

# In the land of forgotten colors

On the trail of Cranach, Dürer and Stradivari: chemist Georg Kremer studies and reproduces the paints used by the old masters.



A magician's wares: dragon's blood, dried cuttlefish ink, red fermented rice, charred ivory, curcuma powder, gallnuts, buckthorn bark and walnut shells, plus bismuth, ink stone, Russian jade, Spanish ocher, rock crystal and dried cochineal insects, as well as an extract from a purple dye murex that costs 2,000 euros a gram. The most valuable substances are more precious than gold. An alchemist in the heart of Bavaria, inhabiting an historic mill in the village of Aichstetten?

Georg Kremer laughs at the idea. The Ph.D. in chemistry considers himself to be a scientific analyst in search of age-old formulations long since forgotten today. From precious stones, earths, glass, plants and animals, he recreates pigments used by the old master painters in his Color Mill. The 55 year-old has rediscovered the secrets of their manufacture, and now supplies powdered pigments to artists and conservators the world over. It all began a good 25 years ago with half a gram of smalt.

**"A friend of mine had asked me** to help him restore the ceiling of a church in London," recalls Kremer. The friend was looking for smalt, a blue pigment obtained from glass comprising silica and cobalt ore, which is baked at nearly 1,200 degrees Celsius. The last company to manufacture the substance closed down in 1910. Kremer, still a student at the time, went to work and, with the relatively simple production process, ultimately ended up laying the groundwork for his business. Nowadays, conservators are not the only ones dipping

their brushes in pigments; artists, architects and even violin-makers today prefer these rediscovered natural materials to mass-produced industrial paints.

In the mid-Eighties, Kremer purchased the old mill at the southwestern tip of Bavaria. Today, the company and its multi-million sales support not only Kremer's family, but also some thirty employees. Although shops have been opened in Munich, Stuttgart and New York, Kremer continues to coordinate his worldwide business from Bavaria. The quiet nest of Aichstetten has become the European hub of trade in traditional pigments.

While Kremer's wife stokes up the ceramic woodstove in the living room (lab workers later process the soot from the beechwood fire into bistre, an historical pigment previously used to copy bibles), Georg Kremer describes his never-ending search for historical formulations, for natural substances old and new: "Just as words have gone out of use in the course of time, pigments have also been forgotten. Lukas Cranach even had his own apothecary and sold a variety of substances, mixing colors in his studio and using them to paint his pictures. But cheaper, industrially manufactured paints started to be-



Home of a thousand pigments: the historical Color Mill in Aichstetten.



The stuff colors are made of: Georg Kremer makes pigments from minerals, earths, glass, animals and plants.

come more popular in the mid-nineteenth century as a result of the progress made in the field of chemistry.”

**The synthetic paints used today** in place of natural pigments have different properties than their predecessors, which were primarily manufactured from minerals or organic materials. For example, while automotive paints have to be applied as uniformly and thinly as possible, artists and conservators strive for the greatest possible differentiation and have no problem with greater volume. “My customers don’t think in terms of paint per square foot. Their unit of measure is beauty,” says Georg Kremer.

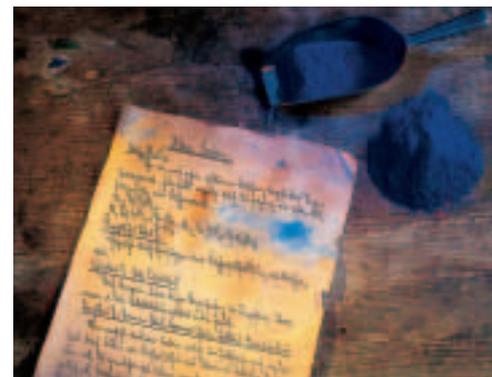
Unlike synthetic paints with a sealed surfaced, mineral-based pigments prove to comprise tiny crystals that shine like stars when viewed under a microscope. “These pigments interact with light not only on

the surface, but also inside the coating layer.” Paints of this kind are referred to as “metamers”, which means that their appearance changes depending on illumination and moisture. Even Kremer’s Color Mill shines in subdued or intense shades of Italian gold ocher and Venetian red, depending on the weather.

With luck, ambition and a broad network of contacts, Georg Kremer has managed to reconstruct sixty historic colors over the last quarter of a century. Once a century-old recipe has finally been deciphered after tedious study of manuscripts and books, the next challenge has to be tackled: the chemist starts searching for the required natural substances. For example, he looks for zinc oxides from Peru, or researches who can supply him with saffron, indigo and sandalwood in the desired qualities. The task is an arduous one. It took seven years before he accidentally

found the exact shade of violet in the gravel of the French Maritime Alps, which the restorers of the Maria Einsiedeln Benedictine abbey in Switzerland had been unable to locate. A shovel, sack and pick are the tools of his trade, and Kremer always has them at hand in the trunk of his car when he travels, just in case.

Nonetheless, Georg Kremer produces only a small fraction of the roughly 1,000 pigments he sells, buying the majority from a worldwide supplier network. Only pigments that have to be carefully made by hand and are accordingly high-priced are produced on the banks of the Aitrach River, which incidentally also provides the old mill with electricity. Stored in plastic barrels, waiting to be processed, are substances like pyrite, malachite, red jasper, rock crystal, azurite, Spanish ocher, cinnabar, lead-tin yellow, purpurite, celadonite green earth and various micas.



“Fra Angelico blue”, the most precious pigment in the world, is made from lapis lazuli according to an old formulation.



Glasses and jars, some with bizarre ingredients, hold valuable pigments that are packaged and shipped around the world.



“Mother Nature has a lot of pretty daughters,” says Georg Kremer democratically in response to the question of which pigment he cherishes above all. The most valuable is undoubtedly “Fra Angelico blue”, which the chemist named after the painter of the famous frescoes in the convent of San Marco in Florence. When the master of the early Renaissance created

## A starry sky of tiny crystals shines under a microscope.

his works of art over 500 years ago, his contract even stipulated how much of the precious paint he was permitted to consume. Today, one kilogram of the blue pigment costs over 15,000 euros, because it takes days to convert ground lapis lazuli into the purest ultramarine pigment – only a few grams can be produced from one kilogram of the stone.

A lab technician first crushes the larger pieces of stone in a cast-iron mortar, removing calcareous deposits and pyrite chips. The material is then re-ground by a “jaw breaker” machine reminiscent of a nutcracker. In the next step, a fine powder is formed between the rotating metal disks of an electric mill and in grinding vessels made of agate, only to be collected once again by the technician and sorted by grain size using stacked sieves. According

to a secret recipe, the powder is then mixed with wax, resin and oils to form a doughy mass, which is left to stand prior to being repeatedly dipped in a linen sack in lukewarm water. The pure bright-blue pigment is washed out by this process, forming a sediment that is dried in a bowl, strained through a hair sieve, filled into small plastic jars and finally shipped around the world in the form of a precious powder. It is not a hardship, but an opportunity, for conservators and professional artists to be able to mix the pigments themselves with additives and binders and thus have total control over the consistency.

**Knowledge of old formulations** is just as important to Georg Kremer as knowing where to find the raw materials in the 21st century. Take “Bohemian green earth”, for example, a standard color up to the mid 20th century: although Kremer knows where it comes from in the Czech Republic, the grounds are now a forbidden military zone and the pigment is accordingly difficult to obtain. “I survive on my good connections,” admits the master of forgotten colors. For example, where can you buy carmine when the cochineal insect apparently no longer occurs in Europe and the warm red pigment made from these tiny animals is at risk of sinking into oblivion? Similarly, no one has been able to get hold of genuine Russian green – with which Albrecht Dürer once colored his engravings – for the last seventy years now. In contrast, poisonous white lead – which virtually every painter used up until the

19th century – is available from Georg Kremer, but he is only permitted to sell it to conservators due to the health risk. And animal activists saw to it that the practice was banned of feeding cattle exclusively with mango leaves in order to obtain the unique pigment “Indian yellow” from the animals’ urine.

**Today, Georg Kremer’s** product line even includes 125 types of glass, each in five grain sizes. Innumerable jars on the expansive display wall in the Color Mill’s main office bear witness to the rediscovered knowledge of herbalists and apothecaries of long-ago centuries – and the materials are still used today for book illustrations, watercolors, frescoes, oil paintings, sculptures and stuccowork.

And not to forget, also for making priceless string instruments. Experts even attribute the outstanding sound quality of old violins, violas and violoncellos in part to the special varnishes used in past eras. Many of the secrets of the old polishes have now been uncovered. Georg Kremer, the master of forgotten colors, has a primer in his assortment whose chemical composition corresponds almost exactly to the mixture prepared over 300 years ago in the workshops of famous violinmakers like Antonio Stradivari. ■

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[www.kremer-pigmente.de](http://www.kremer-pigmente.de)