About Our Mineral World

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by Paul F. Hlava

"The study of the natural sciences ought to expand the mind and enlarge the ability to grasp intellectual problems." Source??

"Mineral collecting can lead the interested and inquisitive person into the broader fields of geology and chemistry. This progression should be the proper outcome. Collecting for its own sake adds nothing to a person's understanding of the world about him. Learning to recognize minerals is only a beginning. The real satisfaction in mineralogy is in gaining knowledge of the ways in which minerals are formed in the earth, of the chemistry of the minerals and of the ways atoms are packed together to form crystals. Only by grouping minerals into definite categories is is possible to study, describe, and discuss them in a systematic and intelligent manner." Rock and Minerals, 1869, p. 260.

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AGATE, JASPER, CHERT AND ....

May86 News Nuggets

It is no wonder that quartz is so abundant; it is composed of the two most abundant elements in the crust of the Earth. But sometimes the multitudinous variations found in nature can be just mind boggling. In this column, I want to explore some of the fine-grained varieties of quartz, namely the chalcedony and chert families.

Chalcedony is a translucent to almost transparent aggregate of tiny, fibrous quartz crystals that usually displays a lumpy appearance (botryoidal, reniform or mammillary). It usually forms delicately colored, concentrically layered crusts on rock surfaces. When polished, it has a bright waxy to subvitreous luster. If chalcedony is deeply colored, it is called by other names such as carnelian (reds) or sard (browns). If it has distinct bands of color or other patterns, it is called agate (with its myriad of varieties), onyx, sardonyx, thunder eggs, etc., etc.

The chert family of material is characterized by tiny, equidimensional, granular crystals. These materials are more opaque than chalcedonies and tend to have a lower luster (dull to waxy). Cherts are often unexciting, gray-colored masses that may form extensive beds or layers. Novaculite is a form of chert found in massive beds in Arkansas and other places. At Cado Gap, Arkansas, novaculite beds aggregate a thickness of over 9000 feet. It is marketed as sharpening stones (Wachita stones). Flint is a form of chert that is a bit finer-grained, colored dark gray (by organic matter?), found in irregular nodules instead of layers and which breaks with a smooth conchoidal fracture instead of the normal splintery one. If chert, which is never very pure, contains lots of impurities (especially iron oxides) it becomes jasper. Jasper is usually some shade of yellow-brown to red-brown to red, but it can be greenish. Jasper has a very low luster and breaks with an even or flat conchoidal fracture. Jasper formed by replacement of earlier rock (especially adjacent to ore veins) is called jasperoid. Occasionally jasper can be cut and polished into cabochons, or vases and other objects. The jasper from the Jemez Mountains is cutting grade material and is the object of our June field trip.

GARNETS

Feb90 News Nuggets

For my first Trivial Pursuits of the year I thought it would be good to talk about a birthstone and garnet, which happens to be the birthstone for January, is an interesting and varied topic. (Amethyst is the birthstone for February but it doesn’t have the complexity of the garnets.) Actually, I will talk about the garnet family because there are lots of different garnets.

Garnets are cubic minerals with the general formula $A_3B_2Si_3O_{12}$ where A can be Mg, Ca, Mn^{2+}, and Fe^{2+} and B can be Al, V^{3+}, Cr^{3+}, Mn^{3+}, and Fe^{3+}. Even though garnets are cubic, you will probably never see a natural crystal of garnet in the shape of a cube. In fact they don’t form octahedra either - or tetrahexahedra or trisoctahedra. They only form as dodecahedra and trapezohedra, crystals with some of both, and some with hexoctahedral modifications. I have included some crystal drawing of common garnet crystal shapes for your perusal. In addition to the common elements, there are a few weird elements that can be found in some natural garnets but, for a change, I don’t want to get involved with the weird stuff too much. (At this point I should also mention that man has created several materials of unusual composition with the garnet structure that are not likely to ever be found in nature, such as YAG - yttrium aluminum garnet and GGG - gadolinium gallium garnet, but I will not dwell on these either.) Simple multiplication of the 4 A elements and the 5 B elements indicates that there are at least 20 possible garnet end-members. Not all of these have been found yet and some may never be but there are still a lot of garnets around. And don’t forget, most garnets will have a little bit of everything in them; natural garnets that are even close to an end-member in composition are quite rare. All of the Al varieties are common: they are Mg-Al-pyrope, Ca-Al-grossular, Mn-Al-spessartine, and Fe-Al- almandine (not an -ite ending in the group). The Fe^{3+} garnets are represented by Mg-Fe-majorite, Ca-Fe-andradite, and Mn-Fe-calderite. An Fe-Fe garnet isn’t known but should be possible-keep looking. The Cr garnets are Mg-Cr-knorringite and Ca-Cr-uvarovite while the only V garnet is goldmanite which was originally described from the Grants, N.M. area. There are no Mn^{3+} garnet end-members known but these may turn up someday. In addition to these end-member garnet names we can find a number of names given to certain garnets to help sell them as gems. These include demantoid, a beautiful green, Cr bearing andradite; tsavorite, a very beautiful, emerald green, KV bearing grossular: topazolite and verdolite, yellow and green varieties of andradite; rhodolite, a pinkish-purple almandine; and Malaya (ma-lye-ah) a pinkish-orange pyrope- spessartine.

The various garnets are found in a wide variety of rock types. The Ca-garnets are almost invariable found where igneous intrusions have invaded into limestones. The calcite from the limestone combines with silica and the other metals which emanate from the intrusion. Well, all except Goldmanite which forms by combining Ca from calcite, V from tyuyamunite, and silica from a basalt sill. Mg garnets (pyrope, Cr-pyrope, and knorringite) tend to come from ultramafic igneous rocks. Spessartine garnets tend to come from acid igneous rocks like rhyolites and pegmatites. Almandines are the common garnet of regionally metamorphosed rocks like schists and gneisses.

Well, which one is the birthstone and what is the significance of this birthstone?

All of the red garnets-almandine, pyrope, rhodolite - qualify as the January birthstone. There is no real significance to the birthstone. It is essentially a sales gimmick to help sell more stones to people. (Wait a minute, I sell jewelry myself.) Hey Lady! Wanna buy a nice necklace with your birthstone? What about a ring or a pair of earrings? You just gotta have something with your own, personal birthstone.

GOLD

Feb87 News Nuggets

Gold! Nothing else matches gold’s ability to enflame the passions and excite the imagination of human beings. Gold raises some people to noble heights and lowers others to ignoble depths; it lures them to strange and forbidding lands and enables them to endure the hardest of environmental extremes, physical deprivations, and brutal, mind-numbing, back-breaking labor. More people have searched for, fought for, stolen for, killed for, lied for, and died for this one material than any other. Gold is responsible for the settling and colonization of many remote corners of the earth. In our own country, it was gold that lured the Spanish into the New World, that caused the mass migrations and explorations of California and Alaska. In fact, it was the golden carrot which lured prospectors to all the remote corners of our land. How many of you have been hiking in some New Mexico wilderness, day dreaming that perhaps you were the first person to pass this way, when you chances across some prospect pit dug over a hundred years before by someone looking for gold? What is this stuff that it can control people so completely?

Mineral gold is a naturally-occurring, or native, metallic element with a rich yellow color. It is soft (2.5 to 3.) and very ductile (can be drawn into wire) and malleable (can be beaten into sheets). It is, in fact, the most malleable substance known: it can be hammered into sheets which are only one quarter of a millionth of one inch thick! That is so thin you can see through it. Because there is so little of the precious metal present in gold leaf, even modestly priced books and such can have embossed, gold-covered lettering on their bindings. Gold is extremely dense, being 15 to 19 times as dense as water (depending on the impurities in the gold) or 5 to 8 ties as “heavy” as ordinary rock! And, of course, gold is rare. The gold content of average rock works out to about one ounce per 8,000+ tons. (In a gold mine with low-grade ore, there is an ounce per 20 tons; 400 times the average amount.) Gold is chemically inert. It doesn’t form oxides or sulfides or lots of other things and it is unaffected by most acids. It does form an amalgam with mercury, which has proven to be useful to many miners. In nature, gold is usually found as the metal with variable, but usually minor, amounts of silver, copper, bismuth, and a few other unusual metals. Sometimes, like in some New Mexico deposits, the gold is over 99 percent pure. Rarely, gold can be found in the form of tellurides. But no one of these properties explains gold’s allure; perhaps several of them together do.

I think that the attraction people have to gold is found in a combination of perhaps nine reasons. Gold is attractive looking. Even if it were common, gold would be used ornamentally. And its workability makes it easy to fabricate into objects of great beauty. Because it is incorruptible, it does not rust, corrode, rot, decay, tarnish, or alter under most natural conditions so the beautiful objects made from it will stay that way. Gold has a relatively stable established value per unit of weight. Gemstones may be more valuable per unit of weight, but it takes an expert to distinguish the various grades and establish values. Gold is easily recognized by everyone while other commodities, say niobium for instance, require extensive training or expertise. Gold deposits are relatively common for such a valuable material. The United States has had lots of rich gold mines but only one, less than profitable, diamond mine. O.K. Those are all pretty good reasons, but the following reasons are the crux of the thing. Gold from veins is concentrated, at the surface of the Earth, into placer deposits which are easy to get to, easy to work and process, and sometimes incredibly rich. Gold is the one valuable commodity that the average guy can find, work with a pick, shovel and pan, and thus become fantastically wealthy. That's the major lure of gold. Instant riches. That's always been one of man's fondest dreams. In days gone by, people searched for gold mines; nowadays they are more apt to enter sweepstakes or buy lottery tickets.

Oh, gold is still around, even if the great gold rushes are essentially over. (The current rush in Brazil is unfortunately limited to locals only.) A few placers in dry areas, like those near Golden, New Mexico, still have lots of gold left. And there are lots of less glamorous and less rich hard rock deposits yet to be developed. But one of the best places to find gold is a lot easier to get to than you'd suspect. You will find a bonanza of New Mexican gold specimens if you just get yourself down to the Albuquerque Gem and Mineral Club's annual show at the Old Airport Terminal, March 14 and 15, l987. Tell 'em the Old Prospector sent ya!!

"The Mystery of the Magnetic Dinosaur Bones"

Oct87 News Nuggets

Many of you know that the New Mexico Museum of Natural History is engaged in the excavation of a huge, new species of sauropod (Brontosaurus-like) dinosaur in New Mexico. In fact, some of you may be volunteers actually digging "Seismosaurus" bones under the direction of the New Mexico Museum of Natural History curator of vertebrate paleontology, Dr. David Gilette. But perhaps you are not familiar with the fact that a large number of sophisticated scientific techniques have been tried out, in the vicinity of the exposed bones, in an attempt to locate the more deeply buried material. Of all the techniques, one has proven to be a consistent winner with a batting average of a mere l00%. This is the magnetometer survey.

Why should dinosaur bone be magnetic? Well, this bone contains about 2% iron while the rock is essentially iron-free. But this doesn't answer all the questions we have. I know and you know that bones don't usually have any iron in them to speak of. So how did this iron get there and what form is it in? It was in order to answer these questions that I procured some of the material for detailed study. But I found the answer as soon as I thoroughly cleaned the bones and perused them with an ordinary binocular microscope. Some of the bone is dark gray and some is very light gray and all of it is rich in holes that used to contain blood vessels, nerves, etc. In one of the best pieces of bone, of a "bone" white color, I saw tiny (1/4 mm) crystals in some of the holes. At high power these were resolvable as perfect cubes of a chocolate brown color. What do you think they are? Most of you should be able to answer that because you know they are brown cubes and they are probably rich in iron. O.K? Well, I hope a lot of you realized that these crystals are "limonite" pseudomorphs after pyrite. And all that iron was easily detected by the magnetometer.

What's that, you say? You don't remember finding pyrite in bones either! That's true, but have you ever noticed that some fossils are pyritized? Well, they are! You can find brachiopods, snails, clams, sand dollars, sea urchins, beautiful ammonites, and even coprolites (fossil excrement) that have been replaced by pyrite. This is how it happens. When the animal material is first buried, it still contains a lot of organic material such as fleshy parts in with the hard parts. This stuff wants to rot away but it needs oxygen to do so. Ground water percolates through the sediments around the future fossil and, if it carries some oxygen, the organic remains might use the oxygen to decay further. But then the ground water changes chemically from oxidizing to reducing. IF there are ferric and sulfate ions in the water, these may be reduced to ferrous and sulfide ions and these would immediately precipitate to form pyrite. These might form crystals in open cavities or they may fill the area formerly occupied by the organic material. If you dig up these fossils before they are attacked by weathering, the pyrite will be bright and shiny. Otherwise the sulfide will be reconverted back to sulfate and wash out while the iron reverts back to a ferric hydroxide ("limonite") which is insolvable and stays put. If the weathering is done right the original shape of the pyrite will be retained - the limonite will form a pseudomorph after the pyrite. That's what happened to the "Seismosaurus" pyrite, except that some of the crystals still have some pyrite left in the core of the crystals. And the pyrite and limonite have enough iron to make the bones magnetic - mystery solved!

P.S. The "best"! example of this type of fossil that I've ever seen is a specimen found by one of my student when I was teaching at Wisconsin State University-River Falls. It was a coprolite from the Eocene Fort Union Formation in Wyoming. It must have been produced by a mammal about the size of a 30 - 40 pound dog. It looks just like the modern equivalent because the pyrite was replaced by brown "limonite" (a crack near the middle of the 6" specimen shows tiny cubic crystals) and the size and shape are just right - even down to the slightly curved, tapered end! The owner delighted in placing it in the middle of the corridor outside the classroom where everyone studiously avoided stepping on it!

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PLAY OF COLORS IN MINERALS

Jun85 News Nuggets

One of the more striking types of color mechanisms is the one causing a play-of-colors. This is what gives those beautiful iridescent colors to gem minerals like labradorite, peristerite, moonstone, opal and fire agate. It is sometimes seen on tarnished sulfides like chalcopyrite or pyrite and occasionally on an oxide or a silicate mineral.

Is this mechanism caused by electrons like most color mechanisms? No, it is caused by an optical effect called interference. When light strikes a shiny, transparent layer at an oblique angle the light rays are split - part of the light is reflected off the upper surface and part goes into the layer. Some of the light that enters the layer is reflected off the bottom surface and exists parallel to the other reflection. However, white light is composed of a numbers of colors - each of which travels at a different speed in the layer. So when the split light rays emerge from the layer they have been retarded and their wave patterns are out of synchronization with the part of the light reflected off the top of the layer. Or rather, MOST of the rays are out of synch. One or two colors will be in phase and the rest out of phase. The in phase color will be very bright and the out of phase colors will be very pale or absent. Thus, we may see a rich, glowing color coming from a colorless, transparent stone, but only in one special direction.

The intensity of the color and the hue are both affected by the thickness of the layer. If the layer is very thin, about the thickness of one wavelength of blue light, only blue will come out. If it is just a tad larger, the color will be green. As the thickness increases, the colors change from intense blue to green to yellow to red to medium blue-green-yellow-red to pale blue-green-yellow-red and so on. (yep-only four colors) You can see this to advantage on any oil slick. If you put a drop of oil on water, it will form sets of iridescent rings on the water with the brightest on the outside edge and a sort of milky haze in the center.

What can cause these kinds of layers? Several things like thin cracks (calcite, opal), thin layers of a different mineral inside a host mineral (peristerite, moonstone), thin layers of two polymorphs of the same mineral (labradorite), and thin surface coating (tarnish on sulfides, etc.). Labradorites have sharp crisp colors because their layers are usually thin while moonstones have pale blues or even gray because their layers are very thick (comparatively).

The best precious opal has another facet to this story but I'd better catch that some other time.

PSEUDOMORPHS

Nov87 News Nuggets

The name pseudomorph obviously means "false form" and it is applied to material that retains the external form of a previous crystal. The original material usually changes chemically but sometimes it can change internal structure or merely be coated by later material. In fact, there are four ways in which pseudomorphs are formed and they are described below.

l) Alteration occurs when some new material is added to the old, or when some of the old material is removed, or both – as long as some original material is retained but some of the chemistry is changed. Last month I mentioned the very common example of pyrite cubes (in dinosaur bone in that cave) being altered to limonite. The correct description of this would be – "Pseudomorphs of limonite after pyrite." This is probably the most common type of pseudomorphism and I can think of dozens of examples of this type – such as copper after azurite, malachite after azurite, malachite after linarite, both limonite or goethite after pyrite, calcite after glauberite, malachite after cuprite, and even turquoise after apatite. One of the most memorable samples was a sample of coarse, garnet schist from New England where each of the one-inch diameter garnets had been perfectly mimicked by chlorite. One commonly finds remnants of the original material in the cores of such pseudomorphs.

2) Substitution occurs when all of formed material is replaced by new elements. This probably involves the gradual removal of the old with simultaneous addition of the new with no chemical reaction between them. This often happens to fossil material as is the case with some silicified, opalized, or agatized wood. (In a lot of petrified wood part of the organic cell walls still remain.) But I’ve also seen opal after clam shells, Glauconite and pyrite after coprolites, chalcocite after wood, and sphalerite after crinoid stems and brachiopod shells as well as silica after barite and fluorite. In the chert on top of the Sandias, you can find silicified crinoid stems. The most elegant example occurs in the Glass Mountains of Texas where brachiopod shells, in a limestone, have been silicified. If you take large blocks of the limestone and dissolve them in acid, you can recover small brachiopods with thin, fragile spines four or more inches long.

3) Incrustation occurs when one mineral coats another. This occurs to some extent at the Blanchard Mines when quartz coats both barite and fluorite. One of my favorites in this category is the chalcocite coated pyrite from such places as the Santa Rita pit in New Mexico. The pyritohedra there are perfectly formed and steel gray.

4) Paramorphism can only occur when a mineral changes its internal structure to that of a polymorph. The aragonite crystals from Santa Rosa that are not calcite constitute a prime example. Others include marcasite going to pyrite, argentite to acanthite, hawleyite to greenochite, olivine to ringwoodite, and wurtzite to sphalerite. One that I haven’t seen yet is graphite going to diamond. You know, Superman used to do that. You know, Superman is 50 years old this year. You know, so is Ray DeMark. Hmmmmm I wonder.

THE COLORS OF QUARTZ

Mar88 News Nuggets

The Often Deceptive Property of Color in Minerals: Quartz

Color is one of the most obvious features of many minerals. In fact, it may be the most obvious of all. Haven’t you ever found yourself looking t a display of gems or minerals in a closed case and when you want to indicate a particular specimen to someone else, you say "Hey, look at that bright green (or red, yellow, brown, blue, orange, purple, puce, mauve, toupe, etc.) one over there. The one to the right of the red (etc.) guy." It seems to be instinctive (and it may well be) that we often notice color before the other (usually more reliable) characteristics of minerals and other objects. This is not all fine and good.

Mot pure minerals are colorless, clear, or white which means that the other colors, we see, are due to impurities. (And dependence on color may make it more difficult for students to identify the mineral.) Quartz is one of the best examples of a mineral that is often found in a wide variety of colors but is clear when pure. These colored varieties are so common, distinctive, and beautiful that many have been given names which are familiar to us all. Amethyst is purple; citrine is yellow, orange, and brown; prase is green; smoky quartz (and caringorm and morion) is pale brown to black; rose quartz is pink. Red and blues are also found. What causes these colors? Well, in many cases, quartz is colored by inclusions of other minerals such as hematite, chlorite, rutile, lepidolite, ajoite, etc. In these instances, you can see the individual grains inside the quartz and they make the stone cloudy or opaque. But, in many other cases, the quartz is clear but colored yellow, purple, etc. It is not colored by mineral impurities but by elements that replace silicon in the structure of the quartz. Impurities such as small amounts of aluminum or iron. Now, aluminum, but itself, doesn't impart color to most things but, if it is irradiated, it produces color centers (F-centers, Farbe centers) and it becomes smoky. It can be naturally irradiated by other minerals in the rock where it grows or by man using X-Rays, gamma rays, etc. The more aluminum present in the quartz, the darker it gets. Some of this smoky quartz can be turned to a greenish-yellow by heating, but this isn't universal. Ferric iron, is on the other hand, usually produced yellow quartz. If the iron is in the right place in the quartz structure, the stone can be turned into amethyst by irradiation. Unfortunately, this is rare. But, most amethyst can be heated or "burned" into yellow to orange - brown citrine and this is often done commercially. And, if you don't overburn the stone, you can irradiate it back into amethyst. (Now class, for your homework assignment: How is Ametrine (1/2 amethyst + ½ citrine) produced?

Well, enough for now. This month, I'll be the speaker for our March meeting and my topic is "Color in Minerals". If you want to know more about color centers, you'll have to be there. You may, also, want to bring in some of your old nagging questions about colored minerals.

WHAT IS A MINERAL??

Mar89 News Nuggets

For my first Trivial Pursuits article in a long time I decided that it might be a good idea to concentrate on precisely what it is we collect. I believe that most of us have a good idea of just exactly what a mineral is but we can't put it in to words very well. So it might be a good idea to define the term mineral this time and in the future I can define terms such as rock and gem (maybe even fossil). After you read this column I hope you can tell other people what minerals are to a geologist or mineral collector and how these differ from those that go into Wonder Bread or are used as a category in twenty questions.

If you look in a lot of books you will find a number of different definitions for the term mineral as we use it. Over the years, I have looked at quite a few of these definitions and I've come up with one that I am comfortable with and which I think has the least number of problems or gray area. It goes like this - A mineral is a naturally occurring, inorganic substance with a characteristic, orderly atomic arrangement, and with a chemical composition and set of physical properties that are fixed or vary within definite limits. There are five major parts to this definition. Let's analyze each of these parts and see what they tell us.

l. A mineral is a naturally occurring substance - it is a material that is not made by man, it is found in nature just as you see it. Bakelite and Masonite are not minerals. Nor is glass, steel, flower pots, brass, etc. Just because it's not animal or vegetable doesn't mean that is has to be mineral.

WHAT IS A ROCK??

Aug89 News Nuggets

In the March, 1989 Trivial Pursuits article I defined what the term mineral means to me (and I hope that it means roughly the same to a lot of other people in the geological community). I mentioned in that article that I would be doing the same for the terms rock, gem, and maybe even fossil. This article will be about rock (the geological kind - not the entertainment kind, notice I didn't say the musical kind).

Again, if you look in a lot of books you will find a number of different definitions for the term rock, as we use it. Over the years, I have looked at quite a few of these definitions and I've come up with one that I am comfortable with and which I think has the least number of problems or gray areas. It goes like this - A ROCK IS A NATURALLY OCCURRING, INORGAINC AGGREGATE OF MINERAL MATERIAL WHICH

CONSTITUTES AN ESSENTIAL AND APPRECIABLE PORTION OF THE EARTH'S CRUST. There are five major parts to this definition., Let's analyze each of these parts and see what they tell us.

1. l. A rock is naturally occurring - it is material that is not made by man, it is found in nature just as you see it. Concrete and terrazzo are not rocks. Nor is terra cotta, flower pots, mortar, rocky road ice cream, etc. There are a lot of man-made materials that look a lot like rocks. A cobble of concrete that has been wave washed on a beach until it is nice and smooth looks an awful lot like a conglomerate or breccia. So much so that I used to put one of those on rock quizzes when I taught petrology classes. In response, my students invented many delightful and colorful names (for me).

2. Rocks are inorganic - they have never been living tissue. Examples of non-rocks because they are organic include plastics, wood, varnish, amber, and coal (some people call coal a rock, I say it is not a rock but it is a fossil fuel - what do you think I call amber?). What about some limestones that are made up entirely of shells or broken pieces of shells. (Ah yes, this is one of the classic gray areas of the definition - how is the Ol'Man gonna weasel out of this one?) Shell material that is found in limestone is calcite or aragonite that was precipitated by some organism but was never actually living material. It did not ingest, respire, excrete, reproduce, or do any of the things living material is supposed to do; it just sat there as organically precipitated inorganic material. There are other materials that can contribute to the makeup of rocks but these will tend to be the same as the calcite in limestone.

3. Rocks are aggregates of mineral material. They are comprised of more than one grain of a material or they would merely be big crystals of that material. And the material has to be a combination of minerals, a single mineral, or material that would form minerals if it were allowed to cool slowly. Most rocks, like granites and basalts are formed from lots of grains of 3 or 4 major minerals. Other rocks like some sandstones, marbles, dunites, and anorthosites, are formed from many grains of only one major mineral. Finally, a few rocks are masses of glass (eg. Obsidian, pumice, tachylite) that would have crystallized into large aggregates of many crystals if they were allowed to cool slowly.

4. Rocks are appreciable in size. They are mappable lithologic units. They are big. The Sandia Granite is several miles wide, tens of miles long, and thousands of feet thick where exposed - and there is more that is covered by other rocks. One does not pick up a rock one picks up a piece of rock, a sample of rock, or a specimen of a rock. They are essential pieces of the planet; if they were missing there would be huge gaps in the surface of the planet. Some formations (rocks), like the Morrison, extend for over a thousand miles. Other rocks, like some pegmatites in the Petaca area, are only ten or so feet across and a hundred or so feet long. (Okay, so that is the technical size designation - even the most picky of purists may call a fist-sized piece "this rock" once in a while. If in doubt say stone; there is no size limit on the term stone.)

5. Rocks are supposed to be pieces of the Earth. Up until 20 years ago there was no problem with this part of the definition. Rock-like things on the Earth were either rocks or meteorites, rock-like materials from outer space that landed on the Earth. Now there are rock-like things from the Moon that have been brought to Earth - those evil, nasty astronauts have created another gray area to perturb my definition! There are several ways out for the Ol' Weaseler. The term rock can be modified by some term to indicate that some material is not the good ol' homegrown variety. We can call it Moon-rock or Mars-rock or Pluto-rock and everyone will be happy. Or we can modify the definition to say that rocks are essential portions of some planetary body. Ugh1 I prefer calling that junk Moon-rock, etc.

HOW MANY MINERALS ARE THERE?

Nov86 News Nuggets

That is a question that intrigues many collectors and mineralogists but is very difficult to answer. At present, we know of about 2,800 mineral species. But every year more are discovered and a few are discredited with new names, more than compensating for the lost names. We won't really know the answer to our question until all minerals are discovered - if they ever are.

Well then how many minerals are possible? In theory that question is perhaps easier to answer, but the number may be radically different from the one we are seeking. Why? Because the combinations of elements possible in a test tube may not all be found in nature. Let's look at one family of minerals as an example of the possible combinations and examine why some members may not occur naturally.

At the 7th Annual New Mexico Mineral Symposium (which was another success). I described a mineral from Tyrone (corkite) that showed solutions with a number of other minerals. Corkite is a member of the beudantite group and the one I examined also showed affinities to the alunite and crandallite groups. All of these minerals are part of a family of trigonal minerals with the general formula AB3(XO4)(YO4)(OH,H2O)6 where A is Ag, Ba, Bi, Ca, Ce, K, Na, NH4, H3O, Pb, Sr, or Th; B is Al, Cu, or Fe3+; and X and Y can be As, P, S, and Si. If we calculate the mixtures possible we arrive at a total of 12 x 3 x 4 x 4 = 4 gross or 576 possible minerals! It is probable that not all of these are stable compounds (they can't even exist in a test tube). And many require very strange conditions to form. For example, ThCu3(AsO4)(SiO4)OH3.3H2O is a possible combination but it requires an environment where Th is more abundant than K, Na, Ca, etc. and Cu is more abundant than Al and Fe3+. This is improbable. Therefore, this family of minerals may not contribute many more than the 33 minerals now known. I guess this means that we'll never really know just how many minerals exist. Oh well! (but ya know - there's not reason why x and y can't include V, Cr, Sb, Mo, etc. Let's see - 12 x 3 x ------------------)

WHAT IS A GEM STONE

Oct89 News Nuggets

In the March, 1989 Trivial Pursuits article I defined what the term mineral means to me (and I hoped that it means roughly the same to a lot of other people in the geological community). I mentioned in that article that I would be doing the same for the terms rock, gem, and maybe even fossil. Then, I wrote about rocks in the Aug. 14th issue. This article will be about gemstones and gems.

Again, if you look in a lot of books you will find a number of different definitions for the terms gemstone and gems. I have only recently looked at some of these definitions in detail, because I am teaching a noon-hour class on "The Mineralogy of Gemstones" at Sandia. I've come up with definitions that I am more or less comfortable with but I think they can still stand a lot of improvement. So If you have advice to offer, please contact me. The first definition goes like this - A gemstone is any mineral, rock or other natural material (including organic materials such as pearl, amber, jet, shell, ivory, and coral) that when cut and polished, has the necessary beauty (brilliance, color, unusual optical effects, etc.) and durability or hardness for use as a personal adornment or other ornament. Very little is excluded from this definition apart from a few delicate materials such as feathers and butterfly wings. A shorter definition might be: gemstones are natural materials that can be polished and used for ornamentation or personal adornment. One could probably even include wood. In actual usage I notice that people tend to treat mineral and rock gemstones as being a little more legitimate than the organics. (He deals in gemstones and pearls. The bracelet was made of silver set with gemstones, amber, and coral. With the END of the ivory trade, it is lucky for him that he also imports gemstones.)

The definition of gem is a more varied. Some possibilities are: 1. an especially fine or superlative specimen - (she is a gem of a daughter, that vanadinite specimen is a real gem), 2. a semiprecious stone that has been carved or engraved - this is thought to be the origin of gem and gemstones in general. People have used lots of materials for personal adornment for millions of years but when they started cutting and polishing cameos and intaglios for signet rings and seals they started making gems. The definition I've been working up to is that a gem is a cut-and-polished stone that has intrinsic value and possesses the necessary beauty, durability, rarity, and size for use in jewelry or as an ornament for personal adornment: a jewel whose value is not derived from its setting. The properties that make something a gem are beauty (pleasing to the eye), durability (hardness, toughness), rarity (intrinsic value, costly), portability (small enough to be worn, also, because of the costliness one can carry lots of wealth in a few gems), and fashion (Chrysoprase used to be the rage of Europe but now most people hardly know it, and turquois is very popular in the Southwest but much less so in other places). Different gem materials possess these properties to different degrees and in different combinations. Because of this and because different people find different things beautiful or attractive there are lots of different kinds and colors and hardnesses and rarities of gems and gemstones. In fact, there are gems and gemstones to please just about any person. Unlike minerals and rocks, gems and gemstones are much less scientifically restricted - gems are what you make them.

DEFINITION OF GEM STONE AND GEM

May94 News Nuggets

At the April, 1994 meeting I briefly defined the terms gemstone and gem and discussed the definitions. Again, as in the cases for mineral and rock, this is my definition, it has had important input from many good resources. Like all definitions this one has a few "gray areas" or hard spots to fit but it works well for me. (I fully discussed this definition in a Trivial Pursuits column in the October, 1989 News Nuggets.

A gem is any mineral, piece of rock, or other natural material (including organic material such as pearl, amber, jet, shell, ivory, and coral) that, when cut and polished, possesses the necessary beauty (because of its brilliance, color, unusual optical effects, etc.), hardness, and durability for use as a personal adornment or other ornament.

When mot people say gemstone they are usually restricting themselves to mineral and rock materials.

Another definition - A gemstone is any cut-and-polished stone that has intrinsic value and possesses the necessary beauty, durability, rarity, and size for use as jewelry or as an ornament for personal adornment: a jewel whose value does not arise from its setting.

And, if you consult the dictionary, you will find that a gem is an especially fine or superlative specimen or a semiprecious stone that has been carved or engraved (thought to be the origin of all gems). If it sound complicated - it is. Everyone tends to have a slightly different idea of what a gem is. Don’t forget - life isn’t simple either.