illegible] of the [illegible]

[illegible]

[illegible]

We are primarily interested here in the identification of New Mexico minerals by means of their physical characters, and so shall not consider the application of chemical principles to determinative mineralogy. A chemistry laboratory must of course be available for determinations of the chemical composition of minerals, and the ordinary collector has no opportunity to use such a laboratory, even if he has the ability to make mineral analyses.

For the sake of completeness, however, it may be mentioned that there are two general methods of chemical determinations of minerals: (a) Examination in the wet way, with the use of chemical reagents and chemical apparatus; and (b) Examination in the dry way, with the use of the blowpipe as the principal piece of apparatus. This latter method does not require specialized knowledge, and if the reader wishes to investigate the subject more fully, with the intention of learning to make blowpipe analyses for himself, he will find an excellent discussion in Dana's "Textbook of Mineralogy" (see bibliography).

Names of Minerals. Every distinct mineral species, as well as every recognized variety within the species, bears a name by which it is commonly known. Since there are only about 1,200 mineral species at present known, the naming of minerals does not constitute such a problem as does the naming of living and fossil organic types, of which there

are hundreds of thousands of species.

In many cases, minerals have two or more names in common use, but usually one of them is to be preferred. The names as used in this paper for such species are those used by Ford in the fourth edition of Dana's "Textbook of Mineralogy."

The names of all minerals discovered in recent years bear the suffix ite. A few common minerals, named in the early days of mineralogy, still retain their old names. Among these are quartz, beryl, orthoclase, topaz, gypsum, tourmaline, corundum, amphibole, pyroxene, etc. In some species (and varieties) the old names have been replaced by modifications ending in ite, such as almandine and hauyne, now referred to as almandite and hauynite.

The names of minerals have been derived from a variety of sources, as follows:

1. Locality names; after the locality where the mineral was first discovered, or where it is particularly well developed: andalusite, first discovered in Andalusia; cubanite, first discovered at Barracanao, Cuba; franklinite, found in abundance at Franklin Furnace, New Jersey; vesuvianite, first discovered in ancient extrusives from Mt. Vesuvius.

2. Names of men, usually famous mineralogists or discoverers of minerals: bornite, after the mineralogist von

are hundreds of thousands of species.

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2. Names of men, usually famous mineralogists, [illegible] [illegible] of minerals: [illegible], after the [illegible]

Born; sillimanite, after Prof. Benjamin Silliman, famous mineralogist; smithsonite, after James Smithson, founder of the Smithsonian Institution; willemite, after William I, a king of the Netherlands; wollastonite, after the English chemist W. H. Wollaston.

3. From the chemical composition: arsenopyrite, iron sulpharsenide; barite, barium sulphate; calcite, calcium carbonate; columbite, iron and manganese carbonate; cuprite, cuprous oxide; halite, sodium chloride (chlorine is one of the halogens); magnesite, magnesium carbonate; vanadinite, lead chloride and vanadate; zincite, zinc oxide.

4. From some characteristic physical property: azurite, from the azure-blue color; magnetite, from the strong magnetism; pistacite (var. epidote), from the pistachio-green color; satin spar (var. gypsum), from the luster; tetrahedrite, from the crystal habit.

5. From Greek or Latin names indicating some property or association of the mineral: argentite, silver sulphide, from the Latin name for silver; graphite, from the Greek verb meaning "To write", referring to its use in lead pencils; orthoclase, from the Greek words referring to its regular right-angled cleavage; sphalerite, from the Greek word for "treacherous", referring to the fact that it was often mistaken for galena; gypsum, from the Greek words for "earth" and "cook", referring to the calcining of gypsum

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in making Plaster of Paris; pyroxene, from the Greek words for "fire" and "stranger", from the early idea that the mineral was not of igneous origin; pyrite, also from the Greek for "fire", referring to the fact that pyrite often yields sparks when struck.

Classification of Minerals. The first scientific classification of minerals was made by James Dwight Dana in his "System of Mineralogy", published in 1837. The sixth edition of the System appeared in 1892, but three appendices have been published since then, the last in 1915, and a new edition of the complete work will probably be published within a year or two. The "System of Mineralogy" is the most complete and comprehensive work on the classification of minerals in the English language.

The method of classification used in the System is that which groups similar chemical compounds together in a common class, and further arranges the species into groups within the classes according to less fundamental relations existing among them, in chemical composition, crystalline formform and other physical properties.

Dana's Scheme of Classification

I. Native Elements.

II. Sulphides, Selenides, Tellurides, Arsenides, Antimonides.

III. Sulpho-salts: Sulpharsenites, Sulphantimonites, Sulphobismuthites.

IV. Haloids: Chlorides, Bromides, Iodides, Fluorides.

V. Oxides.

VI. Oxygen Salts.
1. Carbonates.
2. Silicates, Titanates.
3. Columbates, Tantalates.
4. Phosphates, Arsenates, Vanadates, Antimonates, Nitrates.
5. Borates, Uranates.
6. Sulphates, Chromates, Tellurates.
7. Tungstates, Molybdates.

VII. Salts of Organic Acids: Oxalates, Mellates.

VIII. Hydrocarbon Compounds.

The following table gives the systematic classification of the New Mexico species, with their chemical composition, according to Dana's method. In Part II, the actual descriptions of the species are given in alphabetical order, for convenience in reference. The classification begins on the next page.

IV. Haloids: Chlorides, Bromides, Iodides, Fluorides.

V. Oxides.

VI. Oxygen Salts.
1. Carbonates.
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The following table gives the systematic classification of the New Mexico species, with their chemical composition according to Dana's method. In Part II, the detailed descriptions of the species are given in alphabetical order for convenience in reference. The classification begins on the next page.

SYSTEMATIC CLASSIFICATION OF NEW MEXICO MINERALS

I. NATIVE ELEMENTS.

Diamond, C
Graphite, C
Sulphur, S
Tellurium, Te
Bismuth, Bi
Gold, Au
Silver, Ag
Copper, Cu
Lead, Pb
Platinum, Pt
Iridium, Ir

II. SULPHIDES, SELENIDES, TELLURIDES, ARSENIDES, ANTIMONIDES.

I. Sulphides, Selenides, Tellurides of the Semi-Metals.

Stibnite Group

Stibnite, Sb_2S_3
Bismuthinite, Bi_2S_3

Tetradymite, $Bi_2(Te,S)_3$
Molybdenite, MoS_2

II. Sulphides, Selenides, Tellurides, Arsenides, Antimonides of the Metals.

A. Basic Division.

Domeykite, Cu_3As
Rickardite, Cu_4Te_3

B. Monosulphides, Monotellurides, etc.

1. Isometric.

Galena Group

Galena, PbS
Cuproplumbite, $Cu_2S.2PbS$(?)
Altaite, PbTe

Argentite Group

Argentite, Ag_2S
Hessite, Ag_2Te
Petzite, $(Ag,Au)_2Te$

2. Chalcocite Group.

Chalcocite, Cu_2S
Stromeyerite, $(Ag,Cu)_2S$
Cubanite, $Cu_2S.Fe_4S_5$
Sternbergite, $AgFe_2S_3$

3. Sphalerite Group.

Sphalerite, ZnS

Alabandite, MnS

4. Rhombohedral or Hexagonal Group.

Greenockite, CdS
Niccolite, NiAs
Pyrrhotite, Fe_5S_6 to $Fe_{16}S_{17}$
Covellite, CuS

C. Intermediate Division.

Bornite, Cu_5FeS_4
Chalcopyrite, $CuFeS_2$

D. Disulphides, Diarsenides, etc.

Pyrite Group

Pyrite, FeS_2
Smaltite-Chloanthite, $(Co,Ni)As_2$
Skutterudite, $CoAs_3$

Marcasite Group

Marcasite, FeS_2
Arsenopyrite, FeAsS

Sylvanite, $(Au,Ag)Te_2$
Calaverite, $AuTe_2$

III. SULPHO-SALTS.

I. Sulpharsenites, Sulphantimonites, Sulphobismuthites.

A. Acidic Division.

B. Meta-Division.

Zinkenite Group

2. Chalcocite Group.
Chalcocite, Cu_2S
Stromeyerite, $(Ag,Cu)_2S$
Cubanite, $CuFe_2S_3$
Sternbergite, $AgFe_2S_3$

3. Sphalerite Group.
Sphalerite, ZnS
———
Alabandite, MnS

4. Unsubstituted or Hexagonal Group.
Greenockite, CdS
Millerite, NiS
Pyrrhotite, FeS to $Fe_{1-x}S$
Covellite, CuS

C. Intermediate Division.
Bornite, Cu_5FeS_4
Chalcopyrite, $CuFeS_2$

D. Disulphides, Diarsenides, etc.
Pyrite Group
Pyrite, FeS_2
Smaltite-Chloanthite, $(Co,Ni)As_{3-2}$
Skutterudite, $CoAs_3$

Marcasite Group
Marcasite, FeS_2
Arsenopyrite, FeAsS
———
Sylvanite, $(Au,Ag)Te_2$
Calaverite, $AuTe_2$

III. SULPHOSALTS.
1. Sulpharsenites, Sulphantimonites, Sulphobismuthites.
A. Acidic Division.

B. Meta-Division.
Jamesonite Group

Miargyrite Group

Miargyrite, $Ag_2S.Sb_2S_3$

C. Intermediate Division.

Jamesonite Group

Cosalite, $2PbS.Bi_2S_3$

D. Ortho-Division.

Bournonite Group

Bournonite, $2PbS.Cu_2S$

Pyrargyrite Group

Pyrargyrite, $3Ag_2S.Sb_2S_3$

Proustite, $3Ag_2S.As_2S_3$

Pyrostilpnite, $3Ag_2S.Sb_2S_3$

Xanthoconite, $3Ag_2S.As_2S_3$

Tetrahedrite Group

Tetrahedrite, $3Cu_2S.Sb_2S_3$

Tennantite, $Cu_2S.As_2S_3$

E. Basic Division.

Stephanite, $5Ag_2S.Sb_2S_3$

Polybasite Group

Polybasite, $9Ag_2S.Sb_2S_3$

Pearceite, $9Ag_2S.As_2S_3$

II. Sulpharsenites, Sulphantimonites.

Enargite, $3Cu_2S.As_2S_5$

III. Sulphostannates, etc.

IV. HALOIDS- CHLORIDES, BROMIDES, IODIDES; FLUORIDES.

I. Anhydrous Chlorides, Bromides, Iodides; Fluorides.

Halite Group

Halite, NaCl

Sylvite, KCl

Cerargyrite Group
Cerargyrite, AgCl
Embolite, Ag(Br,Cl)
Bromyrite, AgBr

Iodyrite, AgI

Fluorite Group
Fluorite, CaF_2

II. Oxychlorides, Oxyfluorides.

III. Hydrous Chlorides, Hydrous Fluorides, etc.
Carnallite, $KMgCl_3.6H_2O$

V. OXIDES.

I. Oxides of Silicon.
Quartz, SiO_2
Tridymite, SiO_2
Opal, $SiO_2.nH_2O$

II. Oxides of the Semi-Metals; also Molybdenum, Tellurium.
Cervantite, $Sb_2O_3.Sb_2O_5$
Stetefeldite, uncertain

III. Oxides of the Metals.
A. Anhydrous Oxides.
I. Protoxides.
Cuprite, Cu_2O

Periclase Group
Manganosite, MnO
Zincite, ZnO

Massicot, PbO
Tenorite, CuO

II. Sesquioxides.
Hematite Group
Corundum, Al_2O_3
Hematite, Fe_2O_3
Ilmenite, $FeTiO_3$

Cerargyrite Group
Cerargyrite, AgCl
Embolite, Ag(Cl,Br)
Bromyrite, AgBr

Iodyrite, AgI

Fluorite Group
Fluorite, CaF_2

II. Oxychlorides, Oxyfluorides.

III. Hydrous Chlorides, Hydrous Fluorides, etc.
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Cervantite, $Sb_2O_3.Sb_2O_5$
[illegible], uncertain

III. Oxides of the Metals.
A. Anhydrous Oxides.
1. Protoxides.
Cuprite, Cu_2O

Periclase Group
Manganosite, MnO
Zincite, ZnO

Bunsenite, NiO
Tenorite, CuO

2. Sesquioxides.
Hematite Group
Corundum, Al_2O_3
Hematite, Fe_2O_3
Ilmenite, $FeTiO_3$

III. Intermediate Oxides.

Spinel Group

Aluminum Spinels

Gahnite, $ZnAl_2O_4$

Iron Spinels

Magnetite, $FeO.Fe_2O_3$

Franklinite, $(Fe,Zn,Mn)O.(Fe,Mn)_2O_3$

Chromium Spinel

Hausmannite, $MnO.Mn_2O_3$

Minium, $2PbO.PbO_2$

Braunite, $3MnMnO_3.MnSiO_3$

IV. Dioxides.

Rutile Group

Cassiterite, SnO_2

Rutile, TiO_2

Plattnerite, PbO_2

Octahedrite, TiO_2

Brookite, TiO_2

Pyrolusite, MnO_2

B. Hydrous Oxides.

Diaspore Group

Diaspore, $Al_2O_3.H_2O$

Goethite, $Fe_2O_3.H_2O$

Manganite, $Mn_2O_3.H_2O$

Limonite, $2Fe_2O_3.3H_2O$

Bauxite, $Al_2O_3.2H_2O$

Brucite Group

Chalcophanite, $(Mn,Zn)O.2MnO_2.2H_2O$

Psilomelane, MnO_2

III. Intermediate Oxides.

Spinel Group

Aluminum Spinels

Spinel, $MgAl_2O_4$

Iron Spinels

Magnetite, Fe_3O_4

Franklinite, [illegible]

Chromium Spinel

Hausmannite, [illegible]

Minium, [illegible]

Braunite, [illegible]

IV. Dioxides.

Rutile Group

Cassiterite, SnO_2

Rutile, TiO_2

Plattnerite, PbO_2

Octahedrite, TiO_2

Brookite, TiO_2

Pyrolusite, MnO_2

B. Hydrous Oxides.

Diaspore Group

Diaspore, [illegible]

Goethite, [illegible]

Manganite, [illegible]

Limonite, [illegible]

Gibbsite, [illegible]

Brucite Group

Chalcophanite, [illegible]

Psilomelane, [illegible]

VI. OXYGEN SALTS.

1. Carbonates.

A. Anhydrous Carbonates.

1. Calcite Group.

Calcite, $CaCO_3$
Dolomite, $CaMg(CO_3)_2$
Ankerite, $CaCO_3.(Mg,Fe,Mn)CO_3$
Magnesite, $MgCO_3$
Siderite, $FeCO_3$
Rhodochrosite, $MnCO_3$
Smithsonite, $ZnCO_3$

2. Aragonite Group.

Aragonite, $CaCO_3$
Witherite, $BaCO_3$
Cerussite, $PbCO_3$

Barytocalcite, $BaCO_3.CaCO_3$
Phosgenite (?), $PbCO_3.PbCl_2$

B. Acid, Basic, and Hydrous Carbonates.

Malachite, $CuCO_3.Cu(OH)_2$
Azurite, $2CuCO_3.Cu(OH)_2$
Aurichalcite, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$
Hydrozincite, $2ZnCO_3.3Zn(OH)_2$

Trona, $Na_2CO_3.NaHCO_3.2H_2O$

Zaratite, $NiCO_3.2Ni(OH)_2.4H\ O$?
Bismutite, $Bi_2O_3.CO_2.H_2O$?

2A. Silicates.

Sec. A. Chiefly Anhydrous Silicates.

I. Disilicates, Polysilicates.

Petalite, $LiAl(Si_2O_5)_2$

Feldspar Group

Monoclinic Section

Orthoclase, $KAlSi_3O_8$

Triclinic Section

Microcline, $KAlSi_3O_8$
Anorthoclase, $(Na,K)AlSi_3O_8$

Albite-Anorthite Series: Plagioclase Feldspars

Albite, $NaAlSi_3O_8$

Intermediate Plagioclase Feldspars

Oligoclase, $NaAlSi_3O_8.CaAl_2Si_2O_8$
Andesine, $NaAlSi_3O_8.CaAl_2Si_2O_8$
Labradorite, $NaAlSi_3O_8.CaAl_2Si_2O_8$
Bytownite, $NaAlSi_3O_8.CaAl_2Si_2O_8$

Anorthite, $CaAl_2Si_2O_8$

II. Metasilicates.

Leucite Group

Leucite, $KAl(SiO_3)_2$

Pyroxene Group

Orthorhombic Section

Hypersthene, $(Fe,Mg)SiO_3$

Monoclinic Section

Pyroxene, $RSiO_3$
Acmite (Aegirite), $Na_2O.Fe_2O_3.4SiO_2$
Jadeite, $NaAl(SiO_3)_2$
Spodumene, $LiAl(SiO_3)_2$

Triclinic Section

Rhodonite, $MnSiO_3$

Wollastonite, $CaSiO_3$
Pectolite, $HNaCa_2(SiO_3)_3$

Amphibole Group

Orthorhombic Section

Monoclinic Section

Amphibole, $RSiO_3$

Beryl, $Be_3Al_2(SiO_3)_6$

Cordierite, $Mg_2Al_4Si_5O_{18}$

III. Orthosilicates.

Nephelite Group

Nephelite, $NaAlSiO_4$

Sodalite Group

Sodalite (?), $3NaAlSiO_4.NaCl$
Hauynite, $3NaAlSiO_4.CaSO_4$
Noselite (?), $3Na_2Al_2Si_2O_8.Na_2SO_4$

Helvite Group

Garnet Group

Garnet, $3RO.R_2O_3.3SiO_2$

Chrysolite Group

Chrysolite, $(Mg,Fe)_2SiO_4$

Phenacite Group

Willemite, Zn_2SiO_4

Dioptase, H_2CuSiO_4

Scapolite Group

Wernerite, $(CaCO_3.3CaAl_2Si_2O_8).-(NaCl.3NaAlSi_3O_8)$

Vesuvianite, $Ca_6(Al(OH,F))Al_2(SiO_4)_5$

Zircon Group

Zircon, $ZrSiO_4$

Danburite-Topaz Group

Andalusite, Al_2SiO_5
Sillimanite, Al_2SiO_5
Kyanite, Al_2SiO_5

Datolite Group

Datolite, $HCaBSiO_5$
Euclase, $HBeAlSiO_5$
Gadolinite, $Be_2FeY_2Si_2O_{10}$

<u>Epidote Group</u>

Zoisite, $HCa_2Al_3Si_3O_{13}$

Epidote, $HCa_2(Al,Fe)_3Si_3O_{13}$

Prehnite, $H_2Ca_2Al_2(SiO_4)_3$

IV. <u>Subsilicates</u>.

<u>Humite Group</u>

Ilvaite, $CaFe_2(FeOH)(SiO_4)_2$

Melanotekite, $3PbO.2Fe_2O_3.3SiO_2$

Calamine, H_2ZnSiO_5

Tourmaline, $H_9Al_3(B.OH)_2Si_4O_{19}$

Dumortierite, $8Al_2O_3.B_2O_3.6SiO_2.H_2O$

Staurolite, $HFeAl_5Si_2O_{13}$

Sec. B. <u>Chiefly Hydrous Silicates</u>.

I. <u>Zeolite Division</u>.

1. <u>Introductory Subdivision</u>.

Okenite, $H_2CaSi_2O_6.H_2O$

2. <u>Zeolites</u>.

<u>Mordenite Group</u>

<u>Heulandite Group</u>

Heulandite, $(Ca,Na_2)O.Al_2O_3.6SiO_2.-5H_2O$

<u>Phillipsite Group</u>

Stilbite, $(Na_2,Ca)Al_2Si_6O_{16}.6H_2O$

<u>Chabazite Group</u>

Analcite, $NaAlSi_2O_6.H_2O$

<u>Natrolite Group</u>

Natrolite, $Na_2Al_2Si_3O_{10}.2H_2O$

Thomsonite, $(Ca,Na_2)Al_2Si_2O_8.2\frac{1}{2}H_2O$

II. Mica Division.

1. Mica Group.

Muscovite, $H_2KAl_3(SiO_4)_3$
Paragonite, $H_2NaAl_3(SiO_4)_3$
Roscoelite, $H_2K(Al,V)(SiO_4)_3$
Lepidolite, $(OH,F)_2KLiAl_2Si_3O_{10}$
Biotite, $H_2K(Mg,Fe)_3Al(SiO_4)_3$
Phlogopite, $H_2KMg_3Al(SiO_4)_3$

2. Clintonite Group.

3. Chlorite Group

Species undetermined

Appendix to Mica Division- Vermiculites.

III. Serpentine and Talc Division.

Serpentine, $H_4Mg_3Si_2O_9$

Talc, $H_2Mg_3(SiO_3)_4$
Sepiolite, $H_4Mg_2Si_3O_{10}$

Iddingsite, $MgO.Fe_2O_3.3SiO_2.4H_2O$
Glauconite, hydrous silicate of Fe and K

IV. Kaolin Division.

Kaolin Minerals

Kaolinite, $H_4Al_2Si_2O_9$

Hydrous Aluminum Silicates

Halloysite, $(Al_2O_3.2SiO_2)nH_2O$

Leverrierite, hydrous Al silicate
Montmorillonite, $(Mg,Ca)O.\ Al_2O_3.-5SiO_2.nH_2O$
Allophane, $Al_2SiO_5.nH_2O$

Hydrous Iron Silicates

Hydrous Manganese Silicates

<u>Hydrous Copper Silicates</u>

Chrysocolla, $CuSiO_3.2H_2O$

<u>Silicates Containing Various Other Acid Radicals</u>

Spurrite, $2Ca_2SiO_4.CaCO_3$
Uranophane, $CaO.2UO_3.2SiO_2.7H_2O$

2B. <u>Titano-Silicates, Titanates</u>.

Titanite, $CaTiSiO_5$

3. <u>Columbates, Tantalates</u>.

Microlite, $Ca_2Ta_2O_7$

Columbite-Tantalite, $(Fe,Mn)(Cb,Ta)_2O_6$

Samarskite, $(Fe,Ca,UO_2)_3(Ce,Y)_2$-$(Cb,Ta)_6O_{21}$

Aeschynite, columbate and titanate of the cerium metals

4. <u>Phosphates, Arsenates, Vanadates, Antimonates</u>.

A. <u>Anhydrous Phosphates, Arsenates, Vanadates, Antimonates</u>.

Monazite, $(Ce,La,Nd,Pr)PO_4$

<u>Triphylite Group</u>

<u>Apatite Group</u>

Apatite, $(CaF)Ca_4(PO_4)_3$
Pyromorphite, $(PbCl)Pb_4(PO_4)_3$
Mimetite, $(PbCl)Pb_4(AsO_4)_3$
Vanadinite, $(PbCl)Pb_4(VO_4)_3$

<u>Wagnerite Group</u>

B. <u>Basic Phosphates</u>.

<u>Olivenite Group</u>

Libethenite, $Cu_3P_2O_8.Cu(OH)_2$
Descloizite, $(Pb,Zn,Cu)_2V_2O_8$.-$(Pb,Zn,Cu)(OH)_2$

Dufrenite, $FePO_4.Fe(OH)_3$

Hydrous Copper Silicates
Chrysocolla, [illegible]

Silicates Containing Various Other Acid Radicals
[illegible]
[illegible]

2a. Titano-Silicates, Titanates.
Titanite, [illegible]

3. Columbates, Tantalates.
Microlite, [illegible]

Columbite-Tantalite, [illegible]

Samarskite, [illegible]

Aeschynite, [illegible]

4. Phosphates, Arsenates, Vanadates, and [illegible].
A. Anhydrous Phosphates, Arsenates, Vanadates, [illegible]

Monazite, [illegible]

Triphylite Group

Apatite Group
Apatite, [illegible]
Pyromorphite, [illegible]
Mimetite, [illegible]
Vanadinite, [illegible]

Wagnerite Group

B. Basic Phosphates
Olivenite Group
[illegible]
[illegible]

[illegible]

C. Normal Hydrous Phosphates, etc.

Vivianite Group

Erythrite, $Co_3As_2O_8 \cdot 8H_2O$
Annabergite, $Ni_3As_2O_8 \cdot 8H_2O$

Zepharovichite, $AlPO_4 \cdot 3H_2O$

Acid Hydrous Phosphates, etc.

Basic Hydrous Phosphates, etc.

Turquois, $CuO \cdot 3Al_2O_3 \cdot 2P_2O_5 \cdot 9H_2O$

Uranite Group

Torbernite, $Cu(UO_2)_2P_2O_8 \cdot 12H_2O$
Autunite, $Ca(UO_2)_2P_2O_8 \cdot 8H\ O$

Carnotite, $K_2O \cdot 2U_2O_3 \cdot V_2O_5 \cdot 2H_2O$

Antimonates; also Antimonites, Arsenites

Phosphates or Arsenates with Carbonates, Sulphates, Borates

Lueneburgite, $3MgO \cdot B_2O_3 \cdot P_2O_5 \cdot 8H_2O$

Nitrates

Soda Niter, $NaNO_3$

Gerhardtite, $Cu(NO_3)_2 \cdot 3Cu(OH)_2$

5. Borates, Uranates.

Borates

Borax, $Na_2B_4O_7 \cdot 10H_2O$

Uranates

Uraninite, uranate of uranyl, lead, etc.
Gummite, alteration product of uraninite, doubtful

C. Normal Hydrous Phosphates, etc.

Vivianite Group

Erythrite, $Co_3(AsO_4)_2 \cdot 8H_2O$

Annabergite, $Ni_3(AsO_4)_2 \cdot 8H_2O$

[illegible], $Al[illegible] \cdot [illegible]H_2O$

Acid Hydrous Phosphates, etc.

Basic Hydrous Phosphates, etc.

Turquoise, $CuO \cdot 3Al_2O_3 \cdot 2P_2O_5 \cdot 9H_2O$

Uranite Group

Torbernite, $Cu(UO_2)_2P_2O_8 \cdot 12H_2O$

Autunite, $Ca(UO_2)_2P_2O_8 \cdot 8H_2O$

Carnotite, $K_2O \cdot 2UO_3 \cdot V_2O_5 \cdot 3H_2O$

Antimonates; also antimonites, arsenites

Phosphates or Arsenates with Carbonates, Sulphates, Borates

Lueneburgite, $3MgO \cdot B_2O_3 \cdot P_2O_5 \cdot 8H_2O$

Nitrates

Soda Niter, $NaNO_3$

Darapskite, $NaNO_3 \cdot Na_2SO_4 \cdot H_2O$

9. Borates, Uranates.

Borates

Borax, $Na_2B_4O_7 \cdot 10H_2O$

Uranates

Uraninite, uranate of uranium, [illegible]

Gummite, alteration product of uraninite, [illegible]

6. <u>Sulphates, Chromates, Tellurates.</u>

A. <u>Anhydrous Sulphates</u>, etc.

Thenardite, Na_2SO_4
Glauberite, $Na_2SO_4.CaSO_4$
Langbeinite, $K_2Mg_2(SO_4)_3$

<u>Barite Group</u>

Barite, $BaSO_4$
Celestite, $SrSO_4$
Anglesite, $PbSO_4$

Anhydrite, $CaSO_4$
Zinkosite, $ZnSO_4$

<u>Sulphates with Chlorides, Carbonates, etc.- In Part Hydrous</u>

Kainite, $MgSO_4.KCl.3H_2O$

B. <u>Acid and Basic Sulphates.</u>

Brochantite, $CuSO_4.3Cu(OH)_2$
Caledonite, $2(Pb,Cu)O.SO_3.H_2O$
Linarite, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$

C. <u>Normal Hydrous Sulphates.</u>

Mirabilite, $Na_2SO_4.10H_2O$
Kieserite, $MgSO_4.H_2O$
Gypsum, $CaSO_4.2H_2O$

<u>Epsomite Group</u>

Epsomite, $MgSO_4.7H_2O$
Goslarite, $ZnSO .7H_2O$

<u>Melanterite Group</u>

Melanterite, $FeSO_4.7H_2O$
Mallardite, $MnSO_4.7H_2O$

Chalcanthite, $CuSO_4.5H_2O$
Bloedite, $MgSO_4.Na_2SO_4.4H_2O$
Leonite, $MgSO_4.K_2SO_4.4H_2O$
Polyhalite, $2CaSO_4.MgSO_4.K_2SO_4.2H_2O$

Alum Group

Tschermigite, $(NH_4)Al(SO_4)_2.12H_2O$

Pickeringite, $MgSO_4.Al_2(SO_4)_3.22H_2O$
Picroallumogene, $2MgSO_4.Al_2(SO_4)_3.28H_2O$
Halotrichite, $FeSO_4.Al_2(SO_4)_3.22H_2O$

Alunogen, $Al_2(SO_4)_3.16H_2O$

Basic Hydrous Sulphates

Copiapite, $Fe_4(OH)_2(SO_4)_5.18H_2O$
Utahite, $3Fe_2O_3.3SO_3.4H_2O$

Alunite Group

Alunite, $K_2Al_6(OH)_{12}(SO_4)_4$
Jarosite, $K_2Fe_6(OH)_{12}(SO_4)_4$
Natrojarosite, $Na_2Fe_6(OH)_{12}(SO_4)_4$
Plumbojarosite, $PbFe_6(OH)_{12}(SO_4)_4$

Tellurates; also Tellurites, Selenites

Durdenite, $Fe_2(TeO_3)_3.4H_2O$

7. Tungstates, Molybdates.

Wolframite Group

Wolframite, $(Fe,Mn)WO_4$

Scheelite Group

Scheelite, $CaWO_4$
Cuprotungstite, $CuWO_4$
Wulfenite, $PbMoO_4$

Ferrimolybdite, $Fe_2O_3.3MoO_3.8H_2O$

VII. SALTS OF ORGANIC ACIDS.

VIII. HYDROCARBON COMPOUNDS.

1. Simple Hydrocarbons.

2. Oxygenated Hydrocarbons.

Resin, composition variable
Wheelerite, $(C_5H_6O)_n$

V. ORIGIN, MODE OF OCCURRENCE, AND ASSOCIATION OF MINERALS

Since we are interested in the individual mineral species from the standpoint of the collector, and since the field of origin, occurrence, and association of minerals properly belongs to the field of Geochemistry and Geophysics, we shall not treat it in great detail, but shall include the fundamentals for the sake of completeness.

Chief Modes of Mineral Origin.

(1) From Fusion. The greater part of the minerals that form the crust of the earth have been formed by solidification of fused material; that is, they are, or were originally, constituents of igneous rocks.

(2) From Solution. Many minerals have been formed by crystallization from a solution. This is especially true for the group of saline minerals, but it also holds true for minerals found lining or filling fissures in rocks (vein minerals). Many vein minerals cannot be formed from solution in the laboratory, since it is impossible to duplicate the conditions of temperature, pressure, and associated materials that occur in nature.

(3) From a Vapor. Some minerals may be formed by direct

V. ORIGIN, MODE OF [illegible]

Since we are interested in the [illegible] from the standpoint of the [illegible], origin, occurrence, and [illegible] belongs to the field of [illegible] not treat it in great detail, [illegible] merals for the sake of [illegible].

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(3) From a Vapor. [illegible]

crystallization from a gas, without an intervening liquid stage. These minerals are most commonly found associated with volcanic fumaroles, etc.

While these three modes of origin seem very distinct, it must be emphasized that the boundaries between them are really very indefinite, since molten rock matter may be considered as a very concentrated solution, and a vapor as a very dilute solution.

Formation of Minerals From Fusion. Igneous rocks have their origin in fused masses of rock constituents known as magmas. A magma may be considered as a very dense solution in which the elements are more or less free to circulate and join to form mineral molecules upon solidification of the mass. The composition of the whole magma will of course determine what minerals will compose the resulting rock. All magmas are composed essentially (about 99%) of the elements oxygen, silicon, aluminum, iron, magnesium, calcium, sodium, and potassium. The elements of course occur in different proportions in different magmas.

The conditions under which the various minerals are formed are very complex. In general, minerals crystallize out in order of their solubilities, insoluble minerals first, but variation in the chemical nature of the solution produces wide variation in the solubility of any certain mineral, and so only a very general prediction may be made of the order of crystallization of minerals from various magmas.

The fluidity of the magma and the temperature at which various minerals will crystallize out are greatly influenced by the presence of small quantities of substances called mineralizers, these being usually water vapor, carbon dioxide, fluorine, boric acid, sulphur, and chlorine. These mineralizers, besides occasionally entering into the composition of certain minerals, are often necessary to permit the crystallization of minerals into which they do not enter as necessary constituents. These minerals, if forming from dry fusion, would not occur as crystals.

Formation of Minerals From Solution.

(1) By the Evaporation of Saline Waters. Lake and ocean waters contain salts in solution in varying amounts. These are precipitated as crystalline minerals when the water is evaporated, the more insoluble constituents first. The normal order of crystallization is: carbonates of calcium and magnesium, calcium sulphate, sodium chloride, magnesium chloride and sulphate, potassium sulphate and chloride, etc. While this order is rather constantly adhered to, varying conditions of concentration, temperature, and proportions of the elements present sometimes alter it.

(2) By Precipitation From Ground Waters. There are numerous openings of various sizes and shapes in the rocks of the earth's crust. Below the water table, and extending to a considerable distance underground, these openings are

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Formation of Minerals from Solution.

(1) By the Evaporation of Saline Waters. Many of the ocean waters contain salts in solution in varying amounts. These are precipitated as crystalline minerals when the water is evaporated, the more insoluble ones crystallizing first. The normal order of crystallization is: carbonates of calcium and magnesium, calcium sulphate, sodium chloride, magnesium chloride and sulphate, potassium salts being the last to separate. While this order is rather constantly adhered to, varying conditions of concentration, temperature, and the nature of the elements present sometimes alter it.

(2) By Precipitation from Hot Solutions. There are numerous openings of various sizes that [illegible] of the earth's crust. [illegible] to a considerable distance [illegible]

filled with water, most of which has seeped down from the surface, while a small part may have come from igneous intrusions. At great depths, the water is hot and under high pressure, and under these conditions is an effective solvent. It circulates slowly through the rocks, dissolving many soluble constituents. When it comes to larger fissures and commences to rise toward the surface, it comes into regions of lower temperature and pressure. Under these conditions, some of the dissolved constituents crystallize out in the form of vein minerals. As was stated above, many of these minerals are not soluble in water under conditions capable of being produced in the laboratory, but there is no doubt that they were actually precipitated from water in nature.

Occasionally, much of the mineral matter may remain in solution until the water reaches the surface, where it usually emerges in the form of a hot spring, and the mineral matter is crystallized out in the form of travertine, geyserite, etc. Sometimes ground waters ascend to the surface by capillary action and evaporate, leaving deposits of sodium and calcium salts, commonly called alkali or caliche.

Formation of Minerals From Vapors. This type of mineral formation is restricted to volcanic regions where mineral gases are discharged from fumaroles. The deposits are not numerous, and are usually small in extent. The ordinary filled with water, most of which has seeped down from the surface, while a small part may have come from igneous intrusions. At great depths, the water is hot and under high pressure, and under these conditions is an effective solvent. It circulates slowly through the rocks, dissolving many soluble constituents. When it comes to larger fissures and commences to rise toward the surface, it comes into regions of lower temperature and pressure. Under these conditions, some of the dissolved constituents crystallize out in the form of vein-minerals. As was stated above, many of these minerals are not soluble in water under conditions capable of being produced in the laboratory, but there is no doubt that they were actually precipitated from water in nature.

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Formation of Minerals from Vapors. This type of mineral formation is restricted to volcanic regions where mineral gases are discharged from fumaroles. The deposits are not numerous, and are found in small amounts. The ordinary minerals deposited are sulphur, tellurium, arsenic sulphides, boric acid, various chlorides, etc.

Occurrence and Association of Minerals. Only a few of the more than one thousand mineral species occur in sufficient quantity to be called common; these are the rock minerals or rock-making minerals. Most mineral species occur in isolated deposits, alone or with other minerals, and are not considered as making up rocks.

The association of minerals with each other is of great interest to mineralogists. The actual association is known as their paragenesis. By a thorough study of the paragenesis of minerals, a great deal may be learned about the history of the deposit in which they occur.

In the following paragraphs, the more important modes of occurrence, and the characteristic types of mineral association, are given briefly.

Rock Minerals. The following relatively short list of mineral species includes all those that can be called common. They are the important minerals in making up the bulk of the rocks of the earth's crust, and some occur only in rare rock types. They are: quartz, the feldspars, nephelite, sodalite, leucite, the micas, the pyroxenes, the amphiboles, chrysolite, kaolin, the chlorites, serpentine, talc, calcite, and dolomite.

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Rock Minerals. The following relatively short list of mineral species includes all those that can be called common. They are the important minerals in making up the main mass of the earth's crust, and some occur only in certain rock types. They are: quartz, the feldspars, nepheline, leucite, the micas, the pyroxenes, the amphiboles, melilite, kaolin, the chlorites, serpentine, talc, calcite, and dolomite.

There is another group of minerals commonly occurring in rocks, usually in scattered grains and seldom forming one of the prime constituents. These are known as _accessory rock-making minerals_. Only a few are common enough to be included here. They are: _garnet_, _epidote_, _staurolite_, _kyanite_, _zircon_, _titanite_, and _apatite_. Still rarer accessory minerals are the following: _rutile_, _iolite_, _scapolite_, _andalusite_, and _sillimanite_. The iron minerals _magnetite_, _hematite_, _ilmenite_, and _pyrite_ may also occur as accessory rock minerals.

Igneous Rocks. Igneous rocks are those formed by the cooling and solidification of a molten magma. In the solidification, there is a general order of crystallization of minerals, as follows: _iron oxides_ first, then _ferromagnesian minerals_ (_pyroxene_, _amphibole_, _chrysolite_), next the _plagioclase feldspars_, then _potash feldspars_, and finally _quartz_.

The minerals formed from a magma of course depend on the chemical composition of the magma. If it is acidic (containing excess silicic acids), then the resulting rock will have abundant free quartz, and will be light in color and specific gravity. If the magma is basic (containing enough of the bases iron, magnesium, etc. to balance the silicic acids), the rock will be dark in color and rather heavy.

The rate of cooling of a magma is of great importance

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The rate of cooling

in determining the texture, and thus the appearance, of the resulting rock. It may also influence the mineral composition, since some minerals require a long time in forming, and will not be formed if cooling is rapid. The general rule is: rapid cooling = fine grain size; slow cooling = large grain size. This is obvious from the following consideration: if a magma cools quickly, there is little opportunity for the gathering of elements into molecular groups, and thus for the formation of minerals, at least in large crystals. If the cooling is slow, as when deep-seated intrusive bodies are formed, there is ample time for the arrangement of elements into molecules, and thus for crystallization of minerals, and the resulting rock will have a coarse texture. A coarse-textured rock is called phaneritic; a fine-grained rock is called aphanitic. Intrusive rocks are usually phaneritic; extrusive (volcanic) rocks are usually aphanitic. In general, the limit of visibility of individual grains with the naked eye is taken as the boundary between phaneritic and aphanitic texture.

The following are the important igneous rocks, with their characteristic minerals:

A. Intrusive, Coarse-Grained Rocks.

1. Granite. Chiefly quartz and orthoclase feldspar, with small amounts of mica and hornblende. If plagioclase feldspar is abundant in the rock, the rock is called a quartz monzonite; if the plagioclase is present in larger

in determining the texture, and thus the appearance, of the resulting rock. It may also influence the mineral composition, since some minerals require a long time to develop and will not be formed if cooling is rapid. The general rule is: rapid cooling = fine grain size; slow cooling = large grain size. This is obvious from the following consideration: if a magma cools quickly, there is little opportunity for the gathering of elements into molecular groups, and thus for the formation of minerals, at least in large crystals. If the cooling is slow, as when deep-seated intrusive bodies are formed, there is ample time for the arrangement of elements into molecules, and thus for crystallization of minerals, and the resulting rock will have coarse texture. A coarse-textured rock is called phanerític; a fine-grained rock is called aphanitic. Intrusive rocks are usually phaneritic; extrusive (volcanic) rocks are usually aphanitic. In general, the limit of visibility of individual grains with the naked eye is taken as the boundary between phaneritic and aphanitic texture.

The following are the important igneous rocks, with their characteristic minerals:

A. Intrusive, Coarse-Grained Rocks.

1. Granite. Chiefly quartz and orthoclase (alkali feldspar), with small amounts of mica and hornblende. If plagioclase feldspar is abundant in the rock, the rock is called quartz monzonite; if the plagioclase is greatly in excess

amount than the orthoclase, the rock is known as a grano-diorite. Granite is a very common rock type.

2. Syenite. Chiefly feldspar, with more or less mica, hornblende, or pyroxene, but little quartz. Often contains nephelite, in nephelite-syenite. Resembles granite. Not a common type.

3. Diorite. Chiefly plagioclase feldspar and some ferromagnesian mineral, as biotite, hornblende, or pyroxene, with plagioclase exceeding the dark minerals in amount. Quartz may be present, in quartz-diorite. Diorite is a common rock type.

4. Gabbro. Chiefly some ferromagnesian mineral (hornblende, pyroxene, chrysolite) with plagioclase feldspar, with the ferromagnesian minerals making up the greater part of the rock. Not a very common type.

5. Dolerite. The name given to fine-grained varieties of dark-colored igneous rocks that cannot be distinguished with the naked eye.

6. Peridotite. Chiefly olivine, pyroxene, or hornblende, and referred to as dunite, pyroxenite, and amphibolite respectively. Not a very common type.

B. Extrusive, Fine-Grained Rocks.

1. Felsite. Fine-grained, with a stony texture, and

amount than the orthoclase, the rock is known as a grano-
diorite. Granite is a very common rock type.

2. Syenite. Chiefly feldspar, with [illegible] hornblende, or pyroxene, but little quartz. [illegible] nepheline, in nepheline-syenite. [illegible] granite. [illegible] common type.

3. Diorite. Chiefly plagioclase feldspar and one or more ferromagnesian minerals, as biotite, hornblende, or pyroxene, with plagioclase exceeding the ferromagnesian minerals. Quartz may be present, in quartz-diorite. [illegible] common rock type.

4. Gabbro. Chiefly some ferromagnesian mineral, as biotite, pyroxene, or olivine with plagioclase feldspar, with the ferromagnesian minerals making up the greater part of the rock. Not a very common type.

5. Dolerite. The name given to fine-grained [illegible] of dark-colored igneous rocks [illegible] with the naked eye.

6. Peridotite. Chiefly olivine, pyroxene, [illegible] blende, and referred to [illegible] ite respectively. Not a [illegible].

B. Extrusive, fine-grained rocks.

1. Rhyolite. Fine-grained, [illegible]

including all colors except dark gray, dark green, and black. Chiefly quartz and feldspar. A very common type, occurring as near-surface intrusions and lava flows.

2. Basalt. The fine-grained, dark green or black extrusives, consisting of ferromagnesian minerals and plagioclase feldspars chiefly.

3. Glassy Rocks. Made up partly or wholly of volcanic glass, in which no distinct minerals can be recognized, even microscopically. Usually with an excess of silica (an acid rock). Called obsidian if entirely glassy; pitchstone, when the luster is dull; perlite, if made up of small spheroids; and pumice, if distinctly cellular in structure.

C. Porphyritic Structure; Magmatic Segregations.

Some igneous rocks show a relatively fine-grained groundmass in which are embedded larger crystals known as phenocrysts. These rocks are called porphyries. The structure is due to peculiar conditions during formation, which allowed crystals of certain minerals to grow to considerable size before the groundmass solidified. The most common minerals occurring as phenocrysts are quartz and feldspar.

When a magma is beginning to solidify, certain heavy minerals are usually the first to crystallize. If their constituents form a considerable percentage of the mass, enough of the minerals may form to sink slowly downward

through the mass, forming large, irregular masses known as magmatic segregations. This is often true in the case of the minerals magnetite, ilmenite, and cassiterite, and important ore bodies of these minerals have been formed in this manner.

Sedimentary Rocks. Sedimentary rocks are always secondary in origin, having been formed by the deposition and solidification of material transported from a decaying and disentigrating rock mass. These rocks are divided into two classes, depending on whether the material was transported in solution or mechanically. Sedimentary rocks are characterized by a parallel or stratified structure. The major types are:

1. Sandstone. Consisting chiefly of grains of quartz, cemented with calcium carbonate, silica, or iron oxides. Usually light in color, yellow or red. If coarse-grained, consisting of weathered pebbles of other rocks, the term conglomerate is used. A breccia is a similar type in which the pebbles are angular. If unweathered feldspar is present, the rock is known as an arkose.

2. Shale. Consisting chiefly of very fine grains of some kaolin mineral or mica, the grains being too small to be seen by the naked eye as individuals. Usually gray to black in color. A thinly laminated structure is typical.

3. Limestone. Consisting chiefly of calcite, though dolomite is sometimes important. Usually gray in color.

through the mass, forming ledges, irregular masses, known as magmatic segregations. This is often true in the case of the minerals magnetite, ilmenite, and chromite. Several important ore bodies of these minerals have been formed in this manner.

Sedimentary Rocks. Sedimentary rocks are always secondary in origin, having been formed by the deposition and consolidation of material transported from a decaying and disintegrating rock mass. These rocks are divided into two classes depending on whether the material was transported in solution or mechanically. Sedimentary rocks are characterized by a parallel or stratified structure. The common types are:

1. Sandstone. Consisting chiefly of grains of quartz cemented with calcium carbonate, silica, or iron oxides. Usually light in color, yellow or red. If coarse-grained, consisting of weathered pebbles of other rocks, the term conglomerate is used. A breccia is a similar type in which the pebbles are angular. If considerable feldspar is present, the rock is known as an arkose.

2. Shale. Consisting chiefly of very fine particles of some kaolin mineral or mica, the grains being too small to be seen by the naked eye or hand lens. It varies in color from black to white. A shaley sandstone is intermediate in character.

3. Limestone. Consisting chiefly of calcite. Where dolomite is abundant, it is known as dolomite. Commonly gray or white.

Limestone ranges in texture from the typical fine-grained types to the coarse-grained, crystalline types. Chalk is a friable, fine-grained limestone composed of the skeletons of minute, one-celled marine animals.

4. Other Sedimentary Formations. Rock salt occurs in beds of considerable size, as does gypsum. Anhydrite also may make up large beds. Silica occurs in various forms as other sedimentary types than sandstone: as geyserite, deposited from hot springs; diatomaceous earth or diatomite, similar to chalk except that the siliceous skeletons are of one-celled marine plants. Iron ores often occur in sedimentary beds, especially hematite and limonite. There are sedimentary beds of phosphate rock of considerable extent in some parts of the United States.

Metamorphic Rocks. Metamorphic rocks are rocks which have undergone a physical or chemical change since their original formation, due to the action of geological processes operating within the earth. The changes involve formation of new minerals that are stable under a new set of physical and chemical conditions which affect the rock. Certain minerals are very characteristic of metamorphic rocks. They are lister on a later page.

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Metamorphic rocks are usually easily recognizable as such, because high pressures have generally caused flattening of mineral grains and the development of [illegible] structure.

The principal types of metamorphic rocks are:

1. Gneiss. Coarse-grained, roughly foliated. Consists chiefly of quartz, feldspar, and some mica. The various types are described with respect to the structure, with respect to the normal igneous rock to which they are similar in composition, or with respect to the dominant mineral, if other than quartz, feldspar, or mica. The gneisses are the most common metamorphic rocks.

2. Mica-schist. A finer-grained, more finely foliated type than gneiss, consisting largely of quartz and a mica. Characteristic accessory minerals are often present. Next to the gneisses, mica-schists are the most common metamorphic types.

3. Quartzite. Consisting essentially of quartz, and derived from a sandstone by intense metamorphism. Light in color; very firm and compact. A common type.

4. Slate. A very fine-grained, finely foliated type, capable of being split into thin sheets. Commonly formed by the metamorphism of a shale. A quite common type.

5. Other Schists. Certain schists do not contain quartz and mica as the dominant minerals. They are usually formed by the metamorphism of ferromagnesian igneous rocks. The common types are talc-schist, chlorite schist, etc.

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6. Marble. Consisting of calcite, and formed by the metamorphism of a limestone or dolomite. Varies in texture from very fine granular to very coarse crystalline.

Contact Metamorphic Minerals. When igneous rocks are intruded into the earth's crust, they cause more or less intense alteration in the surrounding rocks, depending upon the temperature of the intrusive body and the kind and amount of mineralizers. The alteration is manifested in the development of new minerals in the contact zone, both in the igneous body and especially in the country rock. The changes are most striking when the intruded rock is an impure limestone. A pure limestone when intruded is converted into a marble, but if impurities of iron, aluminum, magnesium, carbon, etc., are present, they enter into the composition of new minerals. The most typical contact metamorphic minerals are: graphite, spinel, corundum, wollastonite, tremolite, pyroxene, and the calcium garnets grossularite and andradite.

Igneous rocks on cooling give off large quantities of the so-called mineralizing vapors. These consist largely of water vapor, but also include boron and fluorine gases. Under the influence of these agents, minerals are often formed in the contact zone of a limestone, these being known as pneumatolytic minerals. They are chiefly calcium and aluminum silicates containing hydroxyl, fluorine, or

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Pegmatite Dikes or Veins. Pegmatite dikes or veins are mineral deposits occurring often in deep-seated, coarse-grained igneous rocks, especially granite, and in the country rock surrounding the intrusive mass. The dikes are composed chiefly of minerals found in the igneous rock, but usually in very large crystals. They are formed during the last stages of the cooling of the magma after an igneous intrusion, when the concentrated mineralizers, driven off from the solidified rock, cause more or less simultaneous crystallization of the acid minerals whose constituents remain in solution. The fissures in which the deposition takes place result from cracking of the igneous body when cooling causes contraction.

The pegmatite minerals are divided into three general classes. They are: (a) The minerals prominent in the igneous rock. Thus in a granite pegmatite (the most common type) quartz, feldspar, and mica are prominent. Garnet is often present in smaller amount. (b) A series of rare minerals containing hydroxyl, fluorine, or boron: beryl, tourmaline, topaz, apatite, and fluorite. (c) A series of still rarer minerals, containing the rare elements: molybdenite, lepidolite, spodumene, triphylite, columbite, cassiterite, and monazite.

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These deposits are of peculiar interest to mineralogists, because of the rare minerals which occur in them, and also because large and well-formed crystals frequently occur.

Veins and Vein Minerals. Most of the valuable ore minerals occur in veins, where they have been deposited by the action of heated ground waters. Veins vary in shape according to whether the rock containing them is firm and compact, easily shattered, or soft and easily dissolved. A typical vein occurs in a definite fissure, and fills it from wall to wall. In some deposits, there has been replacement of minerals in the wall rock by ore minerals, forming a more or less irregular replacement deposit.

The kinds of minerals occurring in veins depend on the chemical constituents of the solution from which they are deposited. While many minerals occur in veins, the most characteristic ones are the sulphides pyrite, FeS_2, chalcopyrite, $CuFeS_2$, galena, PbS, sphalerite, ZnS, chalcocite, Cu_2S, bornite, Cu_5FeS_4, marcasite, FeS_2, arsenopyrite, $FeAsS$, stibnite, Sb_2S_3, tetrahedrite, $Cu_6Sb_2S_7$, etc. In addition to these, certain non-metallic minerals often occur as a groundmass or gangue. The common ones are quartz, SiO_2, calcite, $CaCO_3$, dolomite, $CaMg(CO_3)_2$, siderite, $FeCO_3$, barite, $BaSO_4$, fluorite, CaF_2, rhodochrosite, $MnCO_3$, etc.

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The following are the common types of veins, according to the mineral composition:

1. Gold-bearing Quartz Veins. The gold occurs finely disseminated, in nests, or in connection with various sulphides. The common sulphides are pyrite, chalcopyrite, and arsenopyrite.

2. Gold- and Silver-bearing Copper Veins. The gold and silver occur associated with various copper sulphides. The common minerals are chalcopyrite, tetrahedrite, bornite, chalcocite, pyrite, and the rarer silver sulphides.

3. Silver-bearing Lead Veins. The silver occurs associated with some lead mineral. The ordinary minerals found in such veins, including both lead minerals and other minerals, are galena, argentite, tetrahedrite, sphalerite, pyrite, calcite, dolomite, rhodochrosite, etc.

4. Lead-zinc veins. Lead and zinc minerals are often associated in veins. The prominent minerals are galena, sphalerite, marcasite, chalcopyrite, smithsonite, calamine, cerussite, calcite, and dolomite.

5. Copper-iron Veins. Copper and iron minerals are often associated with each other, the chief minerals of such veins being pyrite, chalcopyrite, chalcocite, bornite, tetrahedrite, enargite, etc.

Primary and Secondary Vein Minerals; Secondary Enrichment. In many veins, it is obvious that some of the minerals belong to the original deposit, while others have been formed

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Primary and Secondary Vein Minerals. Secondary Enrichment. In many veins, it is obvious that some of the minerals belong to the original deposit, while others have been formed subsequently. The two classes are known as <u>primary</u> and <u>secondary minerals</u>, respectively. The primary metallic vein minerals are few in number, the more important ones being <u>pyrite</u>, <u>chalcopyrite</u>, <u>galena</u>, and <u>sphalerite</u>. The secondary minerals have been formed from the primary minerals by a chemical and physical change, brought about usually through the influence of oxidizing waters from the surface, which act on the upper part of the vein. Many of the minerals are thus oxidized compounds.

Since the meteoric waters lose their oxygen at only a slight depth, only the upper parts of a mineral vein are oxidized. At the same time, there is usually a tendency for the valuable metallic minerals to be dissolved, carried down, and reprecipitated at the water table. As erosion removes the upper parts of the vein, the oxidized zone penetrates deeper and deeper, and the solution and reprecipitation of the metallic minerals is repeated, until in time the lower parts of a mineral vein, at and just below the water table, may be very considerably enriched by the addition of metallic minerals brought from above. The whole process is known as <u>secondary enrichment</u>. It must be remembered that it takes place near the water table, and thus within a few hundred feet of the top of the vein. As one descends lower, it is usually seen that the metallic mineral content of the vein gradually returns to the original state, and the minerals may be present in quantities too small to permit profitable subsequently. The two classes are known as primary and secondary minerals, respectively. The primary metallic vein minerals are few in number, the more important ones being pyrite, chalcopyrite, galena, and sphalerite. The secondary minerals have been formed from the primary minerals by a chemical and physical change, brought about usually through the influence of oxidizing waters from the surface, which act on the upper part of the vein. Many of the minerals are thus oxidized compounds.

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The following paragraphs give the common primary vein minerals, and the secondary minerals derived from them:

1. Iron Minerals. The common primary mineral is pyrite, FeS_2. Upon oxidation, pyrite commonly yields limonite, the hydrated ferric oxide, $2Fe_2O_3.3H_2O$.

2. Copper Minerals. The only common primary copper mineral is chalcopyrite, $CuFeS_2$. Other copper minerals may sometimes occur as primary minerals, but they are usually secondary. The chalcopyrite is decomposed to yield copper sulphide, which is oxidized to copper sulphate, and descends to enrich lower portions of the vein; and iron sulphide, which is oxidized to form limonite. If the vein is in limestone, copper carbonates are frequently formed in the upper parts of the deposit. The secondary copper minerals include chalcocite, Cu_2S, bornite, Cu_5FeS_4, native copper, Cu, cuprite, Cu_2O, malachite, $(Cu.OH)_2CO_3$, azurite, $Cu(Cu.OH)-(CO_3)_2$, chrysocolla, $CuSiO_3.2H_2O$, and chalcanthite, $CuSO_4.5H_2O$.

3. Lead Minerals. The only common primary lead mineral is galena, PbS. The secondary minerals are all oxidized compounds, and include cerussite, $PbCO_3$, anglesite, $PbSO_4$, pyromorphite, $Pb_4(PbCl)(PO_4)_3$, and wulfenite, $PbMoO_4$.

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<u>sphalerite</u>, ZnS. The secondary minerals include <u>smithsonite</u>, $ZnCO_3$, and <u>calamine</u>, $H_2(Zn_2O)SiO_4$.

5. <u>Silver Minerals</u>. Most silver sulphide minerals are probably primary. Secondary silver minerals include <u>native silver</u>, Ag, which is also often primary, <u>cerargyrite</u>, AgCl, and <u>embolite</u>, Ag(Cl,Br).

PART II

DESCRIPTIVE MINERALOGY
OF
NEW MEXICO

VI. DESCRIPTIVE MINERALOGY.

Scope. In this paper, the Descriptive Mineralogy for each species includes a description of the physical characteristics, the chemical composition, a description of the distinguishing characters of any varieties occurring in New Mexico, and a list of the known occurrences in the State.

The description of the physical characteristics for each species is essentially that given in the "System of Mineralogy" and "Textbook of Mineralogy" (see bibliography). Certain descriptions have been enlarged or changed, and in this the writer has made free use of available sources. The descriptions, then, are general, and not all New Mexico occurrences include specimens with the color, luster, structure, etc., ranges given. It is felt that restricting the description of a certain mineral, perhaps occurring in only one place in New Mexico, to conform to the characters of the specimens from that single locality, might possibly cause the occurrence of other varieties of the same species to be overlooked. The physical characters described for the majority of the species are: crystal system, typical crystal form (habit), structure, cleavage, fracture, tenacity,

hardness, specific gravity, luster, color, streak, transparency, and special characters, in the order named.

No chemical tests are given, since it is impossible for most collectors to make them. Only the chemical composition is included.

The occurrences as given for New Mexico species were taken from a card catalogue prepared by Dr. Stuart A. Northrop, head of the Department of Geology. They are arranged alphabetically by counties, and, within each county, by districts, arranged alphabetically, and regions, also arranged alphabetically. The term district refers to a definite and restricted area, usually a well known mining district. The term region is less definite, and is used where the area is large, or where exact localities are not reported. The lists of occurrences for many species are so long that it is quite impossible to give specific directions for finding particular locations, such as mine dumps, etc. The earnest collector will, however, encounter little difficulty in finding specimens of most of the species if he makes local inquiries when collecting in any of the districts.

This paper is intended not only as a guidebook for the collector, but also as a record of all reported occurrences of minerals in the State, and so there are included descriptions of certain minerals which are no longer obtainable hardness, specific gravity, luster, color, streak, transparency, and special characters, in the order named.

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A question mark after the name of a mineral indicates doubt as to the occurrence of the species in the State. A question mark after a particular occurrence indicates doubt as to its occurrence in a certain locality.

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NEW MEXICO MINERALS

ACMITE. Aegirite.

Physical characteristics. Ordinary acmite is not reported from New Mexico. For aegirite, the characteristics are: Monoclinic. Crystals prismatic, bluntly terminated; twins not common; also in groups of slender acicular to capillary crystals, and in fibrous forms. Cleavage: prismatic, distinct. Fracture uneven. Brittle. H.- 6-6.5. Sp.G.- 3.50-3.55. Luster vitreous, inclining to resinous. Color brownish or reddish brown, green; blackish green on a fracture surface. Streak pale yellowish gray. Subtransparent to opaque.

Chemical composition. Essentially $Na_2O.Fe_2O_3.4SiO_2$.

Occurrence. Colfax County: Pleasant Valley region.

ACTINOLITE. A variety of Amphibole.

Physical characteristics. Monoclinic. Contact-twins common. Commonly in prismatic crystals, short or long bladed. Also columnar or fibrous; granular massive. Cleavage: perfect in two planes, at angles of 55° and 125°. Fracture subconchoidal, uneven. Brittle. H.- 5-6. Sp.G.- 3-3.2. Luster

vitreous, pearly on cleavage surfaces; of fibrous varieties often silky. Color bright to grayish green. Streak uncolored, or paler than mineral color. Transparent to translucent. Long green crystals are glassy actinolite. Fibrous forms are called asbestiform actinolite.

Chemical composition. Metasilicate of calcium and magnesium, with iron, $Ca_2(Mg,Fe)_5(OH)_2(Si_4O_{11})_2$.

Varieties. 1. Uralite. Pyroxene altered to amphibole. Crystals, where distinct, retain the form of the original mineral, but have the cleavage of amphibole. Crystals usually made up of amphibole needles or fibers. Conforms in composition most nearly to actinolite, though it may be white (tremolite). Composition characterized by a decrease in calcium and an increase in magnesium from the proportions in the original mineral.

Occurrence. Grant County: Fierro-Hanover district. San Miguel County: Willow Creek district. Socorro County: Jones Camp district.

Var. Uralite. San Miguel County: Willow Creek district.

AESCHYNITE. (?)

Physical characteristics. Pseudo-orthorhombic. Crystals prismatic. Fracture small conchoidal. Brittle. H.- 5-6.

vitreous, pearly on cleavage surfaces; silky in fibrous varieties, often milky. Color bright to grayish-green. Streak uncolored, or paler than mineral color. Green crust is translucent. Long green crystals are called actinolite. Fibrous forms are called asbestiform actinolite.

Chemical composition. Metasilicate of calcium and magnesium, with iron, $Ca_2(Mg,Fe)_5(OH)_2(Si_4O_{11})_2$.

Varieties. 1. Uralite. Pseudomorph after pyroxene. Crystals, where distinct, retain the form of the original mineral, but have the cleavage of amphibole. Crystals usually made up of amphibole needles or fibers. [illegible] in composition most nearly to actinolite, though it may be white (tremolite). Composition characterized by a [illegible] in calcium and an increase in magnesia [illegible] in the original mineral.

Occurrence. Grant County: Fierro-Hanover district. San Miguel County: Willow Creek district. Sierra County: [illegible] Camp district.

Var. Uralite. San Miguel County: Willow Creek district.

ARFVEDSONITE

Physical characteristics. [illegible] prismatic. [illegible] small [illegible]

Sp.G.- 4.93 (Hittero); 5.168 (Miask). Luster submetallic to resinous, nearly dull. Color nearly black, inclining to brownish yellow when translucent. Streak gray or yellowish brown to nearly black. Subtranslucent to opaque.

Chemical composition. A columbate and titanate (and thorate) of the cerium metals chiefly, with small amounts of iron, calcium, etc. Rammelberg calculates the formula $R_2Cb_4O_{13}.R_2(Ti,Th)_5O_{13}$, where R = the cerium metals.

Occurrence. Rio Arriba County: Petaca district.

ALABANDITE.

Physical characteristics. Isometric. Crystals rare. Granular massive. Cleavage: cubic, perfect. Fracture uneven. Brittle. H.- 3.5-4. Sp.G.- 3.95-4.04. Luster submetallic. Color iron-black. Streak green. Feebly translucent on thin edges.

Chemical composition. Manganese sulphide, MnS.

Occurrence. Santa Fe County: New Placers district. Sierra County: Kingston district.

Sp.G.— 5.69 (Hittero); 5.68 (black). Luster submetallic to resinous, nearly dull. Color nearly black, inclining to brownish yellow when translucent. Streak gray or yellowish brown to nearly black. Subtranslucent to opaque.

Chemical composition. A columbate and titanate (and zirconate) of the cerium metals chiefly, with small amounts of iron, calcium, etc. Rammelsberg calculates the formula $R_3Cb_4O_{15}.R_2(U,Th)_3O_{12}$, where R = the cerium metals.

Occurrence. Rio Arriba County: Petaca district.

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Chemical composition. Manganese sulphide, MnS.

Occurrence. Santa Fe County: San Pedro district. Sierra County: Kingston district.

ALBITE. Moonstone. A species of Feldspar.

Physical characteristics. Triclinic. Orthoclase-type twins common. Also polysynthetic twinning, leading to thin lamellae and consequent fine striations on the surface. Crystals prismatic and tabular. Also massive, lamellar or granular. Lamellae often curved. Occasionally very fine granular. Cleavage: one direction, perfect; two other directions, less perfect. Fracture uneven to conchoidal. Brittle. H.- 6-6.5. Sp.G.- 2.60-2.62. Luster vitreous, pearly on cleavage surfaces. Color white to faintly tinted. Streak colorless. Transparent to subtranslucent.

Chemical composition. Silicate of sodium and aluminum, $NaAlSi_3O_8$. Often contains calcium, sometimes potassium.

Varieties. 1. Cleavelandite. Clevelandite. A white lamellar variety. 2. Moonstone. Variety with a pearly opalescent luster or delicate play of colors; a microperthitic intergrowth of albite and orthoclase.

Occurrence. Lincoln County: White Oaks district. Luna County: Florida Mountains and Fluorite Ridge districts. Rio Arriba County: Petaca district. Sandoval County: Jemez region. Taos County: Harding Mine district. (Indefinite: near Mora.)

Var. Cleavelandite. Rio Arriba County: Petaca district. Taos County: Harding Mine district.

ALBITE. Moonstone. [illegible]

Physical characteristics. Triclinic. [illegible] common. Also polysynthetic twinning, [illegible] lae and consequent fine striations [illegible] prismatic and tabular. Also massive, [illegible] Lamellae often curved. Occasionally [illegible] Cleavage: one direction, perfect; two other directions less perfect. Fracture uneven to conchoidal, brittle. H.= 6-6.5. Sp.G.= 2.60-2.62. Luster vitreous, [illegible] cleavage surfaces. Color white to [illegible] colorless. Transparent to subtranslucent.

Chemical composition. Silicate of sodium and aluminum, $NaAlSi_3O_8$. Often contains [illegible]

Varieties. 1. Cleavelandite. [illegible] lar variety. 2. Moonstone. [illegible] escent luster or delicate play of [illegible] intergrowth of albite and orthoclase.

Occurrence. Lincoln County: [illegible] County: Pinals Mountains and [illegible] Rio Arriba County: Petaca district. [illegible] region. Taos County: Harding mine district. [illegible] near [illegible].)

See. Cleavelandite. [illegible]

Taos County: Harding mine district. [illegible]

Var. Moonstone. Socorro County: San Mateo Mountains region.

ALLOPHANE.

Physical characteristics. Amorphous. In incrustations, usually thin, with a mammillary surface. Fracture imperfectly conchoidal. Very brittle. H.- 3. Sp.G.- 1.85-1.89. Luster vitreous to subresinous. Bright waxy internally. Color pale sky-blue, greenish to deep green, brown, yellow, or colorless. Streak uncolored. Translucent.

Chemical composition. Hydrous aluminum silicate, $Al_2SiO_5.nH_2O$.

Occurrence. Grant County: Fierro-Hanover district. Socorro County: San Jose district.

ALTAITE.

Physical characteristics. Isometric. Crystals rare, cubic or octahedral. Usually massive cleavable. Cleavage cubic. Fracture subconchoidal. Sectile. H.- 3. Sp.G.- 8.16. Luster metallic. Color tin-white, with yellowish tinge, tarnishing to bronze-yellow. Opaque.

Chemical composition. Lead telluride, PbTe.

Var. [illegible]. Socorro County; San Jose [illegible] region.

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Physical characteristics. Amorphous. In incrustations, usually thin, with a mamillary surface. Fracture imperfectly conchoidal. Very brittle. H.= 3. Sp.G.= 1.85-1.89. Luster vitreous to subresinous. Bright and waxy internally. Color pale sky-blue, greenish to deep green, brown, yellow, or colorless. Streak uncolored. Translucent.

Chemical composition. Hydrous aluminum silicate, $Al_2SiO_5 \cdot nH_2O$.

Occurrence. Grant County; Fierro-Hanover district. Socorro County; San Jose district.

ALTAITE.

Physical characteristics. Isometric. Crystals rare, cubic or octahedral. Usually massive cleavable. Cleavage cubic. Fracture subconchoidal. Sectile. H.= 3. Sp.G.= 8.16. Luster metallic. Color tin-white, with yellowish bronze tarnishing to bronze-yellow. Opaque.

Chemical composition. Lead telluride, PbTe.

Occurrence. Dona Ana County: Organ district.

ALUNITE. Alumstone.

Physical characteristics. Hexagonal-rhombohedral. In rhombohedrons, resembling cubes. Also massive, having a fibrous, granular, or impalpable texture. Cleavage: basal, distinct. Fracture flat conchoidal, uneven; of massive varieties splintery, and sometimes earthy. Brittle. H.- 3.5-4. Sp.G.- 2.58-2.752. Luster vitreous, basal plane somewhat pearly. Color white, sometimes grayish or reddish. Streak white. Transparent to subtranslucent.

Chemical composition. Basic hydrous sulphate of aluminum and potassium, $K_2Al_6(OH)_{12}(SO_4)_4$.

Occurrence. Grant County: Santa Rita district.

ALUNOGEN. Alum.

Physical characteristics. Monoclinic or triclinic. Occasionally in rosettes of thin crystals. Usually in delicate fibrous masses or crusts; massive. Fracture uneven. Brittle. H.- 1.5-2. Sp.G.- 1.65. Color white, or tinged with yellow or red. Streak white. Subtranslucent to subtransparent. Taste like that of common alum.

Chemical composition. Hydrous aluminum sulphate, $Al_2(SO_4)_3.18H_2O$.

Occurrence. Catron County: near Glenwood, in Little Dry Canyon. Colfax County: near Springer, on Abbott Ranch. Grant County: Alum Mountain district. Luna County: Cooks Peak district. Mora County: in eastern part, 25 miles east of Wagon Mound. Sandoval County: northwestern part. Taos County: west of Red River. Union County: along Ute Creek. (Indefinite: Bacon Springs region.)

AMPHIBOLE.

Common name for a group of closely related species, as shown by the common prismatic cleavage of 54° to 56°- also in optical characters and chemical composition. Chemically, the amphiboles are metasilicates of calcium, magnesium, and ferrous iron chiefly, but also often containing manganese, sodium, potassium, and hydrogen. Alumina and ferric iron are also often present. The composition in some cases is extremely complex, with extensive replacements among the different metals.

The species of the group form a chemical series parallel to those of the closely allied Pyroxene Group. The Amphibole Group has fewer species than the Pyroxene Group, and these show less variety in form.

<u>Chemical composition</u>. Hydrous aluminum sulphate, $Al_2(SO_4)_3.18H_2O$.

<u>Occurrence</u>. Catron County: near Glenwood, in Little Dry Canyon. Colfax County: near Springer, on Abbott Ranch. Grant County: Alum Mountain district. Luna County: Cooks Peak district. Mora County: in eastern part, 25 miles east of Wagon Mound. Sandoval County: northwestern part. Taos County: west of Red River. Union County: along Ute Creek. (Indefinite: Ojo Caliente hot springs region.)

AMPHIBOLE.

Common name for a group of closely related species, as shown by the common prismatic cleavage of 54° to 56°, also in optical characters and chemical composition. Chemically, the amphiboles are metasilicates of calcium, magnesium, and ferrous iron chiefly, but also often containing manganese, sodium, potassium, and hydrogen. Alumina and ferric iron are also often present. The composition in some cases is extremely complex, with extensive replacements among the different metals.

The species of the group form a chemical series parallel to those of the closely allied Pyroxene Group. The Amphibole Group has fewer species than the Pyroxene Group, and these show less variety in form.

In this paper, the term Amphibole is restricted to the species bearing that name. The varieties of the species occurring in New Mexico are actinolite, tremolite, and hornblende. They are described separately in the text. Asbestos, which may be a phase of several of the varieties, is also described separately.

Occurrence. The following occurrences are of varieties which have not been definitely identified, except as belonging to the species Amphibole: Colfax County: Baldy and Elizabethtown districts. Grant County: Fierro-Hanover district. Luna County: Deming region. Rio Arriba County: Bromide district. San Miguel County: Willow Creek district. Santa Fe County: Santa Fe district. Socorro County: Magdalena district. Taos County: Twining district.

ANALCITE. Analcime.

Physical characteristics. Isometric. Usually in trapezohedrons; also cubes with trapezohedral modifications. Also massive granular; compact with concentric structure. No distinct cleavage. Fracture subconchoidal. Brittle. H.- 5-5.5. Sp.G.- 2.22-2.29. Luster vitreous. Colorless, white; occasionally grayish, greenish, yellowish, or reddish white. Transparent to nearly opaque.

Chemical composition. $NaAlSi_2O_6.H_2O$, or

$Na_2O.Al_2O_3.4SiO_2.2H_2O$.

Occurrence. Colfax County: in four different rocks of the Raton region. McKinley County: Todilto Park region. San Juan County: The Palisades (north of Crystal). San Miguel County: in butte near Las Vegas.

ANDALUSITE.

Physical characteristics. Orthorhombic. Usually in coarse prismatic forms, the prisms nearly square in form. Massive, imperfectly columnar; sometimes radiated and granular. Cleavage: two directions, prismatic, distinct; two others, less distinct. Fracture uneven, subconchoidal. Brittle. H.- 7.5. Sp.G.- 3.16-3.20. Luster vitreous; often weak. Color whitish, rose-red, flesh-red, violet, pearl-gray; reddish brown, olive-green. Streak uncolored. Transparent to opaque, usually subtranslucent.

Chemical composition. Al_2SiO_5, or $(AlO)AlSiO_4$, or $Al_2O_3.SiO_2$.

Occurrence. Socorro County: Iron Mountain No. 2 district (?). Taos County: Glenwoody and Picuris districts.

$MgO.Al_2O_3.4SiO_2.2H_2O$.

Occurrence. Colfax County: in four different rocks of the Raton region. McKinley County: Todilto Park region. San Juan County: The Palisades (north of Crystal). San Miguel County: in butte near Las Vegas.

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Chemical composition. Al_2SiO_5, or $(AlO)AlSiO_4$, or $Al_2O_3.SiO_2$.

Occurrence. Socorro County: Iron Mountain No. 2 district. Taos County: Glenwoody and Picuris districts.

ANDESINE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see Plagioclase Feldspars. Andesine is distinguished chiefly by its cleavage angle (86° 14'), specific gravity (2.645-2.665), and optical characters (differences in indices of refraction and extionction angles).

Chemical composition. $Ab_{70-50}An_{30-50}$. See table under Plagioclase Feldspars.

Occurrence. Catron County: Mogollon district. Colfax County: in two different rocks of the Raton region. Luna County: Cooks Peak district; in Deming region.

ANGLESITE.

Physical characteristics. Orthorhombic. Crystals usually prismatic, sometimes tabular. Also massive, granular to compact; nodular; stalactitic. Cleavage: three directions, interrupted. Fracture conchoidal. Very brittle. H.- 2.75-3. Sp.G.- 6.3-6.39. Luster highly adamantine to resinous and vitreous. Color white, often tinged yellow, gray, and green. Streak colorless. Transparent to opaque.

Chemical composition. Lead sulphate, $PbSO_4$.

Occurrence. Bernalillo County: Tijeras Canyon district.

ANDESINE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see Plagioclase Feldspars. Andesine is distinguished chiefly by its cleavage angle (86° 14'), specific gravity (2.665-2.693), and optical characters (differences in indices of refraction and extinction angles).

Chemical composition. $Ab_{70}An_{30}$-$Ab_{50}An_{50}$. See table under Plagioclase Feldspars.

Occurrence. Catron County: Magdalena district. Colfax County: in two different rocks of the Raton region. Dona Ana County: Organ Mts district; in Dunning section.

ANGLESITE.

Physical characteristics. Orthorhombic. Crystals usually prismatic, sometimes tabular. Also massive, granular to compact; nodular; stalactitic. Cleavage: (110) and (001) interrupted. Fracture conchoidal. Very brittle. H. 2.75-3. Sp.G. = 6.30-6.39. Luster highly adamantine to resinous and vitreous. Color white, often tinged yellow, gray and green. Streak colorless. Transparent to opaque.

Chemical composition. Lead sulphate, $PbSO_4$.

Occurrence. Bernalillo County: Tijeras [illegible] district.

Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Central district. Luna County: Cooks Peak district; Victorio district (?). San Miguel County: Willow Creek district. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, and Macho districts. Socorro County: Hansonburg, Joyita Hills, Magdalena, San Andres Mountains (Mockingbird Gap), and Water Canyon districts.

ANHYDRITE.

Physical characteristics. Orthorhombic. Crystals not common. Usually massive, cleavable, fibrous, lamellar, granular, or impalpable. Cleavage: three directions, yielding rectangular fragments. Fracture uneven, sometimes splintery. Brittle. H.- 3-3.5. Sp.G.- 2.899-2.985. Luster of cleavage surfaces pearly to greasy. Luster of massive varieties vitreous to pearly. Color white, sometimes with a gray, blue, or red tinge. Streak grayish white. Transparent to opaque.

Chemical composition. Anhydrous calcium sulphate, $CaSO_4$.

Occurrence. Bernalillo County: Tijeras Canyon district. Eddy County: Carlsbad Potash district. Lincoln County: White Oaks district. Socorro County: Oscura and San Andres Mountains regions. Torrance County: Estancia Salt district.

[illegible]

[illegible]

[illegible]

Valencia County: Rito region; along Rio Salado, west of Belen.

ANKERITE.

Physical characteristics. Hexagonal-rhombohedral. In rhombohedral crystals. Also crystalline massive, coarse or fine granular, and compact. Cleavage: rhombohedral, perfect. H.- 3.5-4. Sp.G.- 2.95-3.1. Luster vitreous to pearly. Color white, gray, reddish. Translucent to subtranslucent.

Chemical composition. For normal ankerite, $2CaCO_3.MgCO_3.FeCO_3$. Often contains manganese in small quantities.

Occurrence. Grant County: Central and Silver City Manganese-Iron districts. Santa Fe County: Cerrillos district. Sierra County: Lake Valley district.

ANNABERGITE.

Physical characteristics. Monoclinic. In capillary crystals. Also massive and disseminated. Cleavage: one direction, perfect. Fracture uneven or earthy. H.- 2.5-3. Sp.G.- 3. Color apple-green. Streak greenish white.

Chemical composition. Hydrous nickel arsenate, $Ni_3As_2O_8.8H_2O$.

Valencia County: Gila region; along Rio Puerco, west of Belen.

ANKERITE.

Physical characteristics. Hexagonal-rhombohedral. In rhombohedral crystals. Also crystalline massive, coarse or fine granular, and compact. Cleavage: rhombohedral, perfect. H.— 3.5-4. Sp.G.— 2.95-3.1. Luster vitreous to pearly. Color white, gray, reddish. Translucent to subtranslucent.

Chemical composition. For normal ankerite, $2CaCO_3.MgCO_3.FeCO_3$. Often contains manganese in small quantities.

Occurrence. Grant County: Central and Silver City Hanover-Iron districts. Santa Fe County: Cerrillos district. Sierra County: Lake Valley district.

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Physical characteristics. Monoclinic. In capillary crystals. Also massive and disseminated. Cleavage: one direction, perfect. Fracture uneven or earthy. H.— 2.5-3. Sp.G.— 3. Color apple-green. Streak greenish white.

Chemical composition. Hydrous nickel arsenate, $Ni_3As_2O_8.8H_2O$.

<u>Occurrence</u>. Grant County: Black Hawk district.

ANORTHITE. Indianite. A species of Feldspar.

<u>Physical characteristics</u>. Triclinic. Twins of the albite type common. Crystals usually prismatic. Also massive, cleavable, with granular or lamellar structure. Cleavage: two directions, almost at right angles; one perfect, the other less so. Fracture conchoidal to uneven. Brittle. H.- 6-6.5. Sp.G.- 2.74-2.76. Luster vitreous, somewhat pearly on cleavage surfaces. Color white, grayish, reddish. Streak uncolored. Transparent to translucent.

<u>Chemical composition</u>. A silicate of aluminum and calcium, $CaAl_2Si_2O_8$, or $CaO.Al_2O_3.2SiO_2$. Soda often present, increasing as the mineral grades through various stages into <u>albite</u>.

<u>Occurrence</u>. (Indefinite: in various igneous rocks.)

ANORTHOCLASE. Soda-microcline.

<u>Physical characteristics</u>. Triclinic. Form like that of the ordinary feldspars. Twinning as with <u>orthoclase</u>; also polysynthetic twinning. Cleavage: two directions, at angles of nearly 90°, one perfect, one slightly less so. H.- 6-6.5.

Occurrence. Grant County; Black Hawk district.

ANORTHITE. Indianite. A species of feldspar.

Physical characteristics. Triclinic. Twins of the albite type common. Crystals usually prismatic. Also massive, cleavable, with granular or lamellar structure. Cleavage: two directions, almost at right angles; one perfect, the other less so. Fracture conchoidal to uneven. Brittle. H.= 6-6.5. Sp.G.= 2.74-2.76. Luster vitreous, somewhat pearly on cleavage surfaces. Color white, grayish, reddish. Streak uncolored. Transparent to translucent.

Chemical composition. A silicate of aluminum and calcium, $CaAl_2Si_2O_8$, or $CaO.Al_2O_3.2SiO_2$. Soda often present, increasing as the mineral grades through various stages into albite.

Occurrence. (Indefinite: in various igneous rocks.)

ANORTHOCLASE. Soda-microcline.

Physical characteristics. Triclinic. Form like that of the ordinary feldspars. Twinning as with microcline; also pericline twinning. Cleavage: two directions, at angles of nearly 90°, one perfect, one slightly less so. H.= 6.

Sp.G.- 2.57-2.60. Luster vitreous, sometimes pearly on a cleavage surface. Color white, also various pale shades as with other feldspars.

Chemical composition. Chiefly a soda-potash feldspar, $NaAlSi_3O_8.KAlSi_3O_8$, the soda molecule usually in larger proportion (2:1, 3:1, etc.), as if consisting of albite and orthoclase molecules. Calcium silicate may be present in very small amounts.

Occurrence. Luna County: Florida Mountains district.

APATITE.

Physical characteristics. Hexagonal-pyramidal. Crystals long to short prismatic to tabular. Also globular and reniform, with fibrous or columnar structure; massive, granular to compact. No distinct cleavage. Fracture conchoidal to uneven. Brittle. H.- 5, sometimes 4.5 when massive. Sp.G.- 3.17-3.23 in crystals. Luster vitreous to subresinous. Color sea-green, bluish green; sometimes violet-blue or white; occasionally yellow, gray, red, flesh-red, and brown. Streak white. Transparent to opaque.

Chemical composition. Calcium fluoride and phosphate, $(CaF)Ca_4(PO_4)_3$. Sometimes chlorine replaces part or all of the fluorine.

Sp.G.– 2.57–2.60. Luster vitreous, [illegible] cleavage surfaces. Color white, [illegible] with other feldspars.

Chemical composition. Chiefly [illegible] NaAlSi3O8.KAlSi3O8, the [illegible] proportion (3:1, 2:1, etc.) [illegible] orthoclase molecules. [illegible] very small amounts.

Occurrence. Luna County? [illegible]

APATITE.

Physical characteristics. [illegible] long to short prismatic to tabular [illegible] form, with fibrous or columnar [illegible] to compact. No distinct cleavage [illegible] uneven. Brittle. H.= 5; [illegible] Sp.G.– 3.17–3.23 in crystals. [illegible] ous. Color sea-green, bluish green, [illegible] or white; occasionally yellow, [illegible] brown. Streak white. Transparent [illegible]

Chemical composition. [illegible] Ca5F(PO4)3. [illegible] the fluorine.

Occurrence. Grant County: Fierro-Hanover district. Luna County: Deming region. Sandoval County: Jemez region. Sierra County: Hillsboro and Lake Valley districts. Socorro County: Magdalena district. Taos County: Harding Mine and Red River districts.

ARAGONITE.

Physical characteristics. Orthorhombic. Crystals often acicular, with acute domes or pyramids. Twins common, sometimes repeated to form pseudo-hexagonal forms. Also globular and reniform; sometimes columnar; stalactitic; incrusting. One distinct cleavage. Fracture subconchoidal. Brittle. H.- 3.5-4. Sp.G.- 2.93-2.95. Luster vitreous, sometimes resinous on fracture surfaces. Color white; also gray, yellow, green, and violet. Streak uncolored. Transparent to translucent.

Chemical composition. Calcium carbonate, $CaCO_3$.

Varieties. 1. Flos-ferri. In coralloidal groupings of delicate interlacing stems. Color snow-white.

Occurrence. De Baca County: five miles east of Ramon. Luna County: Cooks Peak district. Sierra County: Chloride and Kingston districts. Socorro County: Magdalena and Water Canyon districts. Valencia County: near Rio Puerco Station

Occurrence. Grant County: Pinos-Altos district. Luna County: Deming region. Sandoval County: Jemez region. Sierra County: Hillsboro and Lake Valley districts. Socorro County: Magdalena district. Taos County: Harding Mine and Red River districts.

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Chemical composition. Calcium carbonate, $CaCO_3$.

Varieties. 1. Flos-ferri. In coralloidal groupings of delicate interlacing stems. Color snow-white.

Occurrence. De Baca County: five miles east of Yeso. Luna County: Cooke Peak district. Sierra County: Chloride and Kingston districts. Socorro County: Magdalena and Water Canyon districts. Valencia County: near Rio Puerco Station (finely banded onyx in travertine).

Var. Flos-ferri. Dona Ana County: Organ district.

ARGENTITE. Silver Glance.

Physical characteristics. Isometric. Crystals often octahedral, also cubic; often distorted; frequently grouped in reticulated or arborescent forms; also filiform. Massive, embedded; as a coating. No distinct cleavage. Fracture small conchoidal. Perfectly sectile. H.- 2-2.5. Sp.G.- 7.20-7.36. Luster metallic. Color blackish lead-gray. Streak same, shining. Opaque. Often altered on the surface to a black earthy sulphide.

Chemical composition. Silver sulphide, Ag_2S.

Occurrence. Catron County: Mogollon district. Colfax County: Elizabethtown district. Dona Ana County: Organ district. Grant County: Black Hawk, Chloride Flat, Fleming, Georgetown, Lone Mountain, Pinos Altos, Steeple Rock, and Telegraph districts. Hidalgo County: Lordsburg, San Simon, and Steins Pass districts. Luna County: Florida Mountains district. Sandoval County: Cochiti district. San Miguel County: Willow Creek district. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride, Hermosa, Hillsboro, Kingston, Lake Valley, and Tierra Blanca districts.

Socorro County: North Magdalena and Socorro Peak districts. Taos County: Picuris district.

ARSENOPYRITE. Mispickel.

Physical characteristics. Orthorhombic. Twins and trillings common in crystals. Crystals usually prismatic, flattened vertically. Also columnar, straight and divergent; granular, or compact. One fairly distinct cleavage. Fracture uneven. Brittle. H.- 5.5-6. Sp.G.- 5.9-6.2. Luster metallic. Color silver-white, inclining to steel-gray. Streak dark grayish black. Opaque. Yields arsenical (garlic) odor when struck or rubbed.

Chemical composition. Sulpharsenide of iron, $FeAsS$, or $FeS_2 \cdot FeAs_2$.

Occurrence. Hidalgo County: Lordsburg district. Santa Fe County: Old Placers district.

ASBESTOS. Asbestus. A variety of Amphibole.

Tremolite, actinolite, and other varieties of amphibole, except those high in alumina, pass into fibrous forms, the fibers sometimes long, flexible, and easily separated, much resembling flax. Color varies from white to green and wood-

brown. Much of the material commonly called asbestos is chrysotile (see serpentine). The name amianthus is given to the finer, silky varieties of asbestos derived either from amphibole or from serpentine.

Occurrence.

Amphibole Asbestos. Dona Ana County: Organ district. Hidalgo County: Steins Pass district. Rio Arriba County: Petaca district (probable).

Chrysotile Asbestos. Grant County: west side of Gila River above Red Rock, not far from ricolite deposit (which see).

Not specified. Grant County: Georgetown district. Sierra County: Hillsboro district.

AUGITE. Aluminous Pyroxene.

Physical characteristics. Monoclinic. Contact-twins common, sometimes polysynthetic. Crystals usually prismatic, often short and thick, sometimes tabular, and nearly square or eight-sided. Also granular, coarse or fine, rarely fibrous or columnar. Cleavage: two directions, nearly at right angles, nearly perfect, but interrupted. Basal parting sometimes observed. Fracture uneven to conchoidal. Brittle. H.- 5-6. Sp.G.- 3.2-3.6. Luster vitreous, green. Much of the material commonly called asbestos is chrysotile (see serpentine). The name amianthus is given to the finer, silky varieties of asbestos derived either from amphibole or from serpentine.

Occurrence.

Amphibole asbestos. Dona Ana County: Organ district. Hidalgo County: Steins Pass district. Rio Arriba County: Petaca district (probable).

Chrysotile asbestos. Grant County: east side of Gila River above Red Rock, not far from fluorite deposit (which see).

Not specified. Grant County: Georgetown district. Sierra County: Hillsboro district.

AUGITE. Aluminous Pyroxene.

Physical characteristics. Monoclinic. Contact-twins common, sometimes polysynthetic. Crystals usually prismatic, often short and thick, sometimes tabular, and nearly square or eight-sided. Also granular, coarse or fine, rarely fibrous or columnar. Cleavage: two directions, nearly at right angles, nearly perfect, not interrupted. Basal parting sometimes observed. Fracture uneven to conchoidal. Brittle. H.=5-6. Sp.G.=3.2-3.6. Luster vitreous.

inclining to resinous; often dull; sometimes pearly on planes of parting. Color pale to deep green, brownish black and black. Streak white to gray and grayish green. Translucent to opaque.

Chemical composition. Chiefly $CaMgSi_2O_6$ with $(Mg,Fe)(Al,Fe)_2SiO_6$. Titanium and alkalies may be present.

Occurrence. Catron County: Mogollon district. Colfax County: Raton region. Grant County: Fierro-Hanover district. Lincoln County: Nogal district; Milagro Hill region, near Carrizozo. Sandoval County: Cochiti district; Jemez region. Santa Fe County: Cerrillos and Old Placers districts. Valencia County: near Grant.

AURICHALCITE.

Physical characteristics. Monoclinic. Occurs in drusy incrustations. One perfect cleavage. H.- 2. Sp.G.- 3.54-3.64. Luster pearly. Color pale green to sky-blue. Streak pale greenish to bluish. Translucent.

Chemical composition. A basic carbonate of zinc and copper, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$.

Occurrence. Socorro County: Magdalena district.

AUTUNITE. Lime Uranite.

Physical characteristics. Orthorhombic. In thin tabular crystals, nearly tetragonal in form and similar to torbernite. Also foliated, micaceous. Cleavage: basal, eminent. Also three other cleavages, less perfect. Laminae brittle. H.- 2-2.5. Sp.G.- 3.1. Luster of basal cleavage pearly, elsewhere subadamantine. Color lemon- to sulphur-yellow. Streak yellowish. Transparent to translucent.

Chemical composition. A hydrous phosphate of uranium and calcium, probably analogous to meta-torbernite, $Ca(UO_2)_2P_2O_8.8H_2O$, or $CaO.2UO_3.P_2O_5.8H_2O$.

Occurrence. Grant County: White Signal district. Hidalgo County: Hachita district. Socorro County: San Lorenzo district.

AZURITE. Blue Carbonate of Copper. Chessylite.

Physical characteristics. Monoclinic. Crystals varied and highly modified, common. Also massive, often in imitative shapes, having a columnar structure; also dull and earthy. Cleavage: two directions; one perfect but interrupted, the other less perfect. Fracture conchoidal. Brittle. H.- 3.5-4. Sp.G.- 3.77-3.89. Luster vitreous, almost adamantine. Color shades of azure-blue, passing into Berlin-blue.

[illegible]

Physical characteristics. [illegible]
crystals, nearly tetragonal [illegible]
also foliated, micaceous. [illegible]
three other cleavages. [illegible]
H.- 2-2.5. Sp.G.- 3.1. [illegible]
elsewhere subadamantine. [illegible]
Straw yellowish. Transparent [illegible]

Chemical composition. [illegible]
calcium, probably analogous [illegible]
[illegible]

Occurrence. Grant County: [illegible]
County: Santa Rita district. [illegible]
district.

[illegible]

Physical characteristics. [illegible]
highly modified, common. [illegible]
shape, having a [illegible]
cleavage; [illegible]
other less perfect. [illegible]
H.- [illegible]
Also. Color changes [illegible]

Streak blue, paler than color. Transparent to subtranslucent.

Chemical composition. A basic cupric carbonate, $2CuCO_3 . Cu(OH)_2$.

Occurrence. Catron County: Mogollon district. Dona Ana County: Hembrillo district. Eddy County: (?). Grant County: Burro Mountains, Central, Fierro-Hanover, Georgetown, Pinos Altos, and Santa Rita districts. Guadalupe County: Pastura district. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and San Simon districts. Lincoln County: Estey and Jicarilla districts. Mora County: Coyote Creek district. Otero County: Sacramento and Tularosa districts. Rio Arriba County: Abiquiu, Bromide, and Gallina districts. Sandoval County: Jemez Springs, Nacimiento, and Placitas districts. San Miguel County: Rociada and Tecolote districts. Santa Fe County: Glorieta, La Bajada, and New Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, and Kingston districts. Socorro County: Chupadero, Hansonburg, Ladrones Mountains, Magdalena, Rayo, San Andres Mountains (Mockingbird Gap, Salinas Peak), Scholle, Socorro Peak (?), and Water Canyon districts. Valencia County: Zuni Mountains.

Streak blue, paler than color. Transparent to subtranslucent.

<u>Chemical composition</u>. A basic cupric carbonate, $2CuCO_3.Cu(OH)_2$.

<u>Occurrence</u>. Catron County: Mogollon district. Dona Ana County: Hembrillo district. Eddy County: (?). Grant County: Burro Mountains, Central, Fierro-Hanover, Georgetown, Pinos Altos, and Santa Rita districts. Guadalupe County: Pastura district. Hidalgo County: Apache No. 2, Fremont, [illegible], Lordsburg, and San Simon districts. Lincoln County: Estey and Jicarilla districts. Mora County: Coyote Creek district. Otero County: Sacramento and Tularosa districts. Rio Arriba County: Abiquiu, Bromide, and Gallinas districts. Sandoval County: Jemez Springs, Nacimiento, and Placitas districts. San Miguel County: Rociada and Tecolote districts. Santa Fe County: Cerrillos, La Bajada, and New Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, and Kingston districts. Socorro County: Chupadera, Hansonburg, Ladrones Mountains, Magdalena, Rayo, San Andres Mountains (Rockhouse Gap, Salinas Peak), Scholle, Socorro Peak (?), and Water Canyon districts. Valencia County: Zuni Mountains.

BARITE. Heavy Spar.

Physical characteristics. Orthorhombic. Crystals commonly tabular, in divergent groups; sometimes prismatic. Also globular, fibrous or lamellar, crested; coarsely laminated, laminae convergent and sometimes curved. Granular, resembling marble, and earthy. Colors sometimes banded. Cleavage: three directions, at right angles, perfect. Fracture uneven. Brittle. H.- 2.5-3.5. Sp.G.- 4.3-4.6. Luster vitreous to resinous, sometimes pearly on cleavage surfaces. Color white, also inclining to yellow, gray, blue, red, and brown. Streak white. Transparent to translucent to opaque. Sometimes gives fetid odor when rubbed.

Chemical composition. Barium sulphate, $BaSO_4$.

Varieties. 1. Barytocelestite. Barite containing varying amounts of strontium sulphate, $SrSO_4$.

Occurrence. Bernalillo County: Tijeras Canyon district. Dona Ana County: Organ, Rincon Manganese, and Tonuco Mountain Fluorspar districts. Grant County: Black Hawk, Central, Georgetown, Pinos Altos, and Silver City Manganese-Iron districts. Hidalgo County: Lordsburg district. Luna County: Little Florida Mountains district. Otero County: Tularosa district. Rio Arriba County: Gallina and Petaca (Ojo Caliente) districts. Sandoval County: Placitas district. Sierra County: Caballos Mountains and Chloride districts.

BARITE. Heavy Spar.

Physical characteristics. Orthorhombic. Crystals commonly tabular, in divergent groups; sometimes prismatic. Also globular, fibrous or lamellar, crested; coarsely laminated, laminae convergent and sometimes curved. Granular, resembling marble, and earthy. Colors sometimes banded. Cleavage: three directions, at right angles, [illegible]. Fracture uneven. Brittle. H.= 2.5-3.5. Sp.G.= 4.3-4.6. Luster vitreous to resinous, sometimes pearly on cleavage surfaces. Color white, also inclining to yellow, gray, blue, red, and brown. Streak white. Transparent to translucent to opaque. Sometimes gives fetid odor when rubbed.

Chemical composition. Barium sulphate, $BaSO_4$.

Varieties. 1. Barytocelestite. Barite containing variable amounts of strontium sulphate, $SrSO_4$.

Occurrence. Bernalillo County: Tijeras Canyon district. Dona Ana County: Organ, [illegible], and [illegible] districts. Grant County: [illegible], Georgetown, Pinos Altos, and Silver City [illegible] districts. Hidalgo County: [illegible] district. [illegible] Little Florida Mountains district. [illegible] district. Rio Arriba County: [illegible] districts. [illegible] Sierra County: [illegible].

Socorro County: Chupadero, Council Rock, Hansonburg, Joyita Hills, Lemitar Mountains, Magdalena, North Magdalena, San Andres Mountains (Lava Gap, Mockingbird Gap), Socorro Peak, and Water Canyon districts. Taos County: region east of Wheeler Peak. Valencia County: Zuni Mountains district. (Indefinite: near Fort Wallace.)

Var. Barytocelestite. Socorro County: Oscura Mountains region.

BARYTOCALCITE.

Physical characteristics. Monoclinic. In crystals; also massive. Cleavage: two directions, perfect; another direction, less so. Cleavage planes at angles near those of rhombohedral cleavage planes of calcite. Fracture uneven to subconchoidal. Brittle. H.- 4. Sp.G.- 3.64-3.66. Luster vitreous, inclining to resinous. Color white, grayish, greenish, or yellowish. Streak white. Transparent to translucent.

Chemical composition. Carbonate of barium and calcium, $BaCO_3.CaCO_3$.

Occurrence. Socorro County: Oscura Mountains region.

Socorro County: Chupadero, Council Rock, Hansonburg, Jones Hills, Lemitar Mountains, Magdalena, North Magdalena, San Andres Mountains (Lava Gap, Mockingbird Gap), Socorro Peak, and Water Canyon districts. Taos County: region east of Wheeler Peak. Valencia County: Zuni Mountains district. (Indefinite: near Fort Wallace.)

Var. Barytocelestite. Socorro County: Socorro Mountain region.

BARYTOCALCITE.

Physical characteristics. Monoclinic. In crystals; also massive. Cleavage: two directions, perfect; another direction, less so. Cleavage planes at angles near those of rhombohedral cleavage planes of calcite. Fracture uneven to subconchoidal. Brittle. H.= 4. Sp.Gr.= 3.64-3.66. Luster vitreous, inclining to resinous. Color white, grayish, greenish, or yellowish. Streak white. Transparent to translucent.

Chemical composition. Carbonate of barium and calcium. $BaCO_3 \cdot CaCO_3$.

Occurrence. Socorro County: Socorro Mountain region.

BAUXITE. Beauxite. (?)

Physical characteristics. In round concretionary disseminated grains. Also massive, oolitic; and earthy, clay-like. Sp.G.- 2.55. Color whitish, grayish, to ocher-yellow, brown, and red.

Chemical composition. Essentially $Al_2O_3.2H_2O$. Some analyses give $Al_2O_3.H_2O$ like diaspore, but the $Al_2O_3.H_2O$ is colloidal.

Occurrence. Grant County: Alum Mountain district (?).

BERYL.

Physical characteristics. Hexagonal. Crystals usually long prismatic, often striated vertically, rarely transversely; distinct terminations rare. Occasionally in large masses, coarse columnar or granular to compact. Cleavage: basal, imperfect. Fracture conchoidal to uneven. Brittle. H.- 7.5-8. Sp.G.- 2.63-2.80; usually 2.69-2.70. Luster vitreous, sometimes resinous. Color emerald-green, pale green, passing into light blue, yellow, and white; also pale rose-red. Streak white. Transparent to subtranslucent.

Chemical composition. $Be_3Al_2(SiO_3)_6$, or $3BeO.Al_2O_3.6SiO_2$. Alkalies, as soda, lithia, and caesia, may be present replacing beryllium, up to 5%; also chemically combined water.

Varieties. 1. Aquamarine. A bluish green variety of ordinary beryl. 2. Caesium Beryl. A pinkish yellow variety containing caesia, Cs_2O. 3. Emerald. Color bright emerald-green, due to the presence of a little chromium; a highly prized gem-stone when clear and free from flaws.

Occurrence. Rio Arriba County: Petaca district. Santa Fe County: Emerald reported from gravel beds near Santa Fe. Taos County: Harding Mine district (recorded as microscopic only; new record for crystals). At this locality the crystals are called "emerald", but really are aquamarine.

Var. Caesium Beryl. Taos County: Harding Mine district.

BIOTITE. Black Mica.

Physical characteristics. Monoclinic. Crystals tabular or short prismatic. Crystals often apparently rhombohedral. Mica-type twins. Often in disseminated scales. Cleavage: basal, highly perfect. Elastic in thin plates. H.- 2.5-3. Sp.G.- 2.7-3.1. Luster splendent, pearly on a cleavage surface, sometimes submetallic when black. Color green to black, often deep black in thick crystals, and sometimes in thin laminae. Very thin laminae green, blood-red, or brown by transmitted light. Rarely white. Streak uncolored. Transparent to opaque.

Variation. 1. Aquamarine. A bluish green variety of ordinary beryl. 2. Cesium Beryl. A pinkish yellow variety containing cesium, Cs_2O. 3. Emerald. Color bright emerald-green, due to the presence of a little chromium; a highly prized gem-stone when clear and free from flaws.

Occurrence. Rio Arriba County: Petaca district. Santa Fe County: Emerald reported from gravel beds near Santa Fe. Taos County: Harding Mine district (recorded as microscopic only; new record for crystals). At this locality the crystals are called "emeralds", but really are aquamarine.

Var. Cesium Beryl. Taos County: Harding Mine district.

BIOTITE. Black Mica.

Physical characteristics. Monoclinic. Crystals tabular or short prismatic. Crystals often apparently rhombohedral. Mica-type twins. Often in disseminated scales. Cleavage: basal, highly perfect. Elastic in thin plates. H.- 2.5-3. Sp.G.- 2.7-3.1. Luster splendent, pearly on a cleavage surface, sometimes submetallic when black. Color green to black, often dark brown to black crystals, and sometimes in thin laminae. Very thin laminae green, blood-red, or brown by transmitted light. Rarely white. Streak uncolored. Transparent to opaque.

Chemical composition. Probably $H_2K(Mg,Fe)_3Al(SiO_4)_3$.

Occurrence. Bernalillo County: Tijeras Canyon district. Grant County: Burro Mountains district. Rio Arriba County: Bromide, Hopewell, and Petaca districts. San Miguel County: Willow Creek district. Santa Fe County: New Placers district. Sierra County: Hillsboro district. Taos County: Red River district.

BISMUTH.

Physical characteristics. Hexagonal-rhombohedral. Natural crystals rare and usually indistinct. Usually reticulated, arborescent, foliated or granular. Cleavage: basal, perfect. Brittle, but somewhat malleable when heated. H.- 2-2.5. Sp.G.- 9.70-9.83. Luster metallic. Color and streak silver-white, with a reddish hue, subject to tarnish. Opaque.

Chemical composition. Pure bismuth, Bi, with occasional traces of arsenic, sulphur, and tellurium.

Occurrence. Dona Ana County: Organ district. Grant County: Burro Mountains district. Hidalgo County: Fremont district. Rio Arriba County: Petaca district. Socorro County: San Andres Mountains district (Grandview Canyon).

BISMUTHINITE. Bismuth Glance.

Physical characteristics. Orthorhombic. Rarely in acicular crystals. Usually massive, foliated or fibrous. Cleavage: one direction, perfect. Somewhat sectile. H.- 2. Sp.G.- 6.4-6.5. Luster metallic. Color and streak lead-gray, inclining to tin-white, with a yellowish or iridescent tarnish. Opaque.

Chemical composition. Bismuth trisulphide, Bi_2S_3.

Occurrence. Catron County: Wilcox district. Dona Ana County: Gold Camp and Organ districts. Grant County: 41 miles northwest of Silver City. Luna County: Florida Mountains district. San Miguel County: El Porvenir district. Socorro County: San Andres Mountains district (Grandview Canyon).

BISMUTITE.

Physical characteristics. Amorphous. Incrusting, or earthy and pulvurulent. Also massive, columnar. H.- 4-4.5. Sp.G.- 6.86-6.9. Luster vitreous when pure, sometimes dull. Color white, green, yellow, and gray. Streak greenish gray to colorless. Subtranslucent to opaque. Easily fusible.

Chemical composition. A basic bismuth carbonate, exact composition doubtful, perhaps $Bi_2O_3.CO_2.H_2O$.

BISMUTHINITE. Bismuth Glance.

Physical characteristics. Orthorhombic. Rarely in acicular crystals. Usually massive, foliated or fibrous. Cleavage: one direction, perfect. Somewhat sectile. H.= 2. Sp.G.= 6.4-6.5. Luster metallic. Color and streak lead-gray inclining to tin-white, with a yellowish or iridescent tarnish. Opaque.

Chemical composition. Bismuth trisulphide, Bi_2S_3.

Occurrence. Catron County: Wilcox district. Dona Ana County: Gold Camp and Organ districts. Grant County: 41 miles northeast of Silver City. Luna County: Florida mountains district. San Miguel County: El Porvenir district. Socorro County: San Andres Mountains district ([illegible] Canyon).

BISMUTITE

Physical characteristics. Amorphous. Incrusting, or earthy and pulverulent. Also massive, columnar. H.= 4-4.5. Sp.G.= 6.86-6.9. Luster vitreous when pure, sometimes dull. Color white, green, yellow, and gray. Streak greenish-gray to colorless. Subtranslucent to opaque. Usually impure.

Chemical composition. A basic bismuth carbonate, exact composition doubtful, perhaps $Bi_2O_3.CO_2.H_2O$.

Occurrence. Dona Ana County: Organ district. Grant County: Burro Mountains district; Camp Kithil region. Rio Arriba County: Petaca district. Socorro County: San Andres Mountains district (Grandview Canyon). Taos County: Harding Mine district.

BLOEDITE. Blödite.

Physical characteristics. Monoclinic. In short prismatic crystals. Also massive granular or compact, also somewhat fibrous. No cleavage. H.- 2.5. Sp.G.- 2.22-2.28. Luster vitreous. Colorless transparent to bluish green, reddish yellow and translucent, also flesh- to brick-red. Easily fusible. Taste faint, saline and bitter.

Chemical composition. $MgSO_4.Na_2SO_4.4H_2O$.

Occurrence. Eddy County: Carlsbad Potash district. Torrance County: Estancia Salt district.

BORAX.

Physical characteristics. Monoclinic. Crystals prismatic, sometimes large; resembling pyroxene in habit and angles. Cleavage: two directions, one perfect, one less so. Fracture conchoidal. Rather brittle. H.- 2-2.5. Sp.G.- 1.69-1.72.

Occurrence. Dona Ana County: Organ district. [illegible] [illegible] [illegible] district; Camp [illegible] [illegible] County: Potash district. Socorro County: [illegible] Mountains district (Grandview Canyon). [illegible] County: [illegible] Mine district.

BLOEDITE. [illegible]

Physical characteristics. Monoclinic. In short prismatic crystals. Also massive granular or compact, also somewhat fibrous. No cleavage. H.= 2.5. Sp.G.= 2.22-2.28. Luster vitreous. Colorless transparent to bluish-green, reddish yellow and translucent, also flesh- to brick-red. Easily fusible. Taste faint, saline and bitter.

Chemical composition. $MgSO_4.Na_2SO_4.4H_2O$.

Occurrence. Eddy County: Carlsbad Potash district. Torrance County: Estancia Salt district.

BORAX.

Physical characteristics. Monoclinic. Crystals prismatic, sometimes large; crystalline incrustations [illegible]. Cleavage: two directions, one perfect. [illegible] conchoidal. Luster vitreous. [illegible]

Luster vitreous to resinous; sometimes earthy. Color white; sometimes grayish, bluish, or greenish. Streak white. Translucent to opaque. Taste sweetish alkaline, feeble.

Chemical composition. $Na_2B_4O_7.10H_2O$, or $Na_2O.2B_2O_3.10H_2O$.

Occurrence. Dona Ana-Otero Counties: west of White Sands in Alkali Flat region.

BORNITE. Peacock Ore. Erubescite.

Physical characteristics. Isometric. In cubic crystals, faces rough or curved, but crystals are rare. Usually massive, structure granular or compact. No distinct cleavage. Fracture small conchoidal to uneven. Brittle. H.- 3. Sp.G.- 4.9-5.4. Luster metallic. Color between copper-red and light brown on fresh surfaces, speedily tarnishing to iridescent blue or purple. Streak pale grayish black. Opaque.

Chemical composition. A sulphide of copper and iron, Cu_5FeS_4.

Occurrence. Catron County: Mogollon district. Dona Ana County: Organ district. Grant County: Central, Santa Rita, and Steeple Rock districts. Guadalupe County: Pastura district. Hidalgo County: Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey district. Otero

Luster vitreous to resinous; sometimes earthy. Color white; sometimes grayish, bluish, or greenish. Streak white. Translucent to opaque. Taste sweetish alkaline, feeble.

Chemical composition. $Na_2B_4O_7 \cdot 10H_2O$, or $Na_2O \cdot 2B_2O_3 \cdot 10H_2O$.

Occurrence. Dona Ana-Otero Counties: west of White Sands in Alkali Flat region.

BORNITE. Peacock Ore. Erubescite.

Physical characteristics. Isometric. In cubic crystals, faces rough or curved, but crystals are rare. Usually massive, structure granular or compact. No distinct cleavage. Fracture small conchoidal to uneven. Brittle. H.= 3. Sp.G.= 4.9-5.4. Luster metallic. Color between copper-red and light brown on fresh surfaces, speedily tarnishing to iridescent blue or purple. Streak pale grayish black. Opaque.

Chemical composition. A sulphide of copper and iron, Cu_5FeS_4.

Occurrence. Catron County: Mogollon district. Dona Ana County: Organ district. Grant County: Central, Santa Rita, and Steeple Rock districts. Guadalupe County: Pastura district. Hidalgo County: Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey district. Otero

County: Sacramento district. Rio Arriba County: Gallina district. Sandoval County: Nacimiento Mountains district. San Miguel County: Rociada, Tecolote, and Willow Creek districts. Santa Fe County: indefinite. Sierra County: Caballos Mountains, Chloride, Hermosa, Hillsboro, Hot Springs, and Kingston districts. Socorro County: Joyita Hills, Ladrones Mountains, Magdalena, Mill Canyon, San Andres Mountains (Goodfortune Creek), and Scholle districts. Taos County: Picuris and Twining districts.

BOURNONITE. Wheel Ore.

Physical characteristics. Orthorhombic. Twins common, twinning often repeated, forming cruciform or wheel-shaped twins. Also massive; granular, compact. No distinct cleavage. Fracture subconchoidal to uneven. Rather brittle. H.- 2.5-3. Sp.G.- 5.7-5.9. Luster metallic, brilliant. Color and streak steel-gray, inclining to blackish lead-gray or iron-black. Opaque.

Chemical composition. A sulphide of lead, copper, and antimony, $2PbS.Cu_2S.Sb_2S_3$.

Occurrence. Grant County: Central district. Santa Fe County: Cerrillos district.

County: Sacramento district. San Carlos County: Cochise district. Sandoval County: Cochiti or Bland district. San Miguel County: Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Los Cerrillos. Sierra County: Caballos Mountains, Chloride, Hermosa, Hillsboro, Hot Springs, and Kingston districts. Socorro County: Magdalena Hills, Ladrones Mountains, Magdalena, Mill Canyon, San Andres Mountains (Goodfortune Creek), and Socorro districts. Taos County: Picuris and Twining districts.

BOURNONITE. Wheel Ore.

Physical characteristics. Orthorhombic. Twins common, twinning often repeated, forming cruciform or wheel-shaped twins. Also massive; granular, compact. No distinct cleavage. Fracture subconchoidal to uneven. Rather brittle. H.= 2.5-3. Sp.G.= 5.7-5.9. Luster metallic, brilliant. Color and streak steel-gray, inclining to blackish lead-gray or iron-black. Opaque.

Chemical composition. A sulphide of lead, copper, and antimony, $2PbS.Cu_2S.Sb_2S_3$.

Occurrence. Grant County: Central district. [illegible] County: Cerrillos district.

BRAUNITE. (?)

Physical characteristics. Tetragonal. Commonly in octahedron-like forms, nearly isometric in angle. Also massive. Cleavage: pyramidal, perfect. Fracture uneven to subconchoidal. Brittle. H.- 6-6.5. Sp.G.- 4.75-4.82. Luster submetallic. Color and streak dark brownish black to steel-gray.

Chemical composition. $3MnMnO_3.MnSiO_3$.

Occurrence. Socorro County: Socorro Peak district (?).

BROCHANTITE.

Physical characteristics. Orthorhombic. In groups of prismatic acicular crystals and drusy crusts; massive with reniform structure. Cleavage: one direction, very perfect. Fracture uneven. H.- 3.5-4. Sp.G.- 3.9. Luster vitreous, a little pearly on the perfect cleavage surface. Color emerald-green, blackish green. Streak paler green. Transparent to translucent.

Chemical composition. A basic sulphate of copper, $CuSO_4.3Cu(OH)_2$.

Occurrence. Dona Ana County: Organ district. Socorro County: Magdalena district.

BRAUNITE. (?)

Physical characteristics. Tetragonal. Commonly in octahedron-like forms, nearly isometric in angle. Also massive. Cleavage: pyramidal, perfect. Fracture uneven to subconchoidal. Brittle. H.= 6-6.5. Sp.G.= 4.75-4.8?. Luster submetallic. Color and streak dark brownish black to steel-grey.

Chemical composition. $3Mn_2O_3.MnSiO_3$.

Occurrence. Socorro County: Socorro Peak district (?).

BROCHANTITE.

Crystal characteristics. Orthorhombic. In groups of prismatic acicular crystals and drusy crusts; massive with reniform structure. Cleavage: one direction, very perfect. Fracture uneven. H.= 3.5-4. Sp.G.= 3.9. Luster vitreous, a little pearly on the perfect cleavage surface. Color emerald-green, blackish green. Streak paler green. Transparent to translucent.

Chemical composition. A basic sulphate of copper. $CuSO_4.3Cu(OH)_2$.

Occurrence. Dona Ana County: Organ district. Socorro County: Magdalena district.

BROMYRITE.

Physical characteristics. Isometric. Crystals rare. Usually in small concretions. Cleavage none. Fracture uneven. Sectile. H.- 2-3. Sp.G.- 5.8-6. Luster resinous to adamantine. Color, when pure, bright yellow to amber-yellow, slightly greenish; often grass- or olive-green externally, little altered on exposure. Transparent to translucent.

Chemical composition. Silver bromide, AgBr.

Occurrence. Catron County: Mogollon district. Grant County: Georgetown district. Rio Arriba County: Bromide district (?). Sierra County: Chloride, Hermosa, and Tierra Blanca districts.

BROOKITE.

Physical characteristics. Orthorhombic. Occurs only in crystals, of varied habit. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.- 5.5-6. Sp.G.- 3.87-4.08. Luster metallic-adamantine to submetallic. Color brown, yellowish, reddish; reddish brown, and translucent. Also brown to iron-black, opaque. Streak uncolored to grayish or yellowish.

Chemical composition. Titanium dioxide, TiO_2.

BROMYRITE.

Physical characteristics. Isometric. Crystals rare. Usually in small concretions. Cleavage none. Fracture uneven. Sectile. H.= 1-2. Sp.G.= 5.8-6. Luster resinous to adamantine. Color, when pure, bright yellow to amber-yellow, slightly greenish; often grass- or olive-green externally, little altered on exposure. Transparent to translucent.

Chemical composition. Silver bromide, AgBr.

Occurrence. Catron County: Mogollon district. Grant County: Georgetown district. Rio Arriba County: Bromide district. Sierra County: Chloride, Hermosa, and Tierra Blanca districts.

BROOKITE.

Physical characteristics. Orthorhombic. Occurs only in crystals, of varied habit. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.= 5.5-6. Sp.G.= 3.87-4.08. Luster metallic-adamantine to submetallic. Color brown; yellowish, reddish; reddish brown, and translucent. Also brown to iron-black, opaque. Streak uncolored to grayish or yellowish.

Chemical composition. Titanium dioxide, TiO_2.

Occurrence. Taos County: Picuris district.

BYTOWNITE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see Plagioclase Feldspars. Bytownite is distinguished chiefly by its cleavage angle (85° 56'), specific gravity (2,695-2.73), and optical characters (differences in indices of refraction and extinction angles). It is an uncommon mineral.

Chemical composition. $Ab_{30-10}An_{70-90}$. See table under Plagioclase Feldspars.

Occurrence. Sandoval County: Jemez region. Sierra County: indefinite (?).

CALAMINE. Smithsonite. Hemimorphite.

Physical characteristics. Orthorhombic-hemimorphic. Crystals often tabular; also prismatic; tabular faces vertically striated. Usually implanted and showing one extremity only. Often in sheaf-like forms and forming drusy surfaces in cavities. Also stalactitic, mammillary, botryoidal, and fibrous forms; massive and granular. Cleavage: two directions, perfect; two other directions, less so. Fracture

uneven to subconchoidal. Brittle. H.- 4.5-5, the latter when crystallized. Sp.G.- 3.40-3.50. Luster vitreous, one face subpearly and sometimes adamantine. Color white, sometimes with a delicate bluish or greenish shade; also yellowish to brown. Streak white. Transparent to translucent.

Chemical composition. Hydrous zinc silicate, H_2ZnSiO_5, or $(ZnOH)_2SiO_3$, or $H_2O.2ZnO.SiO_2$.

Occurrence. Dona Ana County: Organ district. Grant County: Central, Fierro-Hanover, and Pinos Altos districts. Luna County: Tres Hermanas district. Sierra County: Cuchillo Negro, Hillsboro, Kingston, and Macho districts. Socorro County: Magdalena and Ojo Caliente districts.

CALAVERITE. (?)

Physical characteristics. Monoclinic. In small lath-shaped crystals striated parallel to their lengths. Also massive granular to crystalline. Fracture uneven, inclining to subconchoidal. Brittle. H.- 2.5. Sp.G.- 9.043. Color silver-white with often a faint yellow tinge. Streak yellowish gray.

Chemical composition. A gold telluride, $AuTe_2$, with smaller amounts of silver than sylvanite.

Occurrence. Sierra County: Tierra Blanca district (?).

uneven to subconchoidal. Brittle. H.= 4.5-5, the latter when crystallized. Sp.G.= 3.40-3.50. Luster vitreous, surface subpearly and sometimes adamantine. Color white, sometimes with a delicate bluish or greenish shade; also yellowish to brown. Streak white. Transparent to translucent.

Chemical composition. Hydrous zinc silicate, $H_2Zn_2SiO_5$, or $(ZnOH)_2SiO_3$, or $H_2O.2ZnO.SiO_2$.

Occurrence. Dona Ana County: Organ district. Grant County: Central, Fierro-Hanover, and Pinos Altos districts. Luna County: Tres Hermanas district. Sierra County: Cuchillo Negro, Hillsboro, Kingston, and Macho districts. Socorro County: Magdalena and Ojo Caliente districts.

CALAVERITE. (?)

Physical characteristics. Monoclinic. In small lath-shaped crystals striated parallel to their lengths. Also massive granular to crystalline. Fracture uneven, inclining to subconchoidal. Brittle. H.= 2.5. Sp.G.= [illegible]. Color silver-white with often a faint yellow tinge. Streak yellowish gray.

Chemical composition. A gold telluride, $AuTe_2$, with smaller amounts of silver than sylvanite.

Occurrence. Sierra County: Tierra Blanca district (?).

Taos County: Anchor (?), and Red River (?) districts.

CALCITE. Calc Spar.

Physical characteristics. Hexagonal-rhombohedral. Habit of crystals highly varied, obtuse to acute rhombohedral; thin tabular to long prismatic; and scalenohedral of many types, often highly modified. Calcite crystals exhibit a greater variety of forms and habits than any other mineral. Twins common. Also fibrous, coarse and fine; sometimes lamellar; often granular; from coarse to impalpable, and compact to earthy. Also stalactitic, tuberose, nodular, and other imitative forms. Cleavage: rhombohedral, highly perfect. Fracture conchoidal, obtained with difficulty due to perfect cleavage. Brittle. H.- 3, but varying with direction on the cleavage face; earthy varieties softer. Sp.G.- 2.710 in pure crystals, but varying rather widely in impure forms. Luster vitreous to subvitreous to earthy; silky in fibrous forms. Color white or colorless, also various shades of gray, red, green, blue, violet, yellow; also brown to black when impure. Streak white or grayish. Transparent to opaque. Some varieties phosphoresce upon heating, and others luminesce on being exposed to sunlight or radium emanations.

Chemical composition. Calcium carbonate, $CaCO_3$. Small

quantities of magnesium, iron, manganese, zinc, and lead may be present replacing the calcium.

Varieties. 1. Anthraconite. Colored black by carbonaceous impurities; in massive rock formations. 2. Manganiferous calcite. Manganocalcite. Containing varying amounts of manganese carbonate, $MnCO_3$. Usually pinkish; may turn dark on exposure. 3. Onyx. True onyx is a variety of quartz. Mexican Onyx and Oriental Onyx-Marble may be included as varieties of calcite. Massive, with banded colors. 4. Zincocalcite. Containing zinc carbonate, $ZnCO_3$.

Occurrence. Bernalillo County: Tijeras Canyon district; Rio Puerco Valley region (concretions). Catron County: Mogollon and Taylor Creek Tin districts. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Organ and Rincon Manganese districts; in Woolfer Canyon at southern end of Caballos Mountains. Eddy County: Carlsbad Caverns (dripstone and pisolites). Grant County: Alum Mountain, Black Hawk, Burro Mountains, Carpenter, Chloride Flat, Fierro-Hanover, Georgetown, Gold Hill, Juniper, Lone Mountain, Meerschaum, Pinos Altos, Santa Rita, Silver City Manganese-Iron, Steeple Rock, and Telegraph districts. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey, Jicarilla, Nogal, and White Oaks districts. Luna County: Cooks Peak, Cooks Range Manganese, Little

Florida Mountains, Tres Hermanas, and Victorio districts. Otero County: Orogrande and Tularosa districts. Rio Arriba County: Bromide, Hopewell, and Petaca (Ojo Caliente) districts. Sandoval County: Jemez Springs district (oolites and pisolites in Soda Dam); Placitas district; Rio Puerco Valley region (concretions). San Miguel County: Rociada district. Santa Fe County: Cerrillos, New Placers, and Old Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Derry Manganese, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, Pittsburg, and Tierra Blanca districts. Socorro County: Council Rock, Iron Mountain No. 2, Joyita Hills, Luis Lopez Manganese, Magdalena, Mill Canyon, North Magdalena, San Andres Mountains (Grandview Canyon, Lava Gap, Mockingbird Gap), San Jose, San Lorenzo, Socorro Peak, and Water Canyon districts. Taos County: Red River and Twining districts.

Var. Anthraconite. Sandoval County: Tejon Grant at northeast end of Sandia Mountains, between Placitas and Golden. Valencia County: Rito region.

Var. Manganiferous Calcite. Catron County: Mogollon district. Dona Ana County: Rincon Manganese district. Grant County: Fierro Manganese and Silver City Manganese-Iron districts. Hidalgo County: Lordsburg district. Luna County: Cooks Range Manganese, Florida Mountains, and Little Florida Mountains districts. Sierra County: Derry Manganese, Florida Mountains, Tres Hermanas, and Victorio districts. Clark County: Goodsprings and [illegible] districts. [illegible] County: Bromide, Rosewell, and [illegible] districts. Sandoval County: [illegible] and pisolites in [illegible] Valley region [illegible] district. Santa Fe County: [illegible] Placers districts. Sierra County: [illegible] Chloride, Cuchillo Negro, [illegible] Kingston, Lake Valley, [illegible] districts. Socorro County: [illegible] 8, Joyita Hills, Lake [illegible] Canyon, North Magdalena, [illegible] Canyon, Lava Gap, [illegible] Socorro Peak, [illegible] River and Twining districts.

Var. [illegible]. [illegible] northeast end of Sandia [illegible] Golden. Valencia County: [illegible]

Var. [illegible]. [illegible] district. [illegible] Grant County: [illegible] Iron districts. [illegible] County: [illegible] Florida Mountains districts.

Hillsboro, Kingston, and Lake Valley districts. Socorro County: Council Rock, Luis Lopez Manganese, Magdalena Mountains Manganese, San Jose, and Socorro Peak districts.

Var. Mexican Onyx. Dona Ana County: Organ district. Grant County: near Silver City. Luna County: four miles west of Columbus; near Mirage. Otero County: near Alamogordo. Valencia County: near Rio Puerco Station (finely banded aragonite in travertine).

Var. Zincocalcite. Socorro County: Magdalena district.

CALEDONITE.

Physical characteristics. Orthorhombic. Crystals prismatic, usually minute; sometimes in divergent groups. Cleavage: basal, perfect; one prismatic cleavage, less perfect. Fracture uneven. Rather brittle. H.- 2.5-3. Sp.G.- 6.4. Luster resinous. Color deep verdigris-green or bluish green; inclining to mountain-green in small crystals. Streak greenish white. Translucent. Easily fusible.

Chemical composition. A basic sulphate of lead and copper, perhaps $2(Pb,Cu)O.SO_3.H_2O$. Said at times to contain CO_2.

Occurrence. Dona Ana County: Organ district.

Hillsboro, Kingston, and Lake Valley districts. Socorro County: Council Rock, Luis Lopez Manganese, Magdalena Mountains Manganese, San Jose, and Socorro Peak districts.

Var. Mexican Onyx. Dona Ana County: Organ district. Grant County: near Silver City. Luna County: four miles west of Columbus; near Mirage. Otero County: near Alamogordo. Valencia County: near Rio Puerco Station (finely banded aragonite in travertine).

Var. Zinc-aragonite. Socorro County: Magdalena district.

CALEDONITE

Physical characteristics. Orthorhombic. Crystals prismatic, usually minute; sometimes in divergent groups. Cleavage: basal, perfect; one prismatic cleavage, less perfect. Fracture uneven. Rather brittle. H.= 2.5-3. Sp.G.= 6.4. Luster resinous. Color deep verdigris-green or bluish green; inclining to mountain-green in small crystals. Streak greenish white. Translucent. Easily fusible.

Chemical composition. A basic sulphate of lead and copper, perhaps $2(Pb,Cu)O.SO_3.H_2O$. Said at times to contain CO_2.

Occurrence. Dona Ana County: Organ district.

CARNALLITE.

Physical characteristics. Orthorhombic. Crystals rare. Commonly massive, granular. No distinct cleavage. Fracture conchoidal. Brittle. H.- 2.5. Sp.G.- 1.60. Luster shining, greasy. Color milk-white, often reddish. Transparent to translucent. Strongly phosphorescent. Taste bitter. Deliquescent.

Chemical composition. $KMgCl_3.6H_2O$, or $KCl.MgCl_2.6H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

CARNOTITE.

Physical characteristics. Orthorhombic. Sometimes in crystalline plates. Also in the form of powder. Basal cleavage. Color yellow.

Chemical composition. Approximately $K_2O.2U_2O_3.V_2O_5.2H_2O$. The amount of water is uncertain, varying with the moisture content of the atmosphere.

Occurrence. Catron County: Carrizo Mountains (error ?). Sandoval County: Cochiti district. Socorro County: Scholle district.

[illegible]

Physical characteristics. [illegible]

Commonly massive, granular. [illegible]

conchoidal. Brittle. [illegible]

ing, greasy. Color milk-white, often [illegible]

to translucent. [illegible]

[illegible].

Chemical composition. [illegible]

Occurrence. [illegible]

[illegible]

Physical characteristics. [illegible]

crystalline plates. Also [illegible]

cleavage. Color yellow.

Chemical composition. [illegible]

The amount of water is [illegible]

content of the atmosphere.

Occurrence. [illegible]

[illegible]

district.

<u>CASSITERITE</u>. Tin-stone.

<u>Physical characteristics</u>. Tetragonal. Twins common, often repeated. Crystals low pyramidal, also prismatic with acute terminations. Sometimes acicular. Prism faces vertically striated. Often reniform, structure fibrous divergent; also massive, granular or impalpable; in rolled grains. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.- 6-7. Sp.G.- 6.8-7.1. Luster adamantine, and crystals usually splendent. Color brown or black, sometimes red, gray, white, or yellow. Streak white, grayish, brownish. From nearly transparent to opaque.

<u>Chemical composition</u>. Tin dioxide, SnO_2. Tantalum and iron oxides sometimes present.

<u>Occurrence</u>. Catron County: Taylor Creek Tin district. Rio Arriba County: Petaca district. Sierra County: Chloride, Cuchillo Negro, and San Mateo Mountains (?) districts; (also Taylor Creek Tin district).

<u>CELESTITE</u>. Coelestine.

<u>Physical characteristics</u>. Orthorhombic. Crystals resembling those of <u>barite</u> in habit; commonly tabular or prismatic. Also fibrous and radiated, sometimes globular; occasionally granular. Cleavage: one direction, perfect; one less per-

CASSITERITE. Tin-stone.

Physical characteristics. Tetragonal. Twins common, often repeated. Crystals low pyramidal, also prismatic with acute terminations. Sometimes acicular. Prism faces vertically striated. Often reniform, structure fibrous divergent; also massive, granular or impalpable; in rolled grains. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.= 6-7. Sp.G.= 6.8-7.1. Luster adamantine, and crystals usually splendent. Color brown or black, sometimes red, gray, white, or yellow. Streak white, grayish, brownish. From nearly transparent to opaque.

Chemical composition. Tin dioxide, SnO_2. Tantalum and iron oxides sometimes present.

Occurrence. Catron County: Taylor Creek Tin district. Rio Arriba County: Petaca district. Sierra County: Chloride, Cuchillo Negro, and San Mateo Mountains (?) districts; (also Taylor Creek Tin district).

CELESTITE. Coelestine.

Physical characteristics. Orthorhombic. Crystals resembling those of barite in habit; commonly tabular or prismatic. Also fibrous and radiated, sometimes globular; occasionally granular. Cleavage: one direction, perfect; one less perfect; another less distinct; all at right angles, and yielding rectangular fragments. Fracture uneven. H.- 3-3.5. Sp.G.- 3.95-3.97. Luster vitreous, sometimes inclining to pearly. Color white, often faint bluish, and sometimes reddish. Streak white. Transparent to subtranslucent.

Chemical composition. Strontium sulphate, $SrSO_4$. Calcium and barium are sometimes present.

Varieties. 1. Calciocelestite. Containing calcium in considerable amount.

Occurrence. Socorro County: Oscura Mountains and San Andres Mountains.

Var. Calciocelestite. Socorro County: Oscura Mountains region.

CERARGYRITE. Horn Silver.

Physical characteristics. Isometric. Habit cubic. Usually massive and resembling wax or horn; sometimes columnar; often in crusts. Cleavage none. Fracture somewhat conchoidal. Highly sectile. H.- 1-1.5. Sp.G.- 5.552. Luster resinous to adamantine. Color pearl-gray, grayish green, whitish to colorless, rarely violet-blue. On exposure to the light turns violet-brown. Transparent to translucent.

fect; another less distinct; all at right angles, yielding rectangular fragments. Fracture uneven. H = 3-3.5. Sp.G. = 3.95-3.97. Luster vitreous, sometimes inclining to pearly. Color white, often faint bluish, and sometimes reddish. Streak white. Transparent to subtranslucent.

Chemical composition. Strontium sulphate, $SrSO_4$. Calcium and barium are sometimes present.

Varieties. 1. Calciocelestite. Containing calcium in considerable amount.

Occurrence. Socorro County; Socorro Mountains and Lemitar Mountains.

Var. Calciocelestite. Socorro County; Lemitar Mountains region.

CERARGYRITE. Horn Silver.

Physical characteristics. Isometric. Rarely in cubes. Commonly massive and resembling wax or horn; sometimes columnar, often in crusts. Cleavage none. Fracture uneven to subconchoidal. Highly sectile. H = 1-1.5. Sp.G. = 5.5-5.6. Luster resinous to adamantine. Color pearl-gray, grayish green, whitish to colorless, rarely violet-blue, on exposure to the light turns violet-brown. Transparent to translucent.

Chemical composition. Silver chloride, AgCl. May contain mercury in some varieties.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Black Hawk, Burro Mountains, Chloride Flat, Fleming, Georgetown, Lone Mountain, Pinos Altos, and Telegraph districts. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and Steins Pass districts. Luna County: Florida Mountains district. Rio Arriba County: Bromide district. Santa Fe County: "San Ysidro Mountain"- (may refer to New Placers district). Sierra County: Chloride, Cuchillo Negro, Hermosa, Hillsboro, Hot Springs, Kingston, Lake Valley, and Tierra Blanca districts. Socorro County: San Jose and Socorro Peak districts. Taos County: Picuris district.

CERUSSITE. Cerusite. White Lead Ore.

Physical characteristics. Orthorhombic. Simple crystals often tabular, prismatic, or pyramidal. Twins common, often repeated, yielding six-rayed stellate groups. Crystals grouped in clusters, and aggregates. Rarely fibrous, often granular massive and compact; earthy. Sometimes stalactitic. Cleavage: four directions, distinct. Fracture conchoidal. Very brittle. H.- 3-3.5. Sp.G.- 6.46-6.574. Luster

Chemical composition. Silver chloride, AgCl. May contain mercury in some varieties.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Black Hawk, Burro Mountains, Chloride Flat, Fleming, Georgetown, Lone Mountain, Pinos Altos, and Telegraph districts. Hidalgo County: Apache No. 2, Fremont, Gasbita, Lordsburg, and Steins Pass districts. Luna County: Florida Mountains district. Rio Arriba County: Bromide district. Santa Fe County: "San Ysidro Mountain" (may refer to New Placers district). Sierra County: Chloride, Cuchillo Negro, Hermosa, Hillsboro, Hot Springs, Kingston, Lake Valley, and Tierra Blanca districts. Socorro County: San Jose and Socorro Peak districts. Taos County: Picuris district.

CERUSSITE. Cerussite. White Lead Ore.

Physical characteristics. Orthorhombic. Single crystals often tabular, prismatic, or pyramidal. Twins common, often repeated, yielding six-rayed stellate groups. Crystals grouped in clusters, and aggregates. Mainly fibrous, often granular massive and compact; earthy. Stalactitic. Cleavage: four directions, distinct. Fracture conchoidal. Very brittle. H = 3-3.5. Sp.G. = 6.46-6.57. Luster adamantine, inclining to vitreous, resinous, and pearly; sometimes submetallic. Color white, gray, grayish black, sometimes tinged blue or green by copper. Streak uncolored. Transparent to subtranslucent.

Chemical composition. Lead carbonate, $PbCO_3$.

Occurrence. Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Central, Fierro-Hanover, Georgetown, Gold Hill, Pinos Altos, and Santa Rita districts. Hidalgo County: Fremont, Hachita, Lordsburg, and San Simon districts. Luna County: Cooks Peak, Florida Mountains, and Victorio districts. Sandoval County: Nacimiento Mountains district. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos and New Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, and Macho districts. Socorro County: Hansonburg, Magdalena, North Magdalena, Ojo Caliente, San Andres Mountains (Mockingbird Gap), Socorro Peak, and Water Canyon districts.

CERVANTITE.

Physical characteristics. Orthorhombic. In acicular crystals. Also massive; as a crust, or a powder. H.- 4-5. Sp.G.- 4.084. Luster greasy or pearly, also bright or earthy. Color yellow to white, sometimes reddish. Streak adamantine, inclining to vitreous, resinous, and pearly; sometimes submetallic. Color white, gray, grayish black, sometimes tinged blue or green by copper. Streak uncolored. Transparent to subtranslucent.

Chemical composition. Lead carbonate, $PbCO_3$.

Occurrence. Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Central, Fierro-Hanover, Georgetown, Gold Hill, Pinos Altos, and Santa Rita districts. Hidalgo County: Fremont, Hachita, Lordsburg, and Red Rock districts. Luna County: Cooks Peak, Florida Mountains, and Victorio districts. Sandoval County: Nacimiento Mountains district. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos and New Placers districts. Sierra County: Caballos Mountains, Chloride, [illegible], Hermosa, Hillsboro, Kingston, Lake Valley, and [illegible] districts. Socorro County: Hansonburg, Magdalena, North Magdalena, Ojo Caliente, San Andres Mountains ([illegible] Gap), Socorro Peak, and Water Canyon districts.

CERVANTITE

Physical characteristics. Orthorhombic. In acicular crystals. Also massive; as a crust, or a powder. H. 4–5. Sp.G. 4.084. Luster greasy or pearly, also earthy. Color yellow to white, sometimes reddish white.

yellowish white to white.

Chemical composition. Sb_2O_4, or $Sb_2O_3 . Sb_2O_5$.

Occurrence. Grant County: Central district. Luna County: "near Deming".

CHALCANTHITE. Blue Vitriol.

Physical characteristics. Triclinic. Crystals commonly flattened. Also massive, stalactitic, reniform, sometimes with fibrous structure. No distinct cleavage. Fracture conchoidal. Brittle. H.- 2.5. Sp.G.- 2.12-2.30. Luster vitreous. Color Berlin- to sky-blue, of different shades; sometimes a little greenish. Streak uncolored. Subtransparent to translucent. Taste metallic and nauseous.

Chemical composition. Hydrous cupric sulphate, $CuSO_4 . 5H_2O$.

Occurrence. Grant County: Central district. San Miguel County: Willow Creek district. Socorro County: Magdalena district.

CHALCOCITE. Copper Glance. Redruthite.

Physical characteristics. Orthorhombic. Crystals rare, pseudo-hexagonal. Usually massive, structure granular to

compact and impalpable. No distinct cleavage. Fracture conchoidal. Rather sectile. H.- 2.5-3. Sp.G.- 5.5-5.8. Luster metallic. Color and streak blackish lead-gray, often tarnished blue or green, dull. Opaque.

Chemical composition. Cuprous sulphide, Cu_2S.

Occurrence. Catron County: Mogollon district. Dona Ana County: Hembrillo and Organ districts. Eddy County: (?) Grant County: Burro Mountains, Central, Fierro-Hanover, Santa Rita, and Silver City Manganese-Iron districts. Guadalupe County: Pastura district. Hidalgo County: Apache No. 2, Hachita, Lordsburg, and Steins Pass districts. Lincoln County: Estey and Jicarilla districts. Mora County: Coyote Creek district. Otero County: Orogrande, Sacramento, and Tularosa districts. Rio Arriba County: Abiquiu district. Sandoval County: Jemez Springs and Nacimiento Mountains districts. San Miguel County: Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Glorieta and La Bajada districts. Sierra County: Caballos Mountains, Chloride, Hermosa, and Hillsboro districts. Socorro County: Hansonburg, Hop Canyon, Jones Camp, Joyita Hills, Ladrones Mountains, Magdalena, Mill Canyon, North Magdalena, Rayo, San Andres Mountains (Goodfortune Creek, Mockingbird Gap), Scholle, and Water Canyon districts. Taos County: Picuris district. Valencia County: Zuni Mountains district.

compact and impalpable. No distinct cleavage. [illegible]
conchoidal. Luster metallic. [illegible]
luster metallic. Color and streak [illegible]
tarnished blue or green, dull. [illegible]

<u>Chemical composition</u>. Copper [illegible]

<u>Occurrence</u>. Catron County: Mogollon district. Dona Ana County: Hembrillo and Organ districts. [illegible] Grant County: Burro Mountains, [illegible] Santa Rita, and Silver City [illegible]. Guadalupe County: Pastura district. [illegible] No. 2, Hachita, Lordsburg, and [illegible] districts. Lincoln County: Estey and [illegible] districts. [illegible] Coyote Creek district. Otero County: [illegible] and Tularosa districts. Rio Arriba County: [illegible] trict. Sandoval County: Jemez Springs and [illegible] taine districts. San Miguel County: [illegible] Willow Creek districts. Santa Fe County: [illegible] districts. Sierra County: [illegible] Chloride, Hermosa, and Hillsboro districts. Socorro County: [illegible] Rosedale, Dog Canyon, Jones [illegible] Mountains, Magdalena, Hill [illegible] San Andres Mountains (Consolidated [illegible] Socorro, and Water Canyon districts. [illegible] district. Valencia County: [illegible]

CHALCOPHANITE. Hydrofranklinite.

Physical characteristics. Hexagonal-rhombohedral. In druses of minute tabular rhombohedral crystals, sometimes octahedral in aspect. Also in foliated aggregates, stalactitic and plumose. Cleavage: basal, perfect. H.- 2.5. Sp.G.- 3.907. Luster metallic, brilliant. Color bluish black to iron-black. Streak chocolate-brown, dull. Translucent.

Chemical composition. $(Mn,Zn)O.2MnO_2.2H_2O$.

Occurrence. Socorro County: Magdalena district.

CHALCOPYRITE. Copper Pyrites.

Physical characteristics. Tetragonal-sphenoidal. Crystals commonly tetragonal in aspect. Sometimes octahedral in form. Twins common, sometimes repeated. Often massive, compact, sometimes botryoidal or reniform. No distinct cleavage. Fracture uneven. Brittle. H.- 3.5-4. Sp.G.- 4.1-4.3. Luster metallic. Color brass-yellow, often tarnished or iridescent. Streak greenish black. Opaque.

Chemical composition. A sulphide of copper and iron, $CuFeS_2$.

Occurrence. Catron County: Mogollon district. Colfax

County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Gold Camp and Organ districts. Grant County: Burro Mountains, Central, Fierro-Hanover, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey and Nogal districts. Luna County: Florida Mountains district. Otero County: Orogrande, Sacramento, and Tularosa districts. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. San Miguel County: El Porvenir, Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Cerrillos, La Bajada, New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballos Mountains, Chloride, Hermosa, Hillsboro, Hot Springs, Kingston, and Tierra Blanca districts. Socorro County: Hansonburg, Joyita Hills, Lemitar Mountains, Magdalena, Mill Canyon, North Magdalena, San Andres Mountains (Goodfortune Creek, Grandview Canyon, Salinas Peak), Scholle, and Water Canyon districts. Taos County: Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains district.

CHLORITE.

Common name for a group of mineral species, taking its name from the green color common in silicates in which

County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Gold Camp and Organ districts. Grant County: Burro Mountains, Central, Pierro-Hanover, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: Apache No. 2, Fremont, Sanhita, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey and Nogal districts. Luna County: Florida Mountains districts. Otero County: Orogrande, Sacramento, and Tularosa districts. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. San Miguel County: El Porvenir, Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Cerrillos, La Bajada, New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballos Mountains, Chloride, Hermosa, Hillsboro, Hot Springs, Kingston, and Tierra Blanca districts. Socorro County: Hansonburg, Joyita Hills, Ladrón Mountains, Magdalena, Mill Canyon, North Magdalena, San Andres Mountains (Goodfortune Creek, Grandview Canyon, Salinas Peak), Socorro, and Water Canyon districts. Taos County: Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains district.

EMERALD.

Common name for a group of mineral species, taking the name from the green color common in silicates in which ferrous iron is prominent. The species are closely related in many respects to the micas. They are monoclinic, in part distinctly so, and in part with rhombohedral symmetry. The micaceous basal cleavage is prominent in crystallized forms, but the laminae are tough and inelastic.

The chlorites are silicates of aluminum with ferrous iron and magnesium and chemically combined water. Ferric iron and chromium may replace the aluminum, those forms with chromium being pink in color. Calcium and alkalies are absent, or present in small amounts. The chlorites are alteration products of micas, due to hydrothermal agents or weathering. Several distinct species are known, but are difficult to distinguish, and are generally grouped together and referred to as chlorite.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Tonuco Mountains Fluorspar district. Grant County: Burro Mountains and Santa Rita districts. Hidalgo County: Lordsburg district. Rio Arriba County: Bromide and Hopewell districts. San Miguel County: Rociada and Willow Creek districts. Santa Fe County: Old Placers district. Sierra County: Hillsboro and Macho districts. Socorro County: Magdalena and San Andres Mountains (Sulphur Canyon) districts. Taos County: Red River and Twining districts.

ferrous iron is prominent. [illegible]
in many respects to the mica. [illegible]
part distinctly so, and [illegible]
The microscopic basal cleavage [illegible]
forms, but the laminae are [illegible]

- -

The chlorites are silicates of aluminum with [illegible]
iron and magnesium and chemically combined [illegible]
iron and chromium may replace the aluminum, [illegible]
with chromium being pink in [illegible]
are absent, or present in small amounts. [illegible]
alteration products of mica, [illegible]
weathering. Several distinct [illegible]
difficult to distinguish; [illegible]
and referred to as chlorite.

Occurrence. [illegible]
Catron County: Mogollon district. [illegible]
district. Dona Ana County: [illegible]
trict. Grant County: [illegible]
tricts. Hidalgo County: [illegible]
County: [illegible]
Bonanza and [illegible]
Placers district. Sierra County: [illegible]
tricts. Socorro County: [illegible]
(Sulphur Canyon) district. [illegible]
Tularosa districts.

CHRYSOCOLLA.

Physical characteristics. Cryptocrystalline; often with opal-like or enamel-like texture; earthy. Crystals are known, the only recorded occurrence being in Idaho. Incrusting or filling seams. Sometimes botryoidal. Fracture conchoidal. Rather sectile; translucent varieties brittle. H.- 2.4. Sp.G.- 2-2.24. Luster vitreous, shining, earthy. Color various shades of green and bluish green, passing into sky-blue and turquois-blue; brown to black when impure. Streak white when pure. Translucent to opaque.

Chemical composition. A hydrous copper silicate, $CuSiO_3.2H_2O$.

Varieties. 1. Copper-pitch Ore. A mixture of chrysocolla and limonite, dark in color.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains and Santa Rita districts. Guadalupe County: Pastura district. Hidalgo County: Apache No. 2, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Jicarilla district. Otero County: Orogrande district. Sandoval County: Nacimiento Mountains district. San Juan County: Navajo Reservation (indefinite). San Miguel County: Willow Creek district. Santa Fe County: Santa Fe Mountains region.

Sierra County: Hillsboro district. Socorro County: Joyita Hills, Ladrones Mountains, Magdalena, Mill Canyon, North Magdalena, Ojo Caliente, San Andres Mountains (Mockingbird Gap, Sulphur Canyon), and San Lorenzo districts; indefinite: Oscura Mountains region. Taos County: Picuris district.

Var. Copper-pitch Ore. Catron County: Mogollon district. Grant County: Burro Mountains district. Hidalgo County: Fremont district. Otero County: Orogrande district. Socorro County: Magdalena district.

CHRYSOLITE. Olivine. Peridot.

Physical characteristics. Orthorhombic. Crystals often flattened, less often elongated. Massive, compact, or granular; in embedded grains. Cleavage: two directions, at right angles, fairly distinct. Fracture conchoidal. Brittle. H.- 6.5-7. Sp.G.- 3.27-3.37. Luster vitreous. Color commonly olive-green, sometimes brownish, grayish red, grayish green, becoming yellowish brown or red by oxidation of the iron. Streak usually uncolored, rarely yellowish. Transparent to translucent.

Chemical composition. $(Mg,Fe)_2SiO_4$, or $2(Mg,Fe)O.SiO_2$. The ratio of Mg:Fe varies widely.

Occurrence. Catron County: Mogollon district. Colfax

County: Raton region. Luna County: in Deming region (near Fort Cummings; near Black Mountain). McKinley County: Fort Wingate region. Zuni Reservation. Rio Arriba County: Abiquiu district. Sandoval County: Rio Grande Valley region. San Juan County: Navajo Reservation (southwest corner). Santa Fe County: Old Placers district. (Indefinite: Fort Craig region.)

COLUMBITE-TANTALITE.

Physical characteristics. Orthorhombic. Heart-shaped contact-twins sometimes occur. Crystals short prismatic, often rectangular prisms; also thin tabular. Also in large groups of parallel crystals, and massive. Two fairly distinct cleavages, at right angles. Fracture subconchoidal to uneven. Brittle. H.- 6. Sp.G.- 5.3-7.3, varying with composition. Luster submetallic, often very brilliant, subresinous. Color iron-black, grayish and brownish black, opaque; rarely reddish brown and translucent; frequently iridescent. Streak dark red to black.

Chemical composition. Columbate and tantalate of iron and manganese, $(Fe,Mn)(Cb,Ta)_2O_6$, passing gradually from normal columbite, the nearly pure columbate, to normal tantalite, the nearly pure tantalate. Tin and tungsten also present

County: Nutt region. Some deposits in Cooke's region (near Fort Cummings; near Black Mountain). McKinley County: Fort Wingate region. Zuni Reservation. Rio Arriba County: Abiquiu district. Sandoval County: Rio Grande Valley region. San Juan County: Navajo Reservation (northwest corner). Santa Fe County: Old Placers district. (Undetermined: Fort Craig region.)

COLUMBITE-TANTALITE.

Physical characteristics. Orthorhombic. Heart-shaped contact-twins sometimes occur. Crystals short prismatic, often rectangular prisms; also thin tabular. Also in large groups of parallel crystals, and massive. Two fairly distinct cleavages at right angles. Fracture subconchoidal to uneven. Brittle. H.= 6. Sp.G.= 5.3-7.3, varying with composition. Luster submetallic, often very brilliant, subresinous. Color iron-black, grayish- and brownish black, opaque; rarely reddish brown and translucent; frequently iridescent. Streak dark red to black.

Chemical composition. Niobate and tantalate of iron and manganese, (Fe,Mn)(Nb,Ta)$_2$O$_6$, passing gradually from normal niobate, the nearly pure columbite, to normal tantalate, the [illegible] with [illegible]. The [illegible] also [illegible] in small amounts. The iron may be largely replaced by manganese. The specific gravity is low for columbite, high for tantalite.

Occurrence. Rio Arriba County: Petaca district (both at Las Tablas and Petaca). San Miguel County: "mountains near Las Vegas". Taos County: Harding Mine district.

COPIAPITE.

Physical characteristics. Orthorhombic. Usually in loose aggregations of crystalline scales, or granular massive; incrusting. Cleavage: one direction, parallel to tabular surfaces of scales. H.- 2.5. Sp.G.- 2.103. Luster pearly. Color sulphur-yellow, citron-yellow. Translucent.

Chemical composition. A basic ferric sulphate, perhaps $Fe_4(OH)_2(SO_4)_5 \cdot 18H_2O$.

Occurrence. San Miguel County: Las Vegas region.

COPPER.

Physical characteristics. Isometric. Common forms tetrahexahedrons, also in octahedral plates. Distinct crystals rare. Frequently irregularly distorted and passing into twisted and wirelike forms, filiform and arborescent.

in small amounts. The iron may be largely replaced by manganese. The specific gravity is low for melanterite, high for mallardite.

Occurrence. Rio Arriba County: Petaca district ([illegible] at Las Tablas and Petaca). San Miguel County: "Tecolote near Las Vegas". Taos County: Harding mine district.

COPIAPITE.

Physical characteristics. Orthorhombic. Usually in loose aggregations of crystalline scales, or granular masses; incrusting. Cleavage one direction, parallel to basal surfaces of scales. H.= 2.5. Sp.G.= 2.103. Luster pearly. Color sulphur-yellow, citron-yellow. Translucent.

Chemical composition. A basic ferric sulphate, $Fe_4(OH)_2(SO_4)_5.18H_2O$.

Occurrence. San Miguel County: Las Vegas region.

COPPER.

Physical characteristics. Isometric. Common in dodecahedrons, also in octahedral planes. Distinct crystals rare. Frequently irregularly distorted and passing into twisted and wire-like forms, filiform and arborescent.

Massive; as sand. Twins very common, flattened and elongated. At times in pseudomorphs, after cuprite, azurite, chalcopyrite, calcite, aragonite, etc. Cleavage none. Fracture hackly. Highly ductile and malleable. H.- 2.5-3. Sp.G.- 8.8-8.9. Luster metallic. Color copper-red. Streak metallic, shining. Opaque. An excellent conductor for heat and electricity.

Chemical composition. Pure copper, Cu, sometimes with small amounts of iron, silver, bismuth, tin, lead, or antimony.

Occurrence. Grant County: Burro Mountains, Central, Fierro-Hanover, Georgetown, Pinos Altos, and Santa Rita districts. Hidalgo County: Lordsburg district. Rio Arriba County: Bromide district. Sandoval County: Jemez Springs and Nacimiento Mountains districts. Santa Fe County: Old Placers district. Sierra County: Hillsboro district. Socorro County: Magdalena, San Andres Mountains (Mockingbird Gap), San Lorenzo, and Water Canyon districts. Valencia County: Zuni Mountains district.

CORDIERITE. Iolite. Dichroite.

Physical characteristics. Orthorhombic. Twins as pseudohexagonal forms. Habit short prismatic. As embedded grains; also massive, compact. Cleavage, one direction, prismatic, distinct. Crystals often show a lamellar

Massive; as sand. Twins very common; flattened and elongated. At times in pseudomorphs after cuprite, azurite, chalcocite, calcite, aragonite, etc. Cleavage none. Fracture hackly. Highly ductile and malleable. H.= 2.5–3. Sp.G.= 8.8–8.9. Luster metallic. Color copper-red. Streak metallic, shining. Opaque. An excellent conductor for heat and electricity.

Chemical composition. Pure copper, Cu, sometimes with small amounts of iron, silver, bismuth, tin, lead, or antimony.

Occurrence. Grant County: Burro Mountains, Central, [illegible] Hanover, Georgetown, Pinos Altos, and [illegible] districts. Hidalgo County: Lordsburg district. [illegible] Bromide district. Sandoval County: [illegible] Nacimiento Mountains district. [illegible] County: [illegible] Placers district. Sierra County: Hillsboro district. Socorro County: Magdalena, San Andres Mountains (Mockingbird Gap), San Lorenzo, and Water Canyon districts. Valencia County: Zuni Mountains district.

CUPRITE. Red [illegible]

Physical characteristics. [illegible]

[illegible] forms. [illegible] grains; also massive, [illegible] prismatic, distinct. [illegible] structure parallel to the base, especially when altered. Fracture subconchoidal. Brittle. H.- 7-7.5. Sp.G.- 2.60-2.66. Luster vitreous. Color various shades of blue, light or dark, smoky blue. Transparent to translucent.

Chemical composition. $Mg_2Al_4Si_5O_{18}$. This is the composition of artificial material with the characters of cordierite. The natural mineral contains ferrous iron replacing a part of the magnesium; calcium and hydroxyl are also present.

Occurrence. Taos County: Glenwoody and Picuris districts.

CORUNDUM.

Physical characteristics. Hexagonal-rhombohedral. Polysynthetic twins with lamellar structure sometimes occur. Crystals usually rough and rounded. Also massive, with rectangular parting (pseudo-cleavage); granular, coarse or fine. Fracture uneven to conchoidal. Brittle, but very tough when compact. H.- 9. Sp.G.- 3.95-4.10. Luster adamantine to vitreous, on basal parting plane sometimes pearly. Occasionally shows asterism. Color blue, red, yellow, brown, gray, and nearly white. Streak uncolored. Transparent to translucent.

Chemical composition. Alumina, Al_2O_3. Variations in color perhaps due to minute quantities of ferric, chromic, and structure parallel to the base, especially when altered. Fracture subconchoidal. Brittle. H.= 7-7.5. Sp.G.= 2.60-2.66. Luster vitreous. Color various shades of blue, light or dark, smoky blue. Transparent to translucent.

Chemical composition. $Mg_2Al_4Si_5O_{18}$. This is the composition of artificial material with the characters of cordierite. The natural mineral contains ferrous iron replacing a part of the magnesium; calcium and hydroxyl are also present.

Occurrence. Taos County: Glenwoody and Picuris districts.

Corundum.

Physical characteristics. Hexagonal-rhombohedral. Polysynthetic twins with lamellar structure sometimes developed. Crystals usually rough and rounded. Also massive, with rectangular parting (pseudo-cleavage); granular, coarse or fine. Fracture uneven to conchoidal. Brittle; but very tough when compact. H.= 9. Sp.G.= 3.95-4.10. Luster adamantine to vitreous, on basal parting plane sometimes pearly. Occasionally shows asterism. Color blue, red, yellow, brown, gray, and nearly white. Streak colorless. Transparent to translucent.

Chemical composition. Alumina, Al_2O_3. Variations in color partly due to minute quantities of ferric, chromic, and manganese oxides.

Varieties. 1. Sapphire. A very pure variety, transparent or translucent; color blue. The term sapphire is also used to indicate gem corundum of any color except red.

Occurrence. Taos County: Glenwoody and Picuris districts.

Var. Sapphire. Santa Fe County: in gravels near Santa Fe.

COSALITE.

Physical characteristics. Orthorhombic. Usually massive, with indistinct crystalline structure; fibrous or radiated. Fracture uneven. Brittle. H.- 2.5-3. Sp.G.- 6.39-6.75. Luster metallic. Color lead-gray, steel-gray. Streak black. Opaque.

Chemical composition. $Pb_2Bi_2S_5$, or $2PbS.Bi_2S_3$. Silver and copper may occur, replacing part of the lead.

Occurrence. Dona Ana County: Organ district.

COVELLITE.

Physical characteristics. Hexagonal. Crystals usually thin hexagonal plates. Often massive. Cleavage: basal, manganese oxides.

Varieties. 1. Sapphire. A very pure variety, transparent or translucent; color blue. The term sapphire is also used to indicate gem corundum of any color except red.

Occurrence. Taos County: Glenwoody and Picuris districts.

Var. Sapphire. Santa Fe County: in gravels near Santa Fe.

COSALITE.

Physical characteristics. Orthorhombic. Usually massive, with indistinct crystalline structure; fibrous or radiated. Fracture uneven. Brittle. H.= 2.5-3. Sp.G.= 6.39-6.75. Luster metallic. Color lead-gray, steel-gray. Streak black. Opaque.

Chemical composition. $Pb_2Bi_2S_5$, or $2PbS.Bi_2S_3$. Silver and copper may occur, replacing part of the lead.

Occurrence. Dona Ana County: Organ district.

COVELLITE.

Physical characteristics. Hexagonal. Crystals usually thin hexagonal plates. Often massive. Cleavage: basal.

perfect. Flexible in thin laminae. H.- 1.5-2. Sp.G.- 4.6. Luster submetallic to resinous. Color indigo-blue or darker. Sometimes has a purple tarnish. Often shows fine purple color when moistened with water. Streak lead-gray to black. Opaque. In very thin plates translucent.

Chemical composition. Cupric sulphide, CuS.

Occurrence. Catron County: Mogollon district. Grant County: Burro Mountains and Central districts. Hidalgo County: Lordsburg district. Lincoln County: Estey district. Otero County: Orogrande district. Rio Arriba County: Bromide district. Sandoval County: Nacimiento Mountains district. Sierra County: Chloride and Hermosa districts. Socorro County: Hansonburg, Joyita Hills, Ladrones Mountains, Magdalena, Mill Canyon, North Magdalena, San Andres Mountains (Goodfortune Creek), Scholle, and Water Canyon districts.

CUBANITE. Chalmersite.

Physical characteristics. Isometric. In thin prisms, vertically striated. Twins common. Also massive. Cleavage: cubic, distinct. H.- 3.5-4. Sp.G.- 4.7. Color brass- to bronze-yellow. Streak dark reddish bronze, black. Strongly magnetic.

Chemical composition. $Cu_2S.Fe_4S_5$.

perfect. Flexible in thin laminae. [illegible]
luster submetallic to resinous. [illegible]
Sometimes has a purple tarnish. [illegible]
color when moistened with acid. [illegible]
Opaque. In very thin plates translucent.

Chemical composition. Cupric sulphide, CuS.

Occurrence. Catron County: [illegible]
Burro Mountains and Central districts. [illegible]
Lordsburg district. Lincoln County: [illegible]
County: Orogrande district. [illegible]
trict. Sandoval County: [illegible]
Sierra County: Chloride and [illegible] districts. [illegible]
County: Hanover, Joyita [illegible]
Magdalena, Hill Canyon, North [illegible]
(Goodfortune Creek), Kelly, [illegible]

[illegible]. Chalcocite.

Physical characteristics. [illegible]
vertically striated. [illegible]
metallic; distinct. H. = [illegible]
brownish-yellow. [illegible]
magnetite.

Chemical composition. [illegible]

Occurrence. Grant County: Fierro-Hanover district.

CUPRITE. Red Copper Ore.

Physical characteristics. Isometric. Commonly in octahedrons; also in cubes and dodecahedrons, often highly modified. At times in capillary crystals. Also massive, granular; sometimes earthy. Cleavage: octahedral, interrupted. Fracture conchoidal, uneven. Brittle. H.- 3.5-4. Sp.G.- 5.85-6.15. Luster adamantine or submetallic to earthy. Color red, of various shades, particularly cochineal-red, sometimes almost black; occasionally crimson-red by transmitted light. Streak several shades of brownish red, shining. Subtransparent to subtranslucent.

Chemical composition. Cuprous oxide, Cu_2O.

Varieties. 1. Chalcotrichite. Plush Copper Ore. In capillary or acicular crystallizations, which may be elongated cubes.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains, Fierro-Hanover, and Santa Rita districts. Hidalgo County: Lordsburg district. Lincoln County: Jicarilla district. Rio Arriba County: Bromide and Hopewell districts. Sandoval

Occurrence. Grant County: Pierro-Hanover district.

CUPRITE. Red Copper Ore.

Physical characteristics. Isometric. Commonly in octahedrons; also in cubes and dodecahedrons, often highly modified. At times in capillary crystals. Also massive, granular; sometimes earthy. Cleavage: octahedral, interrupted. Fracture conchoidal, uneven. Brittle. H.= 3.5-4. Sp.G.= 5.85-6.15. Luster adamantine or submetallic to earthy. Color red, of various shades, particularly cochineal-red, sometimes almost black; occasionally crimson-red by transmitted light. Streak several shades of brownish red, shining. Subtransparent to subtranslucent.

Chemical composition. Cuprous oxide, Cu_2O.

Varieties. 1. Chalcotrichite. Plush Copper Ore. In capillary or acicular crystallizations, which may be elongated cubes.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains, Pierro-Hanover, and Santa Rita districts. Hidalgo County: Lordsburg district. Lincoln County: Jicarilla district. Rio Arriba County: Granite and Hopewell districts. Sandoval

County: Cochiti district. San Miguel County: Rociada district. Sierra County: Caballos Mountains, Cuchillo Negro, Hillsboro, and Kingston districts. Socorro County: Ladrones Mountains, Magdalena, Mill Canyon, San Andres Mountains (Mockingbird Gap), San Lorenzo, and Water Canyon districts. Taos County: Picuris district.

Var. Chalcotrichite. Grant County: Santa Rita district. Sierra County: Hillsboro district.

CUPROPLUMBITE.

A doubtful mineral, massive in structure, varying in characters from those of galena to those of chalcocite and covellite.

Chemical composition. Formula uncertain, $Cu_2S.2PbS$. May be an alteration product and not a homogeneous mineral.

Occurrence. Sierra County: Chloride district.

CUPROTUNGSTITE.

Physical characteristics. Cryptocrystalline. Crystalline-granular, fibrous; also in crusts. One distinct cleavage. H.- 4.5-5. Luster highly vitreous. Color pistachio-green, passing into olive- and leek-green. Streak light greenish

County: Cochiti district. San Miguel County: [illegible] district. Sierra County: Caballos Mountains, Cuchillo, [illegible], Hillsboro, and Kingston districts. Socorro County: Ladrones Mountains, Magdalena, Hill Canyon, San Andres Mountains ([illegible] Gap), San Lorenzo, and Water Canyon districts. Taos County: Picuris district.

Var. Chalmersite. Grant County: Santa Rita district. Sierra County: Hillsboro district.

[illegible].

A doubtful mineral, massive in structure, varying in characters from those of galena to those of [illegible] [illegible].

Chemical composition. Formula uncertain, [illegible]. May be an alteration product and not a homogeneous mineral.

Occurrence. Sierra County: Chloride district.

[illegible].

Physical characteristics. Cryptocrystalline. [illegible] granular, fibrous; also in crusts. [illegible] fracture [illegible]. H.= 2.5-3. Luster highly vitreous. Color [illegible], passing into olive and dark-green. [illegible] gray to greenish yellow.

Chemical composition. Cupric tungstate, $CuWO_4$, sometimes containing calcium (cuproscheelite).

Occurrence. Rio Arriba County: Rinconada district. Socorro County: San Andres Mountains district (?).

DATOLITE.

Physical characteristics. Monoclinic. Crystals varied in habit; usually short prismatic; sometimes tabular; also of other types, and often highly modified. Also botryoidal and globular, with columnar structure; divergent and radiating; sometimes massive, granular to compact and cryptocrystalline. Cleavage not observed. Fracture conchoidal to uneven. Brittle. H.- 5-5.5. Sp.G.- 2.9-3.0. Luster vitreous, rarely subresinous on a fracture surface. Color white; sometimes grayish, pale green, yellow, red, or amethystine, rarely dirty olive-green or honey-yellow. Streak white. Transparent to translucent; rarely opaque white.

Chemical composition. A basic orthosilicate of boron and calcium, empirically $HCaBSiO_5$, or $H_2O.2CaO.B_2O_3.2SiO_2$, or $Ca(BOH)SiO_4$.

Occurrence. Catron or Grant County: "head of the Gila River".

gray to greenish yellow.

Chemical composition. [illegible]
containing calcium [illegible].

Occurrence. Nile [illegible]
County: San Andreas [illegible]

[illegible]

Physical characteristics. [illegible]
habit; usually short, [illegible]
other types, and often highly [illegible]
globular, with radiating [illegible]
sometimes massive, [illegible]
Cleavage not observed. [illegible]
Brittle. H.= [illegible]
rarely subtranslucent [illegible]
sometimes grayish, pale green, [illegible]
rarely dirty olive-green or [illegible]
Transparent to translucent. [illegible]

Chemical composition. [illegible]
calcium, cupric [illegible]
antimonate.

[illegible]

DESCLOIZITE.

Physical characteristics. Orthorhombic. Crystals usually small, short prismatic or pyramidal. Faces seldom perfectly smooth, often striated. Crystals form drusy surfaces and crusts, also in stalactitic aggregates. Also massive, fibrous radiated with mammillary surface. Cleavage none. Fracture small conchoidal to uneven. Brittle. H.- 3.5. Sp.G.- 5.9-6.2. Luster greasy. Color columbine- or cherry-red, brownish red, hair-brown, reddish chestnut-brown, blackish brown, black. Streak orange to brownish red or yellowish. Transparent to nearly opaque.

Chemical composition. $R_3V_2O_8.R(OH)_2$, or $4RO.V_2O_5.H_2O$, where R = lead and zinc chiefly and usually approximately in the ratio of 1:1. Copper is also sometimes present; and also arsenic, replacing vanadium.

Varieties. 1. Cuprodescloizite. A variety in which zinc is replaced partly by copper, the ratio Zn:Cu being 1:1 approximately. Mottramite and psittacinite are terms sometimes used for this variety. Color brown, dark brown, and black.

Occurrence. Grant County: Georgetown district. Sierra County: Caballos Mountains, Hillsboro, and Lake Valley districts. Socorro County: North Magdalena and Socorro Peak districts.

Var. Cuprodescloizite. Grant County: Central district.

DESCLOIZITE

Physical characteristics. Orthorhombic. Crystals usually small, short prismatic or pyramidal. Faces seldom perfectly smooth, often striated. Crystals form drusy surfaces and groups, also in stalactitic aggregates. Also massive, fibrous radiated with mammillary surface. Cleavage none. Fracture small conchoidal to uneven. Brittle. H.= 3.5. Sp.G.= 5.9-6.2. Luster greasy. Color columbine- or cherry-red, brownish red, hair-brown, reddish chestnut-brown, blackish brown, black. Streak orange to brownish red or yellowish. Transparent to nearly opaque.

Chemical composition. $R_4V_2O_8(OH)_2$, or $4RO.V_2O_5.H_2O$, where R = lead and zinc chiefly and usually approximately in the ratio of 1:1. Copper is also sometimes present; and also arsenic, replacing vanadium.

Varieties. 1. Cuprodescloizite. A variety in which zinc is replaced partly by copper, the ratio Zn:Cu being 1:1 approximately. Psittacinite and mottramite are terms sometimes used for this variety. Color brown, dark green, and olive.

Occurrence. Grant County: Georgetown district. Sierra County: Kingston, Hillsboro, and Lake Valley districts. Socorro County: North Magdalena and Socorro Peak districts.

Var. Cuprodescloizite. Grant County: Central district.

Otero County: Sacramento district. Sierra County: Caballos Mountains, Hillsboro, and Lake Valley districts. Socorro County: Hansonburg district.

DIAMOND.

Physical characteristics. Isometric. Commonly in octahedrons and hexoctahedrons; faces frequently rounded or striated and with triangular depressions on the octahedral face. Twins common. Crystals often distorted. In spherical forms; massive. Cleavage: octahedral, highly perfect. Fracture conchoidal. Brittle. H.- 10. Sp.G.- 3.516-3.525 in crystals. Luster adamantine to greasy. Color white or colorless, occasionally various pale shades of yellow, red, orange, green, blue, brown; rarely deeply colored; sometimes black. Usually transparent; also translucent and opaque.

Chemical composition. Pure carbon, C, except in the variety carbonado which yields a slight ash on combustion.

Occurrence. Santa Fe County: "in gravel beds".

DIOPSIDE. Malacolite. Alalite. Calcium-magnesium Pyroxene.

Physical characteristics. Monoclinic. Twins both as contact- and penetration-twins. Crystals prismatic, short and

stout, square or eight-sided; also often slender. Also granular, and columnar to lamellar massive. Cleavage: two directions, nearly at right angles, almost perfect, but interrupted. Basal parting sometimes observed. Fracture uneven to conchoidal. Brittle. H.- 5-6. Sp.G.- 3.2-3.38. Luster vitreous to resinous; often dull; sometimes pearly on planes of parting. Color white, yellowish, grayish white to pale green, dark green and nearly black. May be transparent and colorless. Streak white to pale grayish green. Transparent to opaque.

Chemical composition. $CaMg(SiO_3)_2$. Iron is present in small amount, and it thus grades toward hedenbergite.

Varieties. 1. Chrome-diopside. Chrome-pyroxene. Contains chromium (1%-2.8% Cr_2O_3), often a bright green in color. 2. Malacolite. A pale-colored translucent variety.

Occurrence. Colfax County: Elizabethtown district. Dona Ana County: Organ district. Grant County: Fierro-Hanover district. Hidalgo County: Hachita and San Simon districts. Luna County: Tres Hermanas district. Otero County: Orogrande district. Santa Fe County: New Placers district. Socorro County: Magdalena district.

Var. Chrome-diopside. McKinley-San Juan Counties: Navajo Reservation.

Var. Malacolite. Grant County: on Gila River, 40 miles which, square or eight-sided; also often slender. Also granular, and columnar to lamellar massive. Cleavage: two directions, nearly at right angles, almost perfect, but interrupted. Basal parting sometimes observed. Fracture uneven to conchoidal. Brittle. H.= 5-6. Sp.G.= 3.2-3.38. Luster vitreous to resinous; often dull; sometimes pearly on planes of parting. Color white, yellowish, grayish white to pale green, dark green and nearly black. May be transparent and colorless. Streak white to pale grayish green. Transparent to opaque.

Chemical composition. $CaMg(SiO_3)_2$. Iron is present in small amount, and it thus grades toward hedenbergite.

Varieties. 1. Chrome-diopside. Chrome-pyroxene. Contains chromium (1.5-3.8% Cr_2O_3), often a bright green in color. 2. Malacolite. A pale-colored translucent variety.

Occurrence. Catron County: [illegible] district. Dona Ana County: Organ district. Grant County: Fierro-Hanover district. Hidalgo County: [illegible] and San Simon districts. Luna County: Tres Hermanas district. Otero County: Orogrande district. Santa Fe County: New Placers district. Socorro County: Magdalena district.

Var. [illegible]. [illegible]

Var. [illegible]. Grant County: [illegible] west of Silver City.

DIOPTASE. Emeraudine.

Physical characteristics. Hexagonal-rhombohedral. Commonly in prismatic crystals. Also in crystalline aggregates; massive. Cleavage: rhombohedral, perfect. Fracture conchoidal to uneven. Brittle. H.- 5. Sp.G.- 3.28-3.35. Luster vitreous. Color emerald-green. Streak green. Transparent to subtranslucent.

Chemical composition. Hydrous copper silicate, H_2CuSiO_4, or $H_2O.CuO.SiO_2$.

Occurrence. Grant County: Santa Rita district. Otero County: Orogrande district.

DOLOMITE. Pearl Spar.

Physical characteristics. Hexagonal-rhombohedral. Habit rhombohedral. Rhombohedral faces commonly curved or made up of sub-individuals, and thus passing into saddle-shaped forms. Twins common, sometimes polysynthetic. Also granular, coarse or fine, resembling ordinary marble. Cleavage: rhombohedral, perfect. Fracture subconchoidal. Brittle. H.- 3.5-4. Sp.G.- 2.8-2.9. Luster vitreous, inclining to east of Silver City.

DIOPTASE. Emerald Copper.

Crystal Characteristics. Hexagonal-rhombohedral. Commonly in prismatic crystals. Also in crystalline aggregates; massive. Cleavage: rhombohedral, perfect. Fracture conchoidal to uneven. Brittle. H = 5. Sp.G. = 3.28-3.35. Luster vitreous. Color emerald-green. Streak green. Transparent to subtranslucent.

Chemical Composition. Hydrous copper silicate, H_2CuSiO_4, or $H_2O.CuO.SiO_2$.

Occurrence. Grant County: Santa Rita district. Otero County: Orogrande district.

DOLOMITE. Pearl Spar.

Crystal Characteristics. Hexagonal-rhombohedral. Usually rhombohedral. Rhombohedral faces commonly curved or made up of sub-individuals, and thus passing into saddle-shaped forms. Twins common, sometimes polysynthetic. Also grains, coarse or fine, resembling ordinary marble. Cleavage: rhombohedral, perfect. Fracture subconchoidal. Brittle. H = 3.5-4. Sp.G. = 2.8-2.9. Luster vitreous, inclining to pearly in some varieties. Color white, reddish, or greenish white; also rose-red, green, brown, gray, and black. Transparent to translucent.

Chemical composition. Calcium and magnesium carbonate; for normal dolomite $CaMg(CO_3)_2$, or $CaCO_3.MgCO_3$. Iron and manganese carbonates may replace the magnesium carbonate; the mineral thus grades into ankerite.

Occurrence. Grant County: Black Hawk, Central, and Pinos Altos districts. Lincoln County: Nogal district. Otero County: Tularosa district. Santa Fe County: Cerrillos district. Sierra County: Kingston district. Socorro County: Hansonburg district.

DOMEYKITE.

Physical characteristics. Cryptocrystalline. Reniform and botryoidal; also massive and disseminated. Fracture uneven. H.- 3-3.5. Sp.G.- 7.2-7.75. Luster metallic, but dull on exposure. Color tin-white to steel-gray, with a yellowish to brownish tinge, tarnishing to a dull iridescent purple.

Chemical composition. Copper arsenide, Cu_3As.

Occurrence. Grant County: Central and Pinos Altos districts.

poorly in some varieties [illegible]

[illegible]

[illegible] translucent.

Chemical composition. [illegible]

Occurrence. [illegible]

[illegible] secondary mineral.

[illegible]

Optical characteristics. [illegible]

[illegible]

Chemical composition. [illegible]

Occurrence. [illegible]

DUFRENITE. Kraurite.

Physical characteristics. Monoclinic (?). Crystals rare, small, and indistinct. Usually massive, in nodules; radiated fibrous with drusy surface. Cleavage: one direction, perfect; another, nearly at right angles, distinct. H.- 3.5-4. Sp.G.- 3.2-3.4. Luster silky, weak. Color dull leek-green, olive-green, or blackish green; alters on exposure to yellow and brown. Streak siskin-green. Subtranslucent to nearly opaque.

Chemical composition. Doubtful, in part $FePO_4.Fe(OH)_3$, or $2Fe_2O_3.P_2O_5.3H_2O$.

Occurrence. Grant County: Steeple Rock district. Sandoval County: Cochiti district.

DUMORTIERITE.

Physical characteristics. Orthorhombic. Rarely in distinct crystals. Usually in fibrous to columnar aggregates. Cleavage: one direction, distinct. H.- 7. Sp.G.- 3.26-3.36. Luster vitreous. Color bright smalt-blue to greenish blue. Transparent to translucent.

Chemical composition. A basic aluminum borosilicate, perhaps $8Al_2O_3.B_2O_3.6SiO_2.H_2O$.

Occurrence. Luna County: Tres Hermanas district.

DURDENITE.

Physical characteristics. Orthorhombic. In small mammillary forms. H.- 2-2.5. Luster vitreous, dull. Color greenish yellow. Translucent to nearly opaque. Friable.

Chemical composition. Hydrous ferric tellurite, $Fe_2(TeO_3)_3.4H_2O$.

Occurrence. Hidalgo County: Hachita district.

EMBOLITE.

Physical characteristics. Isometric. Rarely in cubes, octahedrons, dodecahedrons, and pyritohedrons. Usually massive, sometimes stalactitic or concretionary on surface. Cleavage none. Fracture uneven. Sectile. H.- 1-1.5. Sp.G.- 5.31-5.43. Luster resinous, somewhat adamantine. Color grayish to yellowish green; yellow, often dark and becoming darker on exposure. Transparent to translucent.

Chemical composition. Chloride and bromide of silver, Ag(Cl,Br). The ratio of Cl to Br varies indefinitely, the yellow and deeper green varieties containing the largest proportion of bromine.

<u>Occurrence</u>. Luna County: Tres Hermanas district.

<u>EMMONSITE</u>.

<u>Physical characteristics</u>. Orthorhombic. In small capil-lary forms. H.= 2-2.5. Luster vitreous, dull. Color greenish yellow. Translucent to nearly opaque. Friable.

<u>Chemical composition</u>. Hydrous ferric tellurite, $Fe_2(TeO_3)_3 \cdot 4H_2O$.

<u>Occurrence</u>. Hidalgo County: Tacoma district.

<u>EMBOLITE</u>.

<u>Physical characteristics</u>. Isometric. Rarely in cubes, octahedrons, dodecahedrons, and pyritohedrons. Usually massive, sometimes stalactitic or concretionary to waxlike. Cleavage none. Fracture uneven. Sectile. H.= 1-1.5. Sp.G.= 5.31-5.43. Luster resinous, somewhat adamantine. Color grayish to yellowish green; yellow. Also dark and becoming darker on exposure. Transparent to translucent.

<u>Chemical composition</u>. Chloride and bromide of silver, Ag(Cl,Br). The ratio of Cl to Br varies considerably. The yellow and deeper green varieties contain more copper and a higher proportion of bromine.

Occurrence. Grant County: Chloride Flat district (old reference to "Silver City"); Georgetown district. Sierra County: Hermosa and Lake Valley districts. Socorro County: Socorro Peak district.

ENARGITE.

Physical characteristics. Orthorhombic. Crystals usually small, prismatic faces vertically striated. Twins as star-shaped trillings. Also massive, granular, or columnar. Cleavage: one direction, perfect; two others, distinct. Fracture uneven. Brittle. H.- 3. Sp.G.- 4.43-4.45. Luster metallic. Color grayish black to iron-black. Streak grayish black. Opaque.

Chemical composition. Copper and arsenic sulphide, $3Cu_2S.As_2S_5$. The formula has also been written $Cu_2S.4CuS.As_2S_3$. Antimony is often present, and enargite grades into the isomorphous mineral famatinite.

Occurrence. Grant County: Central and Pinos Altos districts. Socorro County: Hansonburg district.

EPIDOTE. Pistacite.

Physical characteristics. Monoclinic. Twins common.

Occurrence: Grant County: [illegible] reference to "Silver City" [illegible] County: Hermosa and Lake Valley [illegible] Socorro Peak district.

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PEARCEITE.

Physical characteristics. [illegible] small, prismatic [illegible] shaped trillings. [illegible] Cleavage: one direction, [illegible] Fracture uneven. Brittle. [illegible] Luster metallic. [illegible] grayish black. Opaque.

Chemical composition. [illegible] $9Ag_2S.As_2S_3$. The [illegible] $9Cu_2S.As_2S_3$. [illegible] grades into the [illegible]

Occurrence. Grant County: [illegible] Bribra. Socorro County: [illegible]

[illegible]

Physical characteristics. [illegible]

Crystals usually prismatic, passing into acicular forms. Also fibrous, divergent or parallel; granular, particles of various sizes, sometimes fine granular, and forming rock-masses. Cleavage: one direction, perfect. Fracture uneven. Brittle. H.- 6-7. Sp.G.- 3.25-3.5. Luster vitreous, on the perfect cleavage surface pearly or resinous. Color pistachio-green or yellowish green to brownish green, greenish black, and black; sometimes clear red or yellow; also gray and grayish white; rarely colorless. Streak uncolored, grayish. Transparent to opaque; generally subtranslucent.

Chemical composition. $HCa_2(Al,Fe)_3Si_3O_{13}$, or $H_2O.4CaO.3(Al,Fe)_2O_3.6SiO_2$.

Varieties. 1. Bucklandite. Black, with a tinge of green. Occurs in small crystals, nearly symmetrical instead of elongated.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Modoc and Organ districts. Grant County: Burro Mountains, Fierro-Hanover, and Santa Rita districts. Hidalgo County: Apache No. 2, Hachita, San Simon, and Steins Pass districts. Otero County: Orogrande district. Rio Arriba County: Bromide district. San Miguel County: Rociada and Willow Creek districts. Santa Fe County: New Placers district. Sierra

County: Chloride and Macho districts. Socorro County: Lemitar Mountains, Magdalena, and Ojo Caliente districts. Taos County: Red River district.

Var. Bucklandite. Santa Fe County: New Placers district.

EPSOMITE. Epsom Salt.

Physical characteristics. Orthorhombic-sphenoidal. Usually in botryoidal masses and fibrous crusts. Cleavage: one direction, very perfect; another, distinct. Fracture conchoidal. H.- 2.0-2.5. Sp.G.- 1.751. Luster vitreous to earthy. Color and streak white. Transparent to translucent. Taste bitter and saline.

Chemical composition. Hydrous magnesium sulphate, $MgSO_4 \cdot 7H_2O$.

Occurrence. Eddy County: Carlsbad Potash district. Torrance County: Estancia Salt district.

ERYTHRITE. Cobalt Bloom.

Physical characteristics. Monoclinic. Crystals prismatic and vertically striated. Also in globular and reniform shapes, having a drusy surface and columnar structure;

County; Chloride and Hoche [illegible]
Lassen Mountains, [illegible]
Taos County; Red River [illegible]

Var. [illegible]. [illegible]
[illegible].

EPSOMITE. [illegible]

Physical characteristics. [illegible] in botryoidal masses and fibrous [illegible] direction, very perfect; [illegible] choidal. H.— 2–2.5. [illegible] surity. Color and streak white. [illegible] lucent. Taste bitter and [illegible].

Chemical composition. Hydrous [illegible] $MgSO_4.7H_2O$.

Occurrence. Eddy County; [illegible] Torrance County; Estancia [illegible].

[illegible]. [illegible]

Physical characteristics. [illegible] and vertically striated. [illegible] shapes, having a [illegible] sometimes stellate. Also pulvurulent and earthy, incrusting. Cleavage: one direction, highly perfect. Sectile. H.- 1.5-2.5, least on the cleavage surface. Sp.G.- 2.95. Luster of cleavage surface pearly; other faces adamantine to vitreous; also dull, earthy. Color crimson- and peach-red, sometimes gray. Streak paler than color. Transparent to subtranslucent.

Chemical composition. Hydrous cobalt arsenate, $Co_3As_2O_8.8H_2O$.

Occurrence. Grant County: Black Hawk district.

EUCLASE.

Physical characteristics. Monoclinic. Only in crystals; habit prismatic with certain faces vertically striated. Cleavage: one direction, highly perfect. Fracture conchoidal. Brittle. H.- 7.5. Sp.G.- 3.05-3.10. Luster vitreous, sometimes pearly on the cleavage surface. Colorless, pale green, passing into blue and white. Streak uncolored. Transparent; occasionally subtransparent.

Chemical composition. $HBeAlSiO_5$, or $Be(AlOH)SiO_4$.

Occurrence. Taos County: "in vicinity of Taos".

sometimes stellate. Also pulverulent and earthy, incrust-
ing. Cleavage: one direction, highly perfect. Sectile.
H.= 1.5-2.5, least on the cleavage surface. Sp.G.= 2.95.
Luster of cleavage surface pearly; other faces adamantine
to vitreous; also dull, earthy. Color crimson- and peach-
red, sometimes gray. Streak paler than color. Transparent
to subtranslucent.

Chemical composition. Hydrous cobalt arsenate,
$Co_3As_2O_8.8H_2O$.

Occurrence. Grant County: Black Hawk district.

EUCLASE

Crystal characteristics. Monoclinic. Only in crystals;
both prismatic with certain faces vertically striated.
Cleavage: one direction, highly perfect. Fracture con-
choidal; brittle. H.= 7.5. Sp.G.= 3.05-3.10. Luster
vitreous, sometimes pearly on the cleavage surface. Color-
less, pale green, passing into blue and white. Streak un-
colored. Transparent; occasionally subtransparent.

Chemical composition. $HBeAlSiO_5$, or $Be(AlOH)SiO_4$.

Occurrence. [illegible] County: "In vicinity of [illegible]."

FELDSPAR.

Common name for a group of related species, of which the general characters are:

1. Crystallization in the monoclinic or triclinic systems, the crystals of the different species resembling each other closely in angle, in general habit, and in methods of twinning. The prismatic angle in all cases is within a few degrees of 60° and 120°.

2. Cleavage in two similar directions at angles of 90° or nearly 90°.

3. Hardness between 6 and 6.5.

4. Specific gravity varying between 2.5 and 2.9, and mostly between 2.55 and 2.75.

5. Color white or pale shades of yellow, red, or green, less commonly dark.

6. Chemically, silicates of aluminum with either potassium, sodium, or calcium, and rarely barium, while magnesium and iron are always absent.

Besides the several distinct species, there are many intermediate compounds having a certain independence of character and yet connected with each other by insensible gradations, all the members of the series showing a close relationship in composition, crystalline form, and optical

FELDSPAR.

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2. Cleavage in two similar directions at angles of 90° or nearly 90°.

3. Hardness between 6 and 6.5.

4. Specific gravity varying between 2.5 and 2.8, and mostly between 2.55 and 2.75.

5. Color white or pale shades of yellow, red, or green, not commonly dark.

6. Chemically, silicates of aluminum with either potassium, sodium, or calcium, and rarely barium, while magnesium and iron are always absent.

Besides the several distinct species, there are many intermediate compounds having a more or less variable character and yet connected with each other by insensible gradations; all the members of the series showing a close relationship in composition, in crystal form, and in optical characters.

The species of the group are classified, first as to form, and second with reference to composition.

The monoclinic species found in New Mexico include orthoclase, potassium feldspar.

The triclinic species include microcline, also a potash feldspar; and, in the albite-anorthite series of Plagioclase Feldspars, albite, andesine, oligoclase, labradorite, bytownite, and anorthite.

With the exception of perhaps orthoclase, microcline, and albite, the species have been identified only in microscopic sections.

The species are described separately in the text. Members of the albite-anorthite series are described under the heading PLAGIOCLASE FELDSPARS, and also separately.

Occurrence. The following occurrences are of feldspar identified only as such, the species not being given: Colfax County: Baldy and Elizabethtown districts. Grant County: Fierro-Hanover district. Rio Arriba County: Petaca district. San Miguel County: El Porvenir district. Santa Fe County: Cerrillos and Old Placers districts. Sierra County: Hillsboro district. Socorro County: Iron Mountain No. 2 district. Taos County: Harding Mine district.

characters.

The species of the group are classified, first, as to form, and second with reference to composition.

The monoclinic species found in New Mexico include orthoclase, potassium feldspar.

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With the exception of perhaps orthoclase, microcline, and albite, the species have been identified only in thin sample sections.

The species are described separately in the text. Members of the albite-anorthite series are described under the heading PLAGIOCLASE FELDSPARS, and also individually.

Occurrence. The following occurrences are of feldspar identified only in mass, the species not being [illegible]. Colfax County: Baldy and Elizabethtown districts. Grant County: Pinos Altos-Hanover districts. Rio Arriba County: Petaca district. San Miguel County: El Porvenir district. Santa Fe County: Cerrillos and Old Placers districts. Sierra County: Hillsboro district. Socorro County: [illegible] Mountain No. 2 district. Taos County: Red River [illegible] district.

Valencia County: near Grant.

FERRIMOLYBDITE. Molybdite.

Physical characteristics. Orthorhombic. In crystal fibers, also earthy, pulvurulent. One distinct cleavage. H.- 1.5. Sp.G.- 4.5. Color sulphur-yellow.

Chemical composition. $Fe_2O_3.3MoO_3.8H_2O$. The material long known as molybdite, and supposed to be molybdic oxide, MoO_3, has been shown to be rather a hydrous ferric molybdate. The existence of molybdic oxide as a mineral has not been established.

Varieties. 1. Molybdic Ocher. The earthy variety, occurring as a powder or as an incrustation.

Occurrence. The ordinary mineral ferrimolybdite is not reported from New Mexico.

Var. Molybdic Ocher. San Miguel County: El Porvenir district. Socorro County: San Andres Mountains district (Grandview Canyon). Taos County: Red River district.

FLUORITE. Fluor Spar.

Physical characteristics. Isometric. Habit cubic, less

Valencia County: near Grant.

FERRIMOLYBDITE. Molybdite.

Physical characteristics. Orthorhombic. In crystal fibers, also earthy, pulverulent. One distinct cleavage. H.= 1.5. Sp.G.= 4.5. Color sulphur-yellow.

Chemical composition. $Fe_2O_3.3MoO_3.8H_2O$. The material long known as molybdite, and supposed to be molybdic oxide, MoO_3, has been shown to be rather a hydrous ferric molybdate. The existence of molybdic oxide as a mineral has not been established.

Varieties. 1. Molybdic Ocher. The earthy variety, occurring as a powder or as an incrustation.

Occurrence. The ordinary mineral ferrimolybdite is not reported from New Mexico.

Var. Molybdic Ocher. San Miguel County: El Porvenir district. Socorro County: San Andres Mountains district (Brandston Canyon). Taos County: Red River district.

ALUNITE. Alum Stone.

Physical characteristics. Rhombohedral. Small cubic, rare often octahedral or dodecahedral. Cubic crystals sometimes grouped in parallel to form a pseudo-octahedron, the faces of which may have a drusy character. Penetration-twins rather common. Also massive; granular, coarse or fine; rarely columnar; compact. Cleavage: octahedral, perfect. Fracture flat conchoidal, splintery in compact types. Brittle. H.- 4. Sp.G.- 3.01-3.25, 3.18 in crystals. Luster vitreous. Color white, yellow, green, rose- and crimson-red, violet-blue; sky-blue, and brown; wine-yellow, greenish blue, most common; red, rare. Color often varies in different parts of the same specimen, banded parallel to the cubic planes. Streak white. Transparent to subtranslucent. Phosphorescent in some varieties when heated, in others when scratched with a knife blade. Most varieties fluorescent when affected by X-rays.

Chemical composition. Calcium fluoride, CaF_2.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district; near Glenwood-Big Spar prospect. Dona Ana County: Bishop's Cap Fluorspar, Organ, Tonuco Mountains Fluorspar, and Tortugas Fluorspar districts. Grant County: Burro Mountains, Pinos Altos, and Telegraph districts; also Blue Bird Mine, Cooks Range (north end), Cottonwood Canyon, Seventy-four Prospect, Tellurium locality (41 miles northwest of Silver City). Hidalgo County: Apache No. 2 district. Lincoln County:

often octahedral or dodecahedral. Cubes [illegible] grouped in parallel to form a pseudo-octahedron, faces of which may have a drusy character. Penetration twins rather common. Also massive; granular, coarse or fine; rarely columnar; compact. Cleavage: octahedral, perfect. Fracture flat conchoidal, splintery in compact types. Brittle. H.= 4. Sp.G. = 3.01-3.25, 3.18 in crystals. Luster vitreous. Color white, yellow, green, rose-red, crimson-red, violet-blue, sky-blue, and brown; wine-yellow, greenish blue, most common; red, rare. Colors often varies in different parts of the same specimen, banded parallel to the cubic planes. Streak white. Transparent to subtranslucent. Phosphorescent in some varieties when heated, others when scratched with a knife blade. Some strongly fluorescent when affected by X-rays.

Chemical composition. Calcium fluoride, CaF_2.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Magdalena district; near [illegible] prospect. Dona Ana County: Bishop's Cap fluorspar, Organ Mountains fluorspar, and Tortugas fluorspar districts. Grant County: Burro Mountains, [illegible] and Telegraph districts; along Gila River, [illegible] (north end), Cottonwood Canyon, [illegible] Tellurium locality (12 miles [illegible]). Hidalgo County: Animas Mt. [illegible]

White Oaks district. Luna County: Cooks Peak, Cooks Range Manganese, Fluorite Ridge, and Little Florida Mountains districts. Rio Arriba County: Bromide and Petaca (La Madera and Ojo Caliente) districts. Sandoval County: Placitas district. San Miguel County: El Porvenir and Willow Creek districts. Sierra County: Caballos Mountains, Cuchillo Negro, Hillsboro, and Lake Valley districts. Socorro County: Chupadero, Council Rock, Hansonburg, Jones Camp, Joyita Hills, Ladrones Mountains, Lemitar Mountains, Magdalena, North Magdalena, San Andres Mountains (Grandview Canyon, Lava Gap, Mockingbird Gap, Salinas Peak), San Jose, and Socorro Peak districts. Taos County: Red River district. Valencia County: Zuni Mountains district.

FRANKLINITE.

Physical characteristics. Isometric. Habit octahedral, edges often rounded, and crystals passing into rounded grains. Massive, granular, coarse to fine to compact. Octahedral parting as in magnetite (pseudo-cleavage). Fracture conchoidal to uneven. Brittle. H.- 5.5-6.5. Sp.G.- 5.07-5.22. Luster metallic, sometimes dull. Color iron-black. Streak reddish brown or black. Opaque, except in very thin sections. Slightly magnetic.

Chemical composition. $(Fe,Zn,Mn)O.(Fe,Mn)_2O_3$, but varying

White Oaks district. Luna County: Cooks Peak, Cooks Range, Mangance, Fluorite Ridge, and Little Florida Mountains districts. Rio Arriba County: Bromide and Petaca (La Madera and Ojo Caliente) districts. Sandoval County: Placitas district. San Miguel County: El Porvenir and Willow Creek districts. Sierra County: Caballos Mountains, Cuchillo Negro, Hillsboro, and Lake Valley districts. Socorro County: Chupadera, Council Rock, Hansonburg, Jones Camp, Joyita Hills, Ladrones Mountains, Lemitar Mountains, Magdalena, North Magdalena, San Andres Mountains (Organillos Canyon, Lava Gap, Mockingbird Gap, Salinas Peak), San Jose, and Socorro Peak districts. Taos County: Red River district. Valencia County: Zuni Mountains district.

FRANKLINITE

Physical characteristics. Isometric. Habit octahedral, edges often rounded, and crystals passing into rounded grains. Massive, granular, coarse to fine to compact. Octahedral parting as in magnetite (zinc-manganese?). Fracture subconchoidal to uneven. Brittle. H.= 5.5-6.5. Sp.G.= 5.07-5.22. Luster metallic, sometimes dull. Color iron-black. Streak reddish brown to black. Opaque, except in very thin sections. Slightly magnetic.

Chemical composition. $(Fe,Zn,Mn)(Fe,Mn)_2O_4$, but varying quite widely in the relative quantities of the different metals present. Conforms to the general formula of the spinel group.

Occurrence. Grant County: Central district.

GADOLINITE.

Physical characteristics. Monoclinic. Crystals rough and coarse; commonly prismatic and terminated by the base; sometimes by the pyramid. Also in masses. Cleavage none. Fracture conchoidal or splintery. Brittle. H.- 6.5-7. Sp.G.- 4.0-4.5. Luster vitreous to greasy. Color black, greenish black, also brown; in thin splinters nearly transparent, and usually grass-green to olive-green. Streak greenish gray.

Chemical composition. $Be_2FeY_2Si_2O_{10}$, or $2BeO.FeO.2Y_2O_3.2SiO_2$; also written $Be_2Fe(YO)_2(SiO_4)_2$.

Occurrence. Rio Arriba County: Petaca district.

GAHNITE. Zinc Spinel.

Physical characteristics. Isometric. Habit octahedral, often with striated faces; also less commonly in dodecahedrons and modified cubes. Twins rather common. No distinct quite widely in the relative quantities of the different metals present. Conforms to the general formula of the garnet group.

Occurrence. Grant County; Central district.

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GADOLINITE.

Physical characteristics. Monoclinic. Crystals rough and coarse; commonly prismatic and terminated by the base, sometimes by the pyramid. Also in masses. Cleavage none. Fracture conchoidal or splintery. Brittle. H.— 6.5-7. Sp.G.— 4.0-4.5. Luster vitreous to greasy. Color black, greenish black, also brown; in thin splinters nearly transparent, and usually grass-green to olive-green. Streak greenish gray.

Chemical composition. $Be_2FeY_2Si_2O_{10}$, or $2BeO.FeO.Y_2O_3.2SiO_2$; also written $Be_2Fe(YO)_2(SiO_4)_2$.

Occurrence. Rio Arriba County, Petaca district.

GAHNITE. Zinc Spinel.

Physical characteristics. Isometric. Crystals octahedral, often with striated faces; also in [illegible] masses, [illegible] in sand and rolled grains. [illegible] cleavage. Fracture conchoidal to uneven. Brittle. H.- 7.5-8. Sp.G.- 4.0-4.6. Luster vitreous, or somewhat greasy. Color dark green, grayish green, deep leek-green, greenish black, bluish black, yellowish, or grayish brown. Streak grayish. Subtransparent to nearly opaque.

Chemical composition. Zinc aluminate, $ZnAl_2O_4$.

Varieties. 1. Automolite. Zinc Gahnite. Nearly pure zinc aluminate, with perhaps a little iron. Sp.G.- 4.1-4.6.

Occurrence. Santa Fe County: Cerrillos district.

Var. Automolite. Santa Fe County: "Santa Fe Mountains" region.

GALENA. Lead Glance.

Physical characteristics. Isometric. Commonly in cubes, or cubo-octahedrons; less often octahedral. Also in skeleton crystals, reticulated, tabular. Twins: contact and penetration, sometimes repeated. Massive cleavable, coarse or fine granular, to impalpable; occasionally fibrous or plumose. Cleavage: cubic, highly perfect. Also an octahedral parting sometimes. Fracture flat subconchoidal or even. H.- 2.5-2.75. Sp.G.- 7.4-7.6. Luster metallic. Color and streak pure lead-gray. Opaque.

cleavage. Fracture conchoidal to uneven. Brittle. H.= 7.5-8. Sp.G.= 4.0-4.6. Luster vitreous, or somewhat greasy. Color dark green, grayish green, deep leek-green, greenish black, bluish black, yellowish, or grayish brown. Streak grayish. Subtransparent to nearly opaque.

Chemical composition. Zinc aluminate, $ZnAl_2O_4$.

Varieties. 1. Automolite. Zinc Gahnite. Nearly pure zinc aluminate, with perhaps a little iron. Sp.G.= 4.3-4.6.

Occurrence. Santa Fe County: Cerrillos district.

Var. Automolite. Santa Fe County: "Santa Fe Mountains" region.

GALENA. Lead Glance.

Physical characteristics. Isometric. Commonly in cubes, or cubo-octahedrons; less often octahedral. Also in skeleton crystals, reticulated, tabular. Twins: contact and penetration, sometimes repeated. Massive cleavable, coarse or fine granular, to impalpable; occasionally fibrous or plumose. Cleavage: cubic, highly perfect. Also an octahedral parting sometimes. Fracture flat subconchoidal or even. H.= 2.5-2.75. Sp.G.= 7.4-7.6. Luster metallic. Color and streak pure lead-gray. Opaque.

Chemical composition. Lead sulphide, PbS. Often contains silver, as sulphide or native; also native gold.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy and Elizabethtown districts. Dona Ana County: Modoc and Organ districts. Grant County: Burro Mountains, Carpenter, Central, Chloride Flat, Fierro-Hanover, Georgetown, Gold Hill, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: Fremont, Hachita, Lordsburg, Pyramid, San Simon, and Steins Pass districts. Lincoln County: Nogal district. Luna County: Cooks Peak, Florida Mountains, Tres Hermanas, and Victorio districts. Otero County: Sacramento district. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti and Placitas districts. San Miguel County: Rociada and Willow Creek districts. Santa Fe County: Cerrillos, New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, and Tierra Blanca districts. Socorro County: Abbey, Chupadero, Council Rock, Hansonburg, Jones Camp, Joyita Hills, Lemitar Mountains, Magdalena, Mill Canyon, North Magdalena, San Andres Mountains (Goodfortune Creek, Mockingbird Gap, Salinas Peak), Socorro Peak, and Water Canyon districts. Taos County: Red River and Twining districts. Valencia County: Zuni Mountains district.

Chemical composition. Lead [illegible], [illegible] often contains silver, as [illegible]; [illegible].

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: [illegible] Elizabethtown districts. [illegible] and Organ districts. Grant County: [illegible], Central, Chloride Flat, Fierro-Hanover, [illegible], Gold Hill, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: [illegible], Lordsburg, Pyramid, San Simon, and Steins Pass districts. Lincoln County: Nogal district. Luna County: [illegible] Peak, Florida Mountains, Tres Hermanas, and Victorio districts. Otero County: Sacramento district. Rio Arriba County: [illegible] and [illegible] districts. Sandoval County: Cochiti and Placitas districts. San Miguel County: [illegible] and Willow Creek districts. Santa Fe County: Cerrillos, New Placers, Old Placers, and [illegible] districts. Sierra County: Caballo, [illegible], Chloride, Cuchillo, [illegible], Hermosa, Hillsboro, Kingston, Lake Valley, [illegible], and Tierra Blanca districts. Socorro County: [illegible] Rock, Hansonburg, [illegible], Ladron, Magdalena, [illegible] Mountains (Chupadera [illegible]) [illegible] Peak), [illegible] Peak, and [illegible] districts. Taos County: Red River and Twining districts. Valencia County: Zuni Mountains district.

GARNET.

Physical characteristics. Isometric. The dodecahedron and trapezohedron are the common simple forms; also these in combination, or with the hexoctahedron. Cubic and octahedral faces rare. Often in irregular imbedded grains. Also massive; granular, coarse or fine, and sometimes friable; lamellar. Sometimes compact, cryptocrystalline. Cleavage none. Parting: dodecahedral, sometimes distinct. Fracture subconchoidal to uneven. Brittle, sometimes friable when granular massive; very tough when compact cryptocrystalline. H.- 6.5-7.5. Sp.G.- 3.15-4.3, varying with the composition. Luster vitreous to resinous. Color red, brown, yellow, white, apple-green, black; red and green often bright. Streak white. Transparent to subtranslucent.

Chemical composition. An orthosilicate with the general formula $R^{II}_3R^{III}_2(SiO_4)_3$, or $3RO.R_2O_3.3SiO_2$. The bivalent element may be calcium, magnesium, ferrous iron, or manganese; the trivalent element may be aluminum, ferric iron or chromium, rarely titanium. Titanium may replace silicon. Index of refraction and specific gravity vary directly with composition.

Varieties.

A. Almandite. Almandine. Precious garnet in part. Common garnet in part. Iron-aluminum Garnet. Formula

GARNET.

Physical characteristics. Isometric. The dodecahedron and trapezohedron are the common simple forms; also shown in combination, or with the hexoctahedron. [illegible] hedral faces [illegible]. Often in irregular rounded grains. Also massive; granular, coarse or fine, and sometimes friable; lamellar. Compact massive, cryptocrystalline. Cleavage none. Parting: dodecahedral, sometimes distinct. Fracture subconchoidal to uneven. Brittle, sometimes friable when granular massive; very tough when compact cryptocrystalline. H = 6.5-7.5. Sp. G. = 3.15-4.3, varying with the composition. Luster vitreous to resinous. Color red, brown, yellow, white, apple-green, black; [illegible] green often bright. Streak white. Transparent to subtranslucent.

Chemical composition. An orthosilicate with the general formula $R''_3R'''_2(SiO_4)_3$, or $3R''O.R'''_2O_3.3SiO_2$. The bivalent element may be calcium, magnesium, ferrous iron, or manganese; the trivalent element may be aluminum, ferric iron or chromium, rarely titanium. Titanium may replace silicon. [illegible] rarely with [illegible].

Varieties.

[illegible]. [illegible]. [illegible]

[illegible]

$3FeO.Al_2O_3.3SiO_2$. Ferric iron may replace part of the aluminum. Magnesium may replace the ferrous iron, and thus it grades toward pyrope. Sp.G.- 4.25. Color fine deep red, transparent, in precious garnet; brownish red, translucent or subtranslucent, in common garnet; black. Part of common garnet belongs to andradite.

B. Andradite. Common Garnet. Black Garnet. Calcium-iron Garnet. Formula $3CaO.Fe_2O_3.3SiO_2$. Aluminum may replace the ferric iron; ferrous iron, manganese, and sometimes magnesium, may replace the calcium. Sp.G.- 3.75. Colors various: wine-, topaz-, and greenish yellow, apple-green to emerald-green; brownish red, brownish yellow, grayish green, dark green; brown, grayish black, glack.

C. Grossularite. Essonite or Hessonite. Cinnamon-stone. Calcium-aluminum Garnet. Formula $3CaO.Al_2O_3.3SiO_2$. Ferrous iron may replace the calcium, and ferric iron the aluminum, thus grading toward almandite and andradite. Sp.G.- 3.53. Colorless to white; pale green; amber- and honey-yellow; wine-yellow, brownish yellow, cinnamon-brown; rose-red; rarely emerald-green from the presence of chromium.

D. Pyrope. Precious garnet in part. Magnesium-aluminum Garnet. Formula $3MgO.Al_2O_3.3SiO_2$. Calcium and iron may be present, and also chromium. Sp.G.- 3.51. Color deep red to nearly black. Often perfectly transparent

$3FeO.Al_2O_3.3SiO_2$. Ferric iron may replace part of the aluminum. Magnesium may replace the ferrous iron, and then it grades toward pyrope. Sp.G.= 4.25. Color fine deep red, transparent, in precious garnet; brownish red, translucent or subtranslucent, in common garnet; black. Part of common garnet belongs to andradite.

5. Andradite. Common Garnet. Black Garnet. Calcium-iron Garnet. Formula $3CaO.Fe_2O_3.3SiO_2$. Aluminum may replace the ferric iron; ferrous iron, manganese, and sometimes magnesium, may replace the calcium. Sp.G.= 3.75. Colors various: wine-, topaz-, and greenish yellow, apple-green to emerald-green; brownish red, brownish yellow, grayish green, dark green; brown, grayish black; black.

6. Grossularite. Essonite or Hessonite. Cinnamon-stone. Calcium-aluminum Garnet. Formula $3CaO.Al_2O_3.3SiO_2$. Ferrous iron may replace the calcium, and ferric iron the aluminum, thus grading toward almandite and andradite. Sp.G.= 3.55. Colorless to white; pale green; orange- and honey-yellow; wine-yellow, brownish yellow, cinnamon-brown; rose-red; rarely emerald-green from the presence of chromium.

7. Pyrope. Precious garnet in part. Magnesium-aluminum Garnet. Formula $3MgO.Al_2O_3.3SiO_2$. Calcium and iron may be present, and also chromium. Sp.G.= 3.7. Color deep red to nearly black.

and then prized as a gem.

<u>Occurrence</u>. The occurrences immediately following are of garnet in which the varieties are not determined: Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Fierro-Hanover, Pinos Altos, and Santa Rita districts. Hidalgo County: Apache No. 2, Hachita, and San Simon districts. Luna County: Tres Hermanas district. McKinley County: Navajo Reservation and Zuni Reservation. Otero County: Orogrande district. Rio Arriba County: Bromide and Petaca districts. San Juan County: Navajo Reservation (especially southwest corner). San Miguel County: Rociada and Willow Creek districts. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride and Cuchillo Negro districts. Socorro County: Iron Mountain No. 2 and Magdalena districts. Taos County: Glenwoody, Harding Mine, and Picuris districts.

Var. <u>Almandite</u>. Santa Fe County: New Placers district.

Var. <u>Andradite</u>. Colfax County: Cimarroncito district. Dona Ana County: Organ district. Otero County: Orogrande district. Santa Fe County: New Placers district. Socorro County: Iron Mountain No. 2 district. Taos County: Glenwoody district.

Var. <u>Grossularite</u>. Dona Ana County: Organ district.

and been prized as a gem.

Occurrences. The occurrences immediately following are of garnet in which the varieties are not determined: Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains, Hanover, Pinos Altos, and Santa Rita districts. Hidalgo County: Apache No. 2, Hachita, and San Simon districts. Luna County: Tres Hermanas district. McKinley County: Navajo Reservation and Zuni Reservation. Otero County: Orogrande district. Rio Arriba County: Bromide and Petaca districts. San Juan County: Navajo Reservation (vicinity southeast corner). San Miguel County: Pecos and Willow Creek districts. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride and Cuchillo Negro districts. Socorro County: Iron Mountain No. 2 and Magdalena districts. Taos County: Glenwoody, [illegible], and Picuris districts.

Var. Almandite. Santa Fe County: Old Placers district.

Var. Andradite. Colfax County: Cimarroncito district. Dona Ana County: Organ district. Grant County: Central district. Santa Fe County: Old Placers district. Socorro County: Iron Mountain No. 2 district. Taos County: Picuris district.

Var. Grossularite. Dona Ana County: Organ district.

Grant County: Fierro-Hanover district. Santa Fe County: New Placers district. Sierra County: (not specified).

Var. Pyrope. McKinley County: near Thoreau; Navajo Reservation and Zuni Reservation. San Juan County: Navajo Reservation (southwest corner). Santa Fe County: (not specified). Taos County: (not specified). (Indefinite: near Fort Craig.)

GERHARDTITE.

Physical characteristics. Orthorhombic. In pyramidal crystals, faces striated. Cleavage: basal, highly perfect, yielding flexible laminae. Another less perfect cleavage at right angles. Sectile, fragile. H.- 2. Sp.G.- 3.426. Luster vitreous, brilliant. Color deep emerald green. Streak light green. Transparent. Easily fusible.

Chemical composition. Basic cupric nitrate, $Cu(NO_3)_2$, or $4CuO.N_2O_5.3H_2O$.

Occurrence. Socorro County: Magdalena district.

GLAUBERITE.

Physical characteristics. Monoclinic. In tabular and prismatic crystals. Cleavage: one direction, perfect.

Grant County: Pierro-Hanover district. Santa Rita district. San Lorenzo district. Sierra County (not specified).

Var. Ferrous. McKinley County: near Thoreau, Navajo Reservation and Zuni Reservation. San Juan County: Navajo Reservation (northwest corner). Santa Fe County (not specified). Taos County (not specified). (Questionable near Fort Craig.)

GERHARDTITE.

Physical characteristics. Orthorhombic. In prismatic crystals, faces striated. Cleavage basal, highly perfect, yielding flexible laminae. Another 2 to perfect cleavage at right angles. Sectile, fragile. H = 2. G = 3.43. Luster vitreous, brilliant. Color deep emerald green. Streak light green. Transparent. Easily fusible.

Chemical composition. Basic copper nitrate, $Cu(NO_3)_2 \cdot 3Cu(OH)_2$, or $4CuO \cdot N_2O_5 \cdot 3H_2O$.

Occurrence. Socorro County: Magdalena district.

GLAUBERITE.

Physical characteristics. Monoclinic. In crystals; prismatic or tabular. Cleavage perfect.

Fracture conchoidal. Brittle. H.- 2.5-3. Sp.G.- 2.7-2.85. Luster vitreous. Color pale yellow or gray; sometimes brick-red. Streak white. Taste slightly saline.

Chemical composition. Sodium and calcium sulphate, $Na_2SO_4.CaSO_4$.

Occurrence. Catron County: Quemado Salt district. Eddy County: Carlsbad Potash district. Torrance County: Estancia Salt district.

GLAUCONITE.

Physical characteristics. Probably both colloidal and crystalline. Usually amorphous, and resembling earthy chlorite. Either in cavities in rocks, or loosely granular massive. Micaceous cleavage. H.- 2. Sp.G.- 2.2-2.4. Luster dull, or glistening. Color olive-green, blackish green, yellowish green, grayish green. Opaque.

Chemical composition. Shows a considerable variation in composition, but is essentially a hydrous silicate of iron and potassium, in which the iron is chiefly ferric.

Occurrence. In the Bliss sandstone of Cambrian age in several mountain ranges in Grant, Luna, and Sierra Counties.

GOETHITE.

Physical characteristics. Orthorhombic. In prisms vertically striated, and often flattened into scales or tables. Also fibrous; foliated or in scales; massive, reniform and stalactitic, with concentric and radiated structure. Cleavage: one direction, parallel to tabular faces, very perfect. Fracture uneven. Brittle. H.- 5-5.5. Sp.G.- 4.28. Luster imperfect adamantine. Color yellowish, reddish, and blackish brown. Often blood-red by transmitted light. Streak brownish yellow to ocher-yellow.

Chemical composition. FeO(OH), or $Fe_2O_3.H_2O$.

Occurrence. Socorro County: San Andres Mountains district (Goodfortune Creek).

GOLD.

Physical characteristics. Isometric. Distinct crystals rare, octahedron most common. Filiform, reticulated, and dendritic. Also massive and in thin laminae; often in flattened grains or scales. Cleavage none. Fracture hackly. Very malleable and ductile. H.- 2.5-3. Sp.G.- 15.6-19.3, 19.33 when pure. Luster metallic. Color and streak gold-yellow, sometimes inclining to silver-white and rarely to orange-red. Opaque.

GOETHITE.

Physical characteristics. Orthorhombic. In prisms vertically striated, and often flattened into scales or tablets. Also fibrous; foliated or in scales; massive, reniform and stalactitic, with concentric and radiated structure. Cleavage: one direction, parallel to 010 (brachy-pinacoid), very perfect. Fracture uneven. Brittle. H.= 5-5.5. G.= 4.28. Luster imperfect adamantine. Color yellowish, reddish, and blackish brown. Often blood-red by transmitted light. Streak brownish yellow to ocher-yellow.

Chemical composition. $FeO(OH)$, or $Fe_2O_3.H_2O$.

Occurrence. Tehama County: the Amador [illegible] district (Woodsford Creek).

GOLD.

Physical characteristics. Isometric. Distinct crystals rare; octahedron most common. Filiform, reticulated, and dendritic. Also massive and in thin laminae; often in flattened grains or scales. Cleavage none. Fracture hackly. Very malleable and ductile. H.= 2.5-3. G.= 15.6-19.3, 19.33 when pure. Luster metallic. Color and streak gold-yellow, sometimes inclining to silver-white and rarely to orange-red. Opaque.

Chemical composition. Gold, Au, but usually alloyed with silver in varying amounts and sometimes containing traces of copper or iron.

Occurrence. Reported as lode deposits and as placer deposits.

Lode Deposits. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Chaves County: Guadalupe Mountains region (?). Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Gold Camp, Organ, and Texas districts. Eddy County: Guadalupe Mountains region (?). Grant County: Burro Mountains, Central, Gold Hill, Malone, Pinos Altos, Steeple Rock, and Telegraph districts; Tellurium locality (41 miles northwest of Silver City). Hidalgo County: Fremont, Hachita, Lordsburg, and Steins Pass districts. Lincoln County: Gallinas Mountains, Jicarilla, Nogal, and White Oaks districts. Luna County: Carrizalillo Hills, Tres Hermanas, and Victorio districts. Otero County: Orogrande district. Rio Arriba County: Bromide and Hopewell districts. Sendoval County: Cochiti and Placitas districts. Santa Fe County: New Placers, Old Placers, and Santa Fe districts. Sierra County: Chloride, Hermosa, Hillsboro, Kingston, San Mateo Mountains, and Tierra Blanca districts. Socorro County: Cat Mountain, Hansonburg, Magdalena, Mill Canyon, Rosedale, San Jose, San Lorenzo, and Water Canyon

Chemical composition. [illegible]

silver in varying amounts [illegible]

or copper or iron.

Occurrence. [illegible]

metals.

Lake Valley [illegible]

district. [illegible]

Guadalupe [illegible]

Cimarroncito, [illegible]

Gold Camp, [illegible]

Guadalupe [illegible]

tains, Central. [illegible]

Rock, [illegible]

northeast of [illegible]

Bonito, [illegible]

Orogrande [illegible]

tain districts. [illegible]

Potrero, and [illegible]

district. [illegible]

trict. [illegible]

Santa Fe County: [illegible]

districts. [illegible]

Kingston; [illegible]

Socorro County: [illegible]

Carmen, [illegible]

districts. Taos County: Anchor, Glenwoody, Picuris, Red River, and Twining districts.

Placer Deposits. Bernalillo County: Tijeras Canyon district. Chaves County: along Rio Hondo. Colfax County: Baldy, Cimarroncito, Elizabethtown, and Ponil districts. Grant County: Gold Camp, Malone, and Pinos Altos districts. Hidalgo County: Hachita and Lordsburg districts. Lincoln County: Gallinas Mountains, Jicarilla, Nogal, and White Oaks districts; along Rio Hondo. Otero County: Orogrande district. Rio Arriba County: Abiquiu and Hopewell districts. Sandoval County: Placitas district. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos (along Galisteo Creek), New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballos Mountains, Hillsboro, and Pittsburg districts. Taos County: Glenwoody, Red River, and Twining districts.

GOSLARITE.

Physical characteristics. Orthorhombic. In long acicular crystals. Commonly massive or stalactitic. Cleavage: one direction, perfect. Brittle. H.- 2-2.5. Sp.G.- 1.9-2.1. Luster vitreous. Color white, reddish, yellowish, bluish. Transparent to translucent. Taste astringent, metallic, and nauseous.

districts. Taos County: Anchor, Glenwoody, Picuris, Red River, and Twining districts.

Placer deposits. Bernalillo County: Tijeras Canyon district. Chaves County: along Rio Peñasco. Colfax County: Baldy, Cimarroncito, Elizabethtown, and Ponil districts. Grant County: Gold Camp, Malone, and Pinos Altos districts. Hidalgo County: Hachita and Lordsburg districts. Lincoln County: Gallinas Mountains, Jicarilla, Nogal, and White Oaks districts; along Rio Bonito. Otero County: Orogrande district. Rio Arriba County: Abiquiu and Hopewell districts. Sandoval County: Placitas district. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos (along Galisteo Creek), New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballos Mountains, Hillsboro, and Pittsburg districts. Taos County: Glenwoody, Red River, and Twining districts.

ORPIMENT.

Physical characteristics. Orthorhombic. In tiny acicular crystals. Commonly massive or stalactitic. Cleavage: one direction, perfect. Sectile. H. 1.5-2. Sp.G. 3.4-3.5. Lemon-yellow. Color white, reddish, yellowish white. Translucent to transparent. Luster adamantine, metallic, and resinous.

Chemical composition. Hydrous zinc sulphate, $ZnSO_4.7H_2O$.

Varieties. 1. Cuprogoslarite. Containing a considerable quantity of cupric sulphate, $CuSO_4$. Light greenish blue, massive or as an incrustation. 2. Ferrogoslarite. Containing ferrous sulphate, $FeSO_4$.

Occurrence. Grant County: Central district. Sierra County: Kingston district. Socorro County: Magdalena and Water Canyon districts.

Var. Cuprogoslarite. Grant County: Central district.

Var. Ferrogoslarite. Grant County: Central district.

GRAPHITE. Plumbago. Black Lead.

Physical characteristics. Hexagonal-rhombohedral. In six-sided tabular crystals. Commonly in embedded foliated masses, also columnar or radiated; scaly or platy; granular to compact; earthy. Cleavage: basal, perfect. Thin laminae flexible, inelastic. Feel greasy. H.- 1-2. Sp.G.- 2.09-2.23. Luster metallic, sometimes dull, earthy. Color iron-black to dark steel-gray. Opaque. Conducts electricity.

Chemical composition. Carbon, C, often impure.

Occurrence. Bernalillo County: Tijeras Canyon district. Colfax County: Raton Graphite district. Grant County: Burro

Chemical composition. Hydrous zinc sulphate, $ZnSO_4.7H_2O$.

Varieties. 1. Cuprogoslarite. Containing a considerable quantity of cupric sulphate, $CuSO_4$. Found [illegible] massive or as an incrustation. 2. Ferrogoslarite. Containing ferrous sulphate, $FeSO_4$.

Occurrence. Grant County: Central district. Sierra County: Kingston district. Socorro County: Magdalena and [illegible] Canyon districts.

Var. Cuprogoslarite. Grant County: Central district.

Var. Ferrogoslarite. Grant County: Central district.

GRAPHITE. Plumbago. Black lead.

Physical characteristics. Hexagonal-rhombohedral. In six-sided tabular crystals. Commonly in embedded foliated masses; also columnar or radiated; scaly or granular to compact; earthy. Cleavage: basal, perfect. Thin laminae flexible, inelastic. Feel greasy. H = [illegible]. G = [illegible] 2.23. Luster metallic, sometimes dull, earthy. Color iron-black to dark steel-gray. Opaque. [illegible] electricity.

Chemical composition. Carbon, C, often impure.

Occurrence. Bernalillo County: Tijeras Canyon district. Colfax County: [illegible] district. [illegible]

Mountains district. Taos County: "in Taos Range". Valencia County: (not specified).

GREENOCKITE.

Physical characteristics. Hexagonal. Rarely in hemimorphic crystals; also as a coating. Cleavage: prismatic, distinct. Fracture conchoidal. Brittle. H.- 3-3.5. Sp.G.- 4.9-5.0. Luster adamantine to resinous. Color honey-, citron-, or orange-yellow. Streak between orange-yellow and brick-red. Nearly transparent.

Chemical composition. Cadmium sulphide, CdS.

Occurrence. Grant County: Pinos Altos district. Socorro County: Magdalena district.

GUMMITE.

Physical characteristics. Crystalline, perhaps in part amorphous. In rounded or flattened pieces, looking much like gum. H.- 2.5-3. Sp.G.- 3.9-4.20. Luster greasy. Color reddish yellow to orange- or hyacinth-red, reddish brown. Streak yellow. Feebly translucent. Isotropic.

Chemical composition. An alteration product of uraninite, of doubtful composition; perhaps essentially

Mountains district.—Luna County: "in Tres Hermanas". Socorro County: (not specified).

GREENOCKITE.

Physical characteristics. Hexagonal. Rarely in hemimorphic crystals; also as a coating. Cleavage: prismatic, distinct. Fracture conchoidal. Brittle. H.= 3-3.5. Sp.G.= 4.9-5.0. Luster adamantine to resinous. Color honey-, citron-, or orange-yellow. Streak between orange-yellow and brick-red. Nearly transparent.

Chemical composition. Cadmium sulphide, CdS.

Occurrence. Grant County: Pinos Altos district. Socorro County: Magdalena district.

GUMMITE.

Physical characteristics. Cryptocrystalline, perhaps in part amorphous. In rounded or flattened pieces, looking much like gum. H.= 2.5-3. Sp.G.= 3.9-6.4. Luster greasy. Color reddish yellow to orange- or brownish-red, reddish brown. Streak yellow. Faintly translucent.

Chemical composition. An alteration product of uraninite, of doubtful composition; perhaps

$(Pb,Ca,Ba)U_3SiO_{12}.6H_2O$ (Foullon).

Occurrence. Rio Arriba County: Petaca district.

GYPSUM.

Physical characteristics. Monoclinic. Crystals usually simple in habit, commonly flattened or prismatic to acicular. Simple crystals often with warped and curved surfaces. Also foliated massive; lamellar-stellate; often granular massive; and sometimes nearly impalpable. Twins very common, often the familiar swallow-tail or arrowhead twins. Cleavage: one direction, eminent, yielding easily thin polished folia; also two other directions, distinct, one giving a surface with conchoidal fracture, the other a surface with a fibrous fracture. A cleavage fragment has the rhombic form with plane angles of 66° and 114°. H.- 1.5-2. Sp.G.- 2.314-2.328, when in pure crystals. Luster of eminent cleavage surface pearly and shining; other faces subvitreous. Massive varieties often glistening, sometimes dull earthy. Color usually white; sometimes gray, flesh-red, honey-yellow, ocher-yellow, blue; impure varieties often black, brown, red, or reddish brown. Streak white. Transparent to opaque.

Chemical composition. Hydrous calcium sulphate, $CaSO_4.2H_2O$.

[illegible]

Occurrence. [illegible]

GYPSUM.

Physical characteristics. [illegible]

single in habit, commonly [illegible]

Simple crystals often [illegible]

foliated massive; [illegible]

and sometimes nearly [illegible]

the familiar swallow-tail [illegible]

one direction, [illegible]

also two other directions, [illegible]

with conchoidal fracture [illegible]

fracture. A cleavage [illegible]

plane angles of 66° and [illegible]

2.32, when in pure crystals. [illegible]

surface pearly and [illegible]

site variations often [illegible]

Color usually white; [illegible]

yellow, ocher-yellow, [illegible]

brown, red, or reddish [illegible]

to opaque.

Chemical composition.

Varieties. 1. Alabaster. A fine-grained, massive variety, white or delicately shaded. 2. Satin Spar. A fine fibrous variety, with pearly opalescence. 3. Selenite. Crystallized gypsum. Colorless, transparent; in distinct crystals, or broad folia, often large. Usually flexible and yielding a fibrous fracture.

Occurrence. The following occurrences are of gypsum of undetermined variety: Bernalillo County: Tijeras Canyon district. Chaves County: Acme region. Dona Ana County: Organ and Tonuco Mountains Fluorspar districts; region west of White Sands. Eddy County: Carlsbad Potash district; Oriental region. Grant County: Fierro-Hanover and Lone Mountain districts. Guadalupe County: (not specified). Lincoln County: White Oaks district; Ancho region. Luna County: Cooks Peak district. McKinley County: (not specified). Otero County: White Sands region. Quay County: (not specified). Rio Arriba County: near El Rito. Roosevelt County: Elida region. Sandoval County: Nacimiento Mountains region. San Juan County: (not specified). San Miguel County: near Pecos. Santa Fe County: (not specified). Sierra County: Caballos Mountains and Lake Valley districts. Socorro County: Chupadero, Magdalena, North Magdalena, and San Andres Mountains (Lava Gap) districts. Torrance County: Estancia Salt district. Valencia County: Zuni Mountains district; Rito region.

Varieties. 1. Alabaster. A fine-grained, massive variety, white or delicately shaded. 2. Satin Spar. A fine fibrous variety, with pearly opalescence. 3. Selenite. Crystallized gypsum. Colorless, transparent; in distinct crystals, or broad folia, often large. Usually flexible and yielding a fibrous fracture.

Occurrence. The following occurrences are of gypsum of undetermined variety: Bernalillo County: Tijeras Canyon district. Chaves County: Acme region. Dona Ana County: Organ and Jarilla Mountains (Jarilla?) districts; region west of White Sands. Eddy County: Carlsbad Potash district; Oriental region. Grant County: Fierro-Hanover and Lone Mountain districts. Guadalupe County: (not specified). Lincoln County: White Oaks district; Ancho region. Luna County: Cooks Peak district. McKinley County: (not specified). Otero County: White Sands region. Quay County: (not specified). Rio Arriba County: near El Rito. Roosevelt County: Elida region. Sandoval County: Nacimiento Mountains region. San Juan County: (not specified). San Miguel County: near Pecos. Santa Fe County: (not specified). Sierra County: Caballos Mountains and Lake Valley districts. Socorro County: Chupadera, Magdalena, North Magdalena, and San Andres Mountains (Lava Gap) districts. Torrance County: Estancia Salt district. Valencia County: Zuni Mountains district; Laguna region.

Var. <u>Alabaster</u>. Otero County: Tularosa district. Socorro County: Jones Camp district.

Var. <u>Satin Spar</u>. Socorro County: district east of Strawberry Peak.

Var. <u>Selenite</u>. De Baca County: Fort Sumnar-Dunlap region. Dona Ana County: North Lucero Ranch, west of White Sands. Sierra County: Pittsburg district. Torrance County: Estancia Salt district. Valencia County: region west of Belen, especially in caves.

HALITE. Rock Salt.

Physical characteristics. Isometric. Usually in cubes; crystals sometimes distorted, or with cavernous faces. Also massive, granular to compact; less often columnar. Cleavage: cubic, perfect. Fracture conchoidal. Rather brittle. H.- 2.5. Sp.G.- 2.1-2.6; pure crystals 2.164. Luster vitreous. Colorless or white, also yellowish, reddish, bluish, purplish. At times shows a deep blue color in irregular spots. Transparent to translucent. Soluble, taste saline.

Chemical composition. Sodium chloride, NaCl. Commonly mixed with calcium sulphate, calcium chloride, magnesium chloride, and sometimes magnesium sulphate.

Var. Alabaster. Otero County: Tularosa district. Socorro County: Jones Camp district.

Var. Satin Spar. Socorro County: district east of Strawberry Peak.

Var. Selenite. De Baca County: Fort Sumner-Yeso region. Dona Ana County: North Lucero Lake, east of White Sands. Sierra County: Pittsburg district. Torrance County: Estancia Salt district. Valencia County: region west of Belen, especially in caves.

HALITE. Rock Salt.

Physical characteristics. Isometric. Usually in cubic crystals sometimes distorted, or with cavernous faces. Also massive, granular to compact; less often columnar. Cleavage: cubic, perfect. Fracture conchoidal. Rather brittle. H= 2.5. Sp.G.= 2.1-2.6; pure crystals 2.135. Luster vitreous. Colorless or white; also yellowish, reddish, bluish, purplish. At times shows a deep blue color in irregular spots. Transparent to translucent. Saline, taste saltish.

Chemical composition. Sodium chloride, NaCl. Commonly mixed with calcium sulphate, calcium chloride, magnesium chloride, and sometimes magnesium sulphate.

Varieties. 1. Sylvinite. A mixture of sylvite and halite.

Occurrence. Catron County: Quemado Salt district. Dona Ana County: region west of White Sands. Eddy County: Carlsbad Potash district; saline lakes east of the Pecos River. Otero County: White Sands district. Torrance County: Estancia Salt district. Valencia County: (?)

Var. Sylvinite. Eddy County: Carlsbad Potash district.

HALLOYSITE.

Physical characteristics. Massive. Clay-like or earthy. Fracture conchoidal. Hardly plastic. H.- 1-2. Sp.G.- 2.0-2.20. Luster somewhat pearly, or waxy, to dull. Color white, grayish, greenish, yellowish, bluish, reddish. Translucent to opaque, sometimes becoming translucent or even transparent in water, with an increase of one-fifth in weight.

Chemical composition. A silicate of aluminum, $Al_2O_3.SiO_2$, like kaolin, but amorphous and containing more water.

Occurrence. Catron County: Mogollon district. Grant County: Burro Mountains, Central, and Santa Rita districts. Santa Fe County: Cerrillos district.

Varieties. 1. Sylvinite. A mixture of sylvite and halite.

Occurrence. Catron County: Quemado Salt district. Dona Ana County: region west of White Sands. Eddy County: Carlsbad potash district; saline lakes east of the Pecos River. Otero County: White Sands district. Torrance County: Estancia Salt district. Valencia County (?)

Var. Sylvinite. Eddy County: Carlsbad potash district.

HALLOYSITE.

Physical characteristics. Massive. Clay-like or earthy. Fracture conchoidal. Hardly plastic. H.— 1-2. Sp.G.— 2.0-2.20. Luster somewhat pearly, or waxy, to dull. Color white, grayish, greenish, yellowish, bluish, reddish. Translucent to opaque, sometimes becoming translucent or even transparent in water, with an increase of one-fifth in weight.

Chemical composition. A silicate of aluminum, [illegible] like kaolin, but amorphous and containing more water.

Occurrence. Catron County: Mogollon district. Grant County: Burro Mountains, Central, and Santa Rita districts. Santa Fe County: Cerrillos district.

HALOTRICHITE. Iron Alum.

Physical characteristics. Monoclinic. In silky fibrous forms. H.- 2. Sp.G.- 1.9. Color yellowish white. Taste inky-astringent. Becomes dull and pulvurulent on exposure.

Chemical composition. $FeSO_4.Al_2(SO_4)_3.22H_2O$.

Occurrence. Grant County: Alum Mountain district.

HAUSMANNITE.

Physical characteristics. Tetragonal. Twins common, often repeated as fivelings. Habit octahedral, faces striated, often dull. Also granular massive, particles strongly coherent. Cleavage: basal, nearly perfect. Fracture uneven. Brittle. H.- 5-5.5. Sp.G.- 4.722-4.856. Luster submetallic. Color brownish black. Streak chestnut-brown. Opaque.

Chemical composition. Mn_3O_4, or $MnO.Mn_2O_3$.

Occurrence. Sierra County: (not specified). Socorro County: San Lorenzo district.

HAUYNITE. Haüyne.

Physical characteristics. Isometric. Sometimes in

dodecahedrons, octahedrons, etc. Twins both as contact- and penetration-twins. Commonly in rounded grains, often looking like crystals with fused surfaces. Cleavage: dodecahedral, rather distinct. Fracture flat conchoidal to uneven. Brittle. H.- 5.5-6. Sp.G.- 2.4-2.5. Luster vitreous, to somewhat greasy. Color bright blue, sky-blue, greenish blue; asparagus-green, red, yellow. Streak slightly bluish to colorless. Subtransparent to translucent; often enclosing symmetrically arranged inclusions.

Chemical composition. $3NaAlSiO_4.CaSO_4$. Potassium and calcium may be present in small amounts.

Occurrence. Colfax County: Raton region.

HEDENBERGITE. Calcium-iron Pyroxene.

Physical characteristics. Monoclinic. Twins as contact- and penetration-twins. Crystals prismatic, short and stout, square or eight-sided. Also lamellar massive. Cleavage: two directions, nearly at right angles, almost perfect, but interrupted. Basal parting sometimes observed. Fracture uneven to conchoidal. Brittle. H.- 5-6. Sp.G.- 3.5-3.58. Luster vitreous to resinous; often dull; sometimes pearly on planes of parting. Color black. Streak pale grayish green. Translucent to opaque.

dodecahedrons, octahedrons, etc. Twins both as contact- and penetration-twins. Commonly in rounded grains, often looking like crystals with fused surfaces. Cleavage: dodecahedral, rather distinct. Fracture flat conchoidal to uneven. Brittle. H.= 5.5-6. Sp.G.= 2.4-2.5. Luster vitreous to somewhat greasy. Color bright blue, sky-blue, greenish blue; asparagus-green, red, yellow. Streak slightly bluish to colorless. Subtransparent to translucent; often enclosing symmetrically arranged inclusions.

Chemical composition. $3NaAlSiO_4.CaSO_4$. Potassium and chlorine may be present in small amounts.

Occurrence. Colfax County: Raton Region.

HEDENBERGITE. Calcium-iron Pyroxene.

Physical characteristics. Monoclinic. Twins as contact- and penetration-twins. Crystals prismatic, short and stout, square or eight-sided. Also lamellar massive. Cleavage: two directions, nearly at right angles, almost perfect, but interrupted. Basal parting sometimes observed. Fracture uneven to conchoidal. Brittle. H.= 5-6. Sp.G.= 3.5-3.58. Luster vitreous to resinous; often dull; sometimes pearly on planes of parting. Color black. Streak pale-grayish green. Translucent to opaque.

Chemical composition. $CaFe(SiO_3)_2$. Hedenbergite forms one end-member of an isomorphous series with diopside; there are numerous transitions between the two, with the general formula $Ca(Mg,Fe)Si_2O_6$. As iron increases, the color becomes darker, and specific gravity increases.

Varieties. 1. Mangan-hedenbergite. Contains manganese up to 6.5%. Color grayish green. Sp.G.- 3.55.

Occurrence. Grant County: Fierro-Hanover district. Hidalgo County: Apache No. 2 district. Sierra County: (not specified). Socorro County: Iron Mountain No. 2 district.

Var. Mangan-hedenbergite. Grant County: Fierro-Hanover district.

HEMATITE.

Physical characteristics. Hexagonal-rhombohedral. Twins usually as polysynthetic twinning-lamellae, producing a fine striation on the basal face, and giving rise to a distinct rhombohedral parting or pseudo-cleavage. Crystals often thick to thin tabular; also in cube-like rhombohedrons. Also columnar to granular, botryoidal, and stalactitic shapes. Also lamellar, lamellae bent; also granular, friable; earthy or compact. No true cleavage; basal and rhombohedral parting. Fracture subconchoidal to uneven.

Chemical composition. $CaFe(SiO_3)_2$. Hedenbergite forms one end-member of an isomorphous series with diopside; there are numerous transitions between the two, with the general formula $Ca(Mg,Fe)Si_2O_6$. As iron increases, the color becomes darker, and specific gravity increases.

Varieties. 1. Mangan-hedenbergite. Contains manganese up to 0.80. Color grayish green. Sp.G.= 3.55.

Occurrence. Grant County: Fierro-Hanover district. Hidalgo County: Apache No. 2 district. Sierra County: (not specified). Socorro County: Iron Mountain No. 2 district.

Var. Mangan-hedenbergite. Grant County: Fierro-Hanover district.

HEMATITE

Physical characteristics. Hexagonal-rhombohedral. Twins usually as polysynthetic twinning-lamellae, producing a fine striation on the basal face, and giving rise to a distinct rhombohedral parting or pseudo-cleavage. Crystals often thick to thin tabular; also in cube-like rhombohedrons. Also columnar to granular, botryoidal, and stalactitic shapes. Also lamellar; lamellae bent; also granular, friable; earthy or compact. No true cleavage; basal and rhombohedral parting. Fracture subconchoidal to uneven.

Brittle in compact forms; elastic in thin laminae; soft and unctuous in loosely adherent scaly varieties. H.- 5.5-6.5. Sp.G.- 4.9-5.3; as low as 4.2 in some compact varieties. Luster metallic and occasionally splendent, sometimes dull. Color dark steel-gray or iron-black; in very thin particles blood-red by transmitted light; when earthy, red. Impure clays colored by earthy hematite are called red ocher. Streak cherry-red or reddish brown. Opaque, except in very thin laminae.

Chemical composition. Iron sesquioxide, Fe_2O_3. Sometimes contains titanium and magnesium.

Varieties. 1. Specularite. Specular Hematite. Luster metallic, and often splendent. Structure often foliated or micaceous (micaceous hematite).

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Taylor Creek Tin district. Colfax County: Elizabethtown district. Eddy County: Carlsbad Potash district. Grant County: Burro Mountains, Chloride Flat, Fierro-Hanover, Santa Rita, and Silver City Manganese-Iron districts. Hidalgo County: Apache No. 2 district. Lincoln County: Estey district. Rio Arriba County: Bromide district. Sandoval County: Nacimiento Mountains district. Santa Fe County: Glorieta and Old Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hillsboro, and Lake Valley districts. Socorro County:

Brittle in compact forms; elastic in thin laminae; soft and unctuous in loosely coherent scaly varieties. H.=5.5-6.5. Sp.G.=4.9-5.3; as low as 4.2 in some [illegible]. Luster metallic and occasionally splendent, sometimes dull. Color dark steel-gray or iron-black; in very thin particles blood-red by transmitted light; when earthy, red. [illegible] clays colored by earthy hematite are called red ocher. Streak cherry-red or reddish brown. Opaque, except in very thin laminae.

Chemical composition. Iron sesquioxide, Fe_2O_3. Sometimes contains titanium and magnesium.

Varieties. 1. Specularite. Specular hematite. Luster metallic, and often splendent. Micaceous: foliated or micaceous (micaceous hematite).

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Taylor Creek Tin district. Colfax County: Elizabethtown district. Eddy County: Carlsbad potash district. Grant County: Burro Mountains, Chloride Flat, Pierro-Hanover, Santa Rita, and Silver City [illegible] districts. Hidalgo County: Apache No. 2 district. [illegible] County: Estey district. Rio Arriba County: [illegible] district. Sandoval County: Nacimiento district. Santa Fe County: district and Sierra County: Caballos Mountains, Chloride, Hillsboro, and Lake Valley districts.

Council Rock, Iron Mountain No. 2, Jones Camp, and San Andres Mountains (Goodfortune Creek, Mockingbird Gap, Sulphur Canyon) districts. Taos County: Twining district.

Var. Specularite. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon and Taylor Creek Tin districts. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains, Central, Fierro-Hanover, Pinos Altos, Santa Rita, and Steeple Rock districts. Hidalgo County: Lordsburg and Steins Pass districts. Luna County: Cooks Peak and Tres Hermanas districts. Otero County: Orogrande district. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride, Cuchillo Negro, and Lake Valley districts. Socorro County: Iron Mountain No. 2, Ladrones Mountains, and Magdalena districts. Taos County: Red River district.

HESSITE.

Physical characteristics. Isometric. Crystals not common, habit cubic, octahedral, dodecahedral, etc. Usually massive, compact or fine-grained; rarely coarse granular. Cleavage indistinct. Fracture even. Somewhat sectile.

Cornwall Bank, Cross Mountain No. 2, Trace Creek, and San Andres Mountains ([illegible] Creek, [illegible] Gap, Sulphur Canyon) districts. Taos County: Twining district.

Var. Chlorophane. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon and Taylor Creek Tin districts. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains, Central, Pierro-Hanover, Pinos Altos, Santa Rita, and Steeple Rock districts. Hidalgo County: Lordsburg and Steins Pass districts. Luna County: Cooks Peak and Tres Hermanas districts. Otero County: Orogrande district. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride, Cuchillo Negro, and Lake Valley districts. Socorro County: Iron Mountain No. 2, Ladrones Mountains, and Magdalena districts. Taos County: Red River district.

GARNET.

Chemical classification. Isometric. Crystals not common, both [illegible], [illegible], etc. Usually massive, compact or disseminated grains, massive granular. Cleavage indistinct. [illegible]. [illegible].

H.- 2.5-3. Sp.G.- 8.31-8.45. Luster metallic. Color between lead-gray and steel-gray.

Chemical composition. Silver telluride, Ag_2Te. Gold is often present, replacing part of the silver; it thus grades toward petzite.

Occurrence. Sierra County: Tierra Blanca district.

HEULANDITE. Stilbite some authors.

Physical characteristics. Monoclinic. Crystals sometimes flattened parallel to the surface of pearly luster; form often similar to the orthorhombic. Also in globular forms, granular. Cleavage: one direction, parallel to the tabular face, perfect. Fracture subconchoidal to uneven. Brittle. H.- 3.5-4. Sp.G.- 2.18-2.22. Luster of cleavage surface strong pearly; of other faces vitreous. Color various shades of white, passing into red, gray, and brown. Streak white. Transparent to subtranslucent.

Chemical composition. $(Ca,Na_2)O.Al_2O_3.6SiO_2.5H_2O$. Strontia is usually present in small amount.

Occurrence. Luna County: region near Fort Cummings.

H.= 2.5-3. Sp.G.= 8.31-8.45. Luster metallic. Color between lead-gray and steel-gray.

Chemical composition. Silver telluride, Ag_2Te. Gold is often present, replacing part of the silver; it then grades toward petzite.

Occurrence. Sierra County: Sierra Blanca district.

HEULANDITE. Zeolite group.

Physical characteristics. Monoclinic. Crystals sometimes flattened parallel to the surface of pearly luster; form often similar to the orthorhombic. Also in globular forms, granular. Cleavage: one direction, parallel to the tabular face, perfect. Fracture subconchoidal to uneven. Brittle. H.= 3.5-4. Sp.G.= 2.18-2.22. Luster of cleavage surface strong pearly; of other faces vitreous. Color various shades of white, passing into red, gray, and brown. Streak white. Transparent to subtranslucent.

Chemical composition. $(Ca,Na_2)O.Al_2O_3.6SiO_2.5H_2O$. Strontium is usually present in small amount.

Occurrence. Luna County: region near Fort Cummings.

HORNBLENDE. Aluminous Amphibole. Common Amphibole.

Physical characteristics. Monoclinic. Crystals commonly prismatic, often long and bladed, sometimes short and stout. Also columnar, fibrous, and massive granular. Cleavage: two directions, at angles of 55° and 125° approximately, perfect. Fracture uneven. Brittle. H.- 5-6. Sp.G.- 3.0-3.47. Luster vitreous to pearly on cleavage surfaces; fibrous varieties often silky. Color white to gray and pale green, also colorless; bright green, dark green, bluish green to grayish black and black. Streak uncolored, or paler than color. Translucent to opaque.

Chemical composition. Containing aluminum oxide or ferric iron, and usually both, with ferrous iron (sometimes manganese), magnesium, calcium, and alkalies. General formula $RSiO_3$, where R = various bivalent metals usually.

Occurrence. Bernalillo County: Tijeras Canyon district. Colfax County: Elizabethtown district. Rio Arriba County: Bromide and Petaca districts. San Miguel County: Willow Creek district. Sierra County: (not specified). Socorro County: Magdalena district.

HYDROCARBON.

An unidentified hydrocarbon, mentioned here because it

occurs in an otherwise typical mineral vein. "A black resinous hydrocarbon is intergrown with the vein minerals and occurs also in limestone wallrock." (New Mexico School of Mines, Bulletin 7, p.87.)

Occurrence. Otero County: Tularosa district.

HYDROZINCITE.

Physical characteristics. Monoclinic. Crystals are minute thin blades parallel to a perfect cleavage. Usually massive, fibrous, earthy or compact, as incrustations. At times reniform, pisolitic, stalactitic. H.- 2-2.5. Sp.G.- 3.58-3.8. Luster dull. Color pure white, grayish or yellowish. Streak shining. Usually earthy or chalk-like.

Chemical composition. A copper-free variety of aurichalcite, a basic zinc carbonate, $2ZnCO_3.3Zn(OH)_2$.

Varieties. 1. Marionite. In concentric and contorted laminae and botryoidal crusts.

Occurrence. Luna County: Tres Hermanas district. Socorro County: Magdalena district.

Var. Marionite. Socorro County: Magdalena district.

HYPERSTHENE.

Physical characteristics. Orthorhombic. Crystals rare, prismatic or tabular. Usually foliated massive; sometimes in embedded spherical forms. Cleavage: one direction, distinct; one good parting. Fracture uneven. Brittle. H.- 5-6. Sp.G.- 3.40-3.50. Luster somewhat pearly on a cleavage surface, sometimes inclining to metalloidal. Color dark brownish green, grayish black, greenish black, pinchbeck-brown. Streak grayish, brownish gray. Translucent to nearly opaque.

Chemical composition. $(Fe,Mg)SiO_3$ with FeO greater than 15%. Alumina may be present (up to 10%), and then the composition is similar to that of the aluminous pyroxenes.

Occurrence. Sandoval County: Jemez region.

IDDINGSITE.

Physical characteristics. Orthorhombic. Structure laminated or foliated. Three pinacoidal cleavages. H.- 3. Sp.G.- 2.5-2.8. Luster on most perfect cleavage bronze-like. Color brown.

Chemical composition. An alteration product of chrysolite, $MgO.Fe_2O_3.3SiO_2.4H_2O$.

HYPERSTHENE.

Physical characteristics. Orthorhombic. Crystals rare, prismatic or tabular. Usually foliated massive; sometimes in embedded spherical forms. Cleavage: one distinct, one good parting. Fracture uneven. Brittle. H.= 5-6. Sp.G.= 3.40-3.50. Luster somewhat pearly on cleavage surface, sometimes inclining to metalloidal. Color dark brownish green, grayish black, greenish black, pinchbeck-brown. Streak grayish, brownish gray. Translucent to nearly opaque.

Chemical composition. $(Fe,Mg)SiO_3$ with FeO greater than 15%. Alumina may be present (up to 10%), and then the composition is similar to that of the aluminous pyroxenes.

Occurrence. Sandoval County; Jemez region.

IDDINGSITE.

Physical characteristics. Orthorhombic. Structure lamellar or foliated. Three pinacoidal cleavages. H.= Sp.G.= 2.5-2.8. Luster on most perfect cleavage brilliant. Color brown.

Chemical composition. An alteration product of olivine, $MgO.Fe_2O_3.3SiO_2.4H_2O$.

Occurrence. Colfax County: Raton region; at end of San Rafael lava flow. Luna County: Fort Cummings region.

ILMENITE. Menaccanite. Titanic Iron Ore.

Physical characteristics. Hexagonal-rhombohedral. Crystals usually thick tabular, also acute rhombohedral. Often in thin plates or laminae. Massive, compact; in embedded grains, also loose as sand. Fracture conchoidal. H.- 5-6. Sp.G.- 4.5-5. Luster submetallic. Color iron-black. Streak submetallic, powder-black to brownish red. Opaque. Slightly magnetic.

Chemical composition. Probably an iron titanate, $FeTiO_3$, or $FeO.TiO_2$, if normal.

Varieties. 1. Leucoxene. A dull white opaque substance, an alteration product of ilmenite. To be identified for the most part with titanite.

Occurrence. Grant County: Fierro-Hanover district. Lincoln County: Estey district. Luna County: Florida Mountains district. Santa Fe County: Old Placers district. Sierra County: (not specified). Socorro County: Magdalena district.

Var. Leucoxene. Luna County: Fluorite Ridge and Florida Mountains districts. San Miguel County: Willow Creek dis-

Occurrence. Valencia County: Grants region; at end of San Rafael lava flow. Luna County: Fort Cummings region.

ILMENITE. Menaccanite. Titanic Iron Ore.

Physical characteristics. Hexagonal-rhombohedral. Crystals usually thick tabular, also acute rhombohedral. Often in thin plates or laminae. Massive, compact; in embedded grains, also loose as sand. Fracture conchoidal. H.= 5-6. Sp.G.= 4.5-5. Luster submetallic. Color iron-black. Streak submetallic, powder-black to brownish red. Opaque. Slightly magnetic.

Chemical composition. Probably an iron titanate, $FeTiO_3$, or $FeO.TiO_2$, if normal.

Variation. 1. Leucoxene. A dull white opaque substance, an alteration product of ilmenite. To be identified for the most part with titanite.

Occurrence. Grant County: Tyrone-Hanover district. Lincoln County: Estey district. Luna County: Florida Mountains district. Santa Fe County: Old Placers district. Sierra County (not specified). Socorro County: Magdalena district.

Var. Leucoxene. Luna County: Victorio Hills and Florida Mountains districts. San Miguel County: Willow Creek district.

ILVAITE. Lievrite. Yenite.

Physical characteristics. Orthorhombic. Commonly in prisms, with prismatic faces vertically striated. Columnar or compact massive. Two rather distinct cleavages at right angles. Fracture uneven. Brittle. H.- 5.5-6. Sp.G.- 3.99-4.04. Luster submetallic. Color iron-black or dark grayish black. Streak black, inclining to green or brown. Opaque.

Chemical composition. $CaFe_2(FeOH)(SiO_4)_2$, or $H_2O.CaO.4FeO.Fe_2O_3.4SiO_2$.

Occurrence. Grant County: Fierro-Hanover and Santa Rita districts.

IODYRITE.

Physical characteristics. Hexagonal-hemimorphic. Natural crystals in hexagonal prisms. Also massive, and in thin plates with a lamellar structure. Cleavage: basal, perfect. Sectile, plates flexible. Soft. Sp.G.- 5.60-5.70. Luster resinous to adamantine. Color citron- and sulphur-yellow to yellowish green, sometimes brownish. Streak trial.

ILVAITE. Lievrite. Yenite.

Crystal characteristics. Orthorhombic. Usually in prisms, with prismatic faces vertically striated. Columnar or compact massive. Two rather distinct cleavages at right angles. Fracture uneven. Brittle. H.=5.5-6. Sp.G.--3.99-4.05. Luster submetallic. Color iron-black or dark grayish black. Streak black, inclining to green or brown. Opaque.

Chemical composition. $CaFe_2(FeOH)(SiO_4)_2$, or $H_2O.CaO.4FeO.Fe_2O_3.4SiO_2$.

Occurrence. Grant County; Fierro-Hanover and Central districts.

IODYRITE.

Crystal characteristics. Hexagonal-hemimorphic. Crystals in hexagonal prisms. Also massive, and in thin plates with a lamellar structure. Cleavage basal, perfect. Sectile, plates flexible. Soft. Sp.G.--5.60-5.71. Luster resinous to adamantine. Color citron- and sulphur-yellow to yellowish green, sometimes brownish. Streak yellow. Translucent.

<u>Chemical composition</u>. Silver iodide, AgI.

<u>Occurrence</u>. Grant County: Georgetown district. Sierra County: Lake Valley district.

<u>IRIDIUM</u>. Platiniridium.

<u>Physical characteristics</u>. Isometric. Crystals rare, generally cubes. Usually in angular grains. No distinct cleavage. Fracture hackly. Somewhat malleable. H.- 6-7. Sp.G.- 22.65-22.84. Luster metallic. Color silver-white, with tinge of yellow on surface; gray on fracture. Opaque.

<u>Chemical composition</u>. Iridium, Ir, alloyed with platinum and other allied metals.

<u>Occurrence</u>. Sierra County: Hillsboro district.

<u>JADEITE</u>.

<u>Physical characteristics</u>. Monoclinic. Usually massive, with crystalline structure. Sometimes granular, also obscurely columnar, fibrous foliated to closely compact. Cleavage: prismatic, at angles of about 93° and 87°.

yellow. Translucent.

Chemical composition. Silver iodide, AgI.

Occurrence. Grant County: Georgetown district. Sierra County: Lake Valley district.

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IRIDIUM. Platiniridium.

Physical characteristics. Isometric. Crystals rare, generally cubes. Usually in angular grains. No distinct cleavage. Fracture hackly. Somewhat malleable. H.= 6-7. Sp.G.= 22.65-22.84. Luster metallic. Color silver-white, with tinge of yellow on surface; gray on fracture. Opaque.

Chemical composition. Iridium, Ir, alloyed with platinum and other allied metals.

Occurrence. Sierra County: Hillsboro district.

JAROSITE.

Physical characteristics. Rhombohedral. Usually massive, with crystalline structure. Sometimes granular, also commonly columnar, fibrous drilled to closely packed. Cleavage: pyramidal, at angles of about 89° and 91°.

Fracture splintery. Extremely tough. H.- 6.5-7. Sp.G.- 3.3-3.5. Luster subvitreous, pearly on cleavage faces. Color apple-green to nearly emerald-green, bluish green, leek-green, greenish white, and nearly white. Sometimes white with spots of bright green. Translucent to subtranslucent.

Chemical composition. Metasilicate of sodium and aluminum, $NaAl(SiO_3)_2$, or $Na_2O.Al_2O_3.4SiO_2$.

Occurrence. Lincoln County: Jicarilla district.

JAROSITE.

Physical characteristics. Hexagonal-rhombohedral. Often in druses of minute crystals; also fibrous, granular massive; nodular, or as an incrustation. Cleavage: basal, distinct. Fracture uneven. Brittle. H.- 2.5-3.5. Sp.G.- 3.15-3.26. Luster vitreous to subadamantine; brilliant, also dull. Color ocher-yellow, yellowish brown, clove-brown. Streak yellow, shining.

Chemical composition. $K_2Fe_6(OH)_{12}(SO_4)_4$, or $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

Occurrence. Grant County: Burro Mountains and Central districts. Otero County: Orogrande district. Socorro County: Magdalena and San Andres Mountains (Goodfortune Creek, Fracture splintery. Extremely tough. H. 6.5-7. G. 3.3-3.5. Luster subvitreous, pearly on cleavage faces. Color apple-green to nearly emerald-green; bluish green, leek-green, greenish white, and nearly white. Sometimes white with spots of bright green. Translucent to subtranslucent.

Chemical composition. Metasilicate of sodium and aluminum. $NaAl(SiO_3)_2$, or $Na_2O.Al_2O_3.4SiO_2$.

Occurrence. Lincoln County: Jicarilla district.

JAROSITE

Physical characteristics. Hexagonal-rhombohedral. Often druses of minute crystals; also fibrous, granular, massive, nodular, or as an incrustation. Cleavage: basal, distinct. Fracture uneven. Brittle. H. 2.5-3.5. G. 3.15-3.26. Luster vitreous to subadamantine; brilliant; also dull. Color ocher-yellow, yellowish brown, clove-brown. Streak yellow, shining.

Chemical composition. $K_2Fe_6(OH)_{12}(SO_4)_4$, or $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

Occurrence. Grant County: Santa Rita and Chloride Flat districts. Sierra County: Caballos ... Hillsboro district. Socorro and San Andres Mountains ...

Grandview Canyon) districts.

KAINITE.

Physical characteristics. Monoclinic. Crystals not common, tabular, prismatic, and pyramidal. Usually granular massive and in crystalline crusts. Cleavage: one direction, very distinct; another direction, distinct. H.- 3. Sp.G.- 2.1. Luster vitreous. Color white or colorless to dark flesh-red. Easily fusible.

Chemical composition. $MgSO_4.KCl.3H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

KAOLINITE.

Physical characteristics. Monoclinic. In thin rhombic, rhomboidal, or hexagonal scales or plates with angles of 60° and 120°. Usually constituting a clay-like mass, either compact, friable, or mealy. Cleavage: basal, perfect. Plates flexible, inelastic. H.- 2-2.5. Sp.G.- 2.6-2.63. Luster of plates, pearly; of mass, pearly to dull earthy. Color white, grayish white, yellowish, sometimes brownish, bluish, or reddish. Scales transparent to translucent; usually unctuous and plastic.

Grandview Canyon) districts.

KAINITE.

Physical characteristics. Monoclinic. Crystals not common, tabular, prismatic, and pyramidal. Usually granular massive and in crystalline crusts. Cleavage: one direction, very distinct; another direction, distinct. H.—3. Sp.G.—2.1. Luster vitreous. Color white or colorless to dark flesh-red. Easily fusible.

Chemical composition. $MgSO_4.KCl.3H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

KAOLINITE.

Physical characteristics. Monoclinic. In thin rhombic, rhomboidal, or hexagonal scales or plates with angles of 60° and 120°. Usually constituting a clay-like mass, either compact, friable, or mealy. Cleavage: basal, perfect. Plates flexible, inelastic. H.—2-2.5. Sp.G.—2.6-2.63. Luster of plates, pearly; of mass, pearly to dull earthy. Color white, grayish white, yellowish, sometimes brownish, bluish, or reddish. Scales transparent to translucent; usually unctuous and plastic.

Chemical composition. $H_4Al_2Si_2O_9$, or $2H_2O.Al_2O_3.2SiO_2$.

Varieties. 1. Lithomarge. Compact kaolin, more or less impure and thus deeper in color than ordinary kaolinite. 2. Common kaolin. A mixture of lithomarge with a little crystalline kaolinite.

Occurrence. Catron County: Mogollon and Taylor Creek Tin districts. Dona Ana County: Organ and Tonuco Mountains Fluorspar districts. Grant County: Burro Mountains, Santa Rita, and Silver City Manganese-Iron districts. Sierra County: Hillsboro and Kingston districts. Socorro County: Magdalena Mountains Manganese, San Andres Mountains (Salinas Peak), and Socorro Peak districts.

Var. Lithomarge. Socorro County: Magdalena district.

KAYSERITE, variety of DIASPORE.

Ordinary varieties of the mineral diaspore are not definitely known in New Mexico. There is a doubtful variety known as kayserite reported in the State, with the following characteristics: Monoclinic. In scaly aggregates. Cleavage micaceous. H.- 5-6.

Chemical composition. $Al_2O_3.H_2O$, same as diaspore.

Occurrence. Socorro County: Ladrones Mountains district.

Chemical composition. [illegible]

Varieties. [illegible]

[illegible]

Occurrence. [illegible]

district. [illegible]

[illegible]

Tests. [illegible]

[illegible]

[illegible]

KIESERITE.

Physical characteristics. Monoclinic. Rarely in crystals, habit pyramidal. Usually massive, coarse to fine granular, or compact. Cleavage: two directions, pyramidal, perfect; several less perfect cleavages. Friable to firm. H.- 3-3.5. Sp.G.- 2.57. Luster vitreous. Color white, grayish, yellowish. Translucent to opaque. Little soluble. Fusible.

Chemical composition. Hydrous magnesium sulphate, $MgSO_4.H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

KYANITE. Cyanite. Disthene.

Physical characteristics. Triclinic. Usually in long bladed crystals, rarely terminated. Also coarsely bladed columnar to subfibrous. Cleavage: one direction, very perfect; another, less perfect; both parallel to the long axis of the bladed crystals; also parting, nearly at right angles to the two cleavages. H.- 5-7.25; the least, 4-5, on the surface of perfect cleavage parallel to the long axis; 6-7 on the same face parallel to the edge between it and the plane of basal parting; 7 on the plane of less perfect cleavage. Sp.G.- 3.56-3.67. Luster vitreous to pearly. Color blue, white; blue along the center of the blades or

KIESERITE.

Physical characteristics. Monoclinic. Rarely in crystals, habit pyramidal. Usually massive, coarse to fine granular, or compact. Cleavage: two directions, pyramidal, perfect; several less perfect cleavages. Friable to firm. H.= 3-3.5. Sp.G.= 2.57. Luster vitreous. Color white, grayish, yellowish. Translucent to opaque. Little soluble. Fusible.

Chemical composition. Hydrous magnesium sulphate, $MgSO_4 . H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

KYANITE. Cyanite. Disthene.

Physical characteristics. Triclinic. Usually in long bladed crystals, rarely terminated. Also coarsely bladed columnar to subfibrous. Cleavage: one direction, very perfect; another, less perfect; both parallel to the long axis of the bladed crystals; also parting, nearly at right angles to the two cleavages. H.= 5-7.25; the least, 4-5, on the surface of perfect cleavage parallel to the long axis; 6-7 on the same face parallel to the edge between it and the plane of basal parting; 7 on the plane of less perfect cleavage. Sp.G.= 3.56-3.67. Luster vitreous to pearly. Color blue, white; blue along the center of the blades or crystals, with white margins; also gray, green, black. Streak uncolored. Translucent to transparent.

Chemical composition. Al_2SiO_5, or $Al_2O_3 \cdot SiO_2$, like andalusite and sillimanite.

Occurrence. Rio Arriba County: Bromide and Petaca districts. Sierra County: (not specified). Taos County: Glenwoody district.

LABRADORITE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see Plagioclase Feldspars. Labradorite is distinguished chiefly by the cleavage angle (86° 4'), specific gravity (2.665-2.695), and optical characters (differences in indices of refraction and extinction angles).

Chemical composition. $Ab_{50-30}An_{50-70}$. See table under Plagioclase Feldspars.

Occurrence. Catron County: Mogollon district. Colfax County: Raton region. Hidalgo County: Lordsburg district. Luna County: Florida Mountains district. Sandoval County: Jemez region. Sierra County: (not specified).

crystals, with white margins; also gray, green, black. Streak uncolored. Translucent to transparent.

Chemical composition. Al_2SiO_5, as are andalusite and sillimanite.

Occurrence. Rio Arriba County: Bromide and Petaca districts. Sierra County: (not specified). Taos County: Glenwoody district.

LABRADORITE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see *Plagioclase Feldspars*. Labradorite is distinguished chiefly by the cleavage angle (86° 4'), specific gravity ([illegible]), and optical characteristics (differences in indices of refraction and extinction angles).

Chemical composition. $Ab_{50}An_{50}$ to [illegible]. See table under *Plagioclase Feldspars*.

Occurrence. Catron County: Mogollon district. Grant County: [illegible] region. Hidalgo County: Lordsburg district. Luna County: Florida Mountains district. Sandoval County: Jemez region. Sierra County: (not specified).

LANGBEINITE.

Physical characteristics. Isometric. In highly modified crystals. Fracture conchoidal. H.- 3-4. Sp.G.- 2.81-2.86. Luster greasy to vitreous. Colorless when fresh, but taking up water rapidly when exposed to the air. Tasteless.

Chemical composition. $K_2Mg_2(SO_4)_3$, or $K_2SO_4.2MgSO_4$.

Occurrence. Eddy County: Carlsbad Potash district.

LEAD.

Physical characteristics. Isometric. Crystals rare. Usually in thin plates and small globular masses. Very malleable, and somewhat ductile. H.- 1.5. Sp.G.- 11.4. Luster metallic. Color lead-gray. Opaque.

Chemical composition. Nearly pure lead, Pb. Sometimes contains a little silver, also antimony.

Occurrence. Socorro County: Magdalena district.

LEONITE.

Physical characteristics. Monoclinic. In tabular crystals, also commonly massive. No distinct cleavage. Fracture conchoidal. H.- 3. Sp.G.- 2.25. Luster vitreous.

Colorless, white, or yellowish. Easily fusible.

Chemical composition. $MgSO_4 \cdot K_2SO_4 \cdot 4H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

LEPIDOLITE. Lithia Mica.

Physical characteristics. Monoclinic. In aggregates of short prisms. Crystals sometimes twins or trillings. Also in cleavable plates, but commonly massive scaly-granular, coarse or fine. Cleavage: basal, highly eminent. H.- 2.5-4. Sp.G.- 2.8-3.3. Luster pearly. Color rose-red, violet-gray or lilac, yellowish, grayish white, white. Translucent.

Chemical composition. Chiefly $(OH,F)_2KLiAl_2Si_3O_{10}$, but uncertain.

Occurrence. Taos County: Harding Mine district.

LEUCITE. Amphigene.

Physical characteristics. Isometric at about 600° C.; pseudo-isometric under ordinary conditions. Commonly in crystals varying in angle but little from the trapezohedron, sometimes with the cube and dodecahedron as subordinate

Colorless, white, or yellowish. Easily soluble.

Chemical composition. $MgCO_3.K_2CO_3.4H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

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LEPIDOLITE. Lithia Mica.

Physical characteristics. Monoclinic. In aggregates of short prisms. Crystals sometimes tabular or [illegible]. In cleavable plates, but commonly massive scaly-granular, coarse or fine. Cleavage: basal, highly eminent. H.2.5-4. Sp.G.= 2.8-2.9. Luster pearly. Color rose-red, violet-gray or lilac, yellowish, grayish white, white. Translucent.

Chemical composition. Chiefly $(OH,F)_2KLiAl_2Si_3O_{10}$, but uncertain.

Occurrence. Taos County: Harding Mine district.

LEUCITE. Amphigene.

Physical characteristics. Isometric at about 500° C.; pseudo-isometric under ordinary conditions. Commonly in crystals varying in angle [illegible] sometimes with the cube and [illegible] forms. Faces often showing fine striations due to twinning. Also in disseminated grains; rarely massive granular. No distinct cleavage. Fracture conchoidal. Brittle. H.- 5.5-6. Sp.G.- 2.45-2.50. Luster vitreous. Color white, ash-gray or smoke-gray. Streak uncolored. Translucent to opaque.

Chemical composition. $KAl(SiO_3)_2$, or $K_2O.Al_2O_3.4SiO_2$.

Occurrence. Mora County: near Fort Union. McKinley County: Todilto Park region.

LEVERRIERITE.

Physical characteristics. Monoclinic, pseudo-hexagonal. Crystals prismatic. In vermicular aggregates. Cleavage: basal, perfect; micaceous. H.- 1.5. Sp.G.- 2.5-2.6. Luster vitreous to pearly. Colorless to brown.

Chemical composition. A hydrated silicate of aluminum, formula doubtful, parhaps $2Al_2O_3.5SiO_2.5H_2O$.

Occurrence. McKinley County: Gallup-Zuni Coal Basin.

LIBETHENITE.

Physical characteristics. Orthorhombic. In crystals

usually small, short prismatic; often united in druses. Also globular or reniform and compact. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.- 4. Sp.G.- 3.6-3.8. Luster resinous. Color olive-green, generally dark. Streak olive-green. Translucent to subtranslucent.

Chemical composition. Basic copper phosphate, $Cu_3P_2O_8 \cdot Cu(OH)_2$, or $4CuO \cdot P_2O_5 \cdot H_2O$.

Occurrence. Grant County: Santa Rita district.

LIMONITE. Brown Hematite.

Physical characteristics. Not crystallized. A mineral colloid. Usually in stalactitic and botryoidal or mammillary forms, having a fibrous or subfibrous structure; also concretionary, massive; and occasionally earthy. H.- 5-5.5. Sp.G.- 3.6-4.0. Luster silky, often submetallic; sometimes dull and earthy. Color of fracture surface various shades of brown, commonly dark, and none bright; sometimes with a nearly black varnish-like exterior; when earthy, brownish yellow, ocher-yellow. Impure clay colored by earthy limonite is called yellow ocher. Streak yellowish brown. Opaque.

Chemical composition. Hydrous iron sesquioxide, approxi-

mately $2Fe_2O_3 \cdot 3H_2O$. May be considered as the amorphous form of goethite with adsorbed and capillary water.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Burro Mountains, Carpenter, Chloride Flat, Fierro-Hanover, Fierro Manganese, Georgetown, Gold Hill, Lone Mountain, Pinos Altos, Silver City Manganese-Iron, and Telegraph districts; Cottonwood Canyon Fluorite Prospect. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and San Simon districts. Lincoln County: Estey, Gallinas Mountains, Jicarilla, Tecolote Iron, and White Oaks districts. Luna County: Cooks Peak and Victorio districts. Otero County: Orogrande district. Rio Arriba County: Hopewell and Petaca districts; Tres Piedras region. Sandoval County: Cochiti, Nacimiento Mountains, and Placitas districts. San Miguel County: Rociada district; Las Vegas region, Upper Pecos region. Santa Fe County: Glorieta and New Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Derry Manganese, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, San Mateo Mountains, and Tierra Blanca districts. Socorro County: Gran Quivira, Hansonburg, Jones Camp, Joyita Hills, Magdalena Mountains Manganese, North Magdalena, Ojo Caliente, Rosedale, San Andres Mountains (Mockingbird Gap, Salinas Peak), Socorro Peak, and Water Canyon districts. Valencia County: Zuni mately $2Fe_2O_3.3H_2O$. May be considered as the amorphous form of goethite with adsorbed and capillary water.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Burro Mountains, Carpenter, Chloride Flat, Fierro-Hanover, Fierro Manganese, Georgetown, Gold Hill, Lone Mountain, Pinos Altos, Silver City Manganese-Iron, and Telegraph districts; Cottonwood Canyon Fluorite Prospect. Hidalgo County: Apache No. 2, Fremont, Sandia, Lordsburg, and San Simon districts. Lincoln County: Ancho, Gallinas Mountains, Jicarilla, Tecolote Iron, and White Oaks districts. Luna County: Cooks Peak and Victorio districts. Otero County: Orogrande district. Rio Arriba County: Hopewell and Ojo Caliente districts; Tres Piedras region. Sandoval County: Cochiti, Nacimiento Mountains, and Placitas districts. San Miguel County: Rociada district; Las Vegas region, Upper Pecos region. Santa Fe County: Cerrillos and San Pedro districts. Sierra County: Caballo Mountains, Chloride, Cuchillo Negro, Derry Manganese, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, San Mateo Mountains, and Tierra Blanca districts. Socorro County: Chupadera [illegible], Hansonburg, Jones Camp, Joyita Hills, Magdalena, Magdalena Manganese, North Magdalena, Ojo Caliente, Rosedale, San Andres Mountains (Hansonburg) [illegible], Salinas Peak, and Water Canyon districts. Valencia County: and

Mountains district.

LINARITE.

Physical characteristics. Monoclinic. In elongated or tabular crystals. Cleavage: one direction, perfect; another, distinct. Fracture conchoidal. Brittle. H.- 2.5. Sp.G.- 5.4. Luster vitreous to adamantine. Color deep azure-blue. Streak pale blue. Translucent. Easily fusible.

Chemical composition. A basic sulphate of lead and copper, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Occurrence. Dona Ana County: Organ district.

LUENEBURGITE. Lüneburgite.

Physical characteristics. Probably monoclinic. Crystals as six-sided plates. In flattened masses, fibrous to earthy structure. Cleavage prismatic. Sp.G.- 2.05. Colorless. Fusible.

Chemical composition. $3MgO.B_2O_3.P_2O_5.8H_2O$. May contain a little fluorine.

Occurrence. Eddy County: Carlsbad Potash district.

[illegible] district.

LINARITE

Physical characteristics. [illegible]
tabular crystals. Cleavage [illegible]
another, distinct. [illegible]
H.5. Sp.G.= 5.4. Luster [illegible]
deep azure-blue. [illegible]
fusible.

Chemical composition. A basic [illegible]
$(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Occurrence. Dense [illegible]

[illegible]

Physical characteristics. [illegible]
as six-sided plates [illegible]
structure. Cleavage [illegible]
flexible.

Chemical composition. [illegible]
little fluorite.

Occurrence. [illegible]

MAGNESITE.

Physical characteristics. Hexagonal-rhombohedral. Crystals rare, usually rhombohedral, also prismatic. Commonly massive; granular cleavable to very compact; earthy. Cleavage: rhombohedral, perfect. Fracture flat conchoidal. Brittle. H.- 3.5-4.5. Sp.G.- 3.0-3.12, in crystals. Luster vitreous; fibrous varieties sometimes silky. Color white, yellowish, or grayish white, brown. Transparent to opaque.

Chemical composition. Magnesium carbonate, $MgCO_3$. Iron carbonate is often present.

Occurrence. Eddy County: Carlsbad Potash district.

MAGNETITE. Magnetic Iron Ore.

Physical characteristics. Isometric. Most commonly in octahedrons, also in dodecahedrons with striated faces; in dendrites between plates of mica; crystals sometimes highly modified; cubic forms rare. Twins common, sometimes as polysynthetic twinning-lamellae, producing striations on the octahedral face and often parting or pseudo-cleavage. Massive, laminated; granular, coarse or fine; impalpable. Cleavage not distinct; parting octahedral, often highly developed. Fracture subconchoidal, uneven. Brittle.

MAGNESITE.

Physical characteristics. Hexagonal-rhombohedral. Crystals rare, usually rhombohedral; also prismatic. Commonly massive; granular cleavable to very compact; earthy. Cleavage: rhombohedral, perfect. Fracture flat conchoidal. Brittle. H.= 3.5-4.5. Sp.G.= 3.0-3.12, in crystals. Luster vitreous; fibrous varieties sometimes silky. Color white, yellowish, or grayish white, brown. Transparent to opaque.

Chemical composition. Magnesium carbonate, $MgCO_3$. Iron carbonate is often present.

Occurrence. Eddy County; Carlsbad Potash district.

MAGNETITE. Magnetic Iron Ore.

Physical characteristics. Isometric. Most commonly in octahedrons, also in dodecahedrons with striated faces; in dendrites between plates of mica; crystals sometimes highly modified, cubic forms rare. Twins common, sometimes as polysynthetic twinning-lamellae, producing striations on the octahedral face and often parting or pseudo-cleavage. Massive, laminated; granular, coarse or fine; impalpable. Cleavage not distinct; parting octahedral, often highly developed. Fracture subconchoidal to uneven. Brittle.

H.- 5.5-6.5. Sp.G.- 5.168-5.180 in crystals. Luster metallic and splendent to submetallic and rather dull. Color iron-black. Streak black. Opaque. Strongly magnetic.

Chemical composition. $Fe^{II}Fe^{III}_2O_4$, or $FeO.Fe_2O_3$. Sometimes contains titanium, up to 6% TiO_2.

Occurrence. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Ordan district. Grant County: Burro Mountains, Chloride Flat, Fierro-Hanover, and Santa Rita districts. Hidalgo County: Apache No. 2 district. Lincoln County: Capitan Mountain, Gallinas Mountains, Jicarilla, and White Oaks districts. Otero County: Orogrande district. Rio Arriba County: Bromide and Hopewell districts. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride and Cuchillo Negro districts. Socorro County: Gran Quivira, Iron Mountain No. 2, Jones Camp, and Magdalena districts.

MALACHITE.

Physical characteristics. Monoclinic. Crystals rarely distinct, usually slender, acicular prisms, grouped in tufts and rosettes. Twins common. Commonly massive or incrusting, with surface botryoidal, or stalactitic, and structure divergent; often delicately compact fibrous, and banded in color; frequently granular or earthy. Cleavage: basal, H.= 5.5-6.5. Sp.G.= 5.168-5.180 in crystals. Luster metallic and splendent to submetallic and rather dull. Color iron-black. Streak black. Opaque. Strongly magnetic.

Chemical composition. $Fe\,Fe_2O_4$, or $FeO \cdot Fe_2O_3$. Sometimes contains titanium, up to 6% TiO_2.

Occurrence. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Burro Mountains, Chloride Flat, Pierce-Hanover, and Santa Rita districts. Hidalgo County: Apache No. 2 district. Lincoln County: Capitan Mountain, Gallinas Mountains, Jicarilla, and White Oaks districts. Otero County: Orogrande district. Rio Arriba County: Petaca and Hopewell districts. Santa Fe County: New Placers and Old Placers districts. Sierra County: Chloride and Cuchillo Negro districts. Socorro County: Gran Quivira, Iron Mountain No. 2, Jones Camp, and Magdalena districts.

MALACHITE.

Physical characteristics. Monoclinic. Crystals rarely distinct, usually slender, acicular prisms, grouped in tufts and rosettes. Twins common. Commonly massive or incrusting, with surface botryoidal, or stalactitic, and structure divergent; often delicately compact fibrous, and banded in color; frequently granular or earthy. Cleavage perfect; another less perfect cleavage. Fracture subconchoidal, uneven. Brittle. H.- 3.5-4. Sp.G.- 3.9-4.03. Luster of crystals adamantine, inclining to vitreous; of fibrous varieties more or less silky; often dull and earthy. Color bright green. Streak paler green. Translucent to subtranslucent and opaque.

Chemical composition. Basic cupric carbonate, $CuCO_3.Cu(OH)_2$.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Hembrillo and Organ districts. Grant County: Burro Mountains, Central, Fierro-Hanover, Georgetown, Pinos Altos, and Santa Rita districts. Guadalupe County: Pastura district. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, and San Simon districts. Lincoln County: Estey and Jicarilla districts. Luna County: Florida Mountains district. Mora County: Coyote Creek district. Otero County: Orogrande, Sacramento, and Tularosa districts. Rio Arriba County: Abiquiu, Bromide, and Gallina districts. Sandoval County: Cochiti, Jemez Springs, Nacimiento Mountains, and Placitas districts. San Miguel County: El Porvenir, Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Glorieta, La Bajada, and New Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, and Kingston districts. Socorro County:

perfect; another less perfect [illegible]. Fracture [illegible] conchoidal, uneven. Brittle. H. [illegible]. G. [illegible]. Luster of crystals adamantine, [illegible] to vitreous; of fibrous varieties more or less silky; [illegible]. Color bright green. Streak [illegible] green. [illegible] subtranslucent and opaque.

Chemical composition. Basic copper carbonate, [illegible].

Occurrence. Bernalillo County: [illegible] district. Catron County: Mogollon district. [illegible] County: [illegible], and [illegible] districts. [illegible] Organ districts. [illegible] Central, Pierre-Hanover, [illegible] districts. Guadalupe County: [illegible] district. [illegible] County: Apache No. 2, Fremont, [illegible], and San Simon districts. Lincoln County: [illegible] districts. Luna County: Florida [illegible] district. [illegible] County: Coyote Creek district. Sierra County: [illegible], and Palomas districts. [illegible] County: [illegible], and Gallina districts. [illegible] County: Cochiti, Jemez Springs, [illegible] districts. San Miguel County: [illegible], and Willow Creek districts. [illegible] districts, La Bajada, and [illegible] districts. [illegible] County: [illegible] district, [illegible]. [illegible], Hillsboro, and [illegible].

Chupadero, Council Rock, Hansonburg, Hop Canyon, Iron Mountain No. 2, Jones Camp, Joyita Hills, Ladrones Mountains, Magdalena, Mill Canyon, North Magdalena, Ojo Caliente, Rayo, San Andres Mountains (Goodfortune Creek, Grandview Canyon, Mockingbird Gap, Salinas Peak, Sulphur Canyon), San Jose, San Lorenzo, Scholle, Socorro Peak, and Water Canyon districts. Taos County: Picuris district. Valencia County: Zuni Mountains district.

MALLARDITE.

Physical characteristics. Monoclinic. In crystalline masses with fibrous structure. Also massive. Colorless. Transparent. Easily soluble in water.

Chemical composition. Hydrous manganese sulphate, $MnSO_4 \cdot 7H_2O$.

Occurrence. Sierra County: Lake Valley district.

MANGANITE.

Physical characteristics. Orthorhombic. Crystals commonly prismatic, faces deeply striated vertically; often grouped in bundles. Also columnar, stalactitic. Cleavage: two directions, perfect. Fracture uneven. Brittle. H.- 4.

Chupadera, Council Rock, Hansonburg, Hop Canyon, Iron Mountain No. 2, Jones Camp, Joyita Hills, Ladrones Mountains, Magdalena, Mill Canyon, North Magdalena, Ojo Caliente, Rayo, San Andres Mountains (Goodfortune Creek, Grandview Canyon, Hembrillo Gap, Salinas Peak, Sulphur Canyon), San Jose, San Lorenzo, Scholle, Socorro Peak, and Water Canyon districts. Taos County: Picuris district. Valencia County: Zuni Mountains district.

MALLARDITE.

Physical characteristics. Monoclinic. In crystalline masses with fibrous structure. Also massive. Colorless. Transparent. Easily soluble in water.

Chemical composition. Hydrous manganese sulphate. $MnSO_4 \cdot 7H_2O$.

Occurrence. Sierra County: Lake Valley district.

MANGANITE.

Physical characteristics. Orthorhombic. Crystals commonly prismatic, (often deeply striated vertically) often grouped in bundles. Also columnar, stalactitic. Cleavage: one direction, perfect. Fracture uneven. Brittle. H.=4.

Sp.G.- 4.2-4.4. Luster submetallic. Color dark steel-gray to iron-black. Streak reddish brown, sometimes nearly black. Opaque; in thin particles sometimes brown by transmitted light.

Chemical composition. Hydrous manganese sesquioxide, MnO(OH), or $Mn_2O_3.H_2O$.

Occurrence. Dona Ana County: Rincon Manganese district. Grant County: Fierro Manganese and Silver City Manganese-Iron districts. Luna County: Little Florida Mountains district. Sierra County: Lake Valley district.

MANGANOSITE.

Physical characteristics. Isometric. Usually crystalline, in octahedrons. Cleavage cubic. H.- 5-6. Sp.G.- 5.18. Luster vitreous. Color emerald-green, becoming black on exposure.

Chemical composition. Manganese protoxide, MnO.

Occurrence. Socorro County: San Lorenzo district.

MARCASITE.

Physical characteristics. Orthorhombic. Twins sometimes occur, sometimes in stellate fivelings. Crystals commonly

Sp.G.— 4.2-4.4. Luster submetallic. Color dark steel-gray to iron-black. Streak reddish brown, sometimes nearly black. Opaque; in thin particles sometimes brown by transmitted light.

Chemical composition. Hydrous manganese sesquioxide, MnO(OH), or $Mn_2O_3.H_2O$.

Occurrence. Dona Ana County: Bishops Cap manganese district. Grant County: Pierro Manganese and Silver City manganese-iron districts. Luna County: Little Florida Mountains district. Sierra County: Lake Valley district.

MANGANOSITE.

Physical characteristics. Isometric. Usually crystallized in octahedrons. Cleavage cubic. H.= 5-6. Sp.G.= 5.18. Luster vitreous. Color emerald-green, becoming black on exposure.

Chemical composition. Manganese protoxide, MnO.

Occurrence. Socorro County: San Lorenzo district.

MARCASITE.

Physical characteristics. Orthorhombic. [illegible] [illegible], sometimes in stellate [illegible]. [illegible] [illegible] tabular parallel to the base, also pyramidal. Often massive; radiating fibrous; in stalactites; also globular, reniform, and other imitative shapes. No distinct cleavage. Fracture uneven. Brittle. H.- 6-6.5. Sp.G.- 4.85-4.90. Luster metallic. Color pale bronze-yellow, deepening on exposure. Streak grayish or brownish black. Opaque.

Chemical composition. Iron disulphide, like pyrite, FeS_2, but more subject to tarnish and decomposition than pyrite.

Occurrence. Sierra County: Hermosa district. Socorro County: Jones Camp district. Valencia County: Manzano Mountains region.

MASSICOT.

Physical characteristics. Orthorhombic. Massive, scaly, or earthy. H.- 2. Sp.G.- 8.0; 9.2-9.36 when pure. Luster dull. Color between sulphur- and orpiment-yellow, sometimes reddish. Streak lighter than the color. Opaque. Does not soil the fingers.

Chemical composition. Lead monoxide, PbO, more or less impure.

Occurrence. Grant County: Chloride Flat district. Sierra County: Hillsboro district. Socorro County: Magdalena and Socorro Peak districts. (Indefinite: "Spring Hill District".)

tabular parallel to the base, also pyramidal. Often massive; radiating fibrous; in stalactites; also globular, reniform, and other imitative shapes. No distinct cleavage. Fracture uneven. Brittle. H.= 6-6.5. Sp.G.= 4.85-4.90. Luster metallic. Color pale bronze-yellow, deepening on exposure. Streak grayish or brownish black. Opaque.

Chemical composition. Iron disulphide, like pyrite, FeS_2, but more subject to tarnish and decomposition than pyrite.

Occurrence. Sierra County: Hermosa district. Socorro County: Jones Camp district. Valencia County: Zuni Mountains region.

MASSICOT

Physical characteristics. Orthorhombic. Massive, scaly, or earthy. H.= 2. Sp.G.= 8.0; 9.3-9.56 when pure. Luster dull. Color between sulphur- and orpiment-yellow, sometimes reddish. Streak lighter than the color. Opaque. Does not soil the fingers.

Chemical composition. Lead monoxide, PbO, more or less impure.

Occurrence. Grant County: Chloride Flat district. Sierra County: Hillsboro district. Socorro County: Magdalena and Socorro Peak districts. [illegible]

MELANOTEKITE.

Physical characteristics. Orthorhombic. In prismatic crystals. Also massive; cleavable. Cleavage: two directions, distinct. H.- 6.5. Sp.G.- 5.73. Luster metallic to greasy. Color black to blackish gray. Streak greenish gray. Nearly opaque, but translucent in thin sections.

Chemical composition. $(Fe_4O_3)Pb_3(SiO_4)_3$, or $3PbO.2Fe_2O_3.3SiO_2$.

Occurrence. Sierra County: Hillsboro district.

MELANTERITE. Copperas.

Physical characteristics. Monoclinic. Usually capillary, fibrous, stalactitic, and concretionary; also massive, pulvurulent. Cleavage: one direction, perfect; another, less so. Fracture conchoidal. Brittle. H.- 2. Sp.G.- 1.89-1.90. Luster vitreous. Color various shades of green, passing into white, becoming yellowish on exposure. Streak uncolored. Subtransparent to translucent. Easily fusible. Taste sweetish, astringent, and metallic.

Chemical composition. Hydrous ferrous sulphate, $FeSO_4.7H_2O$.

Occurrence. Socorro County: Magdalena district.

[illegible]

Physical characteristics. [illegible]
crystals. [illegible]
tions, distinct [illegible]
to grayish. [illegible]
gray. [illegible]

Chemical composition. [illegible]

Occurrence. [illegible]

[illegible]

Physical characteristics. [illegible]
fibrous, [illegible]
pulverulent. [illegible]
less so. Fracture [illegible]
[illegible]
passing into [illegible]
[illegible]
[illegible]

Chemical composition. [illegible]

Occurrence. [illegible]

MIARGYRITE.

Physical characteristics. Monoclinic. Crystals thick tabular; also prismatic. Also massive. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.- 2-2.5. Sp.G.- 5.1-5.30. Luster metallic-adamantine. Color iron-black to steel-gray, in thin splinters deep blood-red. Streak cherry-red. Nearly opaque.

Chemical composition. $AgSbS_2$, or $Ag_2S.Sb_2S_3$.

Occurrence. Sierra County: Hermosa and Kingston districts.

MICA.

Common name for a group of allied minerals, comprising the separate species muscovite, paragonite, lepidolite, zinnwaldtite, biotite, phlogopite, and lepidomelane. The unimportant species roscoelite is also included. Of these, all except zinnwaldtite and lepidomelane occur in New Mexico. They are described separately in the text.

MICROCLINE. A species of Feldspar.

Physical characteristics. Triclinic. Twins: like orthoclase, also polysynthetic twinning producing lamellar structure. Crystals commonly prismatic, near orthoclase

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MICROCLINE. A species of feldspar.

Physical characteristics. Triclinic. Twins: like orthoclase, also polysynthetic twinning producing lamellar structure. Crystals commonly prismatic, near orthoclase in angles and habit. Also massive cleavable to granular compact. Cleavage: two directions, nearly at right angles, perfect. Fracture uneven. Brittle. H.- 6-6.5. Sp.G.- 2.54-2.57. Luster vitreous; on the most perfect cleavage face sometimes pearly. Color white to pale cream-yellow; also red, green. Transparent to translucent.

Chemical composition. Like orthoclase, $KAlSi_3O_8$, or $K_2O.Al_2O_3.6SiO_2$.

Varieties. 1. Amazonstone. Amazonite. Bright verdigris-green, sometimes mottled with white.

Occurrence. Rio Arriba County: Petaca district. Sierra County: Caballos Mountains district. Taos County: Harding Mine district.

Var. Amazonstone. Rio Arriba County: Petaca district. Taos County: Harding Mine district.

MICROLITE.

Physical characteristics. Isometric. Habit octahedral; crystals often very small and highly modified. Fracture conchoidal. Brittle. H.- 5.5. Sp.G.- 5.485-5.562. Luster resinous. Color pale yellow to brown, rarely hyacinth-red. Streak pale yellowish or brownish. Transparent to translucent or nearly opaque.

in angles and habit. Also massive glistening to granular compact. Cleavage: two directions, nearly at right angles, perfect. Fracture uneven. Brittle. H. = 6-6.5. G. = 2.54-2.57. Luster vitreous; on the most perfect cleavage face sometimes pearly. Color white to pale cream-yellow; also red, green. Transparent to translucent.

Chemical composition. Like orthoclase, $KAlSi_3O_8$, or $K_2O.Al_2O_3.6SiO_2$.

Variation. 1. amazonstone. Amazonite. Bright verdigris-green, sometimes mottled with white.

Occurrence. Rio Arriba County: Petaca district. Sierra County: Caballo Mountains district. Taos County: Harding Mine district.

Var. amazonstone. Rio Arriba County: Petaca district. Taos County: Harding Mine district.

MIMETITE.

Physical characteristics. Hexagonal. [illegible] crystals often very small and [illegible]. Brittle. H. = 3.5. G. = [illegible]. Luster resinous. Color pale yellow to brown, orange-yellow, [illegible] red. Streak white [illegible]. Translucent or nearly opaque.

Chemical composition. Essentially a calcium pyrotantalate, $Ca_2Ta_2O_7$, but containing also columbium, fluorine, and a variety of bases in small amount.

Occurrence. Taos County: Harding Mine district.

MIMETITE. Mimetesite.

Physical characteristics. Hexagonal. Crystals prismatic; sometimes rounded to globular forms. Also in mammillary crusts. No distinct cleavage. Fracture uneven. Brittle. H.- 3.5. Sp.G.- 7.0-7.25. Luster resinous. Color pale yellow, passing into brown; orange-yellow; white or colorless. Streak white or nearly so. Subtransparent to translucent.

Chemical composition. $(PbCl)Pb_4(AsO_4)_3$, or $Pb_3As_2O_8 \cdot PbCl_2$.

Occurrence. Socorro County: Socorro Peak district.

MINIUM.

Physical characteristics. Pulvurulent, occasionally in crystalline scales. H.- 2-3. Sp.G.- 4.6. Luster faint greasy or dull. Color vivid red, mixed with yellow. Streak orange-yellow. Opaque.

Chemical composition. Essentially a calcium pyroantimonate, $Ca_2Sb_2O_7$, but containing also antimony, fluorine, and a variety of bases in small amount.

Occurrence. Taos County: Harding Mine district.

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MIMETITE. Mimetesite.

Physical characteristics. Hexagonal. Crystals prismatic; sometimes rounded to globular forms. Also in mammillary crusts. No distinct cleavage. Fracture uneven. Brittle. H.= 3.5. Sp.G.= 7.0-7.25. Luster resinous. Color pale yellow, passing into brown; orange-yellow; white or colorless. Streak white or nearly so. Subtransparent to translucent.

Chemical composition. $(PbCl)Pb_4(AsO_4)_3$, or $9PbO \cdot 3As_2O_5 \cdot PbCl_2$.

Occurrence. Socorro County: Socorro Peak district.

MINIUM.

Physical characteristics. Pulverulent, occasionally in crystalline scales. H.= 2-3. Sp.G.= 4.6. Luster faint greasy or dull. Color vivid red, mixed with yellow. Streak orange-yellow. Opaque.

Chemical composition. Pb_3O_4, or $2PbO.PbO_2$.

Occurrence. Hidalgo County: Hachita district. Sierra County: Hillsboro district. Socorro County: Magdalena (?) and Socorro Peak (?) districts.

MIRABILITE. Glauber Salt.

Physical characteristics. Monoclinic. Crystals prismatic, short and thick, square or eight-sided. Usually in efflorescent crusts. One perfect prismatic cleavage. H.- 1.5-2. Sp.G.- 1.481. Luster vitreous. Color white. Transparent to opaque. Taste cool, then feebly saline and bitter.

Chemical composition. Hydrous sodium sulphate, $Na_2SO_4.10H_2O$.

Occurrence. Torrance County: Estancia Salt district.

MOLYBDENITE.

Physical characteristics. Hexagonal. Crystals hexagonal in form, tabular, or short prismatic, slightly tapering and horizontally striated. Commonly foliated, massive or in scales; also fine granular. Cleavage: basal, eminent. Laminae very flexible but not elastic. Sectile. H.- 1-1.5. Sp.G.- 4.7-4.8. Luster metallic. Color pure lead-gray.

Streak bluish gray on paper; greenish gray on porcelain. Opaque. Feel greasy.

Chemical composition. Molybdenum disulphide, MoS_2.

Occurrence. Colfax County: Baldy district. Dona Ana County: Organ and Texas districts. Grant County: Burro Mountains, Fierro-Hanover, and Santa Rita districts. Hidalgo County: Lordsburg district. Rio Arriba County: Bromide district. San Miguel County: El Porvenir and Rociada districts. Santa Fe County: Old Placers and Santa Fe districts. Sierra County: Hillsboro district. Socorro County: San Andres Mountains district (Salinas Peak). Taos County: Red River and Twining districts.

MONAZITE.

Physical characteristics. Monoclinic. Crystals commonly small, often flattened; sometimes prismatic; also large and coarse. In masses yielding angular fragments; in rolled grains. Cleavage: basal, sometimes perfect (may be parting). One other distinct cleavage. Fracture conchoidal to uneven. Brittle. H.- 5-5.5. Sp.G.- 4.9-5.3. Luster inclining to resinous. Color hyacinth-red, clove-brown, reddish or yellowish brown. Subtransparent to subtranslucent.

Streak bluish gray on paper, greenish gray on porcelain. Opaque. Feel greasy.

Chemical composition. Molybdenum disulphide, MoS_2.

Occurrence. Colfax County: Baldy district. Dona Ana County: Organ and Texas districts. Grant County: Burro Mountains, Fierro-Hanover, and Santa Rita districts. Hidalgo County: Lordsburg district. Rio Arriba County: Bromide district. San Miguel County: El Porvenir and Rociada districts. Santa Fe County: Old Placers and Santa Fe districts. Sierra County: Hillsboro district. Socorro County: San Andres Mountains district [illegible]. Taos County: Red River and Twining districts.

Monazite.

Physical characteristics. Monoclinic. Crystals usually small; often flattened; sometimes prismatic; also elongated and coarse. In masses yielding angular fragments; in rolled grains. Cleavage: basal, sometimes perfect (parting?). One other distinct cleavage. Fracture [illegible] uneven. Brittle. H.=5-5.5. G.=4.9-5.3. Luster inclining to resinous. Color hyacinth-red, clove-brown, reddish or yellowish brown. [illegible] brown.

Chemical composition. Phosphate of the cerium metals, essentially (Ce,La,Pr,Nd)PO_4. Thoria, ThO_2, and silica, SiO_2, are nearly always present, usually in the proper amounts to form thorium silicate.

Occurrence. Rio Arriba County: Petaca district; indefinite: "Chama River sands". Sierra County: Pittsburg district.

MONTMORILLONITE. A Clay Mineral.

Physical characteristics. Massive, clay-like. Very soft and unctuous. Sp.G.- 2. Luster feeble. Color white or grayish to rose-red, and bluish; also pistachio-green. Does not usually adhere to the tongue.

Chemical composition. Perhaps $(Mg,Ca)O.Al_2O_3.5SiO_2.nH_2O$, with n = 5-7. Always an alteration product of some aluminous mineral.

Occurrence. Rio Arriba County: three miles north of the east end of the Tierra Amarilla Grant. Taos County: Harding Mine district.

MUSCOVITE. Common Mica. Potash Mica.

Physical characteristics. Monoclinic. Twins common. Crystals rhombic or hexagonal in outline with plane angles

Chemical composition. Compounds of the cerium metals, essentially $(Ce,La,Y,Nd)PO_4$. Thoria, ThO_2, and silica, SiO_2, are nearly always present, usually in the proper amounts to form thorium silicate.

Occurrence. Rio Arriba County: Petaca district; indefinite: "Chama River sands". Sierra County: Pittsburg district.

MONTMORILLONITE. A Clay Mineral.

Physical characteristics. Massive, clay-like. Very soft and unctuous. Sp.G.= [illegible]. Luster resinous. Color white or grayish to rose-red, and bluish; also pistachio-green. Does not usually adhere to the tongue.

Chemical composition. Perhaps $(Mg,Ca)O.Al_2O_3.5SiO_2.nH_2O$, with n = 5-7. Always an alteration product of some aluminous mineral.

Occurrence. Rio Arriba County: three miles north of the east end of the Tierra Amarilla Grant. Taos County: Harding Mine district.

MUSCOVITE. Common Mica. Potash Mica.

Physical characteristics. Monoclinic. Prism angles. Crystals rhombic or hexagonal in outline with plane angles of 60° or 120°. Habit tabular, passing into tapering forms. Folia often very small and aggregated in stellate, plumose, or globular forms; or in scales, and scaly massive; also cryptocrystalline and compact massive. Cleavage: basal, eminent. Thin laminae flexible and elastic when bent, very tough, harsh to the touch, passing into kinds which are less elastic and have an unctuouc feel. H.- 2-2.25. Sp.G.- 2.76-3. Luster vitreous to more or less pearly or silky. Colorless, gray, brown, hair-brown, pale green, and violet, yellow, dark olive-green, rarely rose-red. Streak uncolored. Transparent to translucent.

Chemical composition. For the most part an orthosilicate of aluminum and potassium, $(H,K)AlSiO_4$, or $H_2KAl_3(SiO_4)_3$, when H:K = 2:1, as in the common kinds.

Varieties. 1. Sericite. A fine scaly variety, the scales in fibrous aggregates and characterized by silky luster.

Occurrence. Bernalillo County: Tijeras Canyon district. Dona Ana County: Organ district. Luna County: Florida Mountains district. Mora County: Talco region. Rio Arriba County: Bromide and Petaca districts. San Miguel County: Ribera region (Glorieta Mountains). Santa Fe County: Old Placers district; Nambe region. Sierra County: (not specified). Socorro County: San Andres Mountains district (Mockingbird Gap). Taos County: Glenwoody, Harding Mine, and Red River districts.

or 10° or 120°. Habit tabular, passing into tapering forms. Folia often very small and aggregated in stellate, plumose, or globular forms; or in scales, and scaly massive; also cryptocrystalline and compact massive. Cleavage: basal, eminent. Thin laminae flexible and elastic when bent, very tough, harsh to the touch, passing into kinds which are less elastic and have an unctuous feel. H.= 2-2.25. Sp.G.= 2.76-3. Luster vitreous to more or less pearly or silky. Colorless, gray, brown, hair-brown, pale green, and violet, yellow, dark olive-green, rarely rose-red. Streak uncolored. Transparent to translucent.

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Varieties. 1. Sericite. A fine scaly variety, the scales in fibrous aggregates and characterized by silky luster.

Occurrence. Bernalillo County: Tijeras Canyon district. Dona Ana County: Organ district. Luna County: Florida Mountains district. Mora County: Taos region. [illegible] County: Bromide and Petaca districts. San Miguel County: [illegible] region (Colorado, Rociada). [illegible] County: [illegible] districts; [illegible] region. [illegible] [illegible]). [illegible] County: [illegible] district ([illegible]). [illegible] County: [illegible], and Red River districts.

Var. Sericite. Catron County: Mogollon district. Dona Ana County: Tonuco Mountain Fluorspar district. Grant County: Burro Mountains, Central, Fierro-Hanover, and Santa Rita districts. Hidalgo County: Hachita and Lordsburg districts. Luna County: Cooks Peak district. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos and Old Placers districts. Sierra County: Caballos Mountains, Hillsboro, and Macho districts. Taos County: Picuris and Red River districts. Valencia County: Zuni Mountains district.

NATROJAROSITE.

Physical characteristics. Hexagonal-rhombohedral. In minute tabular crystals. H.- 3. Sp.G.- 3.2. Color ywllow-brown.

Chemical composition. $Na_2Fe_6(OH)_{12}(SO_4)_4$.

Occurrence. Luna County: Cooks Peak district.

NATROLITE.

Physical characteristics. Orthorhombic. Crystals prismatic, usually very slender to acicular; frequently divergent, or in stellate groups. Also fibrous, radiating, Var. Carlsite. Catron County: Mogollon district. Dona Ana County: Tonuco Mountain fluorspar district. Grant County: Burro Mountains, Central, Pinos Altos-Hanover, and Santa Rita districts. Hidalgo County: Apache and Lordsburg districts. Luna County: Cooke Peak district. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos and Old Placers districts. Sierra County: Caballos Mountains, Hillsboro, and Macho districts. Taos County: Picuris and Red River districts. Valencia County: Zuni Mountains district.

NATROJAROSITE.

Physical characteristics. Hexagonal-rhombohedral. In minute tabular crystals. H.= 3. Sp.G.= 3.2. Color yellow-brown.

Chemical composition. $Na_2Fe_6(OH)_{12}(SO_4)_4$.

Occurrence. Luna County: Cooke Peak district.

NATROLITE.

Physical characteristics. Orthorhombic. Capillary crystals, usually very slender to acicular; frequently divergent, or in radiate groups. Also fibrous, radiating;

massive, granular, or compact. Cleavage: two directions, prismatic, at right angles, perfect. Fracture uneven. H.- 5-5.5. Sp.G.- 2.20-2.25. Luster vitreous, sometimes inclining to pearly, especially in fibrous varieties. Color white, or colorless; to grayish, yellowish, reddish, to red. Transparent to translucent.

Chemical composition. $Na_2Al_2Si_3O_{10}.2H_2O$, or $Na_2O.Al_2O_3.3SiO_2.2H_2O$.

Occurrence. Colfax County: Raton region (?). Sandoval County: Jèmez region.

NEPHELITE. Nepheline. Elaeolite.

Physical characteristics. Hexagonal. In thick six- or twelve-sided prisms with plane or modified terminations. Also massive compact, and in embedded grains; structure sometimes thin columnar. Cleavage: prismatic, distinct; basal, imperfect. Fracture subconchoidal. Brittle. H.- 5.5-6. Sp.G.- 2.55-2.65. Luster vitreous to greasy; a little opalescent in some varieties. Colorless, white, or yellowish; also, when massive, dark green, greenish or bluish gray, brownish red and brick-red. Transparent to opaque.

Chemical composition. $NaAlSiO_4$. This is the composition

massive, granular, or compact. [illegible]
prismatic, at right angles, [illegible]
H.= 5-5.5. Sp.G.= 2.20-2.25. Luster vitreous, [illegible]
inclining to pearly, especially in [illegible]
Color white, or colorless; [illegible]
to red. Transparent to [illegible]

Chemical composition. [illegible]
$Na_2O.Al_2O_3.3SiO_2.2H_2O$.

Occurrence. Delta County; [illegible]
County; [illegible] region.

NEPHELITE. Nepheline. [illegible]

Physical characteristics. [illegible]
twelve-sided prisms with plane or [illegible]
Also massive compact, and in [illegible]
sometimes thin columnar. Cleavage: [illegible]
basal, imperfect. Fracture [illegible]
5.5-6. Sp.G.= 2.55-2.65. [illegible]
little opalescent in some [illegible]
yellowish; also, when massive, [illegible]
bluish gray, brownish red and [illegible]
opaque.

Chemical composition. [illegible]

of the artificial mineral. The natural mineral always contains varying amounts of excess silica and also small amounts of potash, approximately $Na_8K_2Al_8Si_9O_{34}$.

Occurrence. Colfax County: Raton region; Pleasant Valley region; Ciruella region. McKinley County: Zilditloi Mountain (near Todilto Park); in Todilto Park region. Santa Fe County: Old Placers district.

NICCOLITE. Copper Nickel.

Physical characteristics. Hexagonal. Crystals rare. Usually massive, nearly impalpable; also reniform, columnar; reticulated, arborescent. Fracture uneven. Brittle. H.- 5-5.5. Sp.G.- 7.33-7.67. Luster metallic. Color pale copper-red. Streak pale brownish black. Opaque.

Chemical composition. Nickel arsenide, NiAs, usually with a little iron or cobalt, also sulphur.

Occurrence. Grant County: Black Hawk district.

NOSELITE. (?)

A very doubtful occurrence, in microscopic grains. Colfax County: Pleasant Valley region (?).

OCTAHEDRITE. Anatase.

Physical characteristics. Tetragonal. Commonly octahedral, acute or obtuse; also tabular; rarely in prismatic crystals; frequently highly modified. Cleavage: basal and octahedral, perfect. Fracture subconchoidal. Brittle. H.- 5.5-6. Sp.G.- 3.82-3.95. Luster adamantine or metallic-adamantine. Color various shades of brown, passing into indigo-blue, and black; greenish yellow by transmitted light. Streak uncolored. Transparent to nearly opaque.

Chemical composition. Titanium dioxide, TiO_2. Commonly contains small amounts of iron oxide.

Occurrence. Grant County: Central district.

OKENITE.

Physical characteristics. Triclinic. In minute bladed or acicular crystals. Commonly fibrous; also compact. Cleavage: one direction, perfect. H.- 4.5-5. Sp.G.- 2.33. Luster subpearly. Color white, with a shade of yellow or blue. Subtransparent to subtranslucent. Frequently opalescent.

Chemical composition. $H_2CaSi_2O_6 \cdot H_2O$.

Occurrence. Grant County: Georgetown district.

<u>OCTAHEDRITE</u>. Anatase.

<u>Physical characteristics</u>. Tetragonal. Generally octahedral, acute or obtuse; also tabular; rarely in prismatic crystals; frequently highly modified. Cleavage: basal and octahedral, perfect. Fracture subconchoidal. Brittle. H.= 5.5-6. Sp.G.= 3.82-3.95. Luster adamantine or metallic-adamantine. Color various shades of brown, passing into indigo-blue, and black; greenish yellow by transmitted light. Streak uncolored. Transparent to nearly opaque.

<u>Chemical composition</u>. Titanium dioxide, TiO_2. Generally contains small amounts of iron oxide.

<u>Occurrence</u>. Grant County: Central district.

<u>OKENITE</u>.

<u>Physical characteristics</u>. Triclinic. In minute blades or tabular crystals. Commonly fibrous; also compact. Cleavage one direction, perfect. H.= 4.5-5. Sp.G.= 2.28. Luster subpearly. Color white, with a shade of yellow or bluish. Subtransparent to subtranslucent. [illegible] [illegible].

<u>Chemical composition</u>. $H_2CaSi_2O_6 \cdot H_2O$.

<u>Occurrence</u>. Grant County: [illegible] district.

OLIGOCLASE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see Plagioclase Feldspars. Oligoclase is distinguished chiefly by the cleavage angle (86° 32'), specific gravity (2.625-2.645), and optical characters (differences in indices of refraction and extinction angles).

Chemical composition. $Ab_{90-70}An_{10-30}$. See table under Plagioclase Feldspars.

Occurrence. Catron County: Mogollon district. Grant County: Burro Mountains district. Hidalgo County: Lordsburg district. Sandoval County: Jemez region. Sierra County: (not specified).

OPAL.

Physical characteristics. Amorphous (colloidal). Massive; sometimes small reniform, stalactitic, or large tuberose. Frequently pseudomorphous after other minerals. Also earthy. Fracture conchoidal. H.- 5.5-6.5. Sp.G.- 1.9-2.3; when pure 2.1-2.2. Luster vitreous, frequently subvitreous; often inclining to resinous, and sometimes to pearly. Color white, yellow, red, brown, green, gray, blue, generally pale; dark colors arise from foreign admixtures; sometimes a rich play of colors, or different colors by refracted and

OLIGOCLASE. A Plagioclase Feldspar.

Physical characteristics. For general physical characteristics, see Plagioclase Feldspars. Oligoclase is distinguished chiefly by the cleavage angle (86° 32'), specific gravity (2.650-2.660), and optical characters (differences in indices of refraction and extinction angles).

Chemical composition. $Ab_{90-70}An_{10-30}$. See table under Plagioclase Feldspars.

Occurrence. Catron County: Magdalena district. Grant County: Burro Mountains district. Hidalgo County: [illegible] district. Sandoval County: Jemez region. [illegible] County (not specified).

OPAL.

Physical characteristics. Amorphous ($SiO_2 \cdot nH_2O$). Massive; sometimes small reniform, stalactitic, or large tuberous. Frequently pseudomorphous after other minerals. Also earthy. Fracture conchoidal. H.=[illegible]. G.=[illegible] when pure [illegible]. Luster vitreous, frequently subvitreous, often inclining to resinous, and sometimes to pearly. Color white, yellow, red, brown, green, gray, blue, [illegible]; pale; dark colors arise from [illegible]. [illegible] a rich play of colors, or [illegible] refraction and reflected light. Streak white. Transparent to nearly opaque.

Chemical composition. Silica, like quartz, with a varying amount of water, $SiO_2.nH_2O$. The percentage of water is usually small with a maximum of about 10%.

Varieties. 1. Fiorite. Siliceous sinter. Transparent to opaque; grayish, whitish, or brownish in color; in crusts porous to firm in texture, sometimes fibrous and then pearly in luster (Pearl-sinter); deposited from siliceous waters of hot springs. 2. Hyalite. Muller's Glass. Clear as glass and colorless; in globular concretions, and crusts with a globular or botryoidal surface; also translucent and whitish.

Occurrence. Grant County: Central and Santa Rita districts. Luna County: Deming region. Sandoval County: Cochiti district; Rio Puerco Valley region. Sierra County: (not specified).

Var. Fiorite. Grant County: Faywood Hot Springs. Socorro County: Socorro Hot Springs.

Var. Hyalite. Grant County: Central district. Hidalgo County: San Simon district. Sandoval County: Cochiti district.

reflected light. Opaque white. Transparent to nearly opaque.

Chemical composition. Silica, like quartz, with a varying amount of water, $SiO_2 \cdot nH_2O$. The percentage of water is usually small with a maximum of about 10%.

Variations. 1. Fiorite. Siliceous sinter. Transparent to opaque; grayish, whitish, or brownish in color; in crusts porous to firm in texture, sometimes fibrous and then pearly in luster (Pearl-sinter); deposited from siliceous waters of hot springs. 2. Hyalite. Muller's Glass. Clear as glass and colorless; in globular concretions, and crusts with a globular or botryoidal surface; also translucent and whitish.

Occurrence. Grant County: Central and Santa Rita districts. Luna County: Deming region. Sandoval County: Cochiti district; Rio Puerco Valley region. Sierra County: (not specified).

Var. Fiorite. Grant County: Faywood Hot Springs. Socorro County: Socorro Hot Springs.

Var. Hyalite. Grant County: Central district. Hidalgo County: San Simon district. Sandoval County: Cochiti district.

ORTHOCLASE. Feldspar.

Physical characteristics. Monoclinic. Twins, the common Carlsbad type, either penetration- or contact-twins, common. Crystals often prismatic; rarely tabular. Often massive, coarsely cleavable to granular; sometimes lamellar. Also compact cryptocrystalline, and flint-like or jasper-like. Cleavage: two directions, prismatic, at right angles, perfect. Fracture condhoidal to uneven. Brittle. H.- 6. Sp.G.- 2.56-2.58. Luster vitreous; on the most perfect cleavage face often pearly. Colorless, white, pale yellow and flesh-red common; gray; rarely green. Streak uncolored.

Chemical composition. A silicate of aluminum and potassium, $KAlSi_3O_8$, or $K_2O.Al_2O_3.6SiO_2$. Sodium is often present, replacing part of the potassium (soda orthoclase).

Varieties. 1. Adularia. Pure or nearly pure potassium silicate. Usually in crystals; twins common. Sp.G.- 2.565. Transparent or nearly so. Often with pearly opalescent reflection or play of colors; then known as moonstone, which is a microperthitic intergrowth of orthoclase and albite. 2. Microperthire. A laminated intergrowth of orthoclase and albite; structure discernible only under the microscope. 3. Perthite. Same as microperthite, except that the structure may be observed with the unaided eye. 4. Sanidine. Glassy feldspar. In crystals, often transparent and glassy. Habit often tabular; also in square

prisms; Carlsbad twins common. Sodium prominent in most varieties.

<u>Occurrence</u>. Bernalillo County: Tijeras Canyon district. Dona Ana County: Organ district. Grant County: Burro Mountains district. Hidalgo County: Hachita district. Luna County: Fluorite Ridge district. Otero County: Orogrande district. Sandoval County: Jemez region. Sierra County: Caballos Mountains and Hillsboro districts. Taos County: Harding Mine and Red River districts.

Var. <u>Adularia</u>. Catron County: Mogollon district. Sierra County: Chloride district.

Sub-var. <u>Moonstone</u>. Socorro County: San Mateo Mountains region.

Var. <u>Microperthite</u>. Luna County: Deming region. Santa Fe County: Cerrillos district. Valencia County: Zuni Mountains district.

Var. <u>Perthite</u>. Luna County: Deming region. Valencia County: Zuni Mountains district.

Var. <u>Sanidine</u>. Luna County: in rhyolite and rhyolite porphyry. Sandoval County: Jemez region, at several localities. San Juan County: The Palisades (north of Crystal). Sierra County: (not specified). Socorro County: Magdalena Mountains region.

[illegible]

varieties.

[illegible]

district. [illegible]

Cabaline [illegible]

[illegible]

Sierra County [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

PARAGONITE. Sodium Mica.

Physical characteristics. Massive, sometimes consisting distinctly of fine pearly scales; also compact. Cleavage: basal, eminent. H.- 2.5-3. Sp.G.- 2.78-2.90. Luster strong pearly. Color yellowish, grayish, grayish white, greenish, light apple-green. Translucent, single scales transparent.

Chemical composition. A sodium mica, corresponding to muscovite in composition, $H_2NaAl_3(SiO_4)_3$, or $2H_2O.Na_2O.3Al_2O_3.6SiO_2$. A little potassium is often present.

Occurrence. Taos County: Glenwoody district.

PEARCEITE. Arsenical Polybasite.

Physical characteristics. Monoclinic, pseudo-rhombohedral. In tabular crystals. Probably twinned according to the mica law. Also massive. Cleavage none. Fracture conchoidal. Brittle. H.- 3. Sp.G.- 6.125-6.166. Luster metallic. Color and streak black. Opaque.

Chemical composition. Ag_9AsS_6, or $9Ag_2S.As_2S_3$, an arsenical polybasite.

Occurrence. Socorro County: Magdalena district.

PECTOLITE.

Physical characteristics. Monoclinic. Commonly in close aggregations of acicular crystals, rarely terminated. Fibrous massive, radiated to stellate. Cleavage: two directions, perfect. Fracture uneven. Brittle. H.- 5. Sp.G.- 2.74-2.88. Luster of the surface of fracture silky or subvitreous. Color whitish or grayish. Subtranslucent to opaque. Often gives out light when struck or broken in the dark.

Chemical composition. $HNaCa_2(SiO_3)_3$, or $H_2O.Na_2O.4CaO.6SiO_2$.

Occurrence. Taos County: Glenwoody district.

PETALITE. (?)

Physical characteristics. Monoclinic. Crystals rare. Usually massive, foliated cleavable. Cleavage: one direction, perfect; another, easy. Fracture imperfectly conchoidal. Brittle. H.- 6-6.5. Sp.G.- 2.39-2.46. Luster vitreous, on the perfect cleavage surface pearly. Colorless, white, gray, occasionally reddish or greenish white. Streak uncolored. Transparent to translucent.

Chemical composition. $LiAl(Si_2O_5)_2$, or $Li_2O.Al_2O_3.8SiO_2$.

Occurrence. Taos County: Glenwoody (?), Harding Mine (?),

and Picuris (?) districts.

PETZITE.

Physical characteristics. Massive, fine granular to compact. Fracture subconchoidal. Slightly sectile to brittle. H.- 2.5-3. Sp.G.- 8.7-9.02. Luster metallic. Color steel- or iron-gray to iron-black; often tarnishing.

Chemical composition. A telluride of silver and gold, $(Ag,Au)_2Te$.

Occurrence. Sierra County: Tierra Blanca district. Taos County: Anchor and Red River districts.

PHLOGOPITE. Magnesium Mica.

Physical characteristics. Monoclinic. Crystals prismatic, tapering; often large and coarse; in scales and plates. Cleavage: basal, highly eminent. Thin laminae tough and elastic. H.- 2.5-3. Sp.G.- 2.78-2.85. Luster pearly, often submetallic on cleavage surface. Color yellowish brown to brownish red, with often a copper-like reflection; also pale brownish yellow, green, white, colorless. Transparent to translucent in thin folia.

Chemical composition. A magnesium mica, near biotite, but and Pinuria (?) districts.

PETZITE.

Physical characteristics. Massive, fine granular to compact. Fracture subconchoidal. Slightly sectile to brittle. H.= 2.5-3. Sp.G.= 8.7-9.02. Luster metallic. Color steel-gray to iron-black; often tarnishing.

Chemical composition. A telluride of silver and gold. $(Ag,Au)_2Te$.

Occurrence. Sierra County: Tierra Blanca district. Taos County: Anchor and Red River districts.

PHLOGOPITE. Magnesium Mica.

Physical characteristics. Monoclinic. Crystals prismatic, tapering; often large and coarse; in scales and plates. Cleavage: basal, highly eminent. Thin laminae tough and elastic. H.= 2.5-3. Sp.G.= 2.78-2.85. Luster pearly, often submetallic on cleavage surface. Color yellowish-brown to brownish red, with often a copper-like reflection; also pale brownish yellow, green, white, colorless. Transparent to translucent in thin folia.

Chemical composition. A magnesium mica, near biotite in with little iron; fluorine is nearly always present in traces. $H_2KMg_3Al(SiO_4)_3$.

Occurrence. Santa Fe County: Nambe region.

PHOSGENITE. (?)

Physical characteristics. Tetragonal. Crystals prismatic; sometimes tabular parallel to the base. Cleavage: prismatic, first and second order, distinct. Also basal. Rather sectile. H.- 2.75-3. Sp.G.- 6.0-6.3. Luster adamantine. Color white, gray, and yellow. Streak white. Transparent to translucent.

Chemical composition. Lead chlorocarbonate, $(PbCl)_2CO_3$, or $PbCO_3.PbCl_2$.

Occurrence. Dona Ana County: Organ district (?).

PICKERINGITE. Magnesia Alum.

Physical characteristics. Monoclinic. In fine acicular crystals; in long fibrous masses; and in efflorescences. H.- 1. Sp.G.- 1.85. Luster silky. Colorless, white, yellow, pale rose-red. Becomes white and pulvurulent on exposure. Taste bitter to astringent. Easily fusible.

with little iron; fluorine is nearly always present in traces. $H_2KMg_3Al(SiO_4)_3$.

Occurrence. Santa Fe County: Nambe region.

- -

PHOSGENITE. (?)

Physical characteristics. Tetragonal. Crystals prismatic; sometimes tabular parallel to the base. Cleavage: prismatic, first and second order, distinct. Also basal. Rather sectile. H.—2.75–3. Sp.G.—6.0–6.3. Luster adamantine. Color white, grey, and yellow. Streak white. Transparent to translucent.

Chemical composition. Lead chlorocarbonate, $(PbCl)_2CO_3$ or $PbCO_3 \cdot PbCl_2$.

Occurrence. Dona Ana County: Organ district (?).

PICKERINGITE. Magnesia Alum.

Physical characteristics. Monoclinic. In fine acicular crystals; in long fibrous masses; and as efflorescence. H.—1.5. Sp.G.—1.73. Luster silky. Colorless, white, yellowish, pale rose-red. [illegible] white and [illegible] to [illegible]. Taste bitter to astringent. Easily fusible.

Chemical composition. $MgSO_4.Al_2(SO_4)_3.22H_2O$.

Occurrence. Quay County: Tucumcari region.

PICROALLUMOGENE. Picrallumogene.

Physical characteristics. Stalactitic; in nodular and fibrous radiated masses. Color white, with a rose-red tinge. Streak nearly white. Semi-translucent. Taste acid, bitter.

Chemical composition. $2MgSO_4.Al_2(SO_4)_3.28H_2O$, if homogeneous.

Occurrence. San Miguel County: Las Vegas region.

INTERMEDIATE PLAGIOCLASE FELDSPARS.

The members of this group are not to be regarded as distinct species, but are instead certain sections of the albite-anorthite isomorphous series. The complete series, grading from pure albite ($NaAlSi_3O_8$) to anorthite (CaAl Si O), consists of the varieties oligoclase, andesine, labradorite, and bytownite. All of these occur in New Mexico, although bytownite is a rare type, occurring only in certain basic rocks.

Chemical composition. [illegible]

Occurrence. Inyo County [illegible]

PICROALLUMOGENE [illegible]

Physical characteristics. [illegible] fibrous radiated masses. [illegible] tinge. Streak nearly white. [illegible] acid, bitter.

Chemical composition. [illegible] gaseous.

Occurrence. San Miguel County [illegible]

INTERMEDIATE [illegible]

The members of this group [illegible] distinct species [illegible] alkali-[illegible] [illegible] grading from pure [illegible] (Na [illegible] O), [illegible] also [illegible] Ben Mohr [illegible] only in certain [illegible]

Physical characteristics. Triclinic. Crystals as with albite and anorthite. Twinning as with albite. Crystals not common. Usually massive, cleavable, granular, or compact. Cleavage as in albite, the two perfect cleavages more nearly at right angles as the albite end of the series is approached. H.- 5-6. Sp.G.- 2.60-2.75, lower toward the albite end of the series. Color white, gray, greenish, yellowish, brown, reddish; at times colorless. A play of colors is a common character, especially in certain labradorites. Blue and green are the predominant colors, but yellow, fire-red, and pearl-gray also occur. Transparent to subtranslucent.

Chemical composition. The table below gives the proportions of the ALBITE molecule ($NaAlSi_3O_8$) to the ANORTHITE molecule ($CaAl_2Si_2O_8$) in the members of the series.

	Albite Molecule	Anorthite Molecule
ALBITE	100 to 90%	0 to 10%
OLIGOCLASE	90 to 70%	10 to 30%
ANDESINE	70 to 50%	30 to 50%
LABRADORITE	50 to 30%	50 to 70%
BYTOWNITE	30 to 10%	70 to 90%
ANORTHITE	10 to 0%	90 to100%

The two end-species, and the varieties, are described separately in the text.

Physical characteristics [illegible]

albite and anorthite. [illegible]

not common. [illegible]

pact. Cleavage as in albite. [illegible]

more nearly at right angles [illegible]

is approximate. [illegible]

the albite end of the [illegible]

yellowish brown, [illegible]

colors in a mineral [illegible]

cadorite. [illegible]

yellow, fire-red, [illegible]

to subtranslucent.

Chemical composition. [illegible]

tions of the [illegible]

molecule [illegible]

[illegible]

The [illegible]

separately in the [illegible]

PLATINUM.

Physical characteristics. Isometric. Crystals rare; usually in grains and scales. Cleavage none. Fracture hackly. Malleable and ductile. H.- 4-4.5. Sp.G.- 14-19 native; 21-22 chemically pure. Luster metallic. Color and streak whitish steel-gray; shining. Sometimes magnetic.

Chemical composition. Platinum, Pt, alloyed with iron, iridium, rhodium, palladium, osmium, and other metals.

Occurrence. Lincoln County: Jicarilla district. Rio Arriba County: Bromide district.

PLATTNERITE.

Physical characteristics. Tetragonal. Rarely in crystals, habit prismatic. Usually massive; sometimes in globular or mammillary forms. Cleavage not observed. Fracture subconchoidal to uneven. Brittle. H.- 5-5.5. Sp.G.- 8.5. Luster submetallic. Color iron-black. Streak chestnut-brown. Translucent to nearly opaque.

Chemical composition. Lead dioxide, PbO_2.

Occurrence. Grant County: Central district. Luna County: Cooks Peak district.

PLATINUM.

Physical characteristics. Isometric. Crystals rare; usually in grains and scales. Cleavage none. Fracture hackly. Malleable and ductile. H.— 4-4.5. Sp.G.— 14-19 native; 21-22 chemically pure. Luster metallic. Color and streak whitish steel-gray; shining. Sometimes magnetic.

Chemical composition. Platinum, Pt, alloyed with iron, iridium, rhodium, palladium, osmium, and other metals.

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Physical characteristics. Tetragonal. Rarely in crystals; habit prismatic. Usually massive; sometimes in globular or mammillary forms. Cleavage not observed. Fracture subconchoidal to uneven. Brittle. H.— 5-5.5. Sp.G.— 8.5. Luster submetallic. Color iron-black. Streak chestnut-brown. Translucent to nearly opaque.

Chemical composition. Lead dioxide, PbO_2.

Occurrence. Grant County: Central district. Luna County: Cooks Peak district.

PLUMBOJAROSITE.

Physical characteristics. Hexagonal-rhombohedral. In minute tabular crystals. Cleavage: rhombohedral. Sp.G.- 3.67. Color dark brown.

Chemical composition. $PbFe_6(OH)_{12}(SO_4)_4$.

Occurrence. Grant County: Central district. Luna County: Cooks Peak district. Sierra County: (not specified). Socorro County: Magdalena and Water Canyon districts.

POLYBASITE.

Physical characteristics. Monoclinic. In short six-sided tabular prisms, with bevelled edges; basal faces with triangular striations; in part repeated twins. No distinct cleavage. Fracture uneven. H.- 2-3. Sp.G.- 6.0-6.2. Luster metallic. Color iron-black, in thin splinters cherry-red. Streak black. Nearly opaque.

Chemical composition. $9Ag_2S.Sb_2S_3$. Silver may be partly replaced by copper, and antimony by arsenic.

Occurrence. Grant County: Telegraph district.

POLYHALITE.

Physical characteristics. Triclinic. Usually in compact fibrous or lamellar masses. Cleavage: one direction, distinct. H.- 2.5-3. Sp.G.- 2.78. Luster resinous or slightly pearly. Color flesh- or brick-red, sometimes yellowish. Streak red. Translucent to opaque. Taste bitter and astringent, but very weak. Easily fusible.

Chemical composition. $2CaSO_4.MgSO_4.K_2SO_4.2H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

PREHNITE.

Physical characteristics. Orthorhombic. Distinct individual crystals rare, tabular or prismatic. Commonly in groups of tabular crystals, often barrel-shaped. Reniform, globular, and stalactitic with a crystalline surface. Structure imperfectly columnar or lamellar, strongly coherent; also compact granular or impalpable. Cleavage: one direction, parallel to tabular faces, distinct. Fracture uneven. Brittle. H.- 6-6.5. Sp.G.- 2.80-2.95. Luster vitreous; on cleavage surface weak pearly. Color light green, oil-green, passing into white and gray; often fading on exposure. Streak uncolored. Subtransparent to translucent.

Chemical composition. An acid orthosilicate of calcium

POLYHALITE.

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Chemical composition. $2CaSO_4.MgSO_4.K_2SO_4.2H_2O$.

Occurrence. Eddy County: Carlsbad Potash district.

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Chemical composition. An acid orthosilicate of calcium and aluminum, $H_2Ca_2Al_2(SiO_4)_3$. Ferric iron may replace aluminum in small amounts.

Occurrence. Colfax County: Raton region.

PROUSTITE. Ruby Silver Ore. Light Red Silver Ore.

Physical characteristics. Hexagonal-rhombohedral. Crystals often acute rhombohedral or scalenohedral. Twins sometimes occur. Also massive, compact. Cleavage: rhombohedral, distinct. Fracture conchoidal to uneven. Brittle. H.- 2-2.5. Sp.G.- 5.57-5.64; 5.57 if pure. Luster adamantine. Color scarlet-vermilion; streak same, also inclined to aurora-red.

Chemical composition. $3Ag_2S.As_2S_3$.

Occurrence. Colfax County: Baldy district. Grant County: Georgetown district. San Miguel County: Willow Creek district. Sierra County: Kingston and Lake Valley districts.

PSILOMELANE.

Physical characteristics. Massive and botryoidal; reniform; stalactitic. H.- 5-7. Sp.G.- 3.3-4.7. Luster submetallic, dull. Streak brownish black, shining. Color iron-black, passing into dark steel-gray. Opaque.

Chemical composition. A manganese oxide containing varying amounts of barium, potassium, and sodium oxides, and water. To be regarded as colloidal MnO_2 with various adsorbed impurities.

Varieties. 1. Wad. In amorphous and reniform masses, earthy or compact; also incrusting and as stains. Usually soft, soiling the fingers; less often hard, to H.- 6. Sp.G.- 3.0-4.26; often loosely aggregated and feeling very light. Color dull black, bluish or brownish black.

Occurrence. Catron County: Mogollon district. Dona Ana County: Rincon Manganese district. Grant County: Burro Mountains, Cap Rock Mountain Manganese, and Silver City Manganese-Iron districts. Luna County: Cooks Range Manganese, Florida Mountains, and Little Florida Mountains districts. Santa Fe County: Santa Fe Manganese district. Sierra County: Caballos Mountains, Derry Manganese, Hermosa, Hillsboro, Hot Springs, Kingston, Lake Valley, Macho, and Pittsburg districts. Socorro County: Luis Lopez Manganese, Magdalena, Magdalena Mountains Manganese, San Lorenzo, and Socorro Peak districts. Taos County: Glenwoody district.

Var. Wad. Dona Ana County: Rincon Manganese district. Grant County: Central, Fierro Manganese, and Silver City Manganese-Iron districts. Luna County: Florida Mountains and Little Florida Mountains districts. Sierra County: Derry Manganese, Hillsboro, Hot Springs, Kingston, and Lake

Chemical composition. A manganese oxide containing varying amounts of barium, potassium, and sodium oxides, and water. To be regarded as colloidal MnO_2 with various absorbed impurities.

Varieties. 1. Wad. In amorphous and reniform masses, earthy or compact; also incrusting and as stains. Usually soft, soiling the fingers; less often hard, up to 5-6. Sp.G.= 3.0-4.26; often loosely aggregated and feeling very light. Color dull black, bluish or brownish black.

Occurrence. Catron County: Mogollon district. Dona Ana County: Rincon Manganese district. Grant County: Burro Mountains, Cap Rock Mountain Manganese, and Silver City Manganese-Iron districts. Luna County: Cooke Range Manganese, Florida Mountains, and Little Florida Mountains districts. Santa Fe County: Santa Fe Manganese district. Sierra County: Caballos Mountains, Derry Manganese, Hermosa, Hillsboro, Hot Springs, Kingston, Lake Valley, Macho, and Pittsburg districts. Socorro County: Luis Lopez Manganese, Magdalena, Magdalena Mountains Manganese, San Lorenzo, and Socorro Peak districts. Taos County: Glenwoody district.

Var. Wad. Dona Ana County: Rincon Manganese district. Grant County: Central, Fierro Manganese, and Silver City Manganese-Iron districts. Luna County: Florida Mountains and Little Florida Mountains districts. Sierra County: Derry Manganese, Hillsboro, Hot Springs, Kingston, and Lake

Valley districts. Socorro County: Luis Lopez Manganese, Magdalena, Magdalena Mountains Manganese, Ojo Caliente, San Lorenzo, and Socorro Peak districts.

PYRARGYRITE. Ruby Silver Ore. Dark Red Silver Ore.

Physical characteristics. Hexagonal-rhombohedral. Crystals commonly prismatic. Twins common, often multiple. Also massive, compact. Cleavage: rhombohedral, distinct. Fracture conchoidal to uneven. Brittle. H.- 2.5. Sp.G.- 5.77-5.86; 5.85 if pure. Luster metallic-adamantine. Color black to grayish black; by transmitted light deep red. Streak purplish red. Nearly opaque, but transparent in very thin splinters.

Chemical composition. $3Ag_2S.Sb_2S_3$. Some varieties contain small amounts of arsenic.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district (?). Grant County: Black Hawk, Georgetown, and Gold Hill districts. Sierra County: Hermosa, Kingston, and Lake Valley districts.

PYRITE. Iron Pyrites.

Physical characteristics. Isometric-pyritohedral. Cube

Valley districts. Socorro County: Luis Lopez manganese, Magdalena, Magdalena mountains manganese, Ojo Caliente, San Lorenzo, and Socorro Peak districts.

<u>PYRARGYRITE</u>. Ruby silver ore. Dark red silver ore.

<u>Physical characteristics</u>. Hexagonal-rhombohedral. Crystals commonly prismatic. Twins common, often multiple. Also massive, compact. Cleavage rhombohedral, indistinct. Fracture conchoidal to uneven. Brittle. H = 2-2.5. G = 5.77-5.86; 5.85 if pure. Luster metallic-adamantine. Color black to grayish black; by transmitted light deep red. Streak purplish red. Nearly opaque, but translucent in very thin splinters.

<u>Chemical composition</u>. Ag_3SbS_3. Some varieties contain small amounts of arsenic.

<u>Occurrence</u>. Catron County: Mogollon district. Socorro County: Kelly district (?). Grant County: Black Hawk, Georgetown, and Gold Hill districts. Sierra County: Hermosa, Kingston, and Lake Valley districts.

<u>PYRITE</u>. Iron pyrites.

<u>Physical characteristics</u>. Isometric-pyritohedral. Crystals

and pyritohedron the common forms; the faces of both often striated and sometimes rounded; octahedron also common. Twins, usually penetration-twins; rarely contact-twins. Frequently massive, fine granular; sometimes subfibrous radiated; reniform, globular, stalactitic. No distinct cleavage. Fracture conchoidal to uneven. Brittle. H.- 6-6.5. Sp.G.- 4.95-5.10. Luster metallic, splendent to glistening. Color a pale brass-yellow, nearly uniform. Streak greenish black or brownish black. Opaque.

Chemical composition. Iron disulphide, FeS_2. Gold is often present in small quantities.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. Dona Ana County: Gold Camp, Modoc, Organ, and Texas districts. Eddy County: Carlsbad Potash district. Grant County: Alum Mountain, Black Hawk, Burro Mountains, Carpenter, Central, Fierro-Hanover, Fleming, Gold Hill, Lone Mountain, Pinos Altos, Santa Rita, Steeple Rock, Telegraph, and White Signal districts; Tellurium locality (41 miles northwest of Silver City). Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey, Jicarilla, Nogal, and White Oaks districts. Luna County: Cooks Peak, Tres Hermanas, and Victorio districts. Otero County: Orogrande and Tularosa districts. Rio Arriba County: Bromide and

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Hopewell districts. Sandoval County: Cochiti and Nacimiento Mountains districts. San Miguel County: Rociada, Tecolote, and Willow Creek districts. Santa Fe County: Cerrillos, New Placers, and Old Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, San Mateo Mountains, and Tierra Blanca districts. Socorro County: Ladrones Mountains, Magdalena, Mill Canyon, Rosedale, San Andres Mountains (Goodfortune Creek, Grandview Canyon), San Jose, Scholle, and Water Canyon districts. Taos County: Anchor, Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains district.

PYROLUSITE.

Physical characteristics. Orthorhombic, but pseudomorphous, commonly after manganite. Usually columnar, often divergent; also granular massive, and frequently in reniform coats. Soft, often soiling the fingers. H.- 2-2.5. Sp.G.- 4.73-4.86. Luster metallic. Color iron-black, dark steel-gray, sometimes bluish. Streak black or bluish black, sometimes submetallic. Opaque.

Chemical composition. Manganese dioxide, MnO_2. Commonly contains a little water, up to 2%.

Occurrence. Catron County: Mogollon district. Grant County:

Hopewell districts. Sandoval County: Cochiti and Nacimiento Mountains districts. San Miguel County: Tecolote, and Willow Creek districts. Santa Fe County: Cerrillos, New Placers, and Old Placers districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, Palomas, and Black Range; and Tierra Blanca districts. Socorro County: Ladrones Mountains, Magdalena, Mill Canyon, Rosedale, San Andres Mountains (Goodfortune Creek, Grandview Canyon), San Jose, Scholle, and Water Canyon districts. Taos County: Anchor, Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains district.

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Chemical composition. Manganese dioxide, MnO_2. Generally contains a little water, up to 2%.

Occurrence. Catron County: Mogollon district. ...

Burro Mountains, Central, Chloride Flat, Fierro-Hanover, and Silver City Manganese-Iron districts. Hidalgo County: Fremont, Hachita, Lordsburg, and San Simon districts. Lincoln County: White Oaks district. Luna County: Little Florida Mountains and Tres Hermanas districts. Santa Fe County: Santa Fe Manganese and New Placers districts. Sierra County: Derry Manganese, Hillsboro, Kingston, Lake Valley, and Macho districts. Socorro County: Luis Lopez Manganese, Magdalena, Magdalena Mountains Manganese, Mill Canyon, Rosedale, San Andres Mountains (Grandview Canyon, Mockingbird Gap), San Lorenzo, Socorro Peak, and Water Canyon districts.

PYROMORPHITE. Green Lead Ore.

Physical characteristics. Hexagonal-pyramidal. Crystals prismatic, often in rounded barrel-shaped forms; also in branching groups of nearly parallel prismatic crystals, tapering to a slender point. Often globular, reniform, and botryoidal or in wart-like shapes, and usually with a sub-columnar structure; also fibrous, and granular. No distinct cleavage. Fracture subconchoidal, uneven. Brittle. H.- 3.5-4. Sp.G.- 6.5-7.1, mostly, when pure; 5.9-6.5, when containing lime. Luster resinous. Color green, yellow, and brown, of different shades; sometimes wax-yellow to fine orange-yellow; also grayish white to milk-white.

Burro Mountains, Central, Chloride Flat, Fierro-Hanover, and Silver City Manganese-Iron districts. Hidalgo County: Fremont; Hachita, Lordsburg, and San Simon districts. Lincoln County: White Oaks district. Luna County: Little Florida Mountains and Tres Hermanas districts. Santa Fe County: Santa Fe Manganese and San Pedro districts. Sierra County: Derry Manganese, Hillsboro, Kingston, Lake Valley, and Macho districts. Socorro County: Luis Lopez Manganese, Magdalena, Magdalena Mountains Manganese, Mill Canyon, Rosedale, San Andres Mountains (Grandview Canyon; Mockingbird Gap), San Lorenzo, Socorro Peak, and Water Canyon districts.

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Streak white, sometimes yellowish. Subtransparent to subtranslucent.

Chemical composition. $(PbCl)Pb_4(PO_4)_3$, or also written $3Pb_3P_2O_8.PbCl_2$. Passes into mimetite as the phosphorus is replaced by arsenic.

Occurrence. Grant County: Central district. Sierra County: Caballos Mountains, Chloride, and Macho districts.

PYROSTILPNITE.

Physical characteristics. Monoclinic. In slender prismatic crystals, usually tabular. Usually grouped in small tufts resembling stilbite. Cleavage: one direction, perfect, parallel to tabular faces. Fracture conchoidal. H.- 2. Sp.G.- 4.2-4.25. Luster adamantine, on tabular faces pearly. Color hyacinth-red. Translucent.

Chemical composition. Same as pyrargyrite, Ag_3SbS_3, or $3Ag_2S.Sb_2S_3$.

Occurrence. Grant County: Black Hawk district. Sierra County: Kingston district.

PYROXENE.

Common name for a group of closely related species, falling into three different crystal systems, yet similar in form. The name is restricted here to a single species, Pyroxene, which is monoclinic. The forms occurring in New Mexico are varieties of this species.

In composition and form, the pyroxenes are very similar to the amphiboles, and are distinguished chiefly by a difference in cleavage angle (pyroxene nearly 90°; amphibole 55°-125° approx.); and by a difference in crystal form, the pyroxenes occurring in short, stout prismatic crystals; the amphiboles in long, slender, bladed crystals.

Varieties occurring in New Mexico include augite, diopside, and hedenbergite, as well as the sub-varieties chrome-diopside and mangan-hedenbergite. They are described separately in the text.

Occurrence. The following occurrences are of varieties identified only as the species pyroxene: Colfax County: Baldy district. Dona Ana County: Organ district. Grant County: Santa Rita district. Hidalgo County: San Simon district. Otero County: Orogrande district. Socorro County: Magdalena district.

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PYRRHOTITE. Magnetic Pyrites.

Physical characteristics. Hexagonal. Distinct crystals rare, commonly tabular; also acute pyramidal. Usually massive, with granular structure. Cleavage none. Parting: basal, sometimes distinct. Fracture uneven to subconchoidal. Brittle. H.- 3.5-4.5. Sp.G.- 4.58-4.64. Luster metallic. Color between bronze-yellow and copper-red, and subject to speedy tarnish. Streak dark grayish black. Magnetic, but varying much in intensity.

Chemical composition. Ferrous sulphide containing variable amounts of dissolved sulphur. Often also contains nickel. Analyses show variations from Fe_5S_6 to $Fe_{16}S_{17}$.

Occurrence. Colfax County: Elizabethtown district. Grant County: Fierro-Hanover and Santa Rita districts. Hidalgo County: Hachita district. San Miguel County: Willow Creek district. Santa Fe County: New Placers and Santa Fe districts. Socorro County: Magdalena district.

QUARTZ.

Physical characteristics. Hexagonal-rhombohedral. Crystals commonly prismatic, with prism faces horizontally striated; terminated commonly by both positive and negative rhombohedrons, in nearly equal development and giving the

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Chemical composition. Ferrous sulphide containing variable amounts of dissolved sulphur. Often also contains nickel. Analyses show variations from Fe_6S_7 to $Fe_{11}S_{12}$.

Occurrence. Colfax County: Elizabethtown-Baldy district. Grant County: Fierro-Hanover and Santa Rita districts. Hidalgo County: Hachita district. San Miguel County: Willow Creek district. Santa Fe County: New Placers and [illegible] districts. Socorro County: Magdalena district.

QUARTZ.

Physical characteristics. Hexagonal-rhombohedral. Crystals commonly prismatic, with prism faces horizontally striated; terminated commonly by both positive and negative rhombohedrons, in nearly equal development and giving the appearance of a hexagonal pyramid. Often in double six-sided pyramids or quartzoids through the equal development of the two rhombohedrons; when one is relatively large the form then has a cubic aspect. Crystals frequently distorted. Often elongated to acicular forms. Frequently in radiated masses, or in druses. Twins both as contact- and penetration-twins. Massive forms common and in great variety, passing from the coarse or fine granular and crystalline kinds to those which are flint-like or cryptocrystalline. Sometimes mammillary, stalactitic, and in concretionary forms; as sand. Cleavage not distinctly observed. Fracture conchoidal to subconchoidal in crystallized forms, uneven to splintery in some massive kinds. Brittle to tough. H.- 7. Sp.G.- 2.653-2.660 in crystals; cryptocrystalline forms somewhat lower (to 2.60) if pure; but impure massive forms (as jasper) higher. Luster vitreous, sometimes greasy; splendent to nearly dull. Colorless when pure; often various shades of yellow, red, brown, green, blue, black. Streak of pure varieties white; if impure, often the same as the color, but much paler. Transparent to opaque.

Chemical composition. Silica, or silicon dioxide, SiO_2. Impure varieties may contain opal, iron oxide, calcium carbonate, clay, sand, and various minerals as inclusions.

Varieties. A. Phenocrystalline or Vitreous. 1. Amethyst.

appearance of a hexagonal pyramid. Often in double six-sided pyramids or quartzoids through the equal development of the two rhombohedrons; when one is relatively large the form then has a cubic aspect. Crystals frequently distorted. Often elongated to acicular forms. Frequently in radiated masses, or in druses. Twins both as contact- and penetration-twins. Massive forms common and in great variety, passing from the coarse or fine granular and crystalline kinds to those which are flint-like or cryptocrystalline. Sometimes mammillary, stalactitic, and in concretionary forms; as sand. Cleavage not distinctly observed. Fracture conchoidal to subconchoidal in crystallized forms, uneven to splintery in some massive kinds. Brittle to tough. H.- 7. Sp.G.- 2.653-2.660 in crystals; cryptocrystalline forms somewhat lower (to 2.60) if pure; but impure massive forms (as jasper) higher. Luster vitreous, sometimes greasy; splendent to nearly dull. Colorless when pure; often various shades of yellow, red, brown, green, blue, black. Streak of pure varieties white; if impure, often the same as the color, but much paler. Transparent to opaque.

Chemical composition. Silica, or silicon dioxide, SiO_2. Impure varieties may contain opal, iron oxide, calcium carbonate, clay, sand, and various minerals as inclusions.

Varieties. - Phenocrystalline or Vitreous. 1. Amethyst.

Amethystine Quartz. Clear Purple, or bluish violet. Color perhaps due to manganese.

B. Cryptocrystalline. 1. Agate. Waterstones. A variegated chalcedony; colors (a) banded; (b) irregularly clouded; (c) due to visible impurities, as moss agate. Bands white, brown, bluish, etc.; straight, wavy, or concentric circular. 2. Agatized Wood. Wood petrified with clouded agate. 3. Carnelian. Sard. A clear red chalcedony, pale to deep in shade; also brownish red to brown. 4. Chalcedony. Having the luster nearly of wax; transparent or translucent. Sp.G.- 2.6-2.64. Colors varied, varieties often based on color. Often mammillary, botryoidal, stalactitic, and as lining or filling in cavities. Often contains disseminated opal-silica. 5. Flint. More opaque than chalcedony, and of dull colors, usually gray, smoky brown, and brownish black. Exterior often whitish from lime or chalk in which it is embedded. Luster subvitreous. Deep conchoidal fracture. Colored by carbonaceous matter. 6. Jasper. Impure opaque colored quartz; commonly red from iron oxide, also other shades.

Occurrence. Bernalillo County: Tijeras Canyon district. Catron County: Mogollon district. Colfax County: Baldy, Cimarroncito, and Elizabethtown districts. De Baca County: five miles east of Ramon. Dona Ana County: Organ and Texas districts; southern end of Caballos Mountains. Grant County:

amethystine quartz. Clear purple, or violet, color perhaps due to manganese.

B. Cryptocrystalline. 1. Agate. [illegible]. A variegated chalcedony; colors (a) banded; (b) irregularly clouded; (c) due to visible impurities, as moss agate. Bands white, brown, bluish, etc.; straight, wavy, or concentric circular. 2. Agatized wood. Wood petrified with clouded agate. 3. Carnelian. Hard. A clear red chalcedony, pale to deep in shade; also brownish red to brown. 4. Chalcedony. Having the luster nearly of wax; white, green or translucent. Sp.G.= 2.6-2.64. Colors varied, varieties often based on color. Often mammillary, botryoidal, stalactitic, and as lining or filling in cavities. Often contains disseminated opal-silica. 5. Flint. [illegible] like chalcedony, but of dull colors, usually gray, smoky brown, and brownish black. Exterior often whitish from lime or chalk in which it is embedded. Luster subvitreous. Deep conchoidal fracture. Colored by carbonaceous matter. 6. Jasper. Impure opaque colored quartz; commonly red from iron oxide, also other shades.

Occurrence. Bernalillo county: Tijeras Canyon district. Catron County: Mogollon district. [illegible] County: Baldy, Cimarroncito, and Elizabethtown districts. De Baca County: Five miles east of Taiban. Dona Ana County: Organ and [illegible] districts; southern end of Caballos Mountains. Grant Coun

Alum Mountain, Black Hawk, Burro Mountains, Carpenter, Central, Chloride Flat, Fierro-Hanover, Fleming, Georgetown, Gold Hill, Juniper, Lone Mountain, Malone, Meerschaum, Pinos Altos, Santa Rita, Silver City Manganese-Iron, Steeple Rock, and Telegraph districts; at Tellurium locality (41 miles northwest of Silver City); at north end of Cooks Range; at several other localities. Hidalgo County: Apache No. 2, Fremont, Hachita, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey, Jicarilla, Nogal, and White Oaks districts. Luna County: Cooks Peak, Cooks Range Manganese, Little Florida Mountains, Tres Hermanas, and Victorio districts. Otero County: Orogrande and Tularosa districts. Rio Arriba County: Bromide, Hopewell, Petaca, and Rinconada districts. Sandoval County: Cochiti and Placitas districts. San Miguel County: El Porvenir, Rociada, and Willow Creek districts; region near Las Vegas. Santa Fe County: Cerrillos, New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballos Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, San Mateo Mountains, and Tierra Blanca districts. Socorro County: Cat Mountain, Council Rock, Hansonburg, Joyita Hills, Ladrones Mountains, Lemitar Mountains, Magdalena, Mill Canyon, North Magdalena, Rosedale, San Andres Mountains (Goodfortune Creek, Grandview Canyon, Mockingbird Gap), San Jose, San Lorenzo, Socorro Peak, and Water Canyon districts. Taos County: Anchor, Glenwoody, Alma Mountain, Black Hawk, Burro Mountains, Carpenter, Central, Chloride Flat, Fierro-Hanover, Fleming, Georgetown, Gold Hill, Juniper, Lone Mountain, Malone, [illegible], Pinos Altos, Santa Rita, Silver City Manganese-Iron, Steeple Rock, and Telegraph districts; at Tellurium locality (11 miles northwest of Silver City); at north end of Cooks Range; at several other localities. Hidalgo County: Apache No. 2, Fremont, Kimball, Lordsburg, San Simon, and Steins Pass districts. Lincoln County: Estey, Jicarilla, Nogal, and White Oaks districts. Luna County: Cooks Peak, Cooks Range Manganese, Little Florida Mountains, Tres Hermanas, and Victorio districts. Otero County: Orogrande and Tularosa districts. Rio Arriba County: Bromide, Hopewell, Petaca, and [illegible] districts. Sandoval County: Cochiti and Placitas districts. San Miguel County: El Porvenir, Rociada, and Willow Creek districts; region near Las Vegas. Santa Fe County: Cerrillos, New Placers, Old Placers, and Santa Fe districts. Sierra County: Caballo Mountains, Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, Macho, San Mateo Mountains, and Tierra Blanca districts. Socorro County: Cat Mountain, Council Rock, Hansonburg, Joyita Hills, Ladrones Mountains, Lemitar Mountains, Magdalena, Mill Canyon, North Magdalena, Rosedale, San Andres Mountains (Goodfortune Creek, Grandview Canyon, Mockingbird Gap), San Jose, San Lorenzo, Socorro Peak, and Water Canyon districts. Taos County: Anchor, [illegible], Harding Mine, Picuris, Red River, and Twining districts. Valencia County: Zuni Mountains district.

Var. Amethyst. Catron County: Mogollon district. Sierra County: Chloride, Kingston, and Tierra Blanca districts. Socorro County: Council Rock, San Jose, and San Lorenzo districts.

Var. Agate. Sandoval County: Nacimiento Mountains district. General: San Mateo Mountains; Sangre de Cristo Mountains; Russels Canyon on Rio Tularosa.

Var. Agatized Wood. Sandoval County: along Rio Puerco. Santa Fe County: at Sweet's Ranch.

Var. Carnelian. General: in various gravel beds.

Var. Chalcedony. Catron County: Mogollon and Taylor Creek Tin districts. Grant County: Burro Mountains district. Luna County: Deming region. Socorro County: south end of Magdalena Range.

Var. Flint. Sierra County: Lake Valley district.

Var. Jasper. Catron County: Mogollon district. Grant County: Burro Mountains, Cap Rock Mountain Manganese, and Central districts. Lincoln County: two miles north of Ancho. Sandoval County: Jemez region. Sierra County: Caballos Mountains and Hillsboro districts. Socorro County: Joyita Hills district. (Indefinite: at Willow Springs.)

Harding Mine, Picuris, San [illegible] districts. Valencia County: Zuni Mountains district.

Var. Amethyst. Catron County: Mogollon district. Sierra County: Chloride, Kingston, and [illegible] districts. Socorro County: [illegible] San Lorenzo districts.

Var. Agate. [illegible] County: [illegible] Mountains district. General: [illegible] Mountains; [illegible].

Var. Agatized Wood. [illegible] County: [illegible]. Santa Fe County: [illegible].

Var. Carnelian. General: [illegible].

Var. Chalcedony. Catron County: Mogollon and [illegible] Creek Tin districts. Grant County: Burro Mountains district. Luna County: [illegible]. Socorro County: [illegible] end of Magdalena Range.

Var. Flint. Sierra County: Lake Valley district.

Var. Jasper. Catron County: Mogollon district. Grant County: Burro Mountains, [illegible] Central districts. Lincoln County: [illegible] Ancho. [illegible] County: [illegible] region. [illegible] Caballos Mountains and Hillsboro districts. Socorro County: Joyita Hills district. [illegible]

RESIN. Amber.

Common name for a number of oxygenated hydrocarbons, of light yellow to brown color, resinous luster, and low specific gravity, occurring usually in coal beds. When compact and hard, and transparent to translucent, fossil resins are called amber.

Chemical composition. Variable in the different varieties, but high in carbon and hydrogen and low in oxygen.

Occurrence. Colfax County: Raton region. McKinley County: Gallup-Zuni Coal Basin region.

RHODOCHROSITE. Dialogite.

Physical characteristics. Hexagonal-rhombohedral. Distinct crystals not common; usually the rhombohedron. Cleavable, massive to granular-massive and compact. Also globular and botryoidal, with columnar structure, sometimes indistinct; incrusting. Cleavage: rhombohedral, perfect. Fracture uneven. Brittle. H.- 3.5-4.5. Sp.G.- 3.45-3.60 and higher. Luster vitreous, inclining to pearly. Color shades of rose-red; yellowish gray, fawn-colored, dark red, brown. Streak white. Translucent to subtranslucent.

Chemical composition. Manganese protocarbonate, $MnCO_3$. Iron carbonate is usually present even up to 40%, as in

manganosiderite; also magnesium, zinc, and rarely cobalt. Calcium carbonate may be present, as in manganocalcite.

Varieties. 1. Manganosiderite. Containing ferrous carbonate, $FeCO_3$, up to 40%. The molecules of rhodochrosite and siderite are apparently completely miscible and may crystallize together in all proportions.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district. Grant County: Pinos Altos and Silver City Manganese-Iron districts. Hidalgo County: Lordsburg district. Sierra County: Kingston district. Socorro County: Magdalena district. Taos County: Red River district.

Var. Manganosiderite. Grant County: Silver City Manganese-Iron district. Sierra County: Hillsboro district (?). Socorro County: Socorro Peak district.

RHODONITE.

Physical characteristics. Triclinic. Crystals usually large and rough with rounded edges. Commonly tabular; sometimes resembling pyroxene in habit. Commonly massive, cleavable to compact; also in embedded grains. Cleavage: two directions, perfect; another, less perfect, parallel to tabular faces. Fracture conchoidal to uneven. Very manganosiderite; also magnesium, zinc, and [illegible]. Calcium carbonate may be present, as in manganocalcite.

Varieties. 1. Manganosiderite. Contains ferrous carbonate, $FeCO_3$, up to 40%. The molecules of rhodochrosite and siderite are apparently completely miscible and may crystallize together in all proportions.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district. Grant County: [illegible] and Silver City Manganese-iron districts. Hidalgo County: Lordsburg district. Sierra County: Kingston district. Socorro County: Magdalena district. Taos County: Red River district.

Var. Manganocalcite. Grant County: Silver City Manganese-iron district. Sierra County: Hillsboro district (?). Socorro County: Socorro Peak district.

RHODONITE.

Physical characteristics. Triclinic. Crystals usually large and rough with rounded edges. Commonly tabular; sometimes resembling pyroxene in habit. Commonly massive; cleavable to compact; also in embedded grains. Cleavage in two directions, perfect; another, less perfect, [illegible] in tabular forms. Fracture conchoidal to uneven. Very tough when compact. H.- 5.5-6.5. Sp.G.- 3.4-3.68. Luster vitreous; on cleavage surfaces somewhat pearly. Color light brownish red, flesh-red, rose-pink; sometimes greenish or yellowish, when impure; often black outside from exposure. Streak white. Transparent to translucent.

Chemical composition. Manganese metasilicate, $MnSiO_3$, or $MnO.SiO_2$. Calcium is always present and may be a necessary constituent, hence the suggested formula $CaMn_5(SiO_3)_6$.

Occurrence. Sierra County: Kingston district. Socorro County: San Lorenzo district.

RICKARDITE.

Physical characteristics. Massive. Fracture irregular. Brittle. H.- 3.5. Sp.G.- 7.54. Luster metallic. Color and streak deep purple, resembling the color of tarnished surfaces of bornite. Opaque.

Chemical composition. A copper telluride, Cu_4Te_3, or $Cu_2Te.2CuTe$.

Occurrence. Dona Ana County: Organ district.

tough when compact. H.= 5.5-6.5. Sp.G.= 3.4-3.68. Luster vitreous; on cleavage surfaces somewhat pearly. Color light brownish red, flesh-red, rose-pink; sometimes greenish or yellowish, when impure; often black outside from exposure. Streak white. Transparent to translucent.

Chemical composition. Manganese metasilicate, $MnSiO_3$, or $MnO.SiO_2$. Calcium is always present and may be a necessary constituent, hence the suggested formula $CaMn_4Si_5O_{15}$.

Occurrence. Sierra County: Kingston district. Socorro County: San Lorenzo district.

RICKARDITE.

Physical characteristics. Massive. Fracture irregular. Brittle. H.= 3.5. Sp.G.= 7.54. Luster metallic. Color and streak deep purple, resembling the color of tarnished surfaces of bornite. Opaque.

Chemical composition. A copper telluride, Cu_4Te_3, or $Cu_2Te.2CuTe$.

Occurrence. Dona Ana County: Organ district.

ROSCOELITE.

Physical characteristics. In minute scales, often in stellate or fan-shaped groups. Structure micaceous. Cleavage: basal, perfect. H.- 2.5. Sp.G.- 2.92-2.97. Luster pearly. Color dark clove-brown to greenish brown, dark brownish green. Translucent.

Chemical composition. Essentially a muscovite in which aluminum is partly replaced by vanadium, formula doubtful: $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$ (Genth).

Occurrence. San Juan County: east flank of Carrizo Mountain.

RUTILE.

Physical characteristics. Tetragonal. Twins common, sometimes repeated. Crystals commonly prismatic, vertically striated or furrowed; often slender acicular. Occasionally compact, massive. Cleavage: two directions, at angles of 45° and 135°, distinct. Fracture subconchoidal to uneven. Brittle. H.- 6-6.5. Sp.G.- 4.18-4.25, also to 5.2. Luster metallic-adamantine. Color reddish brown, passing into red; sometimes yellowish, bluish, violet, black, rarely grass-green; by transmitted light deep red. Streak pale brown. Transparent to opaque.

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Occurrence. San Juan County; east flank of Carrizo Mountain.

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Chemical composition. Titanium dioxide, TiO_2. A little iron is usually present, sometimes up to 10%.

Occurrence. Grant County: Central and Fierro-Hanover districts. Santa Fe County: Cerrillos district. Sierra County: (not specified). Taos County: Harding Mine district.

SAMARSKITE.

Physical characteristics. Orthorhombic. Crystals rectangular prisms. Faces rough. Commonly massive, and in flattened embedded grains. Cleavage: one direction, parallel to a prism face, perfect. Fracture conchoidal. Brittle. H.- 5-6. Sp.G.- 5.6-5.8. Luster vitreous to resinous, splendent. Color velvet-black. Streak dark reddish brown. Nearly opaque.

Chemical composition. $R^{II}_3R^{III}_2(Cb,Ta)_6O_{21}$ with R^{II}= Fe, Ca, UO_2, etc.; R^{III}= cerium and yttrium metals chiefly.

Occurrence. Rio Arriba County: Petaca district.

SCHEELITE.

Physical characteristics. Tetragonal-pyramidal. Twins, both as contact- and penetration-twins. Habit octahedral,

Chemical composition. [illegible]

iron is usually present, sometimes up to [illegible].

Occurrence. [illegible]

tricts. Sands [illegible] County [illegible]

County [illegible]. [illegible]

trict.

[illegible]

Physical characteristics. [illegible]. Crystals rectangular

ular prisms, [illegible] rough. Commonly [illegible]

[illegible] granular. [illegible] distinct [illegible]

[illegible] prism [illegible] perfect. Fracture conchoidal. [illegible]

H.= 5-6. Sp.G.= [illegible]. Luster vitreous to [illegible]

splendent. Color [illegible]-black. Streak [illegible]

Nearly opaque.

Chemical composition. [illegible]

[illegible], etc.; [illegible] and [illegible] locally.

Occurrence. [illegible]

[illegible]

Physical characteristics. [illegible]

both as [illegible]

also tabular. Also reniform with columnar structure; massive granular. Cleavage: pyramidal, distinct. Fracture uneven. Brittle. H.- 4.5-5. Sp.G.- 5.9-6.1. Luster vitreous, inclining to adamantine. Color white, yellowish white, pale yellow, brownish, greenish, reddish. Streak white. Transparent to translucent.

Chemical composition. Calcium tungstate, $CaWO_4$. Molybdenum is usually present, up to 8%.

Occurrence. Grant County: (?) Hidalgo County: Apache No. 2 and Fremont districts. Lincoln County: White Oaks district. Luna County: Victorio district. Rio Arriba County: Petaca district. San Miguel County: El Porvenir district. Santa Fe County: New Placers district. Socorro County: San Andres Mountains district (Grandview Canyon).

SEPIOLITE. Meerschaum.

Physical characteristics. Compact, with a smooth feel, and fine earthy texture, or clay-like. Microscopically is shown to be a mixture of fine fibrous material and an amorphous substance of apparently the same composition. The fibrous mineral has been called alpha-sepiolite or parasepiolite; the amorphous material beta-sepiolite; the mixture forms the variety meerschaum. H.- 2-2.5; impressible by the finger-nail. Sp.G.- 2. In dry masses floats on also tabular. Also fusiform with columnar structure; massive granular. Cleavage: pyramidal, distinct. Fracture uneven. Brittle. H.= 4.5-5. Sp.G.= 5.9-6.1. Luster vitreous, inclining to adamantine. Color white, yellowish white, pale yellow, brownish, greenish, reddish. Streak white. Transparent to translucent.

<u>Chemical composition</u>. Calcium tungstate, $CaWO_4$. Molybdenum is usually present, up to 8%.

<u>Occurrence</u>. Grant County: (?) Hidalgo County: Apache No. 2 and Fremont districts. Lincoln County: White Oaks district. Luna County: Victorio district. Rio Arriba County: Petaca district. San Miguel County: El Porvenir district. Santa Fe County: New Placers district. Socorro County: San Andres Mountains district (Grandview Canyon).

<u>SEPIOLITE</u>. Meerschaum.

<u>Physical characteristics</u>. Compact, with a smooth feel, and fine earthy texture, or clay-like. Microscopically it shows to be a mixture of fine fibrous material and an amorphous substance of apparently the same composition. The fibrous mineral has been called <u>alpha-sepiolite</u> or <u>para-sepiolite</u>; the amorphous material <u>beta-sepiolite</u>; the mixture forms the variety <u>meerschaum</u>. H.= 2-2.5; impressible by the finger-nail. Sp.G.= 2. In dry masses floats on

water. Color grayish white, white, or with a faint yellowish or reddish tinge; bluish green. Opaque.

Chemical composition. $H_4Mg_2Si_3O_{10}$, or $2H_2O.2MgO.3SiO_2$. May contain hygroscopic water. Copper and nickel may replace part of the magnesium.

Occurrence. Grant County: Juniper and Meerschaum districts. San Miguel County: near Sapella.

SERPENTINE.

Physical characteristics. Monoclinic. In distinct crystals, but only as pseudomorphs. Sometimes foliated, folia rarely separable; also delicately fibrous, the fibers often easily separable, and either flexible or brittle. Usually massive, but microscopically finely fibrous and felted, also fine granular to impalpable or cryptocrystalline; slaty. Crystalline in structure, but often nearly isotropic by compensation; amorphous. Cleavage: prismatic (50° angle), in chrysotile (asbestos). Fracture usually conchoidal or splintery. Feel smooth, sometimes greasy. H.- 2.5-4, rarely 5.5. Sp.G.- 2.50-2.65; some fibrous varieties 2.2-2.3. Luster subresinous to greasy, pearly, earthy; resin-like, or wax-like; usually feeble. Color leek-green, blackish green; oil- and siskin-green; brownish red, brownish yellow; none bright; sometimes nearly white.

water. Color grayish white, white, or pale without yellow-ish or reddish tinge; bluish green. Opaque.

Chemical composition. $H_4Mg_3Si_2O_9$, or $3MgO \cdot 2SiO_2 \cdot 2H_2O$. May contain hygroscopic water. [illegible] may also re-place part of the magnesium.

Occurrence. Grant County: [illegible] district. San Miguel County near [illegible].

SERPENTINE.

Physical characteristics. Monoclinic. In distinct crystals, but only as pseudomorphs. Sometimes foliated, folia rarely separable; also delicately fibrous, the fibers often easily separable, and either flexible or brittle. Usually massive, but microscopically finely fibrous and felted, also fine granular to impalpable or cryptocrystalline. Crystalline in structure, but often nearly isotropic by compensation; amorphous. Cleavage: prismatic (50° angle), in antigorite (lamellar). Fracture usually conchoidal or splintery. Feel smooth, sometimes greasy. H.= 2.5-4, rarely 5.5. Sp. gr.= 2.50-2.65; when pure [illegible] variations 2.2-2.3. Luster subresinous to greasy, pearly, earthy; resin-like, or wax-like; usually [illegible]. Color leek-green, blackish green, oil- and siskin-green, brownish-red, brownish yellow; none bright; sometimes nearly white.

On exposure, often becoming yellowish gray. Streak white, slightly shining. Translucent to opaque.

Chemical composition. A hydrous magnesium silicate, $H_4Mg_3Si_2O_9$, or $3MgO.2SiO_2.2H_2O$.

Varieties. 1. Asbestos. Asbestus. Chrysotile. Delicately fibrous, fibers usually flexible and easily separating; luster silky, or silky metallic; color greenish white, green, olive-green, yellow, and brownish. Sp.G.- 2.219.
2. Ricolite. A banded variety with a fine green color.

Occurrence.

Var. Asbestos. See separate description, p.138.

Var. Ricolite. Grant County: on west side of Gila River, north of Red Rock P.O.

SIDERITE. Chalybite. Spathic Iron.

Physical characteristics. Hexagonal-rhombohedral. Crystals commonly rhombohedral, the faces often curved and built up of sub-individuals like dolomite. Often cleavable massive to coarse or fine granular. Also in botryoidal and globular forms, subfibrous within, occasionally silky fibrous; compact and earthy. Cleavage: rhombohedral, perfect. Fracture uneven or subconchoidal. Brittle. H.- 3.5-4. Sp.G.- 3.83-3.88. Luster vitreous, inclining to pearly.

in exposure, often becoming yellowish gray. Streak white, slightly shining. Translucent to opaque.

Chemical composition. A hydrous magnesium silicate, $H_4Mg_3Si_2O_9$, or $3MgO.2SiO_2.2H_2O$.

Varieties. 1. Asbestos.- Amianthus.- Chrysotile.- Delicately fibrous, fibers usually flexible and easily separating; luster silky, or silky metallic; color greenish white, green, olive-green, yellow, and brownish. Sp.G.= 2.219. 2. Bowenite. A banded variety with a fine green color.

Occurrence.

Var. Asbestos. See separate description, p.135.

Var. Bowenite. Grant County: on west side of Gila River, north of Red Rock P.O.

SIDERITE. Chalybite. Spathic Iron.

Physical characteristics. Hexagonal-rhombohedral. Crystals commonly rhombohedral, the faces often curved and built up of sub-individuals like dolomite. Often cleavable massive to coarse or fine granular. Also in botryoidal and globular forms, subfibrous within, occasionally silky fibrous; compact and earthy. Cleavage: rhombohedral, perfect. Fracture uneven or subconchoidal. Brittle. H.= 3.5-4. Sp.G.= 3.83-3.88. Luster vitreous, inclining to pearly.

Color ash-gray, yellowish gray, greenish gray, also brown and brownish red, rarely green; and sometimes white. Streak white. Translucent to subtranslucent.

Chemical composition. Iron protocarbonate, $FeCO_3$. Manganese may be present, also magnesium and calcium.

Varieties. 1. Spherosiderite. Sphaerosiderite. In globular concretions, either solid or concentric scaly, usually with fibrous structure.

Occurrence. Colfax County: along Canadian Valley. Grant County: Black Hawk and Pinos Altos districts. Hidalgo County: Lordsburg and San Simon districts. Luna County: Victorio district. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. Santa Fe County: Cerrillos district (along Galisteo Creek), and Old Placers district. Sierra County: Cuchillo Negro and Hillsboro districts. Taos County: Twining district.

Var. Spherosiderite. Colfax County: along Canadian Valley. Santa Fe County: Cerrillos district (along Galisteo Creek).

SILLIMANITE. Fibrolite.

Physical characteristics. Orthorhombic. Prismatic faces striated and rounded. Commonly in long slender crystals

not distinctly terminated; often in close parallel groups, passing into fibrous and columnar massive forms; sometimes radiating. Cleavage: one direction, prismatic, very perfect. Fracture uneven. H.- 6-7. Sp.G.- 3.23-3.24. Luster vitreous, inclining to subadamantine. Color hair-brown, grayish brown, grayish white, grayish green, pale olive-green. Streak uncolored. Transparent to translucent.

Chemical composition. Al_2SiO_5, or $(AlO)AlSiO_4$, like andalusite and kyanite. The most stable of the three forms of aluminum silicate.

Occurrence. Taos County: Glenwoody and Picuris districts.

SILVER.

Physical characteristics. Isometric. Crystals commonly distorted, in acicular forms, reticulated or arborescent shapes; coarse to fine filiform; also massive, in plates and flattened scales. Cleavage none. Ductile and malleable. Fracture hackly. H.- 2.5-3. Sp.G.- 10.1-11.1, pure 10.5. Luster metallic. Color and streak silver-white, often gray to black by tarnish.

Chemical composition. Silver, Ag, with some gold (up to 10%), copper, and sometimes platinum, antimony, bismuth, not distinctly terminated; often in close parallel groups, passing into fibrous and columnar massive forms; sometimes radiating. Cleavage: one direction, prismatic, very perfect. Fracture uneven. H.= 6-7. Sp.G.= 3.23-3.24. Luster vitreous, inclining to subadamantine. Color hair-brown, grayish brown, grayish white, grayish green, pale olive-green. Streak uncolored. Transparent to translucent.

Chemical composition. Al_2SiO_5, or $(AlO)AlSiO_4$, like andalusite and kyanite. The most stable of the three forms of aluminum silicate.

Occurrence. Taos County: Glenwoody and Picuris districts.

SILVER.

Physical characteristics. Isometric. Crystals commonly distorted, in acicular forms, reticulated or arborescent shapes; coarse to fine filiform; also massive, in plates and flattened scales. Cleavage none. Ductile and malleable. Fracture hackly. H.= 2.5-3. Sp.G.= 10.1-11.1; pure 10.5. Luster metallic. Color and streak silver-white, often gray to black by tarnish.

Chemical composition. Silver, Ag, with some gold (up to 10%), copper, and sometimes platinum, antimony, bismuth, and mercury.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district. Grant County: Black Hawk, Central, Chloride Flat, Fleming, Georgetown, Gold Hill, Lone Mountain, and Pinos Altos districts. Hidalgo County: Lordsburg and San Simon districts. Luna County: Victorio district. Sierra County: Chloride, Hermosa, Hillsboro, Kingston, Lake Valley, and Tierra Blanca districts. Socorro County: Cat Mountain, Magdalena, North Magdalena, San Jose, and Socorro Peak districts. Valencia County: Zuni Mountains district.

SKUTTERUDITE.

Physical characteristics. Isometric-pyritohedral. In crystals; also massive-granular. Cleavage: cubic, distinct. Fracture uneven. Brittle. H.- 6. Sp.G.- 6.5-6.9. Luster bright metallic. Color between tin-white and pale lead-gray.

Chemical composition. Cobalt arsenide, $CoAs_3$.

Varieties. 1. Nickel-skutterudite. Massive, granular. H.- 5. Color gray. Streak black. Chemical composition: RAs_3, where R = Ni:Co:Fe = 4:2:1. "A probably new nickel arsenide from Grant County, New Mexico." (Waller, E., and Moses, A. J., School of Mines Quarterly, 14: 49-51 (1892).

and mercury.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district. Grant County: Black Hawk, Central, Chloride Flat, Fleming, Georgetown, Gold Hill, Lone Mountain, and Pinos Altos districts. Hidalgo County: Lordsburg and San Simon districts. Luna County: Victorio district. Sierra County: Chloride, Hermosa, Hillsboro, Kingston, Lake Valley, and Tierra Blanca districts. Socorro County: Cat Mountain, Magdalena, North Magdalena, San Jose, and Socorro Peak districts. Valencia County: Zuni Mountains district.

SMALTITE.

Physical characteristics. Isometric-pyritohedral. In crystals; also massive-granular. Cleavage: cubic, distinct. Fracture uneven. Brittle. H.= 6. Sp.G.= 6.4-6.6. Luster bright metallic. Color between tin-white and pale lead-gray.

Chemical composition. Cobalt arsenide, $CoAs_2$.

Variation. 1. Nickel-skutterudite. Massive, granular. H.= 6. Color gray. Streak black. Chemical composition RAs_3, where R = Ni:Co:Fe = 4:2:1. "A probably new nickel arsenide from Grant County, New Mexico." (Waller, E., and Moses, A. J., School of Mines Quarterly, 14: 49-51 (1892).

Occurrence. Grant County: Black Hawk district.

Var. Nickel-skutterudite. Grant County: Black Hawk district.

SMALTITE-CHLOANTHITE.

Physical characteristics. Isometric-pyritohedral. Crystals rare. Commonly massive; in reticulated or other imitative shapes. Cleavage indistinct. Fracture granular and uneven. Brittle. H.- 5.5-6. Sp.G.- 5.7-6.8. Luster metallic. Color tin-white, inclining, when massive, to steel-gray, sometimes iridescent, or grayish from tarnish. Streak grayish black. Opaque.

Chemical composition. Smaltite is essentially cobalt diarsenide. Chloanthite is nickel diarsenide. Analyses show considerable variations, RAs_3 representing most nearly the composition, where R = cobalt and (or) nickel.

Occurrence. Grant County: Black Hawk district.

SMITHSONITE. Calamine. Dry-bone Ore.

Physical characteristics. Hexagonal-rhombohedral. Rarely well crystallized; faces curved and rough. Usually reniform,

botryoidal, or stalactitic, and in crystalline incrustations; also granular, and sometimes impalpable, occasionally earthy and friable. Cleavage: rhombohedral, perfect. Fracture uneven to imperfectly conchoidal. Brittle. H.- 5.5. Sp.G.- 4.30-4.45. Luster vitreous, inclining to pearly. Color white, often grayish, greenish, brownish white, sometimes green, blue, and brown. Streak white. Subtransparent to translucent.

Chemical composition. Zinc carbonate, $ZnCO_3$. Iron, manganese, cobalt, calcium, and magnesium carbonates usually present in small quantities.

Varieties. 1. Herrerite. A cupriferous variety. Apple-green, with rhombohedral cleavage. 2. Monheimite. Ferriferous Smithsonite. Contains over 20% iron carbonate, $FeCO_3$.

Occurrence. Bernalillo County: "Sandia Mountains" (?). Grant County: Carpenter, Central, Fierro-Hanover, and Pinos Altos districts. Luna County: Cooks Peak, Florida Mountains, and Tres Hermanas districts. San Miguel County: Willow Creek district. Santa Fe County: Cerrillos district. Sierra County: Cuchillo Negro, Hermosa, Hillsboro, Kingston, and Macho districts. Socorro County: Iron Mountain No. 2 (?) (given as "Tenmile district"), Lemitar Mountains, and Magdalena districts.

Var. Herrerite. Socorro County: Magdalena district.

Var. Monheimite. Socorro County: Magdalena district.

SODALITE. (?)

A very doubtful occurrence, in microscopic grains. Colfax County: Pleasant Valley region (?).

SODA NITER. Chile Saltpeter. (?)

Physical characteristics. Hexagonal-rhombohedral. Usually massive, as an incrustation or in beds. Cleavage: rhombohedral, perfect. Fracture conchoidal, seldom observable. Rather sectile. H.- 1.5-2. Sp.G.- 2.24-2.29. Luster vitreous. Color white; also reddish brown, gray, and lemon-yellow. Transparent. Taste cooling.

Chemical composition. Sodium nitrate, $NaNO_3$.

Occurrence. Hidalgo County: (?) (given as "southern New Mexico"; also as near the International Boundary.)

SPHALERITE. Zinc Blende or Blende. Black Jack. Mock-Lead. False Galena.

Physical characteristics. Isometric-tetrahedral. Often in

Var. Salterita. Socorro County: Magdalena district.

Var. Magdalenita. Socorro County: Magdalena district.

ADALITE (?)

A very doubtful occurrence, in microscopic grains. Colfax County: Pleasant Valley region (?).

NITRATINE. Chile Saltpeter. (?)

Physical characteristics. Hexagonal-rhombohedral. Usually massive, as an incrustation or in beds. Cleavage: rhombohedral, perfect. Fracture conchoidal, seldom observable. Rather sectile. H.= 1.5-2. Sp.G.= 2.24-2.29. Luster vitreous. Color white; also reddish brown, gray, and lemon-yellow. Transparent. Taste cooling.

Chemical composition. Sodium nitrate, $NaNO_3$.

Occurrence. Hidalgo County (?) (given as "southern New Mexico"; also at, near the International Boundary.)

SPHALERITE. Zinc Blende or Blende. Black Jack. Rosin-Jack. False Galena.

Physical characteristics. Isometric-tetrahedral. Often in tetrahedrons. Cube, dodecahedron, and tristetrahedron are forms also present at times. Twins common, twinning often repeated, sometimes as polysynthetic lamellae. Crystals often distorted or rounded. Commonly massive cleavable, coarse to fine granular and compact; also foliated, sometimes fibrous and radiated or plumose; also botryoidal and other imitative shapes. Cryptocrystalline to amorphous, the latter sometimes as a powder. Cleavage: dodecahedral, highly perfect. Fracture conchoidal. Brittle. H.- 3.5-4. Sp.G.- 3.9-4.1. Luster resinous to adamantine. Color commonly yellow, brown, black; also red, green to white, and when pure nearly colorless. Streak brownish to light yellow, and white. Transparent to translucent. Some varieties will phosphoresce when scratched.

Chemical composition. Zinc sulphide, ZnS. Often contains iron and manganese, and traces of many other metals.

Varieties. 1. Marmatite. The ferriferous variety, containing up to 20% iron. Color dark brown to black. Sp.G.- 3.9-4.05. The proportion of FeS to ZnS varies from 1:5 to 1:2. 2. Przibramite. A cadmiferous variety, in which the amount of cadmium is less than 5%.

Occurrence. Bernalillo County: "Sandia Mountains" (?). Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Modoc and Organ districts. Grant County: Burro Mountains, Carpenter, Central, Fierro-Hanover, tetrahedrons. Cube, dodecahedron, and tristetrahedron forms also present at times. Twins common, twinning often repeated, sometimes as polysynthetic lamellae. Crystals often distorted or rounded. Commonly massive cleavable, coarse to fine granular and compact; also botryoidal, sometimes fibrous and radiated or plumose; also botryoidal and other imitative shapes. Cryptocrystalline to amorphous, the latter sometimes as a powder. Cleavage: dodecahedral, highly perfect. Fracture conchoidal. Brittle. H.— 3.5-4. Sp.G.— 3.9-4.1. Luster resinous to adamantine. Color commonly yellow, brown, black; also red, green to white, and when pure nearly colorless. Streak brownish to light yellow, and white. Transparent to translucent. Some varieties will phosphoresce when scratched.

Chemical composition. Zinc sulphide, ZnS. Often contains iron and manganese, and traces of many other metals.

Variation. 1. Marmatite. The ferriferous variety, containing up to 20% iron. Color dark brown to black. Sp.G.— 3.9-4.05. The proportion of FeS to ZnS in marmatite is 1:2. 2. Przibramite. A cadmiferous variety in which the amount of cadmium is less than 5%.

Occurrence. Bernalillo County: "Sandia Mountains" (9). Catron County: Mogollon district. Colfax County: Baldy district. Dona Ana County: Organ and Organ districts. Grant County: Burro Mountains, Carpenter, Central, Clark—Hanover.

Gold Hill, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: Apache No. 2, Fremont, Lordsburg, and Steins Pass districts. Lincoln County: Nogal district. Luna County: Cooks Peak, Florida Mountains, and Tres Hermanas districts. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. San Miguel County: Rociada (?) and Willow Creek districts. Santa Fe County: Cerrillos, New Placers, and Santa Fe districts. Sierra County: Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, and Macho districts. Socorro County: Jones Camp, Lemitar Mountains, Magdalena, San Andres Mountains (Mockingbird Gap), and Water Canyon districts. Taos County: Red River and Twining districts.

Var. Marmatite. Grant County: Central district. San Miguel County: Willow Creek district.

Var. Przibramite. Grant County: Carpenter district.

SPODUMENE. Triphane.

Physical characteristics. Monoclinic. Crystals prismatic, often flattened; the vertical planes striated and furrowed; crystals sometimes very large. Also massive, cleavable. Cleavage: two directions, perfect, one parallel to the tabular face. A lamellar structure parallel to the tabular face sometimes very prominent, a crystal then separating

Gold Hill, Pinos Altos, Santa Rita, Steeple Rock, and White Signal districts. Hidalgo County: Apache No. 2, Fremont, Lordsburg, and Steins Pass districts. Lincoln County: Nogal district. Luna County: Cooks Peak, Florida Mountains, and Tres Hermanas districts. Rio Arriba County: Bromide and Hopewell districts. Sandoval County: Cochiti district. San Miguel County: Rociada (?) and Willow Creek districts. Santa Fe County: Cerrillos, New Placers, and Santa Fe districts. Sierra County: Chloride, Cuchillo Negro, Hermosa, Hillsboro, Kingston, Lake Valley, and Macho districts. Socorro County: Jones Camp, Ladron Mountains, Magdalena, San Andres Mountains (Mockingbird Gap), and Water Canyon districts. Taos County: Red River and Twining districts.

Var. Marmatite. Grant County: Central district. San Miguel County: Willow Creek district.

Var. Cleiophane. Grant County: Carpenter district.

SPODUMENE. Triphane.

Physical characteristics. Monoclinic. Crystals prismatic, often flattened; the vertical planes striated and furrowed; crystals sometimes very large. Also massive, cleavable. Cleavage: two directions, perfect, one parallel to the tabular face. A lamellar structure parallel to the tabular face sometimes very prominent, a crystal then separating into thin plates. Fracture uneven to subconchoidal. Brittle. H.- 6.5-7. Sp.G.- 3.13-3.20. Luster vitreous, on cleavage surfaces somewhat pearly. Color greenish white, grayish white, yellowish green, emerald-green, yellow, amethystine purple. Streak white. Transparent to translucent.

Chemical composition. $LiAl(SiO_3)_2$, or $Li_2O.Al_2O_3.4SiO_2$. Generally contains a little sodium.

Varieties. 1. Cymatolite. An alteration product of spodumene. Spodumene is altered by soda-bearing solutions to a mixture of eucryptite, $LiAlSiO_4$, and albite, $NaAlSi_3O_8$. The eucryptite is later changed through the influence of potash salts to muscovite. The mixture of albite and muscovite is known as cymatolite. It has a wavy fibrous structure and silky luster.

Occurrence. Rio Arriba County: Petaca district. Taos County: Harding Mine district.

Var. Cymatolite. Rio Arriba County: Petaca district (Ojo Caliente).

SPURRITE.

Physical characteristics. Probably monoclinic. In granular cleavable masses. Cleavage: two directions, at angles into thin plates. Fracture uneven to subconchoidal. Brittle. H.= 6.5-7. Sp.G.= 3.13-3.20. Luster vitreous, on cleavage surfaces somewhat pearly. Color greenish white, grayish white, yellowish green, emerald-green, yellow, amethystine purple. Streak white. Transparent to translucent.

Chemical composition. $LiAl(SiO_3)_2$, or $Li_2O.Al_2O_3.4SiO_2$. Generally contains a little sodium.

Variation. 1. Cymatolite. An alteration product of spodumene. Spodumene is altered by soda-bearing solutions to a mixture of eucryptite, $LiAlSiO_4$, and albite, $NaAlSi_3O_8$. The eucryptite is later changed through the influence of potash salts to muscovite. The mixture of albite and muscovite is known as cymatolite. It has a wavy, fibrous structure and silky luster.

Occurrence. Rio Arriba County: Petaca district. Taos County: Harding mine district.

Var. Cymatolite. Rio Arriba County: Petaca district (Ojo Caliente).

[illegible]

Physical characteristics. Probably monoclinic. In [illegible] [illegible] masses. Cleavage: two directions at angles of 79°, one good, the second fair. Fracture uneven to splintery. Brittle. H.- 5. Sp.G.- 3. Luster vitreous to resinous. Color pale gray with bluish tinge, or yellow to colorless. Transparent to translucent.

Chemical composition. $2Ca_2SiO_4.CaCO_3$.

Occurrence. Luna County: Tres Hermanas district.

STAUROLITE. Staurotide.

Physical characteristics. Orthorhombic. Twins cruciform, the crystals crossing nearly at right angles; also crossing at an angle of 60° approx.; also in repeated twins. Crystals commonly prismatic and flattened; often with rough surfaces. Cleavage: one direction, distinct but interrupted. Fracture subconchoidal. Brittle. H.- 7-7.5. Sp.G.- 3.65-3.77. Luster subvitreous, inclining to resinous. Color dark reddish brown to brownish black, and yellowish brown. Streak uncolored to grayish. Translucent to nearly or quite opaque.

Chemical composition. $HFeAl_5Si_2O_{13}$, or $(AlO)_4(AlOH)Fe(SiO_4)_2$, or $H_2O.2FeO.5Al_2O_3.4SiO_2$.

Occurrence. Taos County: Glenwoody and Picuris districts. Torrance County: in Manzano Mountains (?).

STEPHANITE. Brittle Silver Ore.

Physical characteristics. Orthorhombic. Crystals usually short prismatic or tabular. Twins, often repeated, pseudo-hexagonal. Also massive, compact and disseminated. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.- 2-2.5. Sp.G.- 6.2-6.3. Luster metallic. Color and streak iron-black. Opaque.

Chemical composition. $5Ag_2S.Sb_2S_3$.

Occurrence. Colfax County: Baldy district (?). Hidalgo County: Fremont district (?). Rio Arriba County: Bromide district. Sierra County: Lake Valley district. Socorro County: San Jose district (?).

STERNBERGITE.

Physical characteristics. Orthorhombic. Crystals tabular, parallel to the base. Commonly in fan-like aggregations; twins common. Cleavage: basal, highly perfect. Thin laminae flexible, like tin-foil. H.- 1-1.5. Sp.G.- 4.215. Luster metallic. Color pinchbeck-brown. Streak black. Opaque.

Chemical composition. $AgFe_2S_3$, or $Ag_2S.Fe_4S_5$.

Occurrence. Catron County: Mogollon district. (Indefinite:

Spring Hill District (?).)

STETEFELDITE. (?)

Physical characteristics. Massive. H.- 3.5-4.5. Sp.G.- 4.12-4.24. Color blackish and brown. Streak shining.

Chemical composition. Exact composition uncertain. A deduced analysis gives the following proportions: Sb_2O_5 46.47%, S 4.59%, Ag 23.23%, Cu 2.27%, FeO 2.41%, CuO 13.28%, H_2O 7.75% = 100.00%.

Occurrence. (Indefinite: Spring Hill district. (?).)

STIBNITE. Antimonite. Antimony Glance.

Physical characteristics. Orthorhombic. Crystals prismatic; striated or furrowed vertically; often curved or twisted. The better crystals have very numerous faces. Commonly in confused aggregates or radiating groups of acicular crystals; massive, coarse or fine columnar, commonly bladed, less often granular to impalpable. Cleavage: one direction, prismatic, highly perfect; four other less perfect cleavages. Planes of better cleavage are also gliding-planes, movement on which may yield warped and curved crystals. Fracture small conchoidal. Slightly

sectile. H.- 2. Sp.G.- 4.52-4.62. Luster metallic, highly splendent on cleavage or fresh crystalline surfaces. Color and streak lead-gray, inclining to steel-gray; subject to blackish tarnish, sometimes iridescent.

Chemical composition. Antimony trisulphide, Sb_2S_3. Sometimes auriferous, also argentiferous.

Occurrence. Grant County: Santa Rita district. Hidalgo County: Hachita district. Santa Fe County: Cerrillos district. Taos County: Twining district (?).

STILBITE. Desmine.

Physical characteristics. Monoclinic. Crystals uniformly cruciform penetration-twins, with the appearance of a rhombic pyramid. Usually thin tabular. These compound crystals are often grouped in nearly parallel position, forming sheaf-like aggregates. Also divergent or radiated; sometimes globular and thin lamellar-columnar. Cleavage: one direction, perfect. Fracture uneven. Brittle. H.- 3.5-4. Sp.G.- 2.094-2.205. Luster vitreous; of cleavage surface pearly. Color white; occasionally yellow, brown, or red, to brick-red. Streak uncolored. Transparent to translucent.

Chemical composition. For most varieties, metallic. H.— 2. Sp.G.—4.52-4.62. Luster metallic, highly splendent on cleavage or fresh crystalline surfaces. Color and streak lead-gray, inclining to steel-gray; subject to blackish tarnish, sometimes iridescent.

Chemical composition. Antimony trisulphide, Sb_2S_3. Sometimes auriferous, also argentiferous.

Occurrence. Grant County: Santa Rita district. Hidalgo County: Hachita district. Santa Fe County: Cerrillos district. Taos County: Twining district (?).

STILBITE. Desmine.

Physical characteristics. Monoclinic. Crystals uniformly cruciform penetration-twins, with the appearance of a rhombic pyramid. Usually thin tabular. These compound crystals are often grouped in nearly parallel position, forming sheaf-like aggregates. Also divergent or radiated; sometimes globular and thin lamellar-columnar. Cleavage one direction, perfect. Fracture uneven. Brittle. H.— 3.5-4. Sp.G.— 2.094-2.205. Luster vitreous; of cleavage surface pearly. Color white; occasionally yellow, brown, or red, to brick-red. Streak uncolored. Transparent to translucent.

Chemical composition. For most varieties,

$(Na_2,Ca)Al_2Si_6O_{16}.6H_2O$, or $(Na_2,Ca)O.Al_2O_3.6SiO_2.6H_2O$.

Occurrence. Colfax County: Baldy district.

STROMEYERITE.

Physical characteristics. Orthorhombic. Rarely in crystals, sometimes twinned. Commonly massive, compact. Fracture subconchoidal. H.- 2.5-3. Sp.G.- 6.15-6.3. Luster metallic. Color and streak dark steel-gray. Opaque.

Chemical composition. Sulphide of silver and copper, $(Ag,Cu)_2S$, or $Ag_2S.Cu_2S$.

Occurrence. Catron County: Mogollon district. Socorro County: "from a region immediately west of the Magdalenas-the 'Sophia'." (?)

SULPHUR.

Physical characteristics. Orthorhombic. Crystals commonly acute pyramidal; sometimes thick tabular. Rarely twinned. Also massive, in reniform shapes, incrusting, stalactitic and stalagmitic; in powder. No distinct cleavage. Fracture conchoidal to uneven. Rather brittle to imperfectly sectile. H.- 1.5-2.5. Sp.G.- 2.05-2.09. Luster resinous. Color sulphur-yellow, straw- and honey-yellow, yellowish

$(Na_2,Ca)Al_2Si_6O_{16}.6H_2O$, or $(Na_2,Ca)O.Al_2O_3.6SiO_2.6H_2O$.

Occurrence. Colfax County: Baldy district.

STROMEYERITE

Physical characteristics. Orthorhombic. Rarely in crystals, sometimes twinned. Commonly massive, compact. Fracture subconchoidal. H.- 2.5-3. Sp.G.- 6.15-6.3. Luster metallic. Color and streak dark steel-gray. Opaque.

Chemical composition. Sulphide of silver and copper, $(Ag,Cu)_2S$, or $Ag_2S.Cu_2S$.

Occurrence. Catron County: Mogollon district. Socorro County: "from a region immediately west of the Magdalenas–the 'Kophia'." (?)

SULPHUR

Physical characteristics. Orthorhombic. Crystals commonly acute pyramidal; sometimes thick tabular. Rarely twinned. Also massive, in reniform shapes, incrusting, stalactitic and stalagmitic; in powder. No distinct cleavage. Fracture conchoidal to uneven. Rather brittle to imperfectly sectile. H.- 1.5-2.5. Sp.G.- 2.05-2.09. Luster resinous. Color sulphur-yellow, straw- and honey-yellow, yellowish brown, greenish, reddish to yellowish gray. Streak white. Transparent to translucent. A non-conductor of electricity; by friction negatively electrified. A poor conductor of heat.

Chemical composition. Pure sulphur, S; often contaminated with clay, bitumen, etc.

Occurrence. Lincoln County: White Oaks district. Rio Arriba County: in one of the volcanic cones north of Tres Piedras. Sandoval County: Jemez Sulphur district (just above Jemez Springs and at Sulphur Springs). Eddy or Lea County: in southeastern part of the State, near the Texas line.

SYLVANITE. Graphic Tellurium. (?)

Physical characteristics. Monoclinic. Twins common, giving rise to branching arborescent forms resembling written characters; also bladed and imperfectly columnar to granular. Cleavage: one direction, perfect. Fracture uneven. Brittle. H.- 1.5-2. Sp.G.- 7.9-8.3. Luster metallic, brilliant. Color and streak pure steel-gray to silver-white, inclining to yellow.

Chemical composition. Telluride of gold and silver, $(Au,Ag)Te_2$, with Au:Ag = 1:1.

brown, greenish, reddish to yellowish gray. Streak white. Transparent to translucent. A non-conductor of electricity; by friction negatively electrified. A poor conductor of heat.

Chemical composition. Pure sulphur, S; often contaminated with clay, bitumen, etc.

Occurrence. Lincoln County: White Oaks district. Rio Arriba County: in one of the volcanic necks north of Tres Piedras. Sandoval County: Jemez Sulphur district (just above Jemez Springs and at Sulphur Springs). Eddy or Lea County: in southeastern part of the State, near the Texas line.

SYLVANITE. Graphic Tellurium. (?)

Physical characteristics. Monoclinic. Twins common, giving rise to branching arborescent forms resembling written characters; also bladed and imperfectly columnar to granular. Cleavage: one direction, perfect. Fracture uneven. Brittle. H.= 1.5-2. Sp.G.= 7.9-8.3. Luster metallic, brilliant. Color and streak pure steel-gray to silver-white, inclining to yellow.

Chemical composition. Telluride of gold and silver, $(Au,Ag)Te_2$, with $Au:Ag = 1:1$.

Occurrence. Sierra County: Tierra Blanca district (?).

SYLVITE.

Physical characteristics. Isometric. Crystals cubes, often with octahedral truncations. Also in granular crystalline masses; compact. Cleavage: cubic, perfect. Fracture uneven. Brittle. H.- 2. Sp.G.- 1.97-1.99. Luster vitreous. Colorless when pure; white, bluish or yellowish red from inclusions. Soluble, taste like that of common salt, but bitter.

Chemical composition. Potassium chloride, KCl. Sometimes contains sodium chloride.

Varieties. 1. Sylvinite. See halite, p.212.

Occurrence. Eddy County: Carlsbad Potash district.

TALC.

Physical characteristics. Orthorhombic or monoclinic. Rarely in tabular crystals, hexagonal or rhombic with a prismatic angle of 60°. Usually foliated massive; sometimes in globular and stellate groups; also granular massive, coarse or fine; fibrous (pseudomorphous); also compact or cryptocrystalline. Cleavage: basal, perfect.

Sectile. Flexible in thin laminae, but not elastic. Feel greasy. H.- 1-1.5. Sp.G.- 2.7-2.8. Luster pearly on cleavage surface. Color apple-green to white, or silvery white; also greenish gray and dark green; sometimes bright green perpendicular to cleavage surface, and brown and less translucent at right angles to this direction; brownish to blackish green and reddish when impure. Streak usually white; of dark green varieties lighter than the color. Subtrapsparent to translucent.

Chemical composition. An acid metasilicate of magnesium, $H_2Mg_3(SiO_3)_4$, or $H_2O.3MgO.4SiO_2$.

Varieties. 1. Native Ultramarine. A magnesium silicate near talc in composition, in veins and streaks of a bright green color. As separated it is dull and earthy.
2. Steatite. Soapstone. Massive talc, either granular, fine granular, or cryptocrystalline, or hard and slaty. Color grayish green or brownish gray, milk-white in French chalk.

Occurrence. Grant County: Burro Mountains district. Rio Arriba County: Petaca district. Santa Fe County: New Placers (or possibly Old Placers) district. Sierra County: Kingston district. Socorro County: San Andres Mountains district (Salinas Peak).

Var. Native Ultramarine. Grant County: near Silver

City.

Var. Steatite. (Indefinite: reported from "various localities".)

TELLURIUM.

Physical characteristics. Hexagonal-rhombohedral. Crystals commonly minute hexagonal prisms, with the primary rhombohedron, or both primary and secondary rhombohedrons, as terminations. Commonly massive, columnar to fine granular. Cleavage: prismatic, perfect. Somewhat brittle. H.- 2-2.5. Sp.G.- 6.1-6.3. Luster metallic. Color and streak tin-white.

Chemical composition. Pure tellurium, Te, sometimes with a little selenium, also gold, iron, etc.

Occurrence. Catron County: Mogollon (?) and Wilcox districts. Grant County: Burro Mountains district (?); at a prospect 41 miles northwest of Silver City. Hidalgo County: Hachita district. Sierra County: Hillsboro (?) and Tierra Blanca (?) districts.

TENNANTITE.

Physical characteristics. Isometric-tetrahedral. Crystals

often dodecahedral. Also massive, compact. Cleavage none. Fracture subconchoidal to uneven. Rather brittle. H.- 3-4. Sp.G.- 4.37-4.49. Luster metallic, often splendent. Color and streak blackish lead-gray to iron-black. Opaque.

Chemical composition. Probably $3Cu_2S.As_2S_3$. The mineral grades into tetrahedrite as arsenic is replaced by antimony.

Occurrence. Grant County: Central and Pinos Altos districts. Hidalgo County: San Simon district (?). Socorro County: Hansonburg district.

TENORITE.

Physical characteristics. Triclinic, pseudo-monoclinic. Often in thin, shining, flexible scales. Earthy; massive; pulvurulent. Cleavage: basal, easy. Fracture conchoidal to uneven. H.- 3-4. Sp.G.- 6.5. Luster metallic. Color steel- or iron-gray when in thin scales; black or grayish black when dull and earthy. Ordinarily soils the fingers when massive and pulvurulent.

Chemical composition. Cupric oxide, CuO.

Varieties. 1. Melaconite. A black earthy variety, an oxidation product in copper veins. 2. Melanochalcite. A pitchy black material, a variable mixture of tenorite, chrysocolla, and malachite.

<u>Occurrence</u>. Hidalgo County: Fremont district (?). Socorro County: Magdalena and San Lorenzo districts.

Var. <u>Melaconite</u>. Grant County: Burro Mountains (?) and Santa Rita districts. Lincoln County: Estey district. Luna County: in Deming region. Sandoval County: Nacimiento Mountains district. Sierra County: Caballos Mountains, Chloride, and Kingston districts.

Var. <u>Melanochalcite</u>. Grant County: Burro Mountains district (?).

<u>TETRADYMITE</u>.

<u>Physical characteristics</u>. Hexagonal-rhombohedral. Crystals small, indistinct. Commonly in bladed forms foliated to granular massive. Cleavage: basal, perfect. Laminae flexible, not very sectile. H.- 1.5-2; soils paper. Sp.G.- 7.2-7.6. Luster metallic, splendent. Color pale steel-gray.

<u>Chemical composition</u>. Consists of bismuth and tellurium, with sometimes sulphur and a trace of selenium; the analyses for the most part afford the general formula $Bi_2(Te,S)_3$.

<u>Occurrence</u>. Colfax County: Baldy district. Dona Ana County: Organ district. Hidalgo County: Hachita district. Sierra

County: Hillsboro district.

TETRAHEDRITE. Gray Copper Ore. Fahlerz.

Physical characteristics. Isometric-tetrahedral. Habit tetrahedral. Also massive; granular, coarse or fine; compact. Cleavage none. Fracture subconchoidal to uneven. Rather brittle. H.- 3-4. Sp.G.- 4.4-5.1. Luster metallic, often splendent. Color between flint-gray and iron-black. Streak like color, sometimes inclining to brown and cherry-red. Opaque; sometimes subtranslucent (cherry-red) in very thin splinters.

Chemical composition. Essentially $3Cu_2S.Sb_2S_3$. Grades into tennantite as antimony is replaced by arsenic.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district (?). Dona Ana County: Organ district. Grant County: Central, Pinos Altos, and Santa Rita districts. Hidalgo County: Lordsburg and San Simon (?) districts. Rio Arriba County: Bromide district. San Miguel County: Willow Creek district. Sierra County: Chloride, Hermosa, and Kingston districts; near Derry (?). Socorro County: North Magdalena district (Pueblo Springs). Taos County: Picuris district (?).

County: Hillsboro district.

TETRAHEDRITE. Gray Copper Ore. Fahlerz.

Physical characteristics. Isometric-tetrahedral. Habit tetrahedral. Also massive; granular, coarse or fine; compact. Cleavage none. Fracture subconchoidal to uneven. Rather brittle. H. = 3-4. Sp.G. = 4.6-5.1. Luster metallic, often splendent. Color between flint-gray and iron-black. Streak like color, sometimes inclining to brown and cherry-red. Opaque; sometimes subtranslucent (cherry-red) in very thin splinters.

Chemical composition. Essentially $3Cu_2S\cdot Sb_2S_3$. Grades into tennantite as antimony is replaced by arsenic.

Occurrence. Catron County: Mogollon district. Colfax County: Baldy district (?). Dona Ana County: Organ district. Grant County: Central, Pinos Altos, and Santa Rita districts. Hidalgo County: Lordsburg and San Simon (?) districts. Rio Arriba County: Bromide district. San Miguel County: Willow Creek district. Sierra County: Chloride, Hermosa, and Kingston districts; near Derry (?). Socorro County: North Magdalena district (Pueblo Springs). Taos County: Picuris district (?).

THENARDITE. Anhydrous Sodium Sulphate. (?)

Physical characteristics. Orthorhombic. In pyramidal, short prismatic, or tabular crystals; also in cruciform twins. Cleavage: basal, distinct. Fracture uneven. Brittle. H.- 2.7. Sp.G.- 2.68. Luster vitreous. Color white to brownish. Transparent to translucent. Easily soluble in water.

Chemical composition. Anhydrous sodium sulphate, Na_2SO_4.

Occurrence. Dona Ana County: in Alkali Flat, between White Sands and San Andres Mountains (?).

THOMSONITE.

Physical characteristics. Orthorhombic. Distinct crystals rare, usually prismatic. Commonly columnar, structure radiated; in radiated spherical concretions; also closely compact. Cleavage: one direction, perfect; another, less so; another, in traces; all at right angles. Fracture uneven to subconchoidal. Brittle. H.- 5-5.5. Sp.G.- 2.3-2.4. Luster vitreous, more or less pearly. Snow-white; reddish green; impure varieties brown. Streak uncolored. Transparent to translucent.

Chemical composition. $(Ca,Na_2)Al_2Si_2O_8.2\frac{1}{2} H_2O$. The ratio Ca:na varies from 3:1 to 1:1.

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Chemical composition. $(Ca,Na_2)Al_2Si_2O_8 \cdot 2\frac{1}{2}H_2O$. The ratio Ca:Na varies from 3:1 to 1:1.

Occurrence. Colfax County: Raton region (?). Luna County: near Fort Cummings; in Deming region.

TITANITE. Sphene.

Physical characteristics. Monoclinic. Twins rather common, both contact-twins and cruciform penetration-twins. Crystals very varies in habit; often wedge-shaped and flattened; also prismatic. Sometimes massive, compact; rarely lamellar. Two rather distinct cleavages. Parting often easy, due to twinning-lamellae. H.- 5-5.5. Sp.G.- 3.4-3.56. Luster adamantine to resinous. Color brown, gray, yellow, green, rose-red, and black. Streak white. Transparent to opaque.

Chemical composition. $CaTiSiO_5$, or $CaO.TiO_2.SiO_2$.

Varieties. 1. Leucoxene. See ilmenite, p.223.

Occurrence. Grant County: Burro Mountains, Central, and Fierro-Hanover districts. Luna County: Deming region. Sierra County: (not specified). Socorro County: Magdalena district. Valencia County: near Grant.

TORBERNITE. Copper Uranite.

Physical characteristics. Orthorhombic, pseudo-tetragonal.

Crystals usually square tables, thin or thick; less often pyramidal. Also foliated, micaceous. Cleavage: basal, perfect, micaceous; another cleavage at right angles, distinct. Laminae brittle. H.- 2-2.5. Sp.G.- 3.2. Luster of perfect cleavage surface pearly, other faces subadamantine. Color emerald- and grass-green, and sometimes leek-, apple-, and siskin-green. Streak paler than color. Transparent to subtranslucent.

Chemical composition. A hydrous phosphate of uranium and copper, $Cu(UO_2)_2P_2O_8 \cdot 12H_2O$. Arsenic may replace part of the phosphorus.

Occurrence. Grant County: White Signal district; Camp Kithil (?). Socorro County: San Lorenzo district (?).

TOURMALINE. Turmalin.

Physical characteristics. Hexagonal-rhombohedral. Crystals usually prismatic, often slender to acicular; rarely flattened, with prism nearly wanting. Prismatic faces strongly striated vertically, and the crystals often much rounded to barrel-shaped. The cross-section of the prisms three-sided, six-sided, or nine-sided. Crystals commonly hemimorphic. Sometimes isolated, but more commonly in parallel or radiating groups. Sometimes massive compact; also columnar, coarse or fine, parallel or divergent. No

distinct cleavage. Fracture subconchoidal to uneven. Brittle and often rather friable. H.- 7-7.5. Sp.G.- 2.98-3.20. Luster vitreous to resinous. Color black, brownish black, bluish black, most common; blue, green, red, and sometimes of rich shades; rarely white or colorless; sometimes shows variations in colors in the same crystal. Streak uncolored. Transparent to opaque. Becomes electric by friction.

Chemical composition. A complex silicate of boron and aluminum, with also magnesium, iron, or the alkali metals prominent. A general formula may be written as $H_9Al_3(B.OH)_2Si_4O_{19}$, in which H may be replaced by the alkalies and also magnesium, ferrous iron, or calcium. Fluorine is commonly present in small amounts.

Occurrence. Hidalgo County: Lordsburg district. Lincoln County: White Oaks district. Rio Arriba County: Bromide, Hopewell, and Rinconada districts. San Miguel County: Rociada and Willow Creek districts. Santa Fe County: Cerrillos and Santa Fe districts. Sierra County: (not specified). Taos County: Picuris district. Valencia County: Zuni Mountains district.

TREMOLITE. Grammatite, nephrite in part. A variety of Amphibole.

Physical characteristics. Monoclinic. Contact-twins common. In distinct crystals, either long bladed or more rarely short or stout. In aggregates long and thin columnar, or fibrous; also compact granular massive. Cleavage: two directions, perfect, at angles of 55^o and 125^o approx. Fracture subconchoidal, uneven. Brittle. H.- 5-6. Sp.G.- 2.9-3.2. Luster vitreous to pearly on cleavage faces; fibrous varieties often silky. Color white to dark gray, sometimes transparent and colorless. Streak uncolored. Transparent to translucent.

Chemical composition. $Ca_2Mg_5(OH)_2(Si_4O_{11})_2$. Ferrous iron may replace the magnesium, tremolite thus grading into actinolite.

Occurrence. Colfax County: Elizabethtown district. Grant County: Fierro-Hanover district. Otero County: Orogrande district. Santa Fe County: New Placers district. Sierra County: (not specified). Socorro County: Magdalena district.

TRIDYMITE.

Physical characteristics. Hexagonal or pseudo-hexagonal. Crystals usually minute, thin tabular parallel to the base;

often in twins; also in fan-shaped groups. No distinct cleavage; basal parting sometimes observed. Tracture conchoidal. Brittle. H.- 7. Sp.G.- 2.28-2.33. Luster vitreous; on the base pearly. Colorless to white. Transparent.

Chemical composition. Pure silica, SiO_2, like quartz. Formed at temperatures above 800° C.

Occurrence. Sandoval County: Jemez region (near Mount Pelado).

TRONA. Urao.

Physical characteristics. Monoclinic. In tabular or elongated forms, often fibrous or columnar massive. Cleavage: one direction, perfect. Fracture uneven to subconchoidal. H.- 2.5-3. Sp.G.- 2.11-2.14. Luster vitreous, glistening. Color gray or yellowish white. Translucent. Taste alkaline. Little altered by exposure.

Chemical composition. $Na_2CO_3 . HNaCO_3 . 2H_2O$, or $3Na_2O . 4CO_3 . 5H_2O$.

Occurrence. McKinley County: Ojo de Tao, in Valle de San Miguel, four miles north of Cerro de Alesna.

TSCHERMIGITE. Ammonia Alum.

Physical characteristics. Isometric. Habit octahedral. Also fibrous. H.- 2. Sp.G.- 1.64. Luster vitreous. Colorless or white. Transparent to translucent.

Chemical composition. Hydrous sulphate of aluminum and ammonium, $(NH_4)Al(SO_4)_2.12H_2O$.

Occurrence. Quay County: Tucumcari region.

TURQUOIS. Turquoise.

Physical characteristics. Triclinic. Crystals minute and in angle near those of chalcosiderite with which it may be isomorphous. Crystals known only from Lynch Station, Virginia. Despite the abundance of turquois in New Mexico, no crystals have ever been reported. Usually massive; amorphous cryptocrystalline. Reniform, stalactitic, or incrusting. In thin seams and disseminated grains. Also in rolled masses. Cleavage in two directions in crystals; none in massive material. Fracture small conchoidal. Rather brittle. H.- 5-6. Sp.G.- 2.6-2.83. Luster somewhat waxy, feeble. Color sky-blue, bluish green to apple-green, and greenish gray. Streak white or greenish. Feebly subtranslucent to opaque.

Chemical composition. A hydrous phosphate of aluminum and

copper, $CuO.3Al_2O_3.2P_2O_5.9H_2O$, or perhaps $H_5(CuOH)(Al(OH)_2)_6(PO_4)_4$.

Varieties. 1. Odontolite. Bone-turquois. Fossil bone or tooth, colored by a phosphate of iron. Not a true variety, but often mistaken for turquois.

Occurrence. Grant County: Burro Mountains and White Signal districts. Hidalgo County: Hachita district. Lincoln County: Nogal district. Otero County: Orogrande district. Santa Fe County: Cerrillos district.

Var. Odontolite. Sandoval County: Nacimiento Mountains district.

URANINITE. Cleveite. Bröggerite. Nivenite. Pitchblende.

Physical characteristics. Isometric. In octahedrons; less often in cubes. Crystals rare. Usually massive and botryoidal; also in grains; structure sometimes columnar, or curved lamellar. Fracture conchoidal to uneven. Brittle. H.- 5.5. Sp.G.- 9.0-9.7 of crystals; of massive altered forms from 6.4 up. Luster submetallic, to greasy or pitch-like, and dull. Color grayish, greenish, brownish, velvet-black. Streak brownish black, grayish, olive-green, a little shining. Opaque.

copper. $CuO.3Al_2O_3.2P_2O_5.9H_2O$, or perhaps $H_2(CuOH)(Al(OH)_2)_6(PO_4)_4$.

Varieties. 1. Odontolite. Bone-turquoise. Fossil bone or teeth, colored by a phosphate of iron. Not a true variety, but often mistaken for turquoise.

Occurrence. Grant County: Burro Mountains and Little Hatchet districts. Hidalgo County: Eureka district. Lincoln County: Nogal district. Otero County: Jarilla district. Santa Fe County: Cerrillos district.

Var. Odontolite. Sandoval County: Nacimiento Mountains district.

URANINITE. Cleveite. Bröggerite. Nivenite. Pitchblende.

Physical characteristics. Isometric. In octahedrons, less often in cubes. Crystals rare. Usually massive and botryoidal; also in grains; structure columnar or curved lamellar. Fracture conchoidal to uneven. H. 5 – 6. Sp.G. 9.0-9.7 of crystals; of massive material varies from 6.4 up. Luster submetallic, to greasy or pitch-like, and dull. Color grayish, greenish, to velvet black. Streak brownish black, grayish, olive-green, a little shining. Opaque.

Chemical composition. A uranate of uranyl, lead, usually thorium (or zirconium), often the metals of the lanthanum and yttrium groups; also containg the gases nitrogen, helium, and argon, in varying amounts up to 2.6%. Calcium and water (essential ?) are present in small quantities; iron also, but only as an impurity. Radium was first discovered in this mineral, and it has been shown that it and the helium present are products of the breaking down of the uranium. The relation between the bases varies considerably, and no definite formula can be given.

Occurrence. Rio Arriba County: Petaca district.

URANOPHANE. Uranotil.

Physical characteristics. Orthorhombic. In minute acicular prisms, in radiated or stellate aggregations. Also massive with fine fibrous structure. H.- 2-3. Sp.G.- 3.81-3.90. Luster vitreous, of tabular faces pearly. Color honey-yellow, lemon- or straw-yellow.

Chemical composition. A hydrous silicate of uranium and calcium, $CaO.2UO_3.2SiO_2.7H_2O$.

Occurrence. Rio Arriba County: Petaca district. Socorro County: San Lorenzo district (?).

UTAHITE.

Physical characteristics. Hexagonal-rhombohedral. In aggregates of fine scales, microscopically tabular crystals with rhombohedral faces. Luster silky. Color orange-yellow.

Chemical composition. $3Fe_2O_3.2SO_3.7H_2O$. Perhaps identical with jarosite.

Occurrence. Dona Ana County: Organ district. Grant County: Georgetown district.

VANADINITE.

Physical characteristics. Hexagonal-pyramidal. Crystals prismatic, with smooth faces and sharp edges; sometimes cavernous, the crystals hollow prisms; also in rounded forms and in parallel groupings like pyromorphite. In implanted globules or incrustations. Fracture uneven, or flat conchoidal. Brittle. H.- 2.75-3. Sp.G.- 6.66-7.10. Luster of surface of fracture resinous. Color deep ruby-red, light brownish yellow, straw-yellow, reddish brown. Streak white or yellowish. Subtranslucent to opaque.

Chemical composition. $(PbCl)Pb_4(VO_4)_3$, or $3Pb_3V_2O_8.PbCl_2$. Phosphorus or arsenic may occur, replacing vanadium.

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Chemical composition. $(PbCl)Pb_4(VO_4)_3$, or $3Pb_3V_2O_8.PbCl_2$. Phosphorus or arsenic may occur, replacing vanadium.

Varieties. 1. Endlichite. A variety in which arsenic partly replaces vanadium. The ratio V;As = 1:1 nearly.

Occurrence. Dona Ana County: Gold Camp and Organ districts. Grant County: Central, Georgetown, and Lone Mountain districts. Hidalgo County: Steins Pass district (?). Santa Fe County: Cerrillos district. Sierra County: Caballos Mountains, Hillsboro, Lake Valley, and Macho districts. Socorro County: Magdalena (?), North Magdalena, and Socorro Peak (?) districts.

Var. Endlichite. Grant County: Central district. Sierra County: Hillsboro and Lake Valley districts. Socorro County: San Andres Mountains district (Grandview Canyon) (?).

VESUVIANITE. Idocrase.

Physical characteristics. Tetragonal. Often in crystals, prismatic or pyramidal. Also massive; columnar, straight and divergent, or irregular; granular massive; cryptocrystalline. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.- 6.5. Sp.G.- 3.35-3.45. Luster vitreous; often inclining to resinous. Color brown to green, and the latter frequently bright and clear; occasionally sulphur-yellow, and also pale blue. Streak white. Subtransparent to faintly subtranslucent.

Chemical composition. A basic calcium-aluminum silicate of

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Localities. Dona Ana County: Gold Camp and Organ districts. Grant County: Central, Georgetown, and Lone Mountain districts. Hidalgo County: Steins Pass district (?). Santa Fe County: Cerrillos district. Sierra County: Caballos Mountains, Hillsboro, Lake Valley, and Kingston districts. Socorro County: Magdalena (?), North Magdalena, and Socorro Peak (?) districts.

Var. Endlichite. Grant County: Central district. Sierra County: Hillsboro and Lake Valley districts. Socorro County: San Andres Mountains district (Grapevine Canyon) (?).

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Physical characteristics. Tetragonal. Often in crystals, prismatic or pyramidal. Also massive; columnar, straight and divergent, or irregular; granular massive; cryptocrystalline. No distinct cleavage. Fracture subconchoidal to uneven. Brittle. H.= 6.5. Sp.G.= 3.35-3.45. Luster vitreous; often inclining to resinous. Color brown to green, and the latter frequently bright and clear; occasionally sulphur-yellow, and also pale blue. Streak white. Subtransparent to faintly subtranslucent.

Chemical composition. A basic calcium-aluminum silicate of uncertain formula, perhaps $Ca_6(Al(OH,F))Al_2(SiO_4)_5$. Ferric iron may replace part of the aluminum and magnesium the calcium. Titanium and boron may be present.

Occurrence. Dona Ana County: Organ district. Grant County: Pinos Altos district (near Bear Mountain). Santa Fe County: New Placers district.

WERNERITE. Common Scapolite.

Physical characteristics. Tetragonal-pyramidal. Crystals prismatic, usually coarse, with uneven faces, and often large. Also massive, granular, or with a faint fibrous appearance; sometimes columnar. Cleavage: prismatic, both first and second order, rather distinct, but interrupted. Fracture subconchoidal. Brittle. H.- 5-6. Sp.G.- 2.66-2.73. Luster vitreous to pearly externally, inclining to resinous; cleavage and cross-fracture surfaces vitreous. Color white to gray, bluish, greenish, and reddish, usually light. Streak uncolored. Transparent to faintly subtranslucent.

Chemical composition. Intermediate between meionite, $CaCO_3.3CaAl_2Si_2O_8$, and marialite, $NaCl.3NaAlSi_3O_8$, and corresponding to a molecular combination of these in ratios between $Me_{80}Ma_{20}$ and $Me_{40}Ma_{60}$.

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Chemical composition. Intermediate between meionite, $Ca_4Al_6Si_6O_{25}$, and marialite, $Na_4Al_3Si_9O_{24}Cl$, and corresponding to a molecular combination of these in ratios between $Me_{80}Ma_{20}$ and $Ma_{80}Me_{20}$.

Occurrence. Colfax County: Baldy and Elizabethtown districts. Grant County: Fierro-Hanover district.

WHEELERITE. A hydrocarbon compound, exclusive to New Mexico.

Physical characteristics. A resin, yellowish in color, found in the Cretaceous beds in the northern part of the State, filling the fissures of the lignite, or interstratified in thin layers in it.

Chemical composition. Formula probably $(C_5H_6O)n$, where n = 5 or 6 probably.

Occurrence. McKinley County: Gallup-Zuni Coal Basin (near Fort Wingate). Sandoval County: Rio Puerco coal region.

WILLEMITE.

Physical characteristics. Hexagonal, tri-rhombohedral. In hexagonal prisms, long and slender, or short and stout. Also massive and in disseminated grains; fibrous. Cleavage: basal, also prismatic, easy in some specimens. Fracture conchoidal to uneven. Brittle. H.- 5.5. Sp.G.- 3.89-4.18. Luster vitreo-resinous, rather weak. Color white or greenish yellow, when purest; apple-green, flesh-red, grayish white, yellowish brown; often dark brown when

impure. Streak uncolored. Transparent to opaque. Some varieties fluoresce strongly in ultra-violet rays.

Chemical composition. Zinc orthosilicate, Zn_2SiO_4, or $2ZnO.SiO_2$. Manganese often replaces a considerable part of the zinc, and iron is also present in small amount.

Varieties. 1. Troostite. The variety in which zinc is partly replaced by manganese.

Occurrence. Grant County: Central district. Luna County: Tres Hermanas district. Socorro County: Magdalena and Socorro Peak districts.

Var. Troostite. Socorro County: Magdalena district.

WITHERITE.

Physical characteristics. Orthorhombic. Crystals always repeated twins, simulating hexagonal pyramids. Also massive, columnar or granular. Cleavage: one direction, distinct. Fracture uneven. Brittle. H.- 3-3.75. Sp.G.- 4.27-4.35. Luster vitreous, inclining to resinous on fracture surfaces. Color white, yellowish, grayish. Streak white. Subtransparent to translucent.

Chemical composition. Barium carbonate, $BaCO_3$.

Occurrence. Socorro County: San Andres Mountains region;

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Physical characteristics. Orthorhombic. Crystals always repeated twins, simulating hexagonal pyramids. Also massive, columnar or granular. Cleavage: one direction, distinct. Fracture uneven. Brittle. H. = 3-3.75. G. = 4.27-4.35. Luster vitreous, inclining to resinous on fracture surfaces. Color white, yellowish, grayish. Streak white. Subtransparent to translucent.

Chemical composition. Barium carbonate, $BaCO_3$.

Occurrence. Socorro County: San Andres mountains

Oscura Mountains region.

WOLFRAMITE.

Physical characteristics. Monoclinic. Crystals commonly tabular; also prismatic. Prism faces vertically striated. Often bladed, lamellar, coarse divergent columnar, granular. Cleavage: one direction, very perfect. Fracture uneven. Brittle. H.- 5-5.5. Sp.G.- 7-7.5. Luster submetallic. Color dark grayish or brownish black. Streak nearly black. Opaque. Sometimes weakly magnetic.

Chemical composition. Tungstate of iron and manganese, $(Fe,Mn)WO_4$. Forms a series from ferberite, $FeWO_4$, to hübnerite, $MnWO_4$. It has been suggested that ferberite should include that portion of the series up to 20% $MnWO_4$, hübnerite the portion up to 20% $FeWO_4$, and wolframite the remainder.

Occurrence. Hidalgo County: Hachita district. Lincoln County: White Oaks district. Luna County: Victorio district. Rio Arriba County: Rinconada district. Santa Fe County: New Placers district. Socorro County: San Andres Mountains district (?). Taos County: Picuris district (Picuris and near Penasco).

Var. Ferberite. Colfax County: Elizabethtown district.

San Miguel County: El Porvenir district.

Var. Hübnerite. Hidalgo County: Hachita district. Lincoln County: Nogal and White Oaks districts. Luna County: Victorio district.

WOLLASTONITE. Tabular Spar.

Physical characteristics. Monoclinic. Crystals commonly tabular; also short prismatic. Usually cleavable massive to fibrous, fibers parallel or reticulated; also compact. Cleavage: perfect, parallel to usual tabular face; less perfect, parallel to another face; a third less perfect cleavage at an angle between the first two. Fracture uneven. Brittle. H.- 4.5-5. Sp.G.- 2.8-2.9. Luster vitreous, on cleavage surfaces pearly. Color white, inclining to gray, yellow, red, or brown. Streak white. Subtransparent to translucent.

Chemical composition. Calcium metasilicate, $CaSiO_3$, or $CaO.SiO_2$.

Occurrence. Dona Ana County: Organ district. Grant County: Fierro-Hanover district. Hidalgo County: San Simon district. Luna County: Tres Hermanas district. Santa Fe County: New Placers district.

WULFENITE.

Physical characteristics. Tetragonal-pyramidal; hemimorphic. Crystals commonly square tabular, sometimes very thin; less frequently octahedral; also prismatic. Also granular massive, coarse or fine, firmly cohesive. Cleavage: octahedral, very smooth. Two other less distinct cleavages. Fracture subconchoidal. Brittle. H.- 2.75-3. Sp.G.- 6.7-7.0. Luster resinous or adamantine. Color wax- to orange-yellow, siskin- and olive-green, yellowish gray, grayish white to nearly colorless, brown; also orange and bright red. Streak white. Subtransparent to subtranslucent.

Chemical composition. Lead molybdate, $PbMoO_4$. Calcium sometimes replaces the lead.

Occurrence. Dona Ana County: Organ district. Grant County: Central district. Hidalgo County: Lordsburg district. Luna County: Victorio district. Otero County: Orogrande district. Santa Fe County: Cerrillos district. Sierra County: Caballos Mountains, Hillsboro, Lake Valley, and Macho districts. Socorro County: Socorro Peak district.

XANTHOCONITE.

Physical characteristics. Monoclinic. In tabular pseudo-orthorhombic crystals; also massive, reniform. Cleavage

basal. Brittle. H.- 2-3. Sp.G.- 5.5. Luster adamantine. Color orange-yellow to dull red or clove-brown. Streak yellow. Transparent to translucent.

Chemical composition. $3Ag_2S.As_2S_3$.

Occurrence. Santa Fe County: Cerrillos district.

ZARATITE. Emerald Nickel.

Physical characteristics. Amorphous. In mammillary incrustations; also massive compact. Brittle. H.- 3-3.25. Sp.G.- 2.57-2.69. Luster vitreous. Color emerald-green. Streak paler. Transparent to translucent.

Chemical composition. A hydrated basic nickel carbonate, of somewhat uncertain formula, $NiCO_3.2Ni(OH)_2.4H_2O$.

Occurrence. San Miguel County: (not specified).

ZEPHAROVICHITE. (?)

Physical characteristics. Cryptocrystalline fibrous. Fracture conchoidal. H.- 5.5. Sp.G.- 2.37. Color yellowish or grayish white. Translucent.

Chemical composition. Of doubtful specific value, perhaps impure wavellite. Formula $AlPO_4.3H_2O$.

basal. Brittle. H.- 2-3. Sp.G.- 3.3. Luster adamantine. Color orange-yellow to dull red or clove-brown. Streak yellow. Transparent to translucent.

Chemical composition. $3Ag_2S.As_2S_3$.

Occurrence. Santa Fe County; Cerrillos district. - - - - - -

ZARATITE. Emerald Nickel.

Physical characteristics. Amorphous. In mammillary incrustations; also massive compact. Brittle. H.- 3-3.25. Sp.G.- 2.57-2.69. Luster vitreous. Color emerald-green. Streak paler. Transparent to translucent.

Chemical composition. A hydrated basic nickel carbonate of somewhat uncertain formula, $NiCO_3.2Ni(OH)_2.4H_2O$.

Occurrence. San Miguel County (not specified).

ZEPHAROVICHITE. (?)

Physical characteristics. Cryptocrystalline or fibrous. Fracture conchoidal. H.- 5.5. Sp.G.- 2.37. Color yellowish or grayish white. Translucent.

Chemical composition. Of doubtful specific value, perhaps impure wavellite. Formula $AlPO_4.3H_2O$.

Occurrence. Taos County: Harding Mine district (?).

ZINCITE. Red Oxide of Zinc.

Physical characteristics. Hexagonal-hemimorphic. Natural crystals rare. Usually foliated massive, or in coarse particles and grains; also with granular structure. Cleavage: basal, perfect; prismatic, sometimes distinct. Fracture subconchoidal. Brittle. H.- 4-4.5. Sp.G.- 5.43-5.7. Luster subadamantine. Color deep red, also orange-yellow. Color thought to be due to the presence of manganese oxide. Streak orange-yellow. Translucent to subtranslucent.

Chemical composition. Zinc oxide, ZnO. Manganese protoxide is commonly present in small amounts.

Occurrence. Luna County: Tres Hermanas district. Socorro County: Magdalena district (?).

ZINKOSITE. Almagrerite.

Physical characteristics. Probably orthorhombic. In tabular crystals isomorphous with those of anglesite and barite. Sp.G.- 4.331.

Chemical composition. Anhydrous zinc sulphate, $ZnSO_4$.

Occurrence. Socorro County: Magdalena district.

ZIRCON.

Physical characteristics. Tetragonal. Twins sometimes occur. Commonly in square prisms, sometimes pyramidal. Also in irregular forms and grains. No distinct cleavage. Fracture conchoidal. Brittle. H.- 7.5. Sp.G.- 4.2-4.86; 4.68-4.70 most common. Luster adamantine. Colorless, pale yellowish, grayish, yellowish green, brownish yellow, reddish brown. Streak uncolored. Transparent to subtranslucent and opaque.

Chemical composition. $ZrSiO_4$, or $ZrO_2.SiO_2$. A little ferric oxide is usually present.

Occurrence. Grant County: Fierro-Hanover, Pinos Altos, and Santa Rita districts. Hidalgo County: Lordsburg district. Luna County: Deming region. Otero County: Orogrande district. Sandoval County: Jemez region. Sierra County: (not specified).

ZOISITE.

Physical characteristics. Orthorhombic. Crystals prismatic, deeply striated vertically, and seldom distinctly

Occurrence. Socorro County: Magdalena district.

ZIRCON.

Physical characteristics. Tetragonal. Twins sometimes occur. Commonly in square prisms, sometimes pyramidal. Also in irregular forms and grains. Cleavage (110) indistinct; fracture conchoidal. Brittle. H = 7.5. G = 4.68-4.70; 4.68-4.70 most common. Luster adamantine. Colorless, pale yellowish, grayish, yellowish green, brownish yellow, reddish brown. Streak uncolored. Transparent to translucent and opaque.

Chemical composition. $ZrSiO_4$, or $ZrO_2.SiO_2$. Ferric oxide is usually present.

Occurrence. Grant County: Fierro-Hanover, Pinos Altos and Santa Rita districts. Hidalgo County: Lordsburg district. Luna County: Deming region. Otero County: Orogrande district. Sandoval County: Jemez region. Sierra County: (not specified).

ZOISITE.

Physical characteristics. Orthorhombic. Crystals prismatic, deeply striated vertically, and seldom distinctly terminated. Also massive, columnar to compact. Cleavage: one direction, very perfect. Fracture uneven to subconchoidal. Brittle. H.- 6-6.5. Sp.G.- 3.25-3.37. Luster vitreous, on the cleavage face pearly. Color grayish white, gray, yellowish brown, greenish gray, apple-green; also peach-blossom-red to rose-red. Streak uncolored. Transparent to subtranslucent.

Chemical composition. $HCa_2Al_3Si_3O_{13}$, or $4CaO.3Al_2O_3.6SiO_2.H_2O$. The alumina is sometimes replaced by iron, and the mineral grades in composition toward epidote.

Varieties. 1. Saussurite. The compact, massive variety which has arisen from the alteration of feldspar.
2. Thulite. Fragile. Color various shades of rose-red.

Occurrence. Colfax County: Baldy and Elizabethtown districts. Dona Ana County: Organ district. Grant County: Fierro-Hanover district. Luna County: Cooks Peak district. San Miguel County: Willow Creek district. Santa Fe County: New Placers district.

Var. Saussurite. San Miguel County: Willow Creek district.

Var. Thulite. Taos County: Glenwoody district.

terminated. Also massive, columnar to compact. Cleavage one direction, very perfect. Fracture uneven to subconchoidal. Brittle. H.= 6-6.5. Sp.G.= 3.25-3.37. Luster vitreous, on the cleavage face pearly. Color grayish white, gray, yellowish brown, greenish gray, apple-green; also peach-blossom-red to rose-red. Streak uncolored. Transparent to subtranslucent.

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