Minnesota Twin Crystals

When Minnesota mineral enthusiasts talk about twins, they may be talking more about staurolite crystals from near Royalton, MN than about the local baseball team. The crystals are found in abundance in the gravels along the Mississippi, just downstream of the N.S.P. Blanchard Dam, about 4 miles northwest of Royalton. Royalton is along U.S. Hwy 10, between Little Falls and St. Cloud.

Staurolite is a hydrated iron aluminum silicate. It is generally a dark rich brown and often forms tablet shaped crystals embedded in mica schist. The crystals are quite hard, and often weather out of the softer enclosing schist. Gravelly areas and soils near exposures of schist may be full of these crystals. At Royalton, the crystals are about 0.5 to 3 cm. long. One can find dozens of them in an afternoon. Most are single crystals, but in some samples two crystals are grown together either at a 60 degree angle forming an "X" or at a 90 degree angle, forming a perfect cross. At first, one might think these intergrowths form by chance, but after finding more samples with the crystals intergrown at exactly the same angle, one concludes that there is some natural law at work. Indeed, such "twin crystals" are formed because of the way the mineral is put together at the atomic scale.

A twin crystal can be described as two or more separate crystals that grow together at a particular predictable angle. The angular relationship between the individuals in a twin crystal is called the "twin law". Staurolite shows two different twin laws-one producing the X twins and the other producing the 90 degree crosses. There are several ways to make twins. The twin crystals from Royalton are examples of "growth twins", which, as the name suggests, must form while the mineral is growing.

Growth twins can be understood if one thinks about a mineral's atoms linking together to form a larger structure in the same way as bricks build up a house. One can lay one brick next to each other to build a wall. Starting at a corner, however, bricks can be added at right angles to each other, building two walls at once. These walls are at right angles to each other, but join and interlock at the corner. This is similar to the way growth twins form with atoms attaching to the same basic structure in different, but essentially equivalent, directions. The various angles shown in different mineral's twin laws is related to mineral's structures - in effect the shape of the "bricks" and "corners".

It is easy to see how growth twins can form as a fluid such as a magma solidifies, however the staurolite crystals had to grow while embedded in solid rock. The schist matrix is clay that was metamorphosed by being subjected to high temperatures, pressures and squeezing, but not melting, during its history. The staurolite crystals grew in this sort of environment. How can such perfect growth twins form in essentially solid rock? This vexing problem also applies to the formation of the familiar large and perfect crystals of kyanite and garnet that form in the same kind of environment.

The answer to this question is not known, but there are a few clues. Certain minerals can exert a considerable "force of crystallization" as they grow, either engulfing or shouldering aside other minerals having less "forces of crystallization" One an see this by looking carefully at Royalton staurolite crystals. They are often

crowded with inclusion of quartz and mica which have been engulfed as the staurolite grew. In samples where the staurolite crystals are still embedded in the rock, one can see the layering or foliation in the schist has been pushed aside and contorted around the large staurolite crystals. Some geologists speculate that thin films of watery fluid surround the staurolite crystals as they grow, further enabling them to form the sharp, perfect faces.

Whatever the origin, it is with a true sense of wonder that we stand on the shores of the Mississippi River on a sunny day and look down to see, in surprise, these regular crystals amidst the rounded pebbles we expect to see. It opens us to the beauty of order and pattern that exists in the world around us.

-Dr. Bill Cordua, University of Wisconsin-River Falls