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General Science

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crazy, March hares are not mad, pigs are not dirty, the porcupine does not throw his quills, panthers are not dangerous to man, if a turtle bites you he will not hang on until it thunders, and at present there is considerable doubt than a man actually lives in the moon.

Science is both kind and cruel to her disciples. She bares the truth to him who will have it, but in so doing at once leaves him shorn of most of the tingling glamour of things half seen, half understood.

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GENERAL SCIENCE

In our last article we discussed one of the common minerals found on the earth's surface. In this article the writer will attempt two things: first, to describe a few of the common rock-making minerals; and second, to discuss some of the simple ways of distinguishing the common igneous rock found on the earth's surface. The commonest igneous rock-making minerals, besides quartz, are the feldspars, the irons, pyroxene, hornblende, and the micas. Feldspars are of many kinds, although the most common one found in igneous rocks is orthoclase. Its colors are red, pink, gray, and white. It also is very hard, six in the scale, while quartz is seven. It has a very glassy appearance but may be told from quartz in that it has distinct cleavage planes. This fact may easily be seen if the mineral is held in natural light. It is not necessary for the inexperienced to distinguish the various kinds of feldspars. There are three kinds of mica: yellow, white, and black. The micas are easily told since they are composed of thin plates which separate readily one from another. The plates are elastic and are easily cut with a knife. Pyroxene and hornblends are black or greenish black in appearance. They are very hard, but like the feldspars, they possess distinct cleavage. Since both minerals have the same hardness, six in the scale, and the same compositions, it is not easy to tell them apart unless a complete crystal of each is obtained. Pyroxene has cleavage angles of 87 degrees and 93 degrees, while hornblende has cleavage angles of 124 degrees and 56 degrees. As both are dark in color it is impossible to tell which mineral is present in igneous rocks. The best way to express the dark colored mineral is to say either pyroxene or hornblende. The irons are hematite, magnetite, and limonite. Hematite is reddish or reddish-black in color. When the mineral is drawn across a piece of unglazed porcelain, it leaves a brick red streak. If the mineral is broken up and a magnet is used, small fragments will cling to the magnet. Hematite is the commonest of the iron ores. Magnetite is very black in color and is highly magnetic, whence its name. It gives a black streak and is very heavy. When this mineral occurs in rock, the rocks are heavy and black in color. Limonite is a hydrated iron ore; that is, the oxygen of the air has united with the iron in the presence of water. It is always of a yellowish or brownish-yellow color. When the mineral has weathered and is mixed with clay, it is called yellow ochre. Limonite gives a brownish streak and is non-magnetic. It is this mineral that gives the yellowish color to the subsoil. Calcite is also a very common mineral in nature. It has a glassy appearance like quartz, but, unlike it, is soft, has distinct rhomb-like cleavage and is readily soluble in acid. It may have many colors although white, or transparent varieties are most common. The mineral generally crystallizes out in cavities in bed rock or caves. In caves it occurs most frequently in the forms of stalactites which hang from the roof of the caves, while stalagmites build up from the bottom of the caverns. In beds of limestone where small cavities occur, they are often filled with this mineral whence they are called calcite geodes. Limestone, one of the commonest forms of bedrock in Iowa, is an impure form of calcite. Having discussed briefly the common rock-making minerals we will now put them together in the igneous rocks.

There are three great classes of rocks found on the earth: igneous, sedimentary, and metamorphic. The second class is found most universally on the surface of the lithosphere, although the igneous, the original rocks of the earth, are found everywhere some distance beneath the sedimentary. Igneous,

"fire rocks," are composed of many minerals, the commonest being quartz, the feldspars, micas, pyroxene, hornblende, and the irons. It is not only valuable but satisfying to be able to tell the different kinds of igneous rock as one sees them. We will try to give a simple field classification key that will enable anyone to distinguish the various kinds without going into the laboratory to do so.

The classification of igneous rock is based on (a) texture, (b) color, (c) composition, and (d) lustre. By texture we mean wether the rock is coarse-grained or fine-grained. Texture is largely a problem of the rate at which the molten rock mass cools, although composition and pressure may play a large part. When a molten mass cools slowly the various elements composing the different minerals have an opportunity to get together to form large crystals. The rock is then of a coarse texture and the various minerals can easily be detected. If on the other hand the molten mass cools quickly and the various elements do not have an opportunity to combine, the texture is dense or even glassy. In such a rock the various minerals composing the rock cannot be distinguished. The rate of cooling is largely determined by the position the lavas assume at the time of cooling. During various times in the history of the earth, molten matter has been thrust into fissures or intruded between layers of the earth's crust and cooled there without coming to the surface. Sometimes the lava appears to have forced its way into rocks and to have lifted the upper layers or beds and formed great underground tumor-like masses called laccoliths and bysmaliths. Such masses cool very slowly and are therefore coarse-grained. When the molten material is poured out on the surface, however, in the form of great streams or sheets, it cools more quickly and is either dense or glassy. Igneous rocks then are either intrusive or extrusive. If intrusive, the rocks are most likely to be course-grained; if extrusive, they are fine-grained or glassy. There are three kinds of crystalline rocks to be noted: coarse-grained, where all the crystals are large and nearly of the same size; all small crystals, and where both large and small crystals are present. If for some reason a molten mass which starts to cool slowly has the process of cooling hastened because of a sudden reduction in temperature, a porphyry will result. A porphyry is a crystalline igneous rock where large crystals are set into a matrix or background of small crystals.

There are two groups of minerals found in all igneous rocks. One is called the feldspathic, and the other the ferro-magnesian. In the first group belong quartz, the numerous feldspars, and white mica. In the latter group are pyroxene, hornblende, black mica, and the irons. The first group is composed of minerals that are light in color as well as light in weight. In the latter group are the minerals that are dark in color as well as heavy in weight. If an igneous rock is composed largely of the first group of minerals, it will not only be light in color but also light in weight, while rocks composed of the iron minerals will be dark in color and very heavy. It is an interesting fact that where the light colored minerals predominate in a rock, the dark minerals are absent or in the minority. Likewise, where the dark minerals predominate the light colored minerals are in the minority. There are instances where the two are about equal.

To understand the field classification key, it will be necessary to discuss briefly some of the criteria to be used. First of all, it is necessary to determine the texture of the rock. By texture we mean whether the rock is fine or coarse. If the different minerals composing the rock can be seen with the unaided eye, it is crystalline; if not, it is dense and fine-grained. After the texture has been determined, notice whether the rock is light or dark. After the color and texture have been determined, examine the rock carefully to see if the mineral quartz is present. If the rock is crystalline, is light in color and quartz is present, it is a granite. A granite may be defined as any crystalline igneous rock that is light in color and which contains one of the following combinations of minerals: quartz, feldspar and white mica, or quartz and feldspar, or quartz and white mica with or without a subordinate amount of ferremagnesian minerals with each combination: If the granite contains

some large crystals set into a matrix of smaller crystals, it is a granite porphyry. A syenite has the appearance of granite, but has little or no quartz. Crystalline igneous rocks which are as much dark as light, or more dark than light, are called dolerites. The dark mineral present is either pyroxene or hornblende. If the dark mineral is pyroxene, the rock is a gabbro; if, however, the dark mineral is hornblende, the rock is a diorite. In the field it is not possible to tell which mineral is present in the rock, so the term dolerite is applied. Any crystalline rock that is as much dark as light, or more dark than light and has some large crystals present is a dolerite porphyry.

The third division of crystalline rocks are black in color and are called pyroxenites and hornblendites. In this group little or no light colored minerals are present. A hornblendite or pyroxenite is a dark colored igneous rock which has a crystalline texture. When some large crystals are present, the rock is a porphyry. The second class of igneous rocks is known as the dense or fine-grained. If no minerals can be seen, the rock is said to be dense. Any dense light-colored igneous rock is called a felsite. In this case no minerals are named since they cannot be seen. The light color and weight suggest that the feldspathic or light colored minerals compose the bulk of this rock. When large crystals are present, the term felsite porphyry should be used. Felsites are of various colors, as green, gray, red, or orange. The Yellowstone Canyon in Yellowstone National Park is cut in felsite. Basalt, of which most of the common pebbles in the Iowan glacial drift are composed, is a fine-grained, black igneous rock. Basalts are rich in iron and after they are exposed to weathering for some time, their color changes to a light gray. A basalt porphyry is a dark fine-grained igneous rock with some large crystals present.

The third class of igneous rocks is called glassy, and are known as obsidians, pumice, pitchstone, and perlite. In this class the glassy texture has given the name to the group. An obsidian is any glassy igneous rock. The color varies from black to red to brown to gray. Obsidian Cliff in Yellowstone National Park is an excellent example. Pumice is a light, spongy or porous obsidian. An obsidian often appears as if it had been varnished and is then called a pitchstone. If the obsidian is filled with round or irregular-like concretions, it should be called a perlite. This group of rock is not common in Iowa, but may be found in regions of vulcanism in the mountains of the western part of the United States.

The last class of igneous rocks is called pyroclastic or fragmental rock. Rapid and sudden cooling often causes lava in volcanoes to explode violently into the air and to solidify almost instantly. The resulting glassy particles or filaments, if small, constitute volcanic ash. Often the projected particles draw after themselves long filament-like threads of spun glass, and sometimes, while in the air, they may divide and draw apart, spinning a filament of viscous lava between them. Lava of this sort is known as "Pele's hair." Pele was, according to legend, goddess of the volcano. When the exploded fragments are large, they fall about the crater of the volcano and form a kind of volcanic rock called tufa. Many volcanic cones are entirely built of tufa. Fragments of lava too large to be carried any great distance by air currents, but still small, are known as lapilli, especially if they are rounded and gravel-like in form. The rougher, more irregular fragments are known as scoriae or cinders. These fragments are more frequently distended by gas bubbles and are light and sponge-like in appearance. Often large masses of lava are shot into the air and caused to rotate by the unequal force of projection or unequal friction. This causes the lava to assume the form of spheres which are called volcanic bombs. The last two classes of rocks are not commonly found outside of volcanic regions. The crystalline and dense or fine-grained rocks are common in Iowa since they were carried down and deposited by the numerous ice sheets.

These suggestions have been given with the hope that they will make it possible for those interested to tell the common igneous rocks as they are met with in the field.

E. J. Cable