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# 唐墓壁画

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## **A survey into the material evidence of painting techniques used on some of the early Tang Murals**

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### **Introduction**

Tang Murals can be called important witnesses of paintings and painters of an era long gone by. The iconography and value for art – history of these murals have been subjected to research by scientists and art – historians in China as well as in Japan and in the West, but from a painter's perspective I wonder how these murals are made, and as a scientist I have the means to search for the answers with new scientific methods.

In my view many of these great art works are created by artists, or master – painters if you prefer the term, and not by artisans. Several scholars hold that these murals are the work of artisans, but this can only be based on the assumption that the whole image was copied after an already existing model. This assumption proves itself to be untrue when we observe the size of the images, their variation and differentiation in composition, and their variety of forms and subjects. To me it seems clear that there were master – painters at work, especially on the most complicated murals, developing the images as they went along, building a composition from one form to the next, sometimes adding, sometimes taking away and putting new lines superimposed on the earlier sketches.

It is very pleasing to see the beauty of these works of art and appreciate their wonderful scenes. Seeing through this beauty and looking into the technique that created such beauty, however, is a totally different matter. To understand techniques of Chinese painting, many things that are obvious to the Chinese viewer have to be explained in front of a western audience.

### **What can we say about the technique of the painters?**

To tackle this question co – operation with scientists from various fields of research is required. Chemists and restorers play an important role in this research. In this

lecture I will present some of the results of our co-operative testing and analyzing, the result of comparing data and also a first interpretation of the data.

Last year I was for a month in Xi'an, most of that time was spend in this museum, and I am very grateful for the cooperation, and I especially like to mention Dr Shen Qinyan, Miss Yang Xiaojun and Dr Zhang Qunxi. During that very enlightening period I saw many of the Tang-murals in this museum for the first time. This experience confirmed my vision that the murals form an important part of China's cultural treasures. Their value exceeds that of a national treasure, because these works of art represent a magnificent stage in the art-history of the world.

### **Method**

Whereas in the past art-history mainly concerned itself with iconography and questions of historical context, nowadays the relatively new field of technical art history attracts more and more attention. Technical art history is my approach to works of art; so enchanting as they are, the parts that I am looking for are the least beautiful, the most ruined and even the broken up pieces.

Looking through magnifying glasses at the painted surface of the murals at the Shaanxi History Museum provided me with basic visual information. The cracks and crevasses on some of the paintings even allow for a closer look at the underlying structure, but to fully understand the nature of the technique we need more information.

In October 2000, with the gracious help of Mr Liu Xiangyang of the Qianling museum, I collected samples in the tombs of the early Tang dynasty.

The leftovers, as I call them in the title, are certainly not of great iconography value, and for that reason might be considered unimportant or less interesting. Still, they do represent the material evidence of the painting technique, therefore they are of the greatest value for my research. Since these bits and pieces have fallen off the wall, or are about to fall off anyway, there will be no great harm done in collecting them and having them analyzed for examination of both the ground-layers and the paint-layers.

The samples are taken from leftover parts of paint on the walls in the tombs of Prince Yi De, Princess Yong Tai, and Prince Zhang Huai. The murals in the three tombs are all painted in or around the year 706. The tomb of Yong Tai was excavated in 1959, and the tombs of Yi De and Zhang Huai in 1971.

Their dating is unchallenged, and all three are from the same period, early Tang, but as it turns out there is a typical feature to their layer structure that might confirm this dating. I will come back to that proof later.

### **The technique of the murals.**

First of all, what we see here is a 'a secco' technique, 'a secco' meaning that the paint is laid on a dry surface.

I would like to emphasize that the a secco - technique and the *fresco* technique are two different things. *Fresco* is a technique of painting with wet minerals on or rather into a wet freshly plastered surface, which leads to a chemical binding between ground - layer and paint - layer.

The Tang murals however, are created by painting on the plastered surface of a wall, AFTER it was completely dry. For adhesion all the mineral and vegetable colors have to be mixed with glue. For this purely technical reason I prefer to call them murals and not frescoes. The purpose of this explanation will become clear when we look at the test - results.

Now I like to take you back to the research on the layers of the paint and the ground. To this end I took these minute samples of paint including the ground - layers to the laboratory of the Netherlands Institute of Cultural Heritage [ICN] in Amsterdam.

At the ICN every scientist has his or her own field of research, and I like to sum up a short list of the specialists involved and of the methods we used so far; Under the guidance of, and in co - operation with Dr Karin Groen we first started out with the chemical analysis of the layers. I also prepared cross - sections for further testing. HPLC (High Performance Liquid Chromatography) was used by Dr Maarten van Bommel to analyze organic components such as glue and organic - color.

X - ray diffraction, is used by Dr Peter Hallebeek for identification of minerals. Further identification of the components on SEM, (Scanning Electron Microscope), was performed with the help of Ir. Kees Mensch.

This is not the place to go into the specifics of these methods, so I will now focus on the results we have obtained so - far, and after that to some conclusions that might be drawn from their results.

### **The build - up of ground - layers:**

**The first layer, *maicaoni***

To prepare the wall for painting several ground layers have to be put on first. The first layer consists of mud to prepare the wall, and is about 1 to 2 cm thick. The main component is *huangtu* / loess or yellow earth, containing iron, sand and some quarts.

In the case of these three tombs, I was told, this first layer is a mixture of yellow earth /*huangtu*, and *straw/maicao*. To my surprise the HPLC test – results prove that in this basic first layer a glue is added.

In some samples the *huangtu* / yellow earth layer contains an animal – glue, in other samples is found a protein that has not yet be identified.

At this time we are not able to identify the specific animal, or to differentiate between the parts of the animal. Making it impossible, I must admit, to tell whether it was bone or skin they used for the preparation of the glue.

### **An unexpected second layer**

While examining the samples of ground – layers, we found that in two of the three tombs they hold another surprise in the form of an unexpected layer. As I just pointed out, wheat – straw/*miacaoni* is mixed in the yellow earth – ground layer, and this is what I expected to see. To my surprise many of the samples of the yellow earth – ground – layer contain other fibers. At first sight these fibers look black and curly, and in all samples from the Yong Tai tomb the same black – fibers are present.

Furthermore in the Yi De tomb all first – layer, that is to say, all *maicaoni* /yellow earth – layer samples contain the same kind of fine black fibers.

So what kind of fiber is this? Put under the microscope they turn up more bluish than black, and they have a certain twisted appearance identifying them as cotton fibers.

This ‘extra’ layer is a mixture of [*huangtu*] yellow earth and cotton – fibers, a ‘mianhua’.

The composition of this layer could be similar to layers of this ‘mianhua’ nature from the same era found in Dun – Huang.<sup>①</sup> During a relatively short period of the

① See Table “Geshidai bihuashikuaceng cijiegou ji peiliao dui zhaofen jibiao” between page 64 and 65 of *Wenwu Baohu Jishu* 5, 1987, Same table also in *Dun Huang Yanjiu Wenjiao Shiku Baohubian xia*, 1997, page 249 and 250.

early Tang dynasty the ground - layers show this extra layer between the courser-layer of 'maocaoni' and the white - plaster top layer, making them distinctly different from the ground - layers of the other periods. As it turns out, in the Yong Tai tomb, the same kind of fibers are present even in some samples of the next layer, this being the white plaster - layer. <sup>①</sup>

### The third layer

The next layer is a much finer white ground to smoothen the surface for the final painting.

Calcium - carbonate is found in all samples, but there are slight variations in the composition.

X - ray diffraction results shows the mineral component of calcium - carbonate for most samples, this confirm the chemical test - result that also indicated chalk, while being negative for gypsum.

But as I said some samples are different: for example, the result of X - ray diffraction for Sample YD2 shows 50% chalk + 50% aragonite, of which the Aragonite component is confirmed by the sulfur that earlier showed up in chemical testing.

—Different particles in the samples show other components like: Silicon, Potassium, Calcium, Sulfur, Aluminum, Iron and traces of Magnesium and Titanium, indicating a clay - component or possibly a mica component.

However, one fact stands out in this layer: no matter what the different components are of these white ground - layers, **ALL** the white layer samples from the tombs we are examining, are mixed with an animal glue, which is proven by the HPLC - test.

Samples [ZH2], [YT5], [YD2], [YD2], [YD3], [YD4].

This is **very important**, because through testing this fact is now firmly established. The SEM results show also that several of the white layer samples are a mixture of chalk and clay.

I must also point out that in the white layer of some samples other, finer fibers are present, probably hemp, but this still has to be examined further.

One sample is special in several aspects: YT5

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<sup>①</sup> N. B. In Schafer, Golden Peaches of Samarkand, University of California Press, Berkeley, 1963, p204 - 206, "... cotton is a novelty in the mid - Tang period."

In this sample an animal glue of another kind is found: possibly fish - glue. This again is a chalk sample and the majority of samples is of similar composition. Therefore the choice of this glue seems unrelated to chalk - factor and must have another reason. It could be related to the color - layer above, making this a key - issue for further research. I will come back to this specific sample YT5 later.

**The top layer is the paint - layer, what minerals are used?**

Since I have looked at the leftovers, I am not speculating about the more expensive minerals that have been used in the best parts of the murals, the parts that are now here in the museum.

Red is the most used color in all three tombs and all red samples seem at first sight to be some form of iron - oxide, like hematite or red ochre. The red pigment samples of the three tombs are examined with several of the methods mentioned before, some tests leading to unexpected results that I will present to you now.

**Reds:**

Iron oxide/hematite

Iron oxide is by far the most present mineral in the samples I have analyzed. But, contrary to what I expected, in some samples the red is a mixture containing other components. That is to say: Components apart from the glue - component which is essential to attach the color to the white surface.

For example in the before mentioned sample YT5 from the Yong Tai tomb. This is the sample of a red surface of the curved sealing of the Yong Tai tomb. As you can see on the slide the red - layer is very thin, only  $30\mu$ , [micron]. Cinnabar/vermilion is the dominant pigment, but iron - oxide, clay and chalk are also present, and the paint mixture further contains glue and possibly alum. At the top of this paint layer in the cross - section, we see an almost transparent layer that to my surprise turns out to be chalk, instead of the glue I expected. The chalk is only visible in the cross - section and does not influence the red color in normal view. And as has been said before the white layer in this sample contains a mixture of chalk, clay and glue.

In a sample from the YiDe tomb. [YD3] we find also a mixture of vermilion with some of iron oxide and chalk.

In this sample we curiously found the only trace of lead, in the form of a small brown spot in the white - layer. Lead is significantly absent in all other samples.

Again in this sample the paint – layer is very thin, only  $50\mu$  [micron].

Yet another mixture is found in the Zhang Huai tomb, of which at least one sample contains an organic dye in the paint – layer. There was a problem with sample ZH 2 ; it kept disappearing when prepared in a cross – section for microscopic examination. It turned out to be more soluble in water than the other samples, which could be due to its organic component. It is a mixture of a not yet identified organic red, chalk, iron oxide, glue.

Iron – oxide is also found in the other samples from the Zhang Huai tomb [ZH3]. The thickness of this paint – layer between 40 ( and 50 ( , is similar with the cross – sections of the YiDe and YongTai tombs.

### **What about the painter's work?**

Many of the details in the murals require a skilled hand to do the job. To this day it would need an experienced painter, in my view, an artist to come even close to reproduce these murals. Through the ages artisans made things as they were prescribed by a plan or an outline made by an artist for them to follow. A painter, on the other hand will create and develop finding new solutions on the way, solutions that have never been used before. Only an artist dares changing a painting halfway, to try a new mixture of paint or to introduce a new way of mixing materials to get exactly the color he is looking for.

An artist is never finished with his work, keeps thinking about the images to create, is always testing new ways to sharpen an image, looking for solutions to improve the composition, or experimenting with new materials to get an even better color or texture.

Therefore I argue that the more complicated the mixture of paint the more likely that it is an artist has been at work.

And for that reason I like put it to you that in Europe the creator of such magnificent murals would without doubt be called: **“The Unknown Master of the Tomb”**.





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