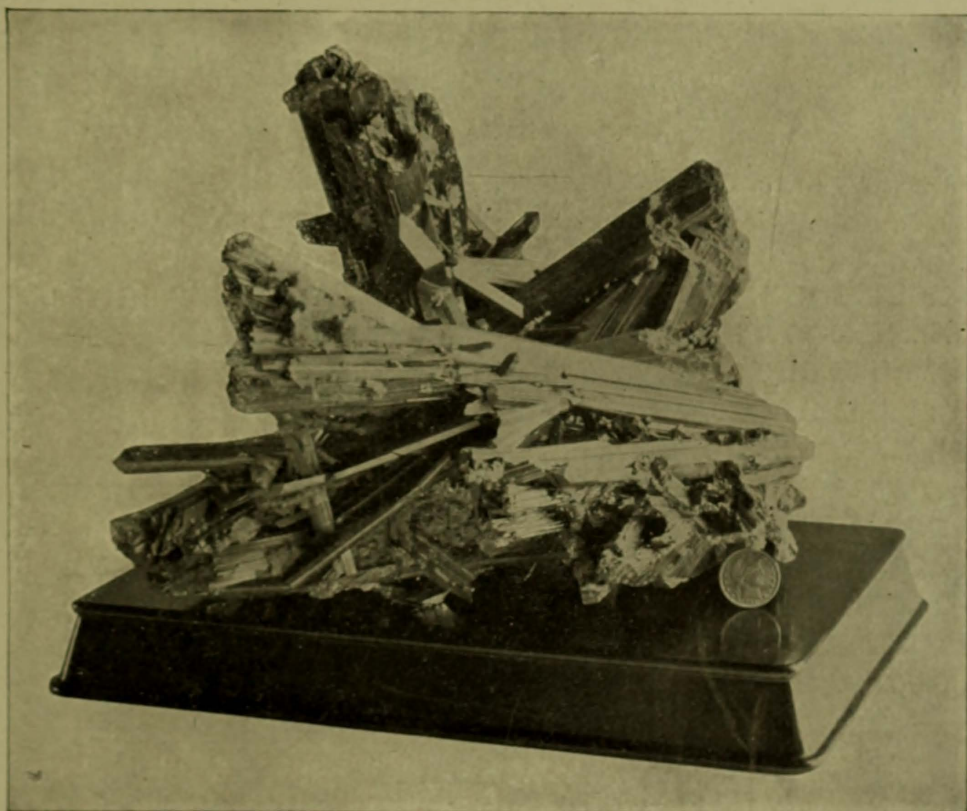


AMERICAN MUSEUM OF NATURAL HISTORY

# The Collection of Minerals



BY

Louis P. Gratacap, A.M.

Curator, Department of Mineralogy

SUPPLEMENT TO AMERICAN MUSEUM JOURNAL

VOL. II, No. 2, FEBRUARY, 1902

Guide Leaflet No. 4

*Second Edition, Revised, May, 1904*

# American Museum of Natural History

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MORGAN HALL OF MINERALOGY. NO. 404

# The Collection of Minerals.

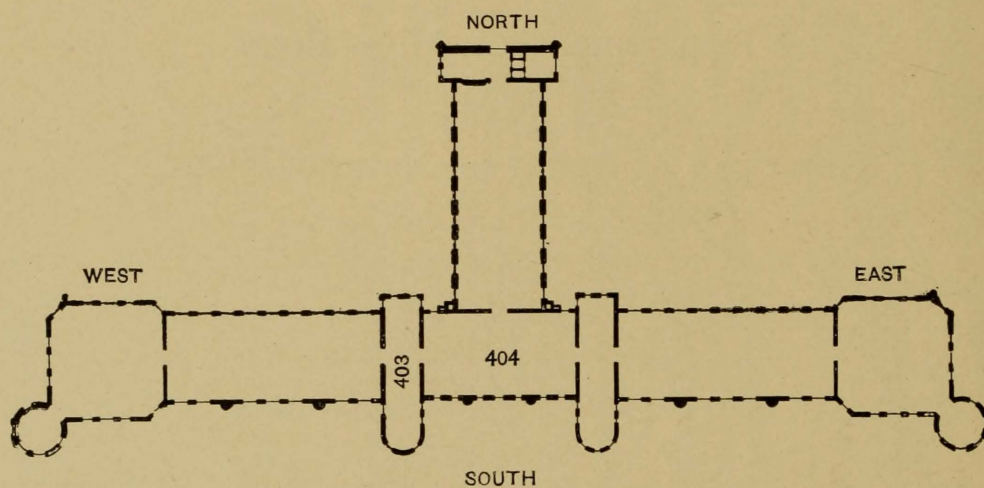
A Guide Leaflet to the Exhibition Halls  
of the  
Department of Mineralogy  
in the  
American Museum of Natural History.

By

LOUIS P. GRATACAP, A.M.,  
Curator of Mineralogy.

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New York: Published by the Museum.  
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#### FOURTH FLOOR

Diagram showing location of the Morgan Halls of Mineralogy  
(Nos. 403 and 404).

## THE COLLECTION OF MINERALS.

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### INTRODUCTION.

MINERALS, in the broad sense in which science uses the term, include the air, the natural gases, water and the results of change in plant structures, such as coal, oil and resins. More popularly defined, minerals are those stony components of the earth which are to be found in its rocks and their crevices and which present similarity to one another in such characteristics as color, form and hardness. Most observers can easily separate Quartz from Calcite. In making the separation they associate with the idea of Quartz a certain lustre and hardness, a peculiar brittle and irregular fracture and, when the mineral is crystallized, a typical form quite in contrast with the same features in Calcite. A brilliant lemon-yellow crystal, or even a compact mass of Sulphur, is quite distinct in appearance from a greasy, black crystal or nodular piece of Graphite. The obvious physical characters of one are so different from those of the other that the most cursory examination serves to distinguish them as independent substances.

Such striking contrasts, however, do not exist generally in the mineral kingdom, and the observer usually is obliged to give more than a superficial examination to a mineral specimen in order to determine what it is. Most of the common minerals may be differentiated by simple tests with blowpipe and file, but all the rest, and they form by far the largest part of the whole number of species, must be examined by more elaborate chemical and physical means for their exact determination.

The collection of minerals to which this Guide Leaflet is an introduction, though large and comprehensive, cannot be considered an exhaustive representation of the mineral kingdom. It combines, however, in almost equal degrees the elements of

## THE COLLECTION OF MINERALS

beauty, scientific interest and educational use. The æsthetic influence of a collection of minerals need not be dwelt upon. It is evident that minerals are beautiful in their colors, in their varied forms and, sometimes, in the extreme delicacy of their development.

### THE HISTORY OF THE COLLECTION.

The growth of the Mineral Collection of the American Museum has been gradual. Its nucleus was the Bailey collection, which contained many of the more common minerals and, while not conspicuous for beauty or completeness, was a fairly representative series serving very well the purpose of an introduction to mineralogy. The Spang collection was purchased in 1891 and more than doubled the number of specimens of minerals in the Museum. This acquisition, furthermore, added a large number of new species, and in many groups increased the variety and richness of form represented.

Previous to the purchase of the Spang collection, a very remarkable group of specimens of Malachite and Azurite (the green and blue carbonates of copper) had been presented to the Museum by the Copper Queen Consolidated Mining Company of Arizona. This unique and very striking assemblage of specimens, together with later additions from the same source, is now installed in the large single case at the north end of the smaller hall (lettered "B" in the diagram).

In the ten years following the acquisition of the Spang collection, many valuable gifts were added to the Museum's series, but preëminence among the exhibition collections in the country was not attained until the close of 1900, when J. Pierpont Morgan, Esq., purchased the Bement collection of minerals and meteorites and presented it to the Museum. This remarkable collection was brought together by Mr. Clarence S. Bement of Philadelphia. It is the result of the careful expenditure of a great deal of money, the purchases having been directed by exquisite taste as well as by scientific judgment. Although the Bement collection contains many rare species, its widespread fame has rested upon the variety of forms representing the com-

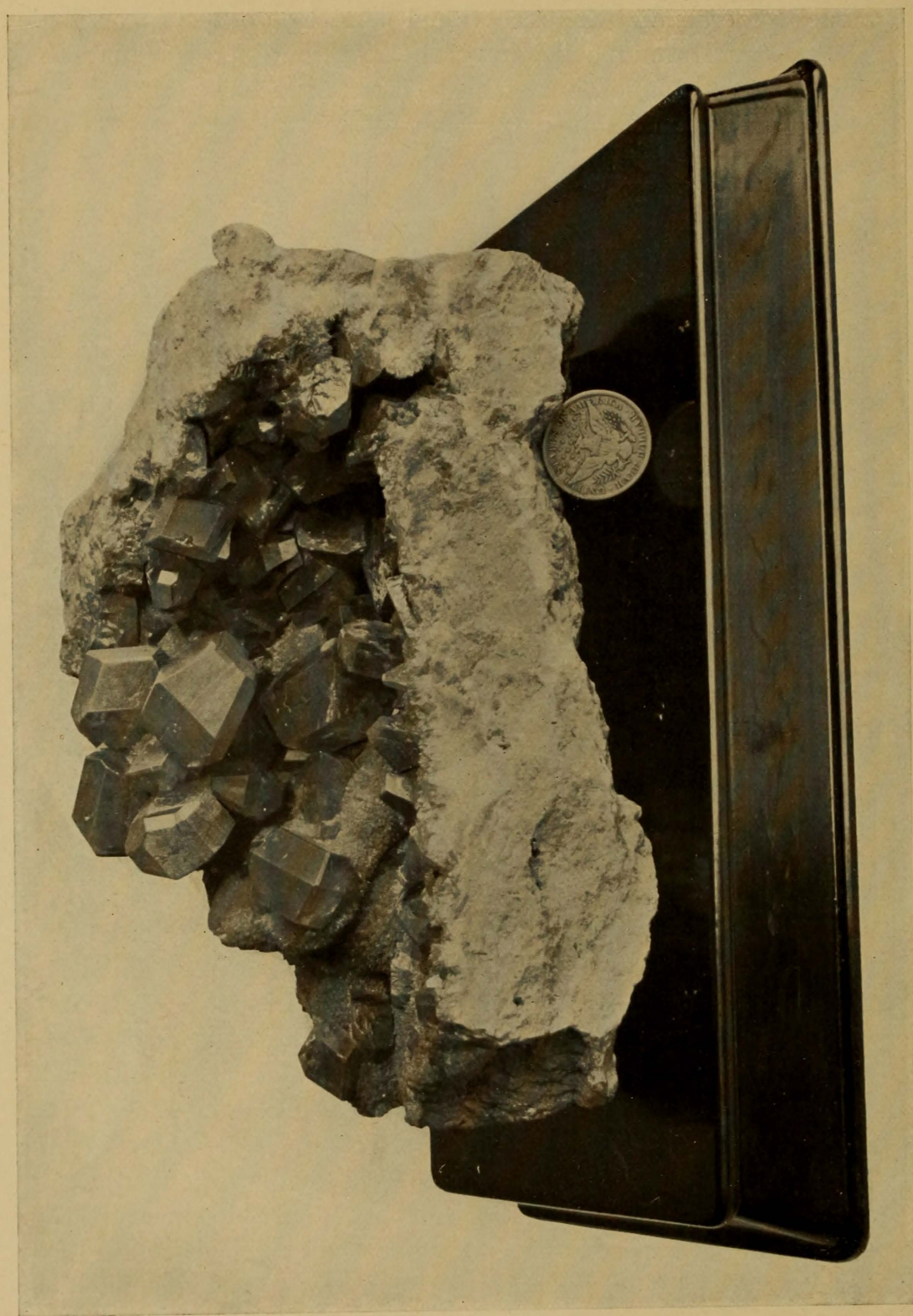
## THE COLLECTION OF MINERALS

moner minerals and the exceptional perfection of the specimens. The present Museum collection is the combination of the material from all these sources, but owing to lack of space the Bement collection only is on exhibition, except in the wall cases.

### CLASSIFICATION.

The classification of minerals in an exact sense was impossible as long as mineralogists adopted artificial systems based solely on color, hardness, source, weight or fanciful external resemblances. Only as the science of chemistry developed and as better methods of analysis were devised could a philosophical classification of minerals become possible. To chemical law mineralogy has adhered more and more closely, and while, to some extent, minor groups are founded upon crystallographic identity or similarity, the underlying basis of classification throughout is chemical composition. Minerals of the same chemical type are grouped together, and under that type minerals of similar physical or crystallographic features are arranged in smaller subdivisions. The forms of minerals are their most obvious characteristic. The six-sided prisms of Quartz and Beryl crystals, the rhomboidal or trapezoidal faces of Garnet, the triangular faces of Magnetite and the square faces of Fluorite are unmistakable. Observation at last passed beyond the first stages of curiosity or admiration and, slowly helped by many early students, and rapidly advanced by the genius of two or three, the branch of mineral science known as Crystallography has developed. Crystal form, furthermore, has been found to have close dependence upon chemical composition.

In the development of the nomenclature of the science the form of the names instituted by the ancients has been retained, and the termination *-ite*, derived from the classic Greek *-itis*, meaning *belonging to*, prevails. For example, Hematite, from the Greek word for blood, alludes to the red color of one mineral; Chlorite, to the green color of another, and Siderite, from the Greek word for iron, has reference to the chemical nature of a third. Several names which are exceptions to the rule, such as



SULPHUR FROM CIANCIANI, ITALY

## THE COLLECTION OF MINERALS

Garnet, Idocrase, Quartz, Mica, Gypsum, Corundum and Spinel, have been so long in use that, like the names of the metals and elements, they must be retained.

According to chemical composition, therefore, the following principal subdivisions of minerals have been established:

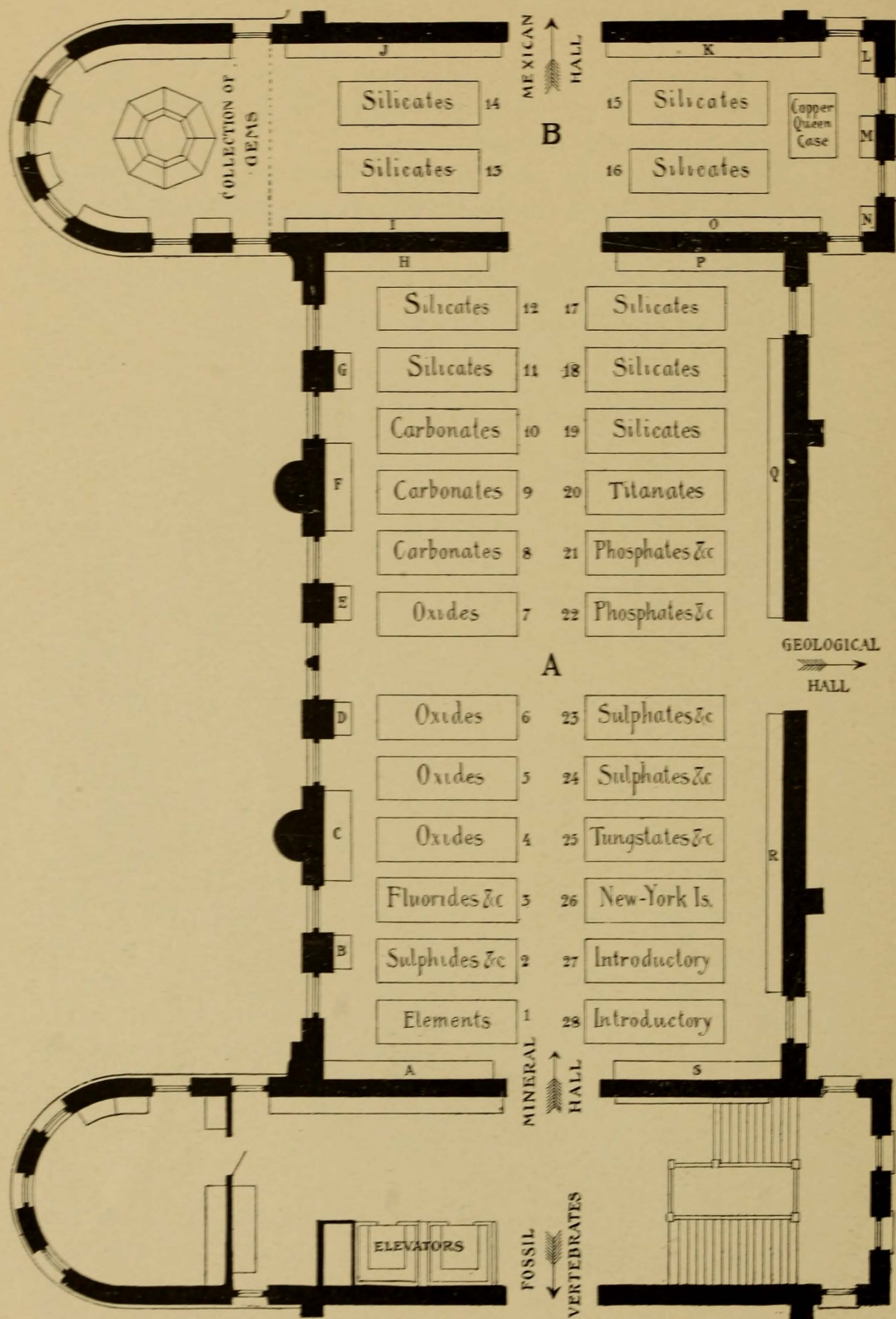
- I. The Native Elements.
- II. The Arsenides, Sulphides, Antimonides, Sulph-arsenides, Sulph-antimonides and similar compounds.
- III. The Haloids.
- IV. The Oxides, anhydrous and hydrous.
- V. The Oxygen-salts, such as Carbonates, Silicates, Phosphates, Columbates, Tantalates, Sulphates and Nitrates.
- VI. The Hydrocarbons.

This system is almost universally used to-day, with changes, however, more or less material in the succession and interpretation of its various parts, and is practically the production of the last century.

Owing to the early activity of chemical agencies and the still continuing energy of oxygen, a gas which is constantly attacking uncombined elements, the list of Native Elements, as at present known, is much shorter than the list of elements known to chemistry, a large number of them being precluded from any independent existence whatever through their strong affinities for other substances. The mineralogist finds, however, in the portions of the earth accessible to him, a small list of native elements, of which six, at the most, are characteristically uncombined, while the remainder, about fifteen in number, are found native only under exceptional conditions, and one of them, iron, is particularly interesting because its most frequent occurrence is in the form of meteorites.

### GUIDE TO THE COLLECTION.

The collection of minerals is exhibited in two halls on the fourth floor of the Museum, marked "A" and "B" on the diagram, and is displayed in two sections, the wall case and the desk case exhibits. The wall cases contain those specimens which are



PLAN OF HALLS, DEPARTMENT OF MINERALOGY

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too large for the desk cases, but the arrangement in the two series is the same. The systematic series in the desk cases is naturally far more complete than that in the wall cases. The specimens are arranged in accordance with the classification given in the sixth edition of Dana's System of Mineralogy, and the series in the desk cases begins at the left of the entrance to Hall A. It is intended to be studied from left to right along each side of every case, so that one advances from west to east along the south side of the hall, enters the small hall, B, and returns along the north side of the large hall to the end of the series at Case 25. Case 27 contains a collection of the minerals of New York and vicinity, and Cases 27 and 28 contain introductory series presenting the chemical and physical features of minerals, together with explanatory tables and photographs. The meteorites of the collection are now to be found in Cases 25 and 27, but they are soon to be arranged by themselves in cases along the center of the hall. At the head of every scientific subdivision will be found a statement, called here a "Rubric," detailing the principal members of the group, and giving their chemical composition and system of crystallization.

In the Museum collection the Sulphurs, Golds and Coppers are the most striking examples of the Native Elements.

The Sulphur specimens (see Desk Case 1 and Wall Case A) arrest attention on account of their beauty and perfect preservation. The crystallographic habit of the mineral is well known, steep pyramids beveled by the narrow planes of more obtuse pyramids, generally broad basal pinacoids, prisms, domes, hemipyramids and frequent sphenoids. An examination of the crystals will generally reveal upon the large brilliant faces curiously wrinkled and clouded surfaces which, under a magnifying glass, show densely crowded pits and irregular etchings. The sulphur deposits of the earth usually are found in connection with gypsum beds or near active or extinct volcanoes. The sulphur has been produced by separation from sulphuretted hydrogen. The mineral is found in large deposits in Wyoming, Nevada, southern Utah, and California.

Particularly choice are the specimens of Gold. The mineral is

## THE COLLECTION OF MINERALS

shown here (Desk Case 1) in sheets like rolled metal; in plates, with crystallized edges; in braided filaments made up of minute octahedrons; in grouped octahedrons with hollow faces; in twisted plates frequently attached to quartz, around which it curls like some irregular yellow flower. Gold, from an elongation of the octahedron, assumes deceptive forms, while cavernous, skeleton and pitted crystals, peculiar distortions, reticulated and tree-shaped groups with spongy masses and rounded water-worn nuggets are common natural appearances of this precious metal.

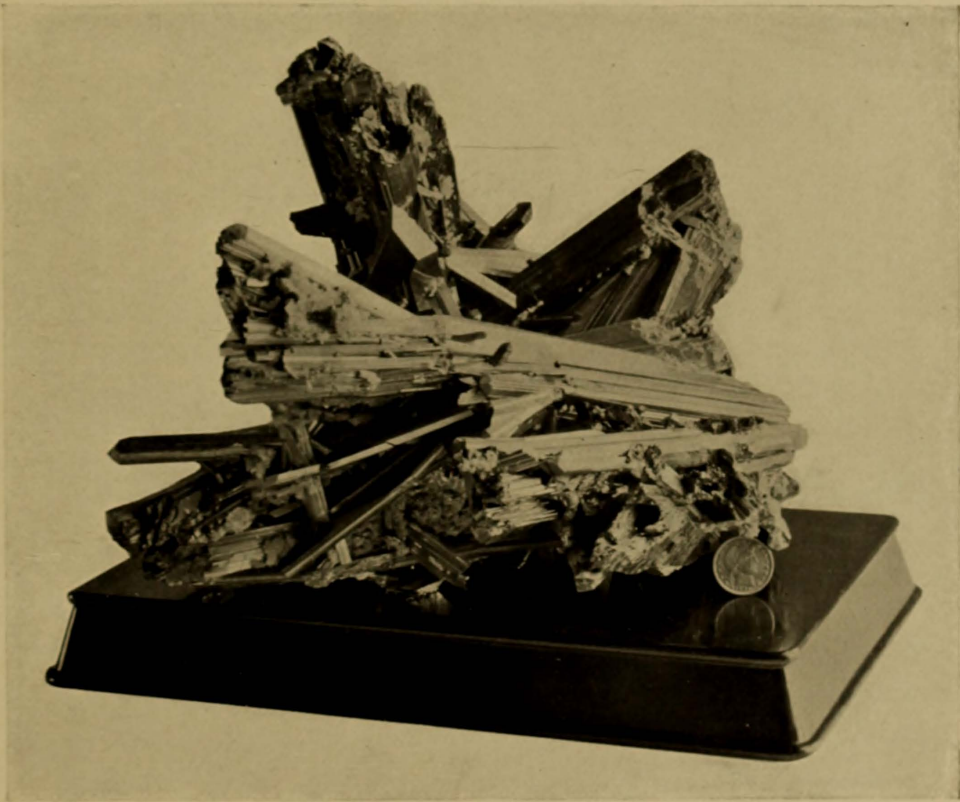
Copper (Desk Case 1) is of especial interest, on account of the beautifully crystallized specimens in which it occurs. Most of our specimens have come from the remarkable deposits of Native Copper in the Lake Superior region of Northern Michigan. They exhibit the characteristic crystal forms of the metal, sprigs and branching crystals, twins and massive plates, the common tetrahedron, cubes and superimposed octahedrons. Here will be found also examples of Copper and Silver which have been welded together by nature.

The next group of minerals is that comprising the Sulphides, Selenides and Tellurides of the metals and semi-metals, and the Arsenides and Antimonides of the metals, which are again succeeded by the so-called Sulpho-salts, in which the union of sulphur with arsenic or antimony is regarded as an acid, chiefly forming compounds with the bases, copper, silver, lead, iron, zinc and mercury. The great variety and number of mineral species resulting from the combinations thus made possible, are for the most part the source of many useful metals, and these combinations characterize the veins, crevices, fissures, caves and beds of mining regions.

One of these, Stibnite, the sulphide of antimony, is a valuable ore (Desk Case 1, Wall Case A). This species affords the mineralogist very beautiful, lustrous, well-terminated prismatic crystals, usually clustered in radiating groups. The striking specimens here displayed, together with many others which have supplied the cabinets of the world, were found at Mt. Kosang near Seijo, province of Iyo, Shikoku Is., Japan. In their size and beauty and

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in the complexity of their forms, they surpass the specimens of the same species from all other localities. They increased the number of known crystalline planes of Stibnite from forty-five to eighty-five. Galenite, the sulphide of lead, and Sphalerite, the sulphide of zinc, are represented by beautiful specimens in Desk Case 2 and Wall Cases A and B. Pyrite, the sulphide of iron (Desk Case 2, Wall Case C) is a very common species, and is very strik-



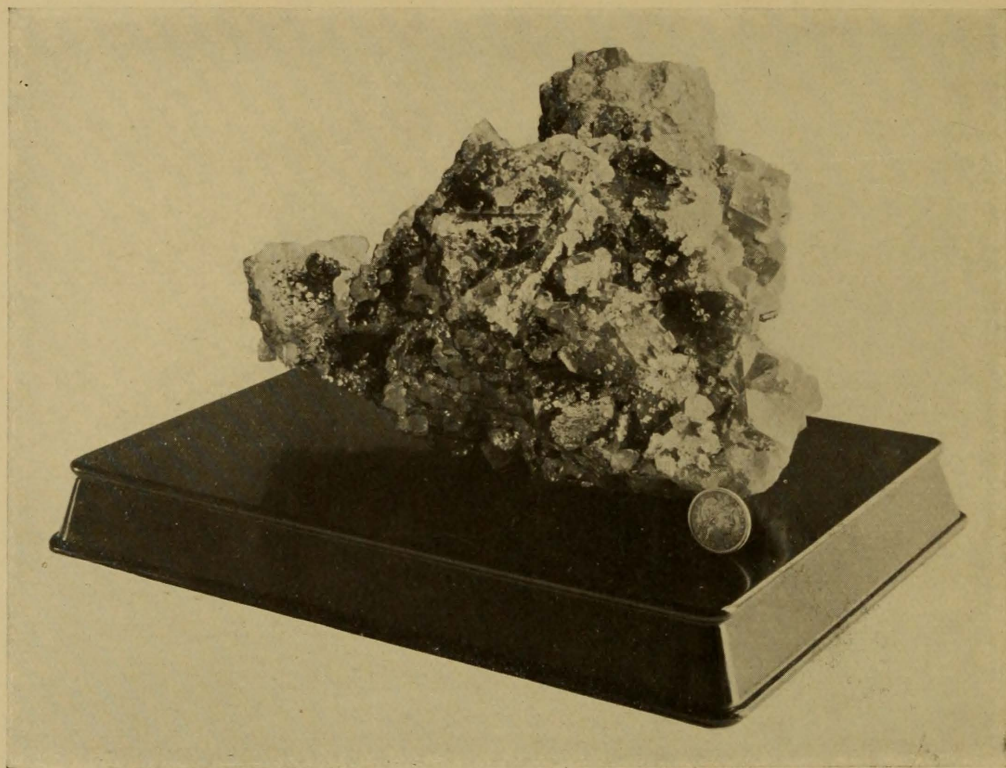
STIBNITE FROM MT. KOSANG, JAPAN

ing on account of its brilliant cubes, dodecahedrons and other crystal forms.

The group of Haloid compounds follows the foregoing division, and is composed of the unions of the elements chlorine, fluorine, iodine and bromine with basic atoms of the metals. The admixture of oxygen produces oxy-salts, and of combined water makes hydrous salts. In this section Fluorite is prominent (Desk

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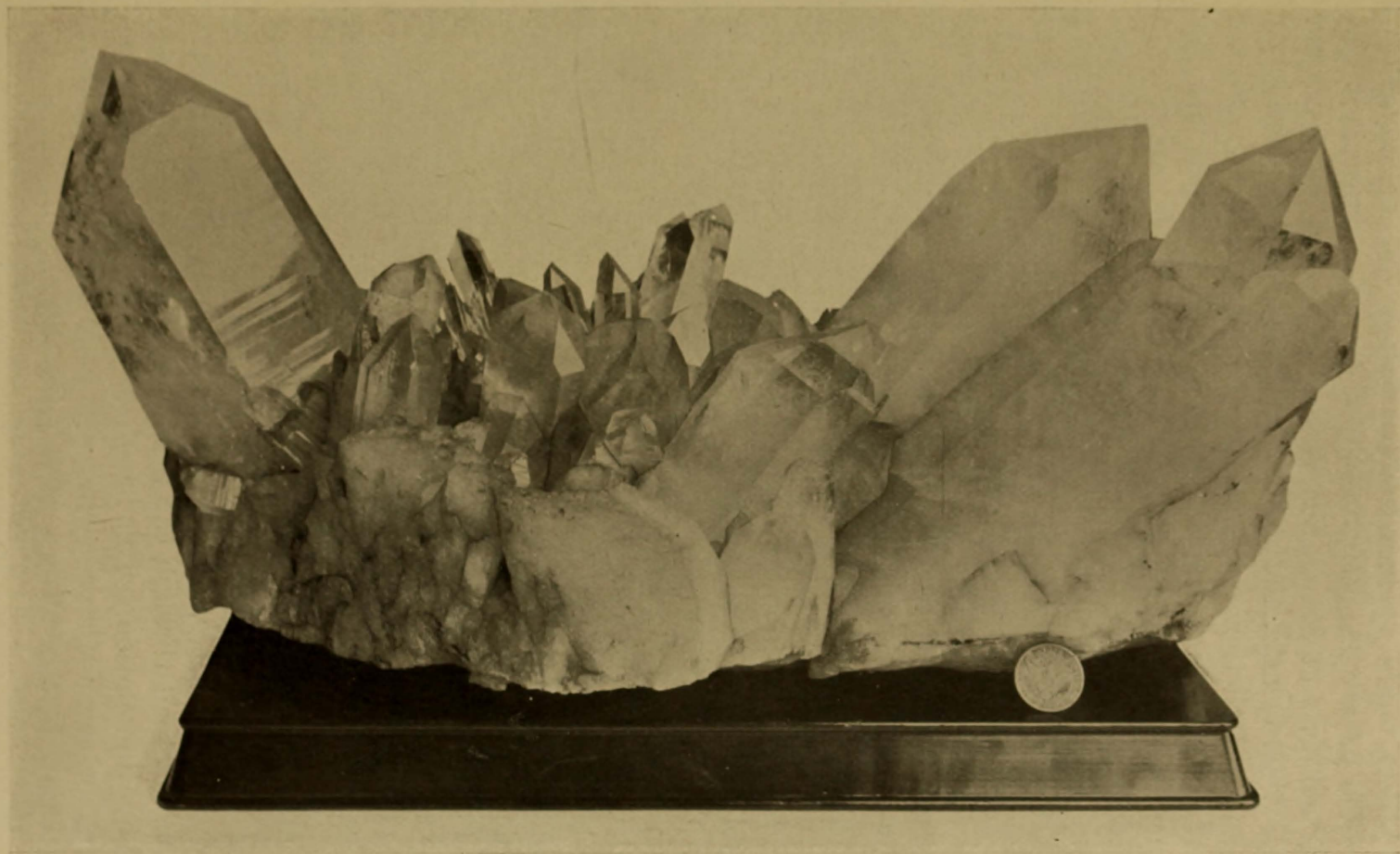
Cases 3 and 4, Wall Cases C, D, E, F). In every large collection this mineral offers a splendid display of colors and associations, and in the Bement collection the series of specimens is especially attractive. From Cumberland, England, there are elongated cubes with attached Calcite crystals; large cubes coated with crystals of Quartz; purple and green cubes densely ruled with fine lines, which indicate oscillations of crystal development;



FLUORITE COATED WITH QUARTZ, CUMBERLAND, ENG.

green cubes from Cornwall with feathery edges of purple, inclusions of black specks and interior colored boundaries (phantoms); also from Brienz, Switzerland, crystals with low scallop-like depressions, pyramidal pits, wrinkling lines and pin-holes, the whole resembling an eroded or half melted ice-block; from Saxony, yellow cubes with Galenite; magnificent pink octahedrons from Switzerland, some of them with blunted or rounded angles made by the planes of the trigonal trisoctahedron.

The Oxides follow the simple compounds of the metals and



QUARTZ FROM MAGNET COVE, ARKANSAS

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semi-metals and represent the combination of oxygen with metallic bases. They form one of the most important classes of minerals, and among them are found many of the valuable ores, while Quartz, the oxide of silicon, is the most widely distributed of all the rock-making minerals. In this section, Hematite, Corundum, Spinel, Magnetite, Franklinite and Rutile present some of the most brilliant phases of the mineral world (Desk Cases 6 and 7, Wall Case I).

Quartz, including the chalcedonic forms of silica (Desk Cases 4 and 5, Wall Cases F, G, H, P), is the most prized, the most beautiful and the most varied of all minerals. In color, form and physical constitution, it assumes so many aspects, and the changes from one form to another are so gradual that its complete illustration is almost impossible. It crystallizes in the hexagonal system and usually has the form of a six-sided prism terminated by a pyramid. In the Bement collection its great diversity of development is well shown. Quartz occurs in easily visible particles in granite and many other igneous and metamorphic rocks, in sandstones and quartzites and, as a deposit from aqueous solution, in cavities and crevices in all kinds of rocks. It is the common vein material of mountainous and ore-bearing regions. The absorption of iron and other metallic oxides produces many colors, especially in the various chalcedonic forms of silica.

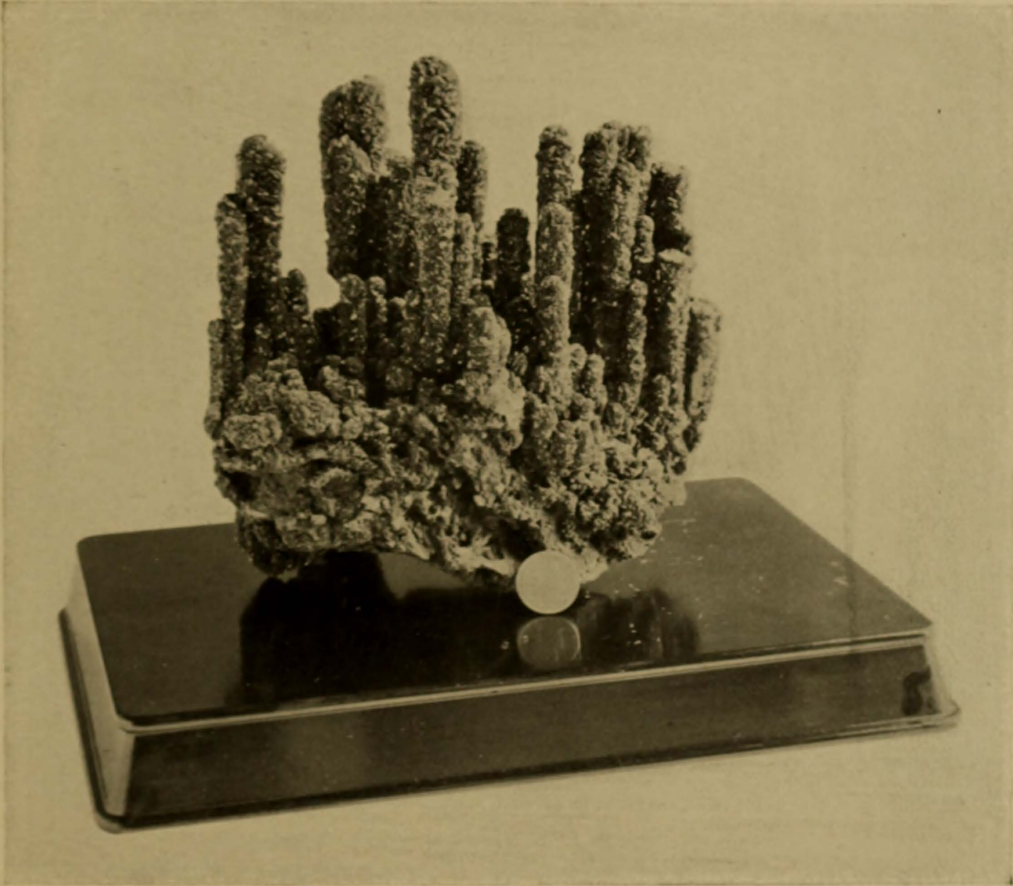
Following the Oxides are the Carbonates, which form a very important group. The carbonates of lime and magnesia constitute the limestones, while the carbonates of iron and copper are valuable ores. On account of their beauty, many Carbonates,—for example, Marbles, Malachite, Azurite and Mexican Onyx,—take a conspicuous position in a mineral cabinet. The carbonates have been formed by the combination of carbon dioxide with various bases, and the union in many instances has been brought about through the agency of water carrying the carbon dioxide in solution. This has dissolved the base of the salt, the whole being re-deposited afterward from a more or less saturated fluid on a further change of conditions.

In this series the Calcite, Aragonite, Malachite, Azurite, Sider-

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ite and Rhodochrosite specimens furnish a long display of forms and colors (Desk Cases 8-10, Wall Cases I, J, K, O).

The Silicates embrace the larger number of mineral species and are the essential components of the crystalline rocks. They are unions of basic elements (the oxides of various metals) with the several forms of silicic acid. The group is subdivided into

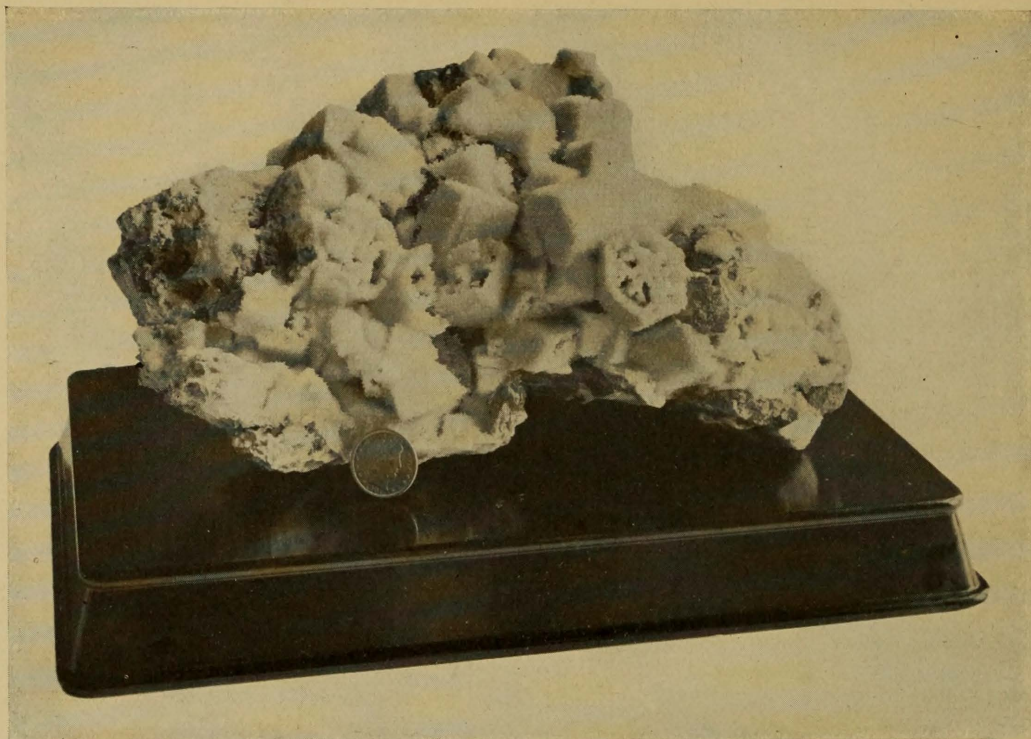


AZURITE FROM BISBEE, ARIZONA

two sections: the Anhydrous and the Hydrus Silicates, and these again are broken up into smaller groups based upon similarity of their members to one another in regard to composition, crystallization and optical qualities. Among the Silicates there are several well-marked and compact groups, such as the Feldspars, the Pyroxenes, the Amphiboles, the Garnets, the Sodalites and the Scapolites.

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A chemical feature of the greatest importance in the constitution of the silicates is the replacing power of the bases, whereby one or more basic molecules take the place in whole or in part of another in the chemical composition of a mineral. For instance, the sesquioxide of alumina ( $\text{Al}_2\text{O}_3$ ) can be replaced by the sesquioxide of iron ( $\text{Fe}_2\text{O}_3$ ), except in the feldspars; and, similarly, lime ( $\text{CaO}$ ), magnesia ( $\text{MgO}$ ) and protoxide of iron



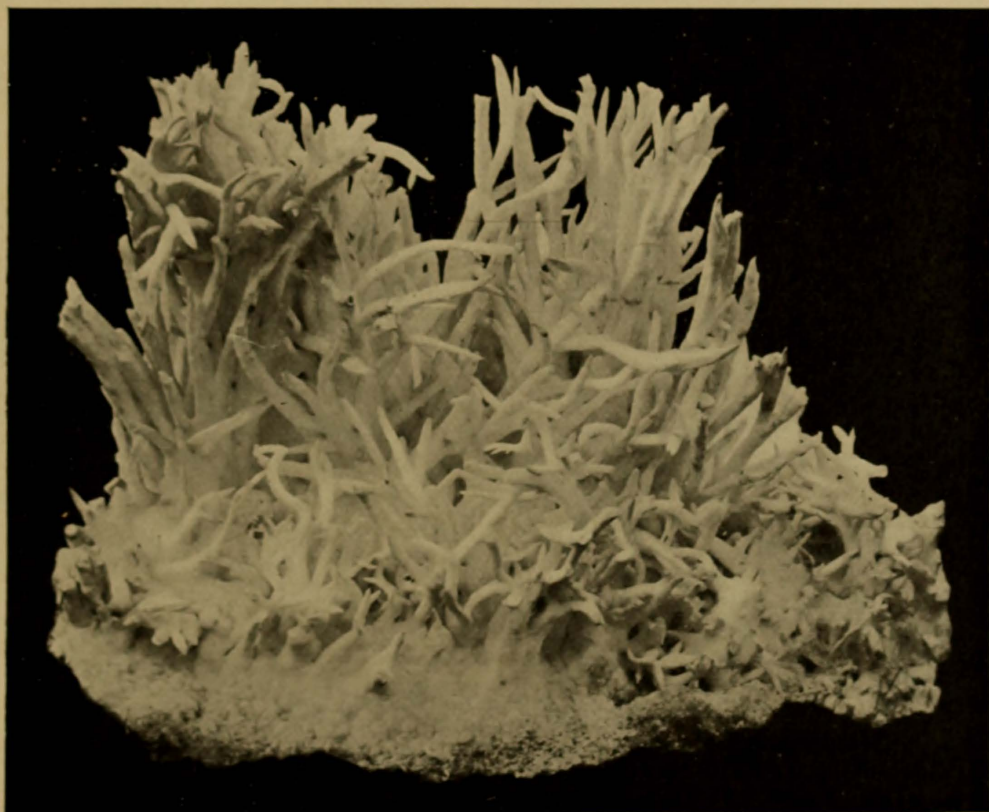
CALCITE PSEUDOMORPH AFTER ARAGONITE, CIANCIANI, ITALY

( $\text{FeO}$ ) are substituted for one another; or any of these can take the place of the oxides of potassium and sodium ( $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ). This replacing process comes prominently into view in Garnet, in which with the same theoretical formula for a very large group the composition of the different varieties is different through the effect of this law. Another, and simpler, instance is the series of compounds connecting Siderite ( $\text{FeCO}_3$ ) with Calcite ( $\text{CaCO}_3$ ).

Among the silicates may be mentioned Feldspar (Desk Cases 10 and 11, Wall Case R), Pyroxene (Desk Case 11), Amphibole

## THE COLLECTION OF MINERALS

(Desk Case 12), Beryl (Desk Case 12, Wall Case R), Garnet (Desk Cases 12 and 13 and Wall Case R), Zircon (Desk Case 14, Wall Case S), Topaz (Desk Case 14, Wall Case S), Tourmaline (Desk Cases 15 and 16, Wall Case S), the Zeolites (Desk Cases 16 and 17, Wall Case S), Mica (Desk Case 18, Wall Case Q), Serpentine (Desk Case 19, Wall Case Q), and Talc (Desk Case 19,



ARAGONITE ("FLOS-FERRI") FROM STEIERMARK, AUSTRIA

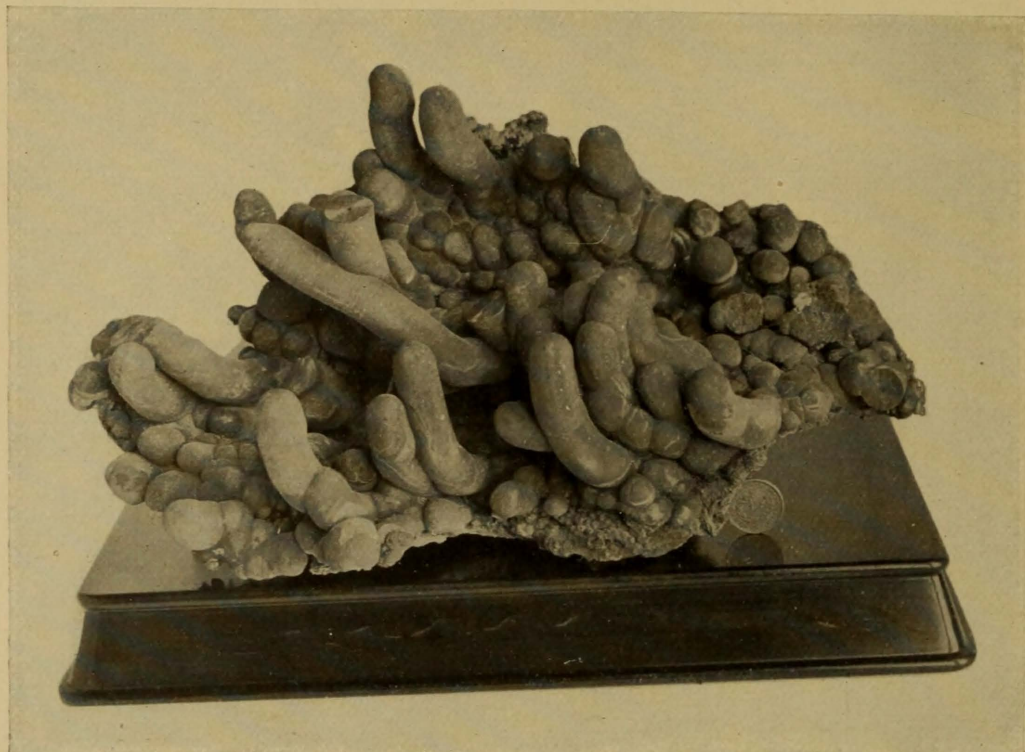
Wall Case Q). Besides these there is a host of less important species. In Wall Case K may be found a beautiful example of Rhodonite, the silicate of manganese. This interesting mineral has a remarkable development in the zinc area of northern New Jersey, and the exceptional group of prisms illustrated on page 19 is from Franklin in that State.

Beyond the silicates are the salts, or compounds with bases, of the other oxygen acids. Here come in order the Titanates,

## THE COLLECTION OF MINERALS

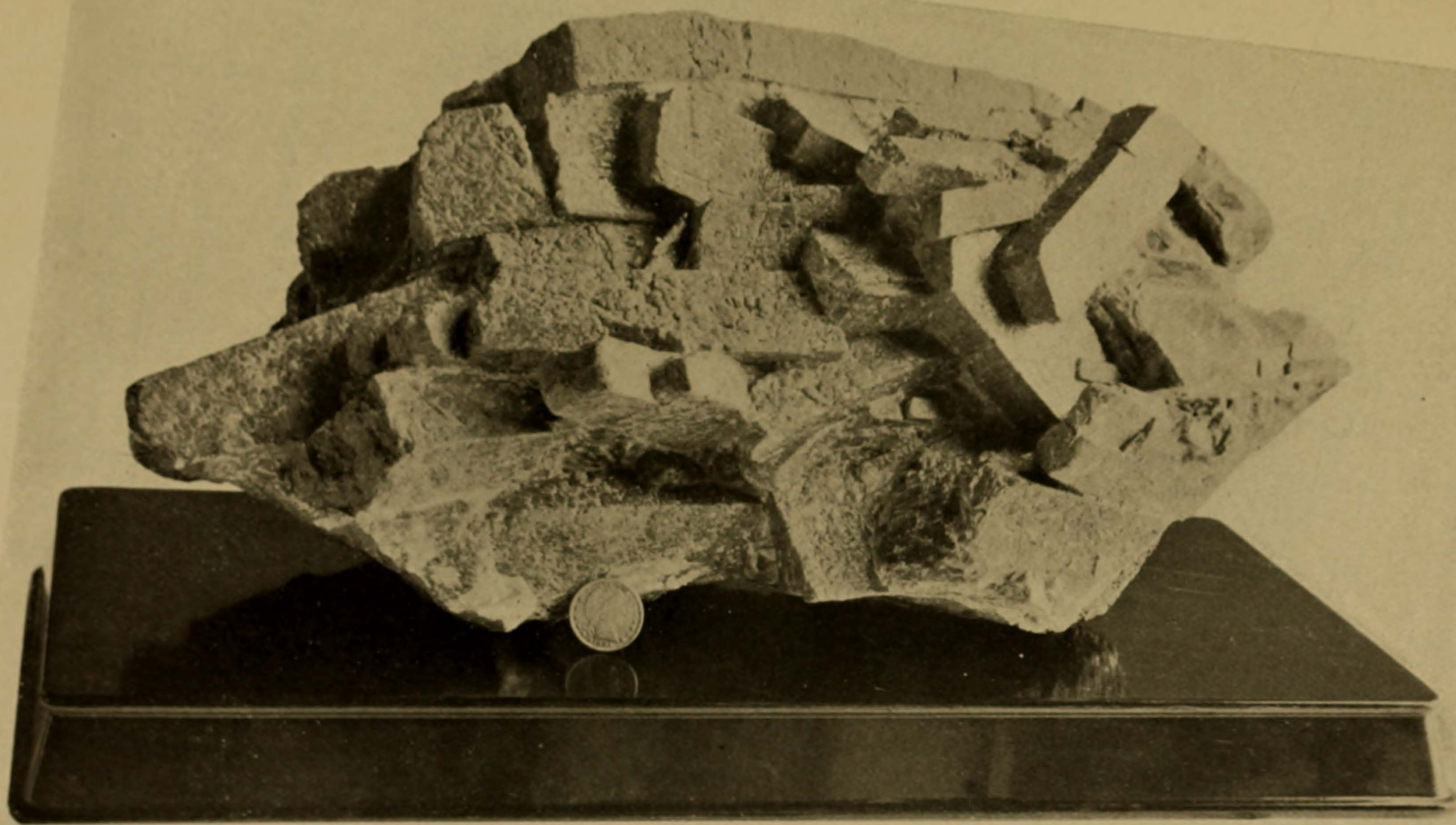
Phosphates, Vanadates, Arsenates, Antimonates, Columbates, Tantalates, Borates, Tungstates, Molybdates, Sulphates, Chromates and Nitrates. These are to be found in Desk Cases 20-25 and in Wall Case Q, but it is impossible in this brief review of the collection to dwell upon the interest and beauty of the many species assembled in this section.

Prominent among them, on account of the great beauty of



MALACHITE FROM BISBEE, ARIZONA

its mineralogical development, is the sulphate of barium, or Barite, (Desk Case 23, Wall Case Q). This is a handsome species not remarkable for crystalline variety, but often grouped in sheaves of radiating plates, frequently massive and banded, occasionally globular, fibrous or granular. The crystals are commonly tabular, somewhat modified on the edges, and frequently are tinged yellow, red, green, blue or brown. Barite is found in metallic veins and is of especially common occurrence in lead



RHODONITE FROM FRANKLIN, NEW JERSEY

## THE COLLECTION OF MINERALS

mines. In recent years extraordinarily beautiful specimens of this mineral have been found in England.

As the visitor completes this preliminary survey of the Hall



BARITE FROM CUMBERLAND, ENGLAND

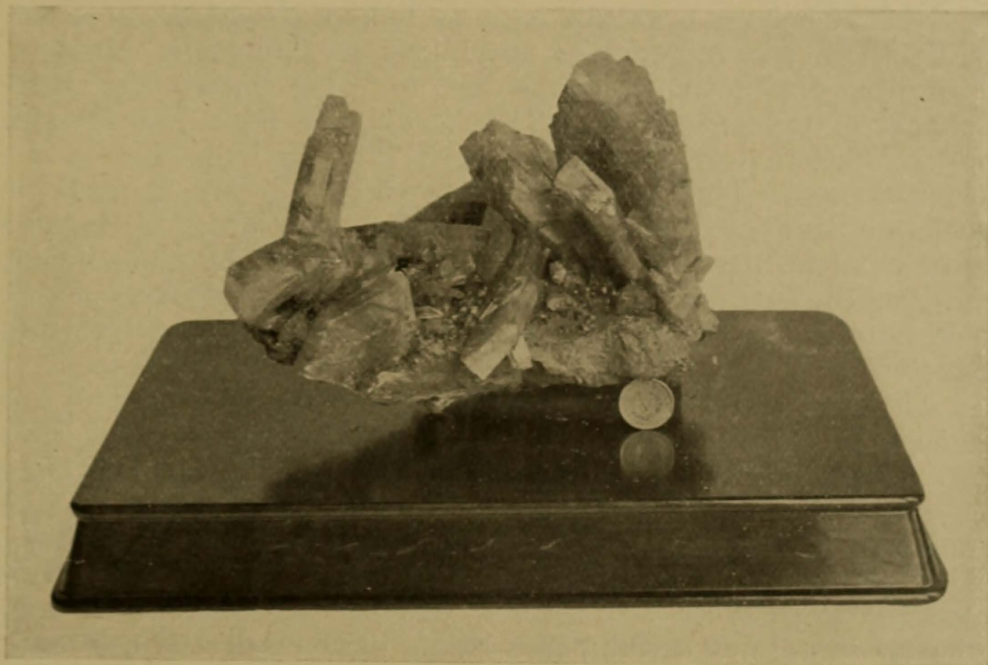
of Minerals, it is suggested that he review his impressions in the light of these general reflections:

First, that in the inorganic or mineral world the forces governing the molecular arrangement of matter in crystalline forms, and the affinities governing the chemical combination of elements, rule universally;

## THE COLLECTION OF MINERALS

Second, that the minerals of the earth's surface necessarily are the sole source of all the elements useful in the industries and the arts;

Third, that minerals appeal to our sense of beauty, and are as much to be regarded as objects of artistic appreciation as are the beautiful colors and forms of the animal creation.



BARITE FROM CUMBERLAND, ENGLAND

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## THE MINERALS OF MANHATTAN ISLAND.

MANHATTAN Island is an area of crystalline rocks, consisting of gneisses, mica-schists, granite, hornblende rock and magnesian limestone (best exposure along the Harlem Ship Canal, Kingsbridge), with a very limited zone of serpentine (10th Avenue and 58th Street). The island has been covered by Drift deposits, sand, gravel, clay and scattered boulders, concealing much of the rock surface. From the original bed rock, especially the numerous granite veins and dikes, and from the mineral masses transported from the north and distributed over its surface, collectors

## THE COLLECTION OF MINERALS

have gathered many minerals. Most of the species which have been found may be seen in the Collection (Case 27) of the New York Mineralogical Club. This collection is arranged to show, approximately, the minerals of the foliated schistose mica and hornblende rocks, the minerals of the granite veins, dikes and bosses and the minerals of the limestone beds.

Beginning with the minerals of the mica rocks, very fine examples of a yellow to brown Stilbite are noteworthy, the rosettes of flat blades lying upon the scaly surface of the gneiss or schist. With these are remarkable specimens of Chabazite, Epidote, Fibrolite, Harmotome, Heulandite and the interesting little spheres of Sphærosiderite. The hornblende rock follows with superb flattened crystals of greenish Titanite imbedded in the black masses. The view taken by geologists of the hornblende rocks on Manhattan Island now is that they are the changed remains of former igneous intrusions, soft pasty lava-like dikes, entering the island beds. They are often associated with epidote. The hornblende rocks are well exposed near 135th Street and Amsterdam Avenue.

The granite section shows a striking group of minerals, and it is in these granites—mostly veins or dikes—that the collector finds the richer collecting grounds. Here are Allanite (in long crystals as Orthite), Apatite, Beryl, Cyanite, Dumortierite (a rare mineral), Feldspars (Albite, Orthoclase, Oligoclase, Microcline), Micas (Muscovite, Biotite), Garnet (note particularly the superb example from West 35th Street), Magnetite, Monazite (a rare mineral containing cerium, didymium, lanthanum and thorium), Ripidolite, Tourmaline (big, splendid black crystals in Quartz), Wernerite and Xenotime (another rare mineral containing yttrium, erbium, cerium and thorium).

The last group of minerals belongs to the limestone beds, and here are pretty bunches of Smoky Quartz crystals, brown Tourmalines and white Pyroxene (Malacolite) with peculiar veinlets of fibrous Aragonite.

Another area (the serpentine) yields examples of an intermixture of Calcite (Dolomite) and Serpentine, forming a speckled rock called (incorrectly) Ophiocalcite. More striking specimens of this can be seen in Case I of the Geological Hall.

There are several mineralogical surprises in the collection, for example: Galenite (sulphide of lead) in minute cubes on Chabazite, Gypsum in radiating prisms on mica rock, Fluorite (large block from the Subway), Iolite (Pinite), Zircon, Uraninite (the chief mineral containing radium).

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EDMUND OTIS HOVEY, *Editor.*

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LOUIS P. GRATACAP,  
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Issued quarterly by the American Museum of Natural History.

Subscription, One Dollar per year.

For sale at the Museum at twenty-five cents per copy.

The Knickerbocker Press, New York