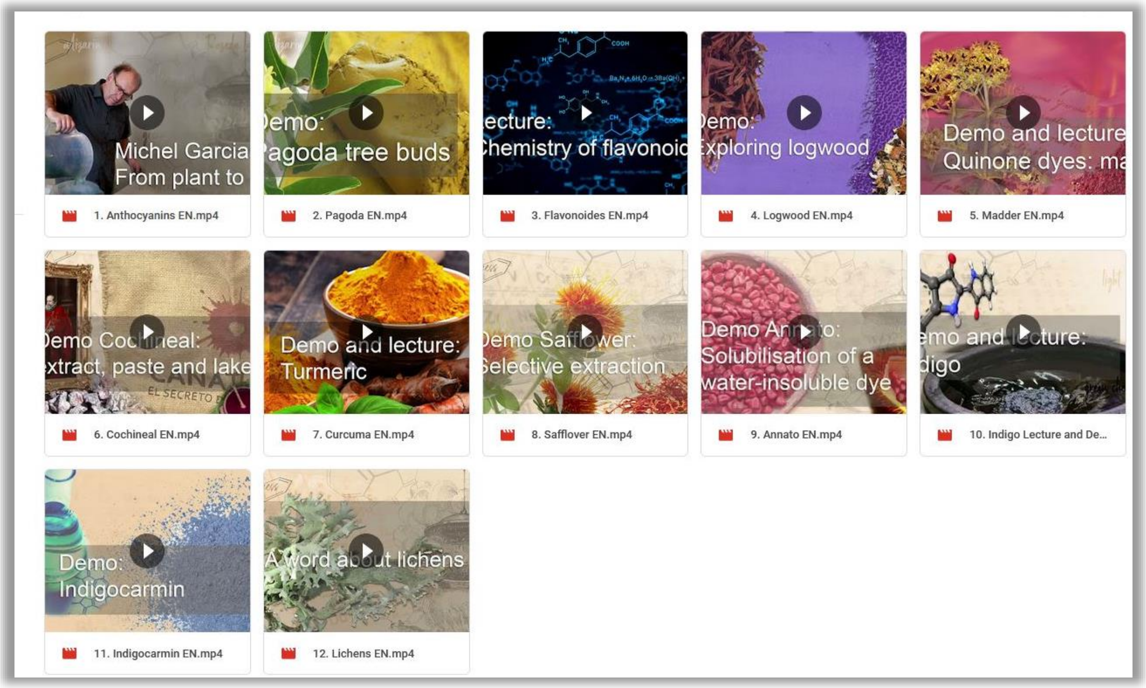

Handout for Tutorial I

Colorants. Beyond the recipe.

Foreword

Dear friends,

welcome to Michel Garcia's online course "From Plant to Dye"!

By purchasing this course, you have access to the videos made in Michel's atelier and to the private Facebook group "From Plant to dye" where the discussion of topics related to natural dyes is held. You can communicate directly with Michel (and of course with each other), ask questions related to the course, discuss dyeing materials, color fastness, history, and philosophy of the subject.

Welcome to the group!

This is a three-part video course. Tutorials 1, 2 and 3 can be studied separately but it makes sense to watch all three as they are related to each other.

This is a handout for Tutorial I, "Colorants. Beyond the recipe".

In this tutorial Michel talks about the main groups of colorants. There are some recipes attached, but the main purpose of Tutorials I and II is to understand the **logic** which is beyond these recipes and to recognize false recipes circulating on the Internet. (Heating or cold extraction? Cold or warm mordanting? Aluminum or tannin?... and so on.)

The aim of the first tutorial is to explains the principles which are beyond the recipes. This course gives you the wonderful possibility to ask Michel directly for the exact settings of your project.

Episode 1. "False friends"

Michel starts this course with presenting several samples from his collection.

Studying the huge heritage of the dyers of the past, Michel came to conclusion that they always used the same families of plants and the same colorants chosen for their beautiful colors and fastness.

Michel: "Plants are not making dyes. Plants, insects, fungi are making coloring matters. These are made by living creatures for survival. They are not made to dye the fiber. Molecular structure of most natural dyes is not ideal for interaction with textiles, as nature did not create them for this application. Plants prepare these compounds not for us, but for their own needs. They take part in the process of photosynthesis and in the other biochemical processes, work as UV protectors, determine the color of flowers, etc.".

Biologists classify the coloring matters according to the families, and this classification has some predictive power. Knowing the class of the colorant as chemical compound, we save a lot of time. Some colorants are very useful for the dyer, but some are almost useless. First, several examples of colorants which are beautiful but useless for dyers: Anthocyanins, betacyanins and chlorophyll.

Molecular structure of most natural dyes is not ideal for interaction with textiles, as nature did not create them for this application. Plants prepare these compounds not for us, but for their own needs."

The landscape of natural dyes is very complex. Some plants contain a mix of "false friends" and "true friends", and it is a challenge for the dyer, how to sort them out.

Real, world-famous dye plants usually contain mostly persistent dyes. But the situation is even more complicated. The dye can change during extraction process, becoming either a "true friend" or, sadly, being hopelessly spoiled if the wrong extraction procedure is chosen. Michel will talk about the mechanisms of it in his lectures.

But first, he will show you one of such plants, the famous Pagoda tree, known in old Europe as "Persian berries".

Episode 2. Pagoda tree demo

Michel: "This is pagoda tree flower buds row material. That's a very traditional dyestuff in China. When it first arrived, it was during the 18th century, it arrived in Holland, in England and in France by the travelers. The boats did bring that from China as being a very good drug, but it was not adopted immediately for dying. It was adopted to make a very good pigment. They did call it Persian berries.

Pay attention that Michel starts with high temperature to get brilliant yellow from Pagoda tree buds

Extract: 0,5 liter of water for 40 grams of pagoda buds' powder.

Michel introduces the Chinese method, mixing this extract with alum, he takes 40 grams of alum.

This preparation will be both usable for printing and for making inks, and for plain dyes.

Michel starts with the plain dye, and then makes a printing paste.

And then this can be added with this solution of gum. This solution of gum contains of 400 grams per liter of gum arabic with water. Michel mixed this thickener with equal part of Pagoda extract and then he adds a bit of guar gum. The paste is ready for printing.

Michel demonstrated us the preparation of a plain dye, ink, and a printing paste, starting from the same Sophora extract. There is one more product we can produce from this extract. We can precipitate the dye and make a pigment for preparing artistic paints, varnish, or wall paint. Michel will show you later in details the preparation of a cochineal lake pigment. Let us go through the procedure briefly now. Michel adds some calcium carbonate to the extract to precipitate the dye, that means to make it not soluble. Michel uses grounded seashells as a source of calcium carbonate. For 40 grams of pagoda buds and 40 grams of alum he takes approximately 53 grams of calcium carbonate. He lets the reaction take place and then filters the pigment. You can take the pigment and prepare an artistic paint.

40 grams of pagoda buds' powder.

0,5 liter of water,

extract, then strain

add 40 grams of alum

For the lake, add 53 grams of calcium carbonate.

Episode 3 Lecture Flavonoids

Michel explains the mystery of Pagoda tree colorant and talks about main groups of flavonoids. Pay attention to his theory of a "hole in a flowerpot". He gives a very comprehensive explanation of the immense difference in the lightfastness between different flavonoids.

Michel: "The problem we have is that we will have to select the good dyes and the false dyes and recognize who is who. Especially for yellows, because we have millions of yellows, but not all of them are equally efficient. Most of yellow colorants belong to flavonoids. This is a skeleton of all flavonoids. I give you the example of one of the very best we like to use, the family of flavon. Flavons can be of different types depending on how many hydroxyl groups they have. I will give you the example of **apigenin**. Apigenin has just one hydroxyl here. Then comes luteolin, luteolin from the dyer's weld, from the dyers broom, from many of our best plants. Luteolin has two hydroxyls. And then the third one, tricin, has something here. If you have just one hydroxyl here, this is giving a kind of pale straw yellow. This is more golden. And this is almost orange. These are interesting. Let's consider just a luteolin for the moment. These are extremely stable. And chemists were wondering what's making them stable. In fact, this is stable because of this strong link here. There's energy here. And this energy is very strongly blocked by just hydrogen here, but nothing else. Not hydroxyl. If ever there's hydroxyl, it makes the dye fragile. I will give you an example of another family of yellows that we normally never use for dyes. Flavons are called 3-deoxyflavonoids, Chemists use numbers for atoms. This is the place number one. This place is number two. This place is number three, four, five, six and so on. But here the number three, 3-deoxy-, it means it's not oxidized here. It's no oxygen, no hydroxyl here. 3-deoxyflavonoids are the very best. And we will discuss this point because when studying the cultural heritage, everything we find in old tombs and very old ancient remains in the salt mines in Austria, in China, in Persia, in Iran and so on are flavonols. People did select those 3-deoxyflavonoids. They never used the ordinary yellow you find everywhere in nature. So now let's consider another family. These are flavons. And now I will present other one. They are flavonols. So Flavonol, that's almost the same structure. I will give the example of a flavonol, it is very similar, almost same, which is called quercetin, the one of onion skin. Onion skin being the great example that lots of people love. I will design this. Let's repeat why different flavonoids vary so dramatically in their light resistance. The crucial point is this carboxyl in position three. If this position is free, like in flavons, the light fastness is high. If this position has hydroxyl residue, the light fastness is low, like in flavonols. Let's continue. Well, it really looks similar. But there's something here in the position 3, there is -OH and I will compare this molecule to the other. This is called quercetin. This is kind of the hole in the flowerpot. If this molecule was a flowerpot, there's a hole at the bottom. That's the bottom here. And then you cannot fill the molecule with light to get the color because you know, there's a hole in the flowerpot, so it's not lasting. This one is super fragile. If you have only one -OH, we call it kaempferol. If you have two, it is the quercetin. And if you have three, this is the myricitin. Like it was apigenin, luteolin and tricin. It's exactly homolog, except that this is very fragile by itself. People think, okay, we will use the alum, we'll put massively alum on the piece so it will stabilize. No, no, no, it will not because the alum could plug here or there. This will not resolve the problem of the hole in the flowerpot. **Quercetin** is not a good candidate unless you find a little cork to block the hole in the flowerpot. What could be this type of cork we can put in the position 3 here? This could be found naturally. There are some flavonols in nature having something here that you can have benefit to use. I will clear the board and design again my quercetin to show you some interesting aspect of the question. So that's the ordinary quercetin you remember. Well, it's this little problem of -OH. Sometimes in some plants, quercetin position 3 is not free. Quercetin appears under the form of a glycoside. That's quercetin. And sometimes it appears as a certain type of a type of coloring matter called glycoside. Glycoside is a kind of combination of coloring matter plus sugar. Under some conditions in some plants quercitin glycosides can be arranged as follows. Instead of having the -OH here there's a link with an oxygen, the oxygen is still there, but instead of the hydrogen, here is a sugar. This is a molecule of sugar. Michel compares the flavonoid molecule, having a hydroxyl group in position 3 with a flowerpot. It has a hole and it's leaking. Mordanting does not fix this problem. The only solution is to choose the stable colorant. But in some cases, nature created a plug for the flowerpot, and it is sugar residue in this famous position number 3. What's important for the dyer is to keep the sugar and do not destroy it during the extraction procedure. Michel will explain how. Let's continue. Sugars like glucose or rhamnose, there are different types, but could be also glucose. They call it glycoside because there's glucose plus the color. This is extremely interesting. Extremely interesting because inside of the same plant you can have the color under this form of glycoside. But there's also the enzyme. Because the plant sometimes needs to change its composition depending to the predators, depending to how it is protected against UV, against different things and sometimes to get energy, the plant need massively sugar. The plant storages the sugar linked with this quercitin. This is extremely interesting because inside of the same plant there's an enzyme called glucosidase. What happens if you put this plant in your dye pot and very gently cooking the plant to get the dye solution? The enzyme is acting. I would compare the enzyme to a pair of scissors. Scissors will cut the link here, and then you will get your ordinary quercetin and the sugar will be free. So that's the job of this enzyme. I have a real paradox. I could use this plant for dye. It could be quite stable. Now we keep the sugar, but when the sugar is separated, it is turning to pure quercetin, which is super fragile. So how can I do? So that's extremely interesting. I will be inspired by old Chinese practices still in use. For example, I will take the example of the pagoda tree buds. The Pagoda tree bud has glycoside, a very special one which is called rutin. Rutin has a kind of double sugar. That's a strange little train like this. Rutin has two sugars. And of course, the enzyme. Rutin, you may hear of that under the name of vitamin P, extremely good for blood pressure, for reinforcing the vein system circulation, blood circulation and everything. This vitamin P is extremely popular for medicine, of course. This rutin is in the pagoda tree and there's also the enzyme. Rutin is precious for medicine, for health care or for dyes much more than the ordinary quercetin, we want to save the whole thing like it is. We have to, like Chinese say, to "kill" the enzyme. Of course, the enzyme is not a beast. It is just figuring. If the enzyme is absent, the whole thing is super stable and a very good dye and a very interesting matter for many purposes, even protection against UV, and so many things. How to kill the enzyme? So, the Chinese got very interesting practice, that they also use to make the tea, the green tea. In the tea, there's also this problem of enzyme. There are other molecules, they are tannins. But if you leave the tea like it is after harvesting, the enzyme will cut the tannins and generate something which is in the black tea. But the green tea is a super antioxidant. Green tea has incredible properties compared to the black tea, so they want to kill the enzyme. So, they put the leaves of tea in a wok. They are heating a metallic bowl and they put the tea and they move it quickly. It's not super-hot, but around 40, 50 degrees.

The enzyme is neutralized. I would prefer the word “neutralize”, of course. And then when the enzyme is absent, so you preserve everything of that.

So that's extremely interesting because we are touching something precious about the

recipe. Imagine you harvest your own pagoda tree, or you buy it at some supplier, but you don't know this. You will put your pagoda tree in water and cook it. So, when warming, the enzyme will run to the molecule and cut that. And you will get a very ordinary yellow, beautiful, of course, but of a very, very poor fastness to light and washings and turning brownish very easily and so on. Unless you put your pagoda tree buds in a wok and you kill the enzyme by just drying process, very, very quick, and simple. So, you kill the enzyme and then you get the perfect product. So, the perfect product, because the carboxyl position 3 is blocked, just kind of cork in the flowerpot hole. So, there is no hole, and you can fill that with light, and you keep the precious wavelengths of the yellow. So that's extremely interesting. What does it mean? Okay, that's my pot. That's the gas. Okay. So that's my dye pot. So, I can wait for the water to boil before I put my dye stuff in. So, because it's boiling, I will kill the enzyme. In other cases, for some other colors, I will need the enzyme, and then I will very gently warm it together with the plant for the enzyme to work for me. In the case of this yellow, I don't like the enzyme because this will convert my precious dye stuff to a very ordinary one. In other cases, I will prefer the enzyme to do the job because I will tell you why. So that's interesting. While investigating old fabrics, they find that there are only two types of flavonoids in the dye stuff. Two types. Some are flavons. It means it's blocked here, there's nothing here. So that's a flavon. And then, 3-deoxyflavonols. It means that something blocking at this position 3. So, there are very interesting examples. For example, in Iran, they are using plants of their environment, but traditionally they know which one to choose. They have the choice. You know, there are many, many plants in some regions, but people use only the ones with this structure. So Persian dyers had a huge number of plants giving flavonoids for yellow dye, but they did only select flavons or 3-deoxyflavonols. And this is the same in most of cultures. There are some other yellows from other families which are not flavonoids, very rare. But if they use flavonoids, they have the choice between these two. So now I will give you an example of another flavonoid useful for dyers. Flavonol, which has only one sugar here. This is quercitron. This is from the dyer's oak, which is **Quercus velutina** in Latin. And this is very interesting because the bark of this oak has been found in America. Probably from natives' use. So, the natives were probably interested on that color. So, the Western people coming to America discovered it and they found the coloring matter being in the bark very stable and in huge quantities. So, this quercitron has only one sugar here, so that's a good pattern for a stable yellow. They started to cut massively all these trees until the moment, and they built very big factories to make the extract in Philadelphia until the moment it totally disappeared. It became extremely rare. Sometimes you can find one of these dyer's oaks in the environment, but they are young trees. All the old trees have been cut for the industrial purpose for printing on textile, especially for the calico printing. This was considered as the very good one. We can discuss, why did the destroyed all the precious resource? Of course, it's not very comfortable to cultivate trees because it takes very long to grow, especially oak. So, they did not even plant that for further generations because they wanted everything for the immediate need of the industry. So why was it destroyed? It was destroyed because it is quite rare to find those kind of 3-deoxyflavonol massively present in a plant. Exclusively present, I would say. I mean, there are plenty of other plants having good and bad together. What I mean good and bad, I mean fragile and stable in the same plant. I will give you another example and you will see how complex is the is the problematic. Okay, here is another flavonoid, which is flavonol and there's another -OH here. When they are -OH like this, super hydrated, super soluble molecule, this one is **quercetagetin.** This quercetagetin is one of the main components of Marigold. Lots of people, they are keen on miracles. Inside of this Marigold there is quercetagetin. But there's also luteolin, the stable one. Just to remind you, 3-deoxyflavon. So that that's the one very stable here, giving a good yellow. This is the perfect one. And that one is the super, super fragile, even more fragile than the quercetin by itself. In the same plant, we have both. What can happen? The dyer will have the best practice he knows. And using Marigold in the pot, he will have a brilliant yellow. Then he will send it, for example, for very, very honest, honest work. He will send some sample for the xenotest to get an idea of the fastness to the light. The quercetagetin will disappear extremely quickly. The color will fade very fast, but not the luteolin! It means that the very saturated yellow will fade suddenly, but it will not fade anymore at some point, because then you have the luteolin in it. So, the xenotest agency would say, okay, this is fading, it's of poor interest. That's a very real paradox because you can complain and say, Oh, but I have this very stable now. So, it was fading as crazy at the very beginning, and now it's not fading anymore. But that's very difficult to explain, because imagine you put your garment to sell, your naturally dyed garment in behind a glass in a shop. So, one side is fading as crazy and not the other one. Not the other one, which is at the shade. How can you explain that to the client? So that's extremely complex. Let's summarize.

Most of the plants having flavonoids, they have a cocktail of that cocktail of flavon and flavonol, for example. So, because it's a cocktail, half of the color you would get will be fragile and the other half could be stable. So, dyers were looking for plants having only one type of stable colorant. For example, luteolin and luteolin derivatives can be found in the dyer's weld. That's the main component together with some glycosides.

Here the sugar that could be plugged, luteolin glycoside. This is stable anyways, luteolin and luteolin derivatives, because of that. So, this dyer's weld was cultivated since remote times. It was also harvested in nature. It was propagated in big, big areas because that was kind of one of the worlds because you just have one thing, but other plants have this plus fragile thing, so they are not considered as good dye. Other good ones, which have this special flavonol with a 3-deoxy flavonol, only that. For example, the tamaris. The tamaris plant has 3-deoxy flavonol, of a very special type. But at least the position 3 is blocked. The hole in the flowerpot is blocked. I will design this. So, in the tamaris there's another type looking like almost the same. It's really the same type except sulphate group here. So that's a sulphate of flavonoid. And this is extremely stable because this position is blocked. So, now, people discovered very stable things. They still used it like for this tamari, which was used in Persian, in Iran. But anyways, in any case, this is blocked. So that’s very interesting because if you consider natural dyes as a beginner, you will say, okay, I was walking with my little basket and harvesting. Almost everything is given attractive thing, but 99.9% is giving fragile dyes.

Among them, maybe 200,000 flavonoid plants in the world, very few has a big amount and among the very few having a big amount of coloring matter, very rare ones contain only that stable type of dye. It makes a stable yellow rare and remarkable.

Not all flavonoids are yellow. Michel prepared another demo for you. He will dye with the famous Logwood, which belongs to **neoflavonoids.** Logwood is known to be a fragile dye.

How can we stabilize it?

Episode 4 Demo Logwood

The colorant from logwood, **hematein**, belongs to the group of **neoflavonoids**.

It is a versatile dye, and Michel shows us an elegant way of stabilizing it with a co-pigment.

Michel: "we say that while exploring many traditions of the world, we had the very best blue being made of indigo plant, the very best red being made from insect or madder family and some black and brown from tannins. And flavonoids did belong to the yellow from flavon and special flavonols, quite rare in nature, despite almost every plant has some yellow. So that was the historical choice for the super quality. But then when European discovered the rest of the planet, they discovered that in America there was some interesting dyestuff they never heard about before. Among them was logwood.

This wood is very heavy, not even floating, it is giving interesting shades. They did call it blue wood, or indigo wood. But in fact, this is a special dye reacting very, very well with the ferrous to get black. But the purple was also fascinating people, but this was versatile. Versatile means that if you use the ordinary process, very simple, ordinary process, you will have nice colors. But any spot of acidic like vinegar or lemon, will generate a kind of pinkish spot, pinkish to beige and then it's damaging the dye.

People were investigating until the moment they discover that not everything in the plant binds correctly with the mordant, we must combine this plant with others and among others, of course, there are tannin plants.

This is the piece I mordanted already. I must fix this, for example, could be in silicate or wheat bran. Well, I will use the wheat bran here. So, this is to fix the mordant before I dye.

(Note: Michel will explain details of mordanting in Tutorial II). So that's first step of what's very important. Second thing is that here I have some birch chips from the birch bark, and I will have a decoction of birch because in the birch there is an incredible complex of tannins and betulin and betulinic acid that would make a very interesting co-pigment together with the logwood. It could be also not only birch, but it could be also poplar for plant family giving interesting things.

So, we'll wait for this to boil, probably 5 minutes will be enough. And then I will add my logwood and then I will be able to dye my piece.

The next step will be inspired by Chinese traditions. As I told you, Chinese say that the very best dyes must be steamed. We will steam after dyeing, and then we will have a very interesting reaction that makes this fragile dye to be stable enough to be useful for garments or any use. We will have some experiments after that. But first, let me summarize all the process. We need to get the stable purple from logwood. First, the piece is mordanted with aluminum acetate. Then the mordant must be fixed, fixed enough to be well hydrated. Excess of mordant is probably eliminated. And in the wheat bran, we also have a kind of anti-UV, which is ferulic acid. The ferulic acid, it's a phenolic component, which is an impressive anti-UV. So that's very good to add the anti-UV here because this ferulic acid will naturally bind on the mordant.

The mordant is kind of protected already. I'm almost ready to dye my piece. We'll have the complex decoction of my chips of birch plus the logwood. Logwood has been ground very, very finely, so there's a much interfacing between the liquid and the powder.

If I use this and boil during hours, I will also have some result. But, well, it's like I need much, much more for the same result because it will not be penetrated by the liquid. This is almost done. I will come back with my rinsed fabric. The dye, properly speaking, the decoction. It's giving that kind of pale, pinkish solution, which is looking like those pinkish things you get from avocado, avocado skin. This pinkish is a mix of many things, the two types of tannins of condensed and hydrolysable tannins together, and some other phenolic acid like betulinic acid which could act also as an anti-UV.

Using multiple treatments in my procedure, I will improve the fastness of my logwood dye. If I just take alum, just dump fabric in logwood, I will have the illusion of a good dye. I will have, obviously, a color which might be considered as very attractive. But then this logwood dye will be still versatile. I mean, versatile, changing when having accident, acidic or basic accident will discolor the dye. Let's prepare the dye pot now by filtering. You see this a kind of pinkish juice here. Oh, I forgot to tell you. There's also another interesting po-pigment. The brownish pink co-pigment is also present in alder woods. And that makes the alder extremely popular in pre-Columbian techniques. I was studying all different dye techniques from North American natives. There are different databases, but I also visited the museums and red some information about that. And then the read alder was the muster plant for dyers because it was combined with many, many other plants to get fast colors. In our tradition, the alder is also sometimes mentioned. But, you know, it is kind of just brown, brownish treatment. It is not considered as a master thing, but in the very old texts, we can see that it was consider as improving the fastness of some dyes. You see that the dye will take quite quickly, but it is not finished. I will take my time. Let's be patient. What's next step? Next step will be finishing the dyeing, rinsing, drying, and steaming the piece.

We will do everything to submit the piece to some accidents. The accident will be interesting because then it might be a bit versatile, but you can reverse the effect by just washing the piece. Imagine you are at the restaurant having your beautiful dark color here, and then you have a spot with the lemon juice at the fish restaurant and then it's giving a kind of reddish spot. So that's a big pity. You just must gently stand up, go to the tap, and treat a little bit your piece and that's it. You can wait for being back home to wash the whole piece to eliminate everything. It is not that dramatic. It is just possible to clean this fabric so it will not be damaged by any spot. This is not the case for the anthocyanin from plants because the anthocyanins are super fragile, and they will be versatile forever. We tried many, many treatments, anthocyanins, you know, they are very common. People are fascinated by these anthocyanins. People see, oh, look at the geranium and the petunia, beautiful flowers. But in fact, these are colorful, but they are not good candidates for stable dyes. We found this trick for logwood, but we never found anything working correctly with the anthocyanin, I will show you the structure of the on the board. It it's a difficult structure. Well, you see the kind of tannin, which is in logwood, which is still in the juice. I will cool it in the in the pot, and then we will dry and steam. The liquid is pale, but it is not exhausted because hematoxylin is colorless, so you cannot see everything. So sometimes even that of looking at the shade of the liquid to determine if it's exhausted or not even that is not exact, it depends on case by case. This is the logwood dye we had. Of course, we can saturate it even more, but it is dark enough. I will dry it at the radiator and then we will steam it to get it as fast as possible. And then when steamed, you will have a very honorable dye regarding both fastness to light and the quality of the dye regarding the washing. So okay, here we are. I will put that on the radiator, and we will finish this piece by steaming it. Michel showed you the plain dyeing of cotton with logwood stabilized with the co pigment from birch bark. In the next demo he will show you how to get an image using differential discharge of aluminum mordant. We will come back to these techniques in tutorials two and three. Discharge. You can see the discharge as it is. And now I must dry it. Then I will fix the mordant, and this paste will be dissolving the mordant. Then I will fix the mordant, I will also dissolve this mordant which is there. I'm discharging the mordant and then I'm fixing the rest very, very strongly. And then when I will be dyeing, I will have perfect dye on this and minimum of die there. What kind of minimum shall I have? For example, bit of tannin from the logwood which will not be which will not need any mordant to fix. I will have a selective dye here, just the substantive, which is the tannin and here will be the whole thing. I put that on the radiator to dry. This is the printed piece. We mordanted the piece and printed the piece with the discharge. So now I will have my dye pot from logwood plus the birch wood. Remember the birch wood, which is important as a co-pigment. Okay, so I have this and now I will fix my mordant and eliminate my discharge. So that's a crucial point. Of course, I will add one drop of sodium silicate. This slightly basic, I put small amount so this could fix the mordant and eliminate the citric acid at the same time. That's important. It's also kind of washing agent to eliminate the gum. There are three actions in the same pot. So that makes this thing a bit mysterious for beginners. But we eliminate the gum, we are neutralizing the acetate in case we still have some acetic acid in, and we eliminate the citric acid which is in the discharge system. So now I can feel that I do not have any more gum in it. So that's important to come to that as a kind of disturbing system. The gum is plenty of citric acid, so I don't want that in my dye pot, of course. You see, logwood binds only to those fibers which were mordanted. That's the good discharge we are getting. Isn't it interesting? And even sometimes we even like more, even more white than it is. And then we can add some wheat bran in the pot, directly in the pot. So, remember, I will insist a little bit for the white not to be white. I want the tannin color. You remember this tannin together with the logwood. After some time, it will be a beautiful beige. But it will take a bit. And maybe I do not have enough logwood, so I will have it kind of white and purple. These are slow processes, slow not because we need hours and hours, slow because there's a sequence. Each step is important in this sequence. So now I will be patient for the dye process. But I did put the very small amount of dye, so it's almost finished. So that's the thing you intend to do, right? We can have that with any color. Okay, that's the right order here. Of course, it's not super clean. The discharge is not perfect. Now I think we will dry the piece and later we will steam it.

We use logwood chips from 10% to 100% of WOF for different shades.

Let’s talk about different reds, about pink, scarlets… about madder and cochineal.

Episode 5. Madder

Let's talk about quinone dyes and of course, about madder or the queen of natural dyes.

Then come QUINONES which are rarer, we find them in the roots of some plants. In contrast to previous groups, quinone dyes are extremely useful for the dyer. They give red, yellow, violet, and brown colors. We will learn to recognize quinone-containing plants because they are irreplaceable for creating natural color palette, if we want more than only yellow and blue. Most of vegetable reds come from the roots of Rubiaceae family. The most known temperate plant in this group is Rubia tinctorum, dyer's madder. But there are other species like Rubia peregrina and Rubia cardifolia. The coloring matter in this case are anthroquinones. They are beautiful and very stable. Let's mention Morinda, a small tropical tree whose roots have a cork with high contents of red dye. Now let's discuss about important coloring matter, which is the alizarin. This is the alizarin. This is a quinone dye. We call it anthraquinone. It means that there are two cycles. This is the benzene cycle. And this is another cycle, and the alizarin is like this. That's the alizarin, the best red dye. And many people will tell you, oh, yes, there is alizarin in madder. The problem is, it's not as simple as it is, because inside of the madder there is a glycoside, which is called ruberythric acid. This ruberythric acid is a glucoside of alizarin. This is alizarin. And the glycosyde is like this. This is a sugar here, it is linked to alizarin. This is making the molecule to be very soluble in water. In fact, that's interesting for the plant because the plant is storing energy, in form of sugar, in its roots because in winter there's no leaves. The plant could use that sugar as a storage, like potato storing starch and so on. And the point is that the alizarin is not ready-made inside of the plant. There is ruberythric acid plus the enzyme, which can cut that, of course. We called the enzyme primeverosidase. This enzyme can cut that and make the alizarin. So that's a very interesting point. We have seen when talking about the pagoda tree that if you let the enzyme work, if you just put the pagoda tree buds in warm water and gently warming, the enzyme will cut the precious rutin and make the very fragile quercetin. Here it's kind of opposite situation. If you do not let the enzyme cut that you will have the ruberythric acid, which is a kind of dull orange shade. And it is not red, only the AGLYCONE, I mean, the pure color (without sugar) from alizarin is red. We need the enzyme. So how can we do? We will very gently warm the madder in the pot, very gently to let the enzyme do the job for some time. And then the ruberythric acid, the genuine component of the madder, will be converted onto alizarin inside the pot. If you put your madder directly in the boiling water, you will have a real problem, because then you immediately break the enzyme, and you will have this dull orange shade and not more and you will never succeed. So, this brings us to consider different problems that people had in the past when they started to cultivate the madder. They did cultivate it in the north of France, and it was in Lille during the 17th century. In Lille there were special mills to grind the root. But before grinding you had to make it very, very dry because if it's humid, still humid from the rain outside the humidity of the air, it's like kind of rubber and you cannot grind it in powder. So, there were two types of apparatus that was the same that was used for the malt, you know, the barley, grain germ. Barley must be dried to make the beer. To make the malt, you must dry the grain. So, they were using the same apparatus for madder, so drying it by gently heating hot air and then they could grind it in powder. But sometimes if the temperature of the drying process is too high, you break the enzyme. Your madder is of very, very poor quality. So that's a real problem. Then when you sell your madder, you were cultivating and doing everything with your heart and you do not understand that's organic, growing and everything except that when drying you did kill the enzyme. At the period when they started to grow the madder in the south of France, people were extremely poor. They just put the madder to the air at the shade outside. And because there was extremely dried, the root could dry very easily before the grinded. Speaker2: So that's one of the paradoxes. And the second paradox is that of making an extract, a commercial extract, you know, how they do for commercial extract. They have a hydro alcoholic solution. They put the madder in water and alcohol together. They have a super solution concentrated and they spray it. It's kind of shower system, you know, with plenty of holes spraying the drops of the solution pumped here. And then it goes in a very hot column. It goes in a very, very hot column of air. There's some air, hot air. And then the drops are falling, but the steam is separate from the drops. So, I mean, the humidity of the drop and then here is falling the powdered extract, which is still soluble in water, of course, but the problem is the temperature. This is a solution of water and alcohol falling. By the hot air, all the steam, all the H_2O is eliminated and then you have your dry extract. It looks perfect. That's what they do for food additive and many things, except that the temperature could be 140 degrees Celsius. It means the enzyme is totally killed. You have a very good extract with ruberythric acid in it, but you cannot use it for red dye. Speaker2: You buy the very expensive madder extract, so you want the very best red and then when you start, it doesn't work because the enzyme was killed. We forget about the enzyme in many,

many cases. So now, of course, they improve the process, and they did fix the problem, case by case. But it is just that little parenthesis to tell you that if you forget the enzyme, you cannot imagine that nature is doing the dye. You must understand how it works and to manage how to warm your pot or how to prepare your dyestuff before dying. That's extremely important from that will be the highest quality or the poorest quality if you are kind of generalizing. You want only one recipe for everything. Like for example, you are gently cooking your things. It's kind of slow process of using because you suffer a very long time. You are so patient that you will have the benefit. It is stupidity if you use the pagoda tree because by having a long process so you suffer so much that you will have a better benefit? Of course not. In that case, no. But for mother, yes. Case by case. So be aware of how it works. So that's why chemistry was made as a science. Science of study, of properties, of bodies and their interaction. Speaker3: Michel talked about dyer's madder. And now he will show you the extraction of dye stuff from the other plant. Indian madder. You may use boiling water for Indian madder. What's the difference? Michel will explain you everything after the demo. Speaker2: I will demonstrate the possibility with madder. So first, we know that madder should be crushed in very tiny powder to optimize the extraction of the color. And then we must not confuse in between long dying process, one dying process and the extraction by itself. We can first do the extract. I will use this little blender here. We'll take this madder here, hot water first to do the extraction. And then I will repeat two or three times this process of extraction, straining it. I will take the maximum. That's my first one. That's not very long. That's not much energy consuming, you know, compared to a very long heating process. So, I can have a bench of color by just stirring. Stirring is extremely important. And then I will repeat a couple of times, and you might be surprised that we will have an incredible extraction from this quick process. And then I will dilute this solution in cold water, and I will dip my silk for some time. But first, let's go on with the extraction. That's very important. Repetition. The second juice is also very, very dark. And the third juice will be much paler. The madder dust after the third extraction can be used for pink shades. Remember that I work with Indian madder now for the dyer’s madder I would never use hot water. We can have a word about that later because of the enzyme, I will use the cold water. This is Indian madder. But if you have the other one, so-called dyer's madder, European madder, I recommend using the same system except the temperature because the other one, the dyer's madder, has some enzyme in it. High temperature will break the enzyme and then you will not get such an attractive shade, it will be kind of brownish or orange. For the extraction of Rubia tinctorum, the European madder, I would recommend using water at room temperature or maximum 40 degrees, MAXIMUM. The same process. But except that you should NOT use high temperature. Indian madder is Rubia cordifolia and European madder is Rubia tinctorum. Indian madder is cultivated in East Africa, India, East like Palestine, in Jordan they grow some. W I had some samples in my garden when I was younger, when I was living in the South of France. And then that was interesting. That was very interesting because the foliage in autumn was turning a bit red so we could harvest the foliage for dyes and save the roots for several years. We could have big plants using the foliage

for dyes, which is not the case for Rubia tinctorum. The botanical difference is very interesting to discuss. In tropical regions, Indian madder doesn't lose its foliage, so the plant is not storing sugars in the roots. On the contrary, (European) dyer's madder is storing a lot of starch in the root, starch, and sugar. And then that makes a difference because to store the starch and use it, the plant needs to plug it, plug the sugar together with the color. Then there are some enzymes required to cut the bonds. If you do not save the enzymes, you will

not be able to cut the bonds in between the color and starch. So was this solution was put in cold water. It's less than 30 degrees. And then you see that some color is coming the fiber. And then I must be patient now to saturate my fiber. It takes a bit of time. We'll come back to this experiment after a couple of hours. About the mechanism, I will take the example of alizarin. Alizarin is supposed to be the main component of dyer's madder. And in fact, it is not true. Alizarin is that kind of molecule. They are six carbon links together and that is one oxygen here. So that's the alizarin. So highly carbonated molecule with -OH sites of oxidization here and here. This is called alizarin, from the Turkish name, like lizard, the root looking like a kind of little snake or lizard. But in the plant, in the dyer's madder, alizarin is not present as a

free molecule. It is linked together with two different molecules of sugar. So here there's a sugar which is linked, together with another sugar. And these two sugars together is called a primeverose. And all that together makes a big molecule. This is alizarin. And this is called ruberythric acid. This is of a poor orange brownish shade. In the plant there are some enzymes. During is a chlorophyll cycle in summer

and until autumn the plant makes photosynthesis. The plant is making sugar and storing sugar under this form of two sugar links together with one molecule of color. The plant is storing that in the roots. You know why? Because during the winter, all the leaves disappear. The plant starts to survive with an animal life, I mean, consuming oxygen and eating sugar. The storage, the plant is using its own

sugar by using an enzyme. The enzyme is called primeverosidase, ending -ase, means „cut" and primeveroside- means that this type of sugar has been found initially in another plant. We need the enzyme because the color of the glycoside is not beautiful. So sometimes when people start making madder extract, they evaporate the juice as crazy. You know, they make the juice, and they evaporate with high temperature to get a powder, but then they kill the enzyme. So

that's the problem of some extracts. You can buy the extract of very poor quality; they are just giving kind of pinkish and not even pinkish but orange brown. We need the enzyme, and that's very important. When extracting the color, we must extract COLD or a maximum 40 degrees, 45-50 with a risk, and then you cook it very gently. Then the enzyme will work during some time and cut the sugar so the alizarin could be absorbed by the moment. So that's extremely important. If you put your madder like the raw powder directly in the boiling water, you will kill the enzyme and you will save all that block like it is. But there's nothing to cut it now, so you will never have the red. So, you understand that all the cautions are the recommendations of the past were based on naturalist approach. They could not explain it with enzymes and this chemistry. They got that from the observation of the phenomenon. That's very interesting.

Next episode contains a big cochineal demo.

Learn how to make cochineal extract, pigment, and a printing paste.

Episode 6. Cochineal

Welcome to the Big Cochineal Workshop. Michel will show you the preparation of a cochineal decoction, of a so-called black cochineal extract and of a beautiful cochineal lake. Using these products, he will make a printing paste and dye solutions for traditional mordanting process and for innovative one-bath process. Michel will show you the creation of artistic watercolor paint organic carmine.

So, these are the cochineal bugs. They're kind of little bugs, you know, that Mesoamerican native people, they were very good for gardening and cultivation. They were cultivating special cactus used to grow these insects. I will try a kind of reconstitution based on some information we had about Mesoamerican practice. So, I could say that they sell cochineal extract at the market, which is the black cochineal, which was really appreciated. I was investigating a bit. And so, my conclusions are that it's not a variety of cochineal, as people say. It is not a pigment for painters, as others says. It is a real extract. First, I will prepare a solution of cochineal by just grinding my cochineal bugs. From this powder, I will have a solution. It's much better if you use some of the demineralized water. If your water is very hard, you will have a problem. Hot water here. I put cochineal inside. A bit more, maybe. About the supplier. I have a good friend in Canary Islands, in Gran Canaria. And he will send me some cochineal soon again. I have some cochineal from him, I can show you the bag. Oh, so this is a big bag. So, the cochineal is produced in Gran Canaria and they sell it in those big bags. Very expensive, of course. But then you can buy it. Such a bag for your production. Very interesting. Like Canarian natural extract. That's European label now, controlled origin label. When doing this extract, I will use hot water. Now it's super-hot, so I'm burning my fingers. Of course, I can repeat the extraction, but looking forward to showing you that black extract.

What do they call black extract? That's very interesting. So here is one water and lime again. So, I must tell you something that the coloring matter of the cochineal, when in contact with lime, is giving a kind of blackish, non-soluble substance, which is called a lake, calcium lake. So, I will prepare the lime water. Lots of people believe what's written in old texts. You know that some cochineal has a kind of black grease, that you must filter the greasy black thing. But so that's my lime water. So, I'm not 100% finished because I must let it sediment. I'll rinse it again. And now I will combine these two things to get the precipitate which is of black color. So, this precipitate is an extract. We were talking about indigo, which is an extract, safflower, which is kind of preparation and people who are not selling the petals of the flower like it is, it was already washed and prepared, ready to make. And so that of preparation we can tell more because even the pagoda tree was prepared together with the alum as a kind of special preparation, ready-made. And in pre-Colombian times also what you could buy in markets was not the raw material as people used today. It was already prepared by specialists for the dyer to get the very best results. So, we'll show you this preparation. So, I need a funnel. I need a cloth.

To filter my preparation. But first, I must rinse this stuff out. So first, I will put my solution of bugs and then some lime water. Then I will have a very thick, dark precipitate. Maybe a bit more. And this very dark precipitate, I can filter it. I must wait one minute for the result to be achieved. But for now, yes, we see the particles. That's kind of dark purple. Yes, they say black, because when you will see how it concentrates. So now I can filter it here. It takes a bit of time, because of course, from the very beginning, I must saturate the filter. I will have a paste. Remember the Indigo Carmine paste? In lots of traditions people were doing color pastes. It maybe not enough lime so. Well, yes, it's coming better, but it will take a bit of time. During the time it's filtering, let's enter in details of the process. What's the characteristic of this product? This product will be easy to filter because it is not soluble.

They did call it an extract, so it means that they can redissolve it. So that's easy to understand, because it was precipitated by a base, we can re-dissolve it by using an acid because please consider the safflower for example, it is dissolved by a base. It is precipitated by an acid. Same was the annatto that we have the extract by a base and then we re-fixed it by an acid. Because it's a basic solution, we will be able to use an acidic solution to redissolve. So, what kind of acid? In fact, from pre-Colombian times we have very, very little information. You know, Spanish did behave very hardly with native people. They did burn all their books and they did kill many, many. And over all that, they bring with them an incredible pandemic of variola. Then they killed so many that we do not have the details. But because it's a basic precipitate, I will use an acid which could be a common one using many, many fruits. I will use the citric acid again because we already know it, because we use the citric acid to fix the safflower and many other things. And here is my citric acid. And then by investigating in other cultures like North American cultures, I discovered pre-Columbian cultures, of course, I discovered that the local people were using tannin together with acidic solutions.

I got this idea of combining this kind of precipitate together with tannin and citric acid. For this class I will propose only one type of tannin, which is the one of gallnut. In Central America, they did not have gallnut, but they did have pods of different legume plants. So dividivi, which is Caesalpinia coriaria, which is a very, very good source of tannin, very equivalent, but that will be difficult for Western people to find some. I recommend a local equivalent, which is the gallnut. We will need citric acid. We also need some tannin from the gallnut. This is taking a bit of time, but it's coming. I can see that in the filter. I must be patient. During the class, I will show you the different tannins. I will come back to this paste when ready. I will present the Mesoamerican best source of tannins, which is a dividivi. The dividivi is the pod, kind of pod of special plant, Caesalpinia coriaria. So that's the fruit. The eastern best tannin is the gallnut. So Chinese also had different types of gallnuts, but this one is from Syria and from Middle East. From the Middle East, people did import that to Western countries. It became the master of all tannins we could imagine because it's very heavy and containing about 50% of pure tannin, which is incredible.

We can crush that in powder and use it together with the cochineal to re-dissolve and use it as a dye. Or we can also have an extract because for food additive people are doing an extract of this gallnut, which is the gallnut extract here. I will have only one recipe for this preparation, which will be one part of extract, one part of tannin extract, and one part of citric acid. So that's very interesting. This extract can be either printed or used for plain dyes, of course. So that's very interesting. We will do it soon. But later I will present you an extension of this process by using different plants belonging to the same chemical family. This recipe works very well with cochineal. I mean cochineal plus tannin plus citric acid. It works also with all quinone dyes like madder, like buckthorn, like rhubarb, and many others. So that's interesting because from this recipe we can have an extension to different dye stuff to be used as plain dyes or for printing. And from the other one, you know, remember the one of Pagoda Tree having alum together with the color, we can also have an extension. So that makes the landscape very interesting because all those called mordant dyes here, so logwood, cochineal, Persian berries, Pagoda tree, they can be used by a mix by using a mix of alum and coloring matter.

But all those from the quinone family like cochineal and different others can be used with a kind of direct dye so they can go back to this column. I will add one line here because I would say that the novelty could be that using quinone dyes plus tannin plus citric acid, this can be used as kind of application of non-prepared (not mordanted) fibers. So that's interesting because we want to save time, but you must recognize which is quinone and which is not. We have plenty of literature on the internet, of course, but I can give you the list. All from madder family, or insect dyes, lichens, it could be also walnut family. Plenty of different dyes. Could be also henna, alkanet and a few others. But these are the most important. So only one process which is inspired from pre-Colombian system, the other, which is inspired from Chinese system, was a mixes of pagoda tree and mordant. And we can extend that to all flavonoids and quinone together. So Western people just kept this idea of mordant, of fixing everything. Of course, it is not true. It will help for some preparation, not everything. We will see that in detail.

So now the first thing we must do is to prepare a bit of this extract together with the citric acid and tannin. It's coming. Not too bad. You can see the paste here. It is a good paste. We can redissolve this paste. Then we will prepare a plain dye of that and then we can also print some. Now the landscape is different than before because we understand that we can combine lots of things and we can generalize under certain limits. We can generalize some of the processes. I would say that, for example, for all so-called mordant dyes, we can have a mix of color and mordant, print it and fix it. For quinone dyes only, we can use citric acid and tannin instead of metallic mordant, and it works as well. We have an incredible landscape and full range of possibilities, which is the key to feel comfortable with that. The key is based on knowledge. What is quinone dye? Which one is a flavonoid? You must learn a bit. There are so plenty of books. If you are curious, you will be extremely creative. If you are not, you will be facing an incredible problem.   I would suggest you enter in the knowledge.

Of the we will show this diagram again in tutorials two, three and four and explore it in detail. Let's come back to Cochineal now.

I need a bit more time to filter this paste. The cochineal paste is precipitated on the fabric here so you can see, so I can take some of this paste. Normally we are patient enough to wait for the paste to be harder, we can even preserve it in a pot for further uses. But you can see we take some of the paste and one part of this paste will be based on preparing a mordant dye by adding alum in it, as we did, you remember, for the pagoda tree. So that's one part here. And then a second part will be kept for having a special preparation with tannin and citric acid. I would take just a bit of it. That will be enough. You remember what we say that this kind of cochineal black lake, calcium lake, will be soluble under acidic conditions. So let me try to add a bit of citric acid, and you see that it is 100% soluble.

And then I will add a little bit of tannin extract and then I'm ready. That's ready dye pot to get some direct dye so I can be in this column, you know, because it is quinone dye plus tannin and citric acid. Cochineal also can be used by two different methods. One will be adding aluminum mordant, and number two would be adding tannin and citric acid. Let's try some dye on silk. Normally we are patient enough to allow the liquid to cool down first. We don't need to mordant the silk fabric, of course, because this is kind of one-bath process. The color will stick on that, and we will get a beautiful shade, kind of scarlet that was appreciated in the past. This is taking. Okay, I will let it here for a while. And now let's consider that we like to use it for printing with the other system. This system here cochineal plus preparation called mordant. I will use the very classical alum.

I will dissolve it together with the paste and we will see how it does because of course we will probably need something else. This is not dissolving as it was before. It's kind of pinkish, the color is very, very different. Yes, of course. And then it is not enough. I would like to add a bit of tartaric acid, but tartaric acid is a very important ingredient made from oak wine barrels. Weinstein in German. And then it will allow the preparation to be stable, not to precipitate. So that's very interesting.

You say precipitate means that it goes down. I did prepare this one for printing, so I will over print. And this was appreciated because it is a kind of which is kind of magenta color. This is different. That's old-fashioned pre-Columbian style or kind of Neolithic style we can find in many, many countries. That's the scarlet color.

And when they discovered tin chloride during the 17th century, so that is Cornelius Drebbel in Holland, who discovered that. They decided to generalize that of heavy metal. You can have the scarlet by just having this preparation together with tin chloride. So that's a pity because so many heavy metals came in the processes, but we can avoid them. Second one will be interesting for printing. We say so by adding gum in it. So, I have 150, I will add a little bit more coloring matter and then if you are interested, I can overlap my blue and yellow piece. I try to pick more of this to saturate a bit more the color because I will have to dilute it by putting the gum, of course. Okay. I'm fine here and then almost ready to print. I just need to add the gum. You remember about the gum. I said you have two possibilities. You can dilute your color with gum water, the gum already prepared, or you can put the powder in and use a mixer. To show both possibilities, actually will show that of the mixer. It's 150. You remember you had 400 grams for one liter, so it means 40 grams for 100 milliliters and then 60, 60 for 150.

That's very easy. We use my mixer again, little mixer. I will have 60 grams of gum; I will put it and I will be ready to print. 60 grams of gum. It seems that 60 is enormous, but we need this. To tell you that I'm very pessimistic regarding the research of coloring matter in only one leaf as people are dying by printing a leaf because in leaf we will talk about milligrams, so we will have difficult to saturate and overall to get enough stability. I know that this is interesting research, but I prefer to present you the coloring matter separately and then you make them and prepare and print afterwards. Proceed as I did before add a pinch of guar gum, you know, so I can thicken and get the beautiful consistence for printing easily on my silk. I feel more comfortable to print this.

Michel shows how to use cochineal printing paste for screen printing. We will show this in detail in tutorial 4. In the next demo, Michel draws numbers one, two and three with aluminum acetate mordants on cotton. He will show you the preparation of the mordants in tutorial 2. The next steps are drying and fixation of the mordants and then dying with cochineal.

I suggest we take a piece of fabric, cotton fabric, and then because they are called number one, two and three, I will design number one, two and three on the fabric. Of course, normally we should thicken it, but that's just an experiment to compare the efficiency of these three approaches. So that's my number one. Okay. I will just do the right one here. Okay. So that's my number two. I will just put number two. Here like this. And that's my number three. And that's it. If I like to have a plain dye, I can just impregnate my fabric with this very concentrated mordant, any of them, dry it and dye. So that's a super quick. So first now I would like to dry it on my radiator and doing the while I will prepare some cochineal solution for the experiment. Okay, so the dye pot is very simple. To prepare for this experiment, I will just have water and cochineal powder. This is the insect that was crushed and put in powder and that's it. So, of course, there are plenty of little cautions, like, for example, be careful of not having a very hard water with calcium. It's not a question of PH, it's a question of calcium in water. So here in Brittany, we do not have that calcium. It's okay. I will prepare that solution. Half of the solution will be dedicated to the dye. The dye of sample we prepared, and the second half will be saved to make a pigment called the lake.

This pigment will be made by mixing this aluminum hydrate together with some clear solution. I will cook this; I will filter it carefully. And one part would be used for the dye and one part will be used for the lake. But the lake, you can reverse the system by re-dissolving the lake with acetic acid. We already did it by redissolving the hydrate by acetic acid. It doesn't matter if it's linked together with color or not. We will have a kind of extract we can apply on any kind of textile, natural textile. I must prepare everything to filter and to separate in two batches. So here is my fabric with the numbers on it. Of course, you cannot see them because, remember, the mordants are transparent, even under the form of hydrate on the fiber they are white like the fabric. You cannot see them. But I would say that the color magnet, the aluminum hydrate, is already in the fiber, the two, the three kinds, the three manners of doing that. Now that's my cochineal pot. I will filter a bit of that. And then my first experiment will be of dying this piece and the rest will be saved for next experiment. Then I need some more water to rinse the piece, to finish the piece, and then we will see.

I can wash it in ordinary water and separate what is spoliation from what is dyed. Let's see what we did. Of course, I'm doing that very, very quickly. Normally it takes a bit more time, but you will see at least how it works. This is my number one. And number two, like this, number one, two and three. There's not a big difference in between the three mordants. You might be surprised that the background is gray. That's from the presence of calcium. So today at the tap water, there was a bit of calcium. We could avoid that by putting a pinch of cream of tartar in the dyepot or by using wheat bran together in the dyepot. If you want, I will improve the system by adding a pinch of wheat bran and putting it back in the pot. This is the wheat bran. It's a bit too late. I did not imagine there still so much hardness in the water, but it is probably because of the rain. You know, at the central station of water, they correct the water by putting some lime. I will finish that dye and then we will clean it again. So that's my first experiment. What about the system you use to make this mordant? It is equivalent. When dried, you will see that even better.

If you use readymade sodium acetate or if you do yours with vinegar and soda. And so so it doesn't make a big difference. You understand now that this is this is a general rule, of course. So now I will be patient to finish this, dye and rinse it, and then will come back to the lake system. We can make the lake by recycling this type of course, or by saving pure solution of cochineal. It's the same. So lots of people did recycle the dye pots to make the lakes. Of course, we know that because in some artists, master painters, Flemish painters, for example, from 17th century, if you analyze the picture, in the colors on the painting, you see there are very, very small pieces of wool inside. So that's the reason why the archaeologists and analysts, they think that they were recycling their dye pots after dyeing the wool. This is my piece of cotton. I must rinse that better, of course. But we'll get an idea. You can see that it is a bit better. After rinsing this piece is not perfect. I will have to consider many, many details if I want to improve my quality. Imagine a calico printer from the antic time, he used the same principle. I am quite happy of my numbers, but not 100% happy of the background because it is still a little bit greyish. There's some calcium, so the very, very easy way of cleaning could be to boil it again in wheat bran solution.

So that's what we will do now. The wheat bran was very, cheap, and useful for many uses. For example, here, obviously my line is bleeding, so that's not very good. I need the thickener. Obviously, I did not even fix my mordants. I was just drying that quickly at the radiator, but I did not fix. I could optimize my fixing better. Obviously, my background is not okay, so I should take care of the quality of my water and maybe having additive to protect the fiber against the calcium bicarbonate which is in the water. And the last point would be I could put an anti UV, something to improve the fastest to the light because there is no not everything in one dye stuff. I could have a mix of different matters to improve the quality. And this could be the tannin decomposition system. These are my three things and background. And now I would like to run a little bit to the lake now. So here is the second part of my liquid, this is the aluminum hydrate. And this is the second part of my cochineal preparation. I will stir it. And then you might be surprised that the cochineal will fix on the aluminum and then when filtering that I will have the non-soluble aluminum hydrate or aluminum hydroxide which will be stained.

So that's very interesting because now you see that all the color is running to the mordant and then I just must find some funnel. I will filter it. My hydrate and my cochineal solution were mixed here. So of course, the color is fixing on the aluminum hydrate. And then I can filter that through a cloth, and we will see what we are doing. So that's interesting to see that just the pure water is passing through more except maybe a trace. The pure water is passing through. And then you can see that everything you recycle of that is a very clean thing. And then here you will have a kind of pasty red which will coat the fabric. This paste is called a LAKE, so we need a few minutes to finish the filtration. But you can see that there is a good separation. All the color is quitting the water to graft on the mordant. That's exactly what we do when we dye. We put the mordant, we transform it onto aluminum hydrate, non-soluble, and then we put it in the dye pot. All the color jumps on that, that's the same here. If you don't use the fabric at all, you see that the color is separating the liquid and goes inside of the hydrate to make that kind of paste, colorful paste.

If we are patient enough to wait for it to be dried, it could be a pigment. We can grind it and make a powder for painters. If we keep the paste, we can of course redissolve it with the acetic acid and make a new acetate. But it's combination of acetate plus color. This can be printed as a direct color that you can print and so on. There are quite many possibilities if you understand what you are doing. Okay, so now we need a few minutes for the thing to go through, for the water to go through, and then we'll take this paste again and this paste will be redissolved with a drop of acetic acid. And then we will paint directly on the textile, and then we'll paint the color, and we'll have kind of direct dye, which is not direct because it has a super complex reaction in between all the partners. But it looks like it is simple. We need to wait for some time. Okay, so this lake is filtering slowly so I can even press the fabric. If the fabric is thick enough, I can press it to speed the filtration. It's a bit dangerous. It depends on the fabric you have in place, of course but you see, I can eliminate a batch of water and then I will have a paste, this paste being useful for many purposes. It could be dried to make the lake for painters, or it could be also re-dissolved for direct painting on fabric. So that's my lake here. I will take part of it to dissolve it in the acetic acid. Then I would be able to paint. I take a little bit of that. I will transfer one piece because the rest will be saved for maybe for finishing the pigment. This paste, I can put it in a pot and store it for long. If I'm working clean, I mean rinsing the paste correctly, I can keep it for very long. So that's the paste now. And then I will add a bit of acetic acid and transform it to acetate again, same acetate on this one. But at that step, the color is stuck to the acetate, so that makes a difference. I have a kind of extract. I could thicken it, of course, because if I do not like it to bleed on the fabric, I will thicken it. But as it is just for the demo, I will show you on this piece of fabric paint over my fabric. It is not 100% ready, but I said some time. Look, that's my pattern. I must dry it.

And then that's more sophisticated, of course. I will eliminate the acetic acid by steaming the piece because this will not evaporate as simply as it was for the rehydrate with simple water. This I have to dry and then I have to evaporate to get the optimum of quality, and then I will just fix that in the wheat bran. Everything we need now: the pigment, empty tube to put the paint in, some palette, and a heavy stone, to grind everything. We need a binder. The binder being the Gum Arabic looking like crystals. But that's kind of gum, that sap from a tree and a preservative, because we will have it in the form of a paste in the tubes. The paste could rot unless you put a drop of essential oil of clove, which is a very best anti-rotting system. So first, I must grind this. So that's very, very easy to grind. Look at the fine powder.

Sometimes there's a little bit of bark, some particles of bark. I must be careful of separating them.

But now it is about homogenous, and I can add some water.

And make the things I need. And now, I will continue to grind it with the stone. First, I would like to hydrate it. Of course, we continue until the paste is very homogenous and a bit brilliant, by physical effort. If the particles are very fine, the color is more enlightened. So that's the first step and then I shouldn't forget the preservative agent. So that's the essential oil of clove. That's it. So now I can put my paste in the tube. I just must close the tube. Click here. Take out the air, of course. I do not need that big piece. And this is my tube. From that, I will show you how is the paint on the paper. This is paper here. I will test it like it is to see. Okay, so that's my cochineal lake watercolor.

In this demo, Michel showed us a lot of possibilities. He started with high quality cochineal buds and simple extraction procedure, and then came to more complex things like famous pre-Columbian black extract, cochineal lake, and beautiful carmine printing paste. We will go back to these subjects many times during the course "From plant to dye", we will explore mordanting of different fibers, one-bath technique, and printing further in detail. If you have some questions, ask Michel in the private Facebook group from Plant to Dye.

Episode 7. Turmeric

The traditional palette for Western people was a woad for blue, weld for yellow and red for madder. But when they discovered silk, they have seen that the compost vat from the woad was damaging silk. They were forced to get an exotic blue indigo pigment. Then they discovered that while the madder was not really giving red on silk, it was giving kind of orange, which was not very brilliant, kind of dark shade. So, they were importing special red, like exotic safflower or exotic cochineal. And the yellow, they kept the weld as much as they could. But they also introduced very easy other yellows. We will see some of them. Among them, the most popular is the turmeric. Turmeric is very famous, actually, for cooking.

I have a little turmeric growing in the garden. It is a small piece, but I guess it has some babies. You see the turmeric here? I will wash them and see how they are. So maybe we have more. I will probably replant this one, but I must see first what is inside. No. Only one this year. It is not.

Brittany is not tropical. It is just mild. It never freezes here, but it is not hot enough. Turmeric is looking like this. And then we can dry the roots and crush them to make this yellow powder. There are different varieties. This one is not super dark. But it is interesting to use as it is. As you see, my production is very small this year. But anyway, we can have a small experiment with turmeric. Remembering that it was abandoned, by the way, but at the time of the development of silk in Europe, people said, "We do not mind if it's fragile. We want extremely brilliant colors to make shiny, more brilliant colors and no matter if it's not so fast to light". So that was one element. Of course, we will see that by the time people did introduce other interesting colors, but this was at the very beginning, considered as a regular dye for the silk during the 18th century. We'll keep this one for experimenting and I will replant the one here to save it. Turmeric is not difficult to grow. It's even easier to buy as a spice. That's the same thing. That's a very, very easy dye. For this purpose, it was imported, and people did like to use it, but very soon they discovered that the yellow was not very lasting. They said we must keep it for special colors like the red, because pink plus yellow was giving red and they gradually abandoned it. But I will show it to you because lots of people look for direct dyes. This is a direct dye, but in tradition, all direct dyes were abandoned. You see that the Indigo required a special preparation called the VAT. We will see later that the ANNATO will require preparation. We will see also that the safflower will require some preparations, and turmeric does not require any preparation. Speaker1: You put your clean fabric directly in the pot and you get your color. Oh, that's interesting of course, but it is not very lasting. So especially for fastness to light, you will have some disagreements. During the 17th century they said, okay, for silk we need exotic supplies, so why not to use what they sell? You know, the East India Company was traveling all over the world, and they did bring the exotic drugs that people were using in place. Turmeric was traditionally in India, so they decided to use it. And look at that. That's an incredible, beautiful shade. But the problem is that the very soon they did abandon it for better fastness. So that was the great dilemma for silk. It was a required brilliant, beautiful colors, but some of them, they were not traditional in Europe. In Europe, you know, madder, weld and woad were the three pillars. So they discovered new things, but they had a hard time to select. We will have a word about some of them because they do not need any preparation on the fiber. It means we will prepare the drug as we did for the indigo making vat, prepared sometimes with sophisticated manners. But we don't need to prepare the fiber at least it is just clean fiber, and it takes the color. You will see soon that people eventually did prefer to do an effort and have a long process better than the super short quick thing, which is brilliant and gorgeous but not very lasting. I will rinse this one and keep it for sampler. Speaker2: So, the truth is that nothing will help in to stabilize turmeric. Neither aluminum nor any sophisticated additions will not help the turmeric to be more stable. Speaker1: No, no, no. It is the truth. I continue. I would explain it. Sometimes we hear about the special system to stabilize like, you know, what people call mordant. So metallic salts added would protect most of the dyes. But many people did try that with turmeric, and they never succeeded. In fact, this is a real direct dye belonging to a special family, which is carotenoids, but this one being soluble in water. It is very hard, in fact, to stabilize it. I never heard of somebody who succeeded. Sometimes it is mixed with another dye, so it makes the dye super beautiful. And after some days this yellow disappears. But the second yellow that was associated is still there. You have something and your piece is super beautiful just now you buy it. So that's even traditional in India. I met some people working with pomegranate and turmeric and I say, oh, don't are you afraid of the poor fastness of turmeric? They say, anyways, they will have the pomegranate afterwards. So that's quite beautiful. It was important to talk about it because people are wondering why is it so difficult? It is difficult because during the history people must select the beautiful and stable things, not only beautiful. So that was the big challenge to make it as beautiful as possible, but quite stable. We give you the example of something we rarely use when dying properly, quite fragile, but very good food additive and very good medicine, which is curcumin. Curcumin has a phenolic ring here. The molecule is big. This is a double bond with the oxygen. And this is the same ring here. You know, that's a big, big thing. It is soluble in water because of these possibilities here. And this is oxidized. And then, of course, you have these valences here. So that's quite interesting to see that most of the molecules are complex, colors are complex. I will design the most important for us just to see together with you how we can use it as a dye. There are several valences that make this to be a dye. This is curcumin from the turmeric. It could be fixed on the fabric, but we rarely use it as a dye. Of course, the beginners are very happy because they put their turmeric in water, they put their fabric and they have beautiful color, but it's not very lasting.

We go to the next demo, safflower as an example of selective extraction.

Episode 8. Safflower. Selective extraction

Safflower is a complex dye plant. It contains red and yellow dyes. How can we separate them? Michel will show you a beautiful safflower red on silk as an example of selective extraction. Safflower Carthamus tinctorius is one of the oldest domesticated plants. It arose in present day Syria more than 5000 years ago and then quickly spread to an area that stretches from ancient Egypt to Japan. Like so many other ideas and goods, Safflower traveled the Silk Road to China. For dyeing only, the safflower petals are used. The problem is that safflower contains several different dyes. The precious red dye in Safflower is carthamin, it is C-glycosyl quinonochalcone. The special thing about Cartman is that it is not soluble in water at neutral pH, but only at high pH. Petals contain also several yellow quinonochalcones with poor light fastness which are water soluble. Michele will show you how to separate these dyes and how to obtain an awesome Carthamus red.

This is safflower, petals of some plant from the Asteraceae family. That's an interesting cultivation because people use both the petal and the seed. There's a special trick. Now the flower is mature, people are spraying water on the cultivation on the plant, so the petals are stuck to the flower, and then the seeds are growing so they can harvest both petals and seeds. That's very, very common. It is from selection. So here we have about 45 grams of safflower. And this is a very interesting example. People were keen on that for certain dresses because it's giving a unique pink. Very brilliant. I will show you the preparation, which is extremely long and sophisticated. People were putting safflower in bags, and they were fulling by feet in some pools during hours to eliminate the yellow because the yellow you will see here, the yellow is very, very important in this plant. And by fulling the plant, you will eliminate an incredible quantity of yellow. You see here some yellow. We have to work on it during hours. What we used to do is to impregnate like it is and change the water. Changing the water many times to remove the yellow.

You will remove the yellow. So that's interesting. For example, let's see how it is by filtering this and preparing some more water to wash it. The yellow is not attractive. It is ordinary yellow, but the fastness is not very good. Very few people save the yellow because you see, it seems that it is a pity because you have so much yellow that you think you shouldn't lose it. But anyways, it is a very fragile yellow. I will eliminate this yellow, and I will start again with new water. And then I will repeat this, maybe more than ten times. Until the moment your petals are turning more reddish. All the yellow disappears. You have the more reddish petals, and from that, you will have your extraction. It takes a bit of time. We will let it soak and repeat five, six times until the moment when pressing it will not be yellow anymore. It takes a bit of time. Let's soak it first and repeat. Safflower has been washed about eight times, so we still have kind of a yellow juice, but much paler. And normally we are supposed to eliminate as much as we can of this yellow. But I think we have enough, especially for silk, because the yellow will stick on the silk and it will damage the beauty of the color. It will affect the beauty of the color.

I want to eliminate this yellow. Yellow is very common. We have so plenty of yellow. So now I have my clean safflower here and I will need to make an extract of that. Safflower still has some coloring matter. But it's not the yellow. It is the pink reddish pink. To make the extraction, we need some alkaline solution. This is soda ash, sodium carbonate. And because this was around 45 grams, I need 45 grams of soda ash, but I will have three extractions. This is the secret of safflower, because lots of people try and they get very pale results so not attractive. But the very big secret is that we will have three extractions by doing this. The first one will give a kind of yellowish juice, but it's not the same yellowish. This yellowish will give the pink. You see, this is different. It is a kind of turning orange. I will soak it for a while. I will press it exactly. And I will repeat those three times. And then now, you must dye, you will start to dye with the weakest solution. Then from this weakest solution, the silk will take as much as possible. Then you will overdye on the medium and you will finish by the very saturated.

You finish by the first one. This is interesting because this is the Chinese method. And remember in the Chinese palette, the safflower is considered as one of their best colors. It is not a madder or not even the lac or others. So that's very funny because what was supposed to be a poor color is considered as very honorable in Japan and China because the process is not the same. Western style is to get kind of extensive things super quick, as quick as possible. It doesn't work very well. Like, you know, the industrial indigo for the blue jeans, they just have that fastness of 4 to 5 on the scale of eight. But if you do that by hand at home, you have more than six. It means that they are not the best at any purpose. They are the best to do, tons and tons per hour. But they are not the best for the quality. Like industrial furniture are not necessarily better than handcraft furniture, but they do tons per day. You can see here that we will have an interesting juice looking like kind of bit orange again. I will strain it. And I will repeat.

What shall we dye in this safflower extract? We can dye, of course, white silk, pre-washed, white silk. And they said in the past it must be accurately washed when using the safflower. You see that kind of orange. It will not stay like this. It will turn to beautiful pink. But at the time, you see that we have an incredible extract. Despite it was supposed to be already washed. So now my second extraction. I need to pick some water. You will see that gradually the petals are turning paler and paler until the moment they just get the color of the straw.

It's interesting that it turns pink afterwards.

My first strong extract will be used at the very end. So now I will have second one. And the third would be my departure point, my starting point. In the past, people were using a press. They were using that at bigger scale. They had the press. By using the press, it is possible to optimize dramatically the extraction. Interestingly, in China they were dying the silk. And then with all leftovers from the dye process, they were putting all the leftover liquids in a special jar. In this jar, they were soaking paper to make business card. Business card got a very beautiful fluorescent pink. And then with the calligraphy, they were doing their name on it.

Genetically speaking, the safflower comes from Egypt. Egypt, Mycenaean Greece, some islands like Crete. So that was probably a kind of endemic that was spread and developed by the time not to Europe at the very antique time, it came to India, Pakistan, India, and then came to China and then from there to Korea and Japan. And that's very funny that Europe and people discovered that stuff very lately. Now, the silk came.

Is it true that in old books they draw this right letters with safflower, sunflower dye?

The calligraphy?

Yeah. In this, you know, in monasteries, there's textbooks. Yeah, the initials. Yes, I read this. I mean, they didn't have any artificial colors. They had to use something natural. Already the old time. Yeah. Since antiquity, they were using artificial, but they were mostly minerals.

Not so much water is the secret. Second secret. So now I would soak this, and then I would present you a salt, which will be useful. You have seen that base to make the extract and then to fix the color. And then on the fabric I will use citric acid. So that's the citric acid.

Okay, so citric acid for that amount, I would use around 60 grams. But the 60 grams can be divided in three, of course. So, it's 20.

These samples I save for green. Remember, we'll start with this one. So normally we must be patient enough to soak, if possible, to get the maximum. But for this demo, I will be a bit quicker than usually.

I'm ready to have my first batch dyed here, this will be very quick. You will see that. But also, if I put my citric acid inside of the juice and then it is turning pink. And then, by the way, I just soak it, you, see? Some will turn pink. Of course, the whites will turn pink, and the others will turn a bit purplish. But of course, we will repeat that with number two and number three. But remember, we start with the very pale.

And that is a very stable color?

Very stable. That's the main question of people here. They want something forever. But well, in fact, in China and Japan, it was super highly considered. And when visiting the Silk Museum in Hangzhou, you will see masterpieces from the 18th century. You can keep it if you take care of your things. Well, that's okay. That's the thing. But, you know, if you just soak your things in strong soap and no, no care of anything, so I'm afraid you will not have it correctly. You see something like a kind of pale juice here. It means that it is almost exhausted. In case your indigo is a little bit bleeding, it will bleed in the first one, which see not very much, but just very, very little amount. And now we will accelerate spilling a little bit to see that now changing for the next one. I do not need that anymore. Normally in this one, you can have your paper, your business cards. You can keep it for paler color. It does a precious drug, so we don't dump it. You will see the second one giving much better, of course, with the same don't forget the do not forget the citric acid.

Because if you forget it, you must redesign all. What is extremely interesting is that during the industrial period in around 1816, the printers were using safflower. Well, they were combining the safflower with fatty substances that you must prepare. I can present that right now. But they were also overdying a quantity of different things. And they said, for example, when overdyeing the black, they had a beautiful kind of shiny effect, especially on silk, that kind of moiré. So that was extremely precious in the past. You see that now the clock is ticking a bit more even on these. You can understand how powerful it's coming. What is interesting is that in the past for silk, once silk arrived, people did adopt Eastern processes. I was working in Hangzhou at the Silk Museum. And I learned there that in the former Chinese dynasties, people were refusing the modern system. They say that's the Western novelties, we don't want that. We prefer to keep it as it was traditionally done. So especially, of course, at the court of the emperor. But even in families, people were keeping their traditions and Western people were fascinated by metals. So metal was kind of synonym of alchemy, so the metals became necessary for any purpose. They did develop plenty of things about metals. We will have a chapter about metals, of course, especially aluminum, and ferrous, but you can see that the traditional colors did not require so many metals. It was just organic with very, very ordinary lime and soda and potassium from ashes and things very common that people can get in their surroundings. That's the second one. And of course, the very best one will be the first one, the first extracted. But from here you see the beauty of those shades, which is very special. And then the last one, and then we can finish with some acidic rinsing to eliminate the poor quantity of yellowish. And sometimes people did even finish with some acidic metallic solution, like potassium aluminum solution, for example. And then they were saying that this would protect a little bit of the color. So that's interesting. It's anti-U.V. effect. It is not for mordanting or something that people say.

It's not binding with the color. It is giving kind of anti-UV coat. People were using sometimes also some tanning. But time is lacking. We cannot have the full range of shades. I need a full week on Safflower to explain all those things. So do not forget the citric acid.

Please pay attention that we are finishing by the first one, you will have a very beautiful silk.

You have seen the range of traditional blue. Now you will see the purple, pink and purple, and then we will go on for other colors. Because I told you, classical indigo is not very easy to print, especially on silk. We will go on with the indigo derivatives. It's not finished. I'm sorry. I need some time here. Well, maybe put it inside. But we have. We still have plenty of color here.

But you can see that this is attractive and very, very surprisingly. Yes, we do not have enough time for the demo, but I can have a word about that. Very surprisingly, if you are patient enough by repeating with other batches of color, it will be more and more and more intensively pink until the moment it will turn to red. So more than pink is red and surprising. This is kind of orange red, which is one the most appreciated in Japan. You know, the very beautiful thing. It's it's consuming a lot of the of dyes, but then it is supposed to be fast to light. The problem is that by diluting extremely we have poor fastness. Same for many dyes that people like. Problem of pale. Even with industrial dye stuff, the pale is not as stable than the dark because saturated colors are resistant. Okay. So, let's forget that for a couple of hours and we will see.

Longer dying procedure allows us to transform this salmon pink into gorgeous, saturated red. And of course, you can prepare safflower lake using alum. Michel will talk about Annatto and other dyes with poor solubility in water in the next episode.

Episode 9. Annato

That was very interesting dye which is not soluble in water that I could compare with safflower, which is annatto. Annatto for orange, very brilliant orange. Orange with the poor quality of red is giving very brilliant scarlet. If you're interested on that, I can have a word about Annatto and tannin. At the Renaissance, there was a big discovery field, a big field of discovery by traveling. People were discovering eastern countries developing silk from that, but they were also discovering Western countries. And from the West came incredible dye stuff. Among them was the Annatto. Annatto is a little tree (Bixa orellana), giving that kind of fruits, and when opening them you have some seeds in it. These are a bit old, but you can see how it is. The seeds were used by native Caribbean people and in Venezuela, Guyana and neighbor countries people were crushing that together with oil. From other plants and they get a kind of special oil to protect the skin against mosquitoes, because you can imagine in Amazonia there are insects there, and against UV. That was very interesting for European people. They started to import that kind of fatty preparation, but they were not very successful until some Western people learned to make another type of extraction with soda ash. They did prepare some types of extract. But what we must know is that inside of the seeds, you have two different coloring matters coming from the same group of carotenoids, bixin and norbixin.

They are not soluble in water. That's why people use annatto with fatty substances. But you can also use alkaline pH. Bixin is only soluble in fatty substances and the norbixin is soluble in alkaline solution. So European were using one or the other, but they never had the two different types because they were not experienced with modern chemistry. We can have a very good extraction of the annatto seeds. So that's a very fresh quality, very beautiful fresh quality here. We will treat this annatto to get the maximum by using something which is alkaline and containing fatty substances at the same time, which is the soap. So that's interesting because you will see that the annatto is not soluble, even in hot water. You can see that. Just very, very poor solubility, of course. But if I put a little bit of soap, the bixin will be dissolved in the fatty part, and the norbixin will be dissolved in soda, which is the other part of the soap. So that's interesting. You will see that very, very quickly. We will get a dark range, I mean, saturated shade. And we can continue the operation until the seeds turn black because the color is just coating the seed. It's not inside. The seeds are black and coated with kind of orange powder. You will see how quick it is and how simple.

So, there is no use of crushing the seeds. No, no, no. All that is folklore. But we don't need. We arrange the surface of the seed. Of course, I am adapting. I'm not trying to copy what I did before because some people did not understand what they were doing. I need a strainer. I will prepare everything. I will show you how to dye with this. That's interesting, because despite it is American, it looks like Eastern style. Well, I mean, we don't rinse, but we have an alkaline extraction and then we precipitate the color by putting it in an acidic solution looking like the safflower. That's interesting because we could extend this process to other dyestuff. But people are not really investigating nowadays. They want a readymade recipe, but we probably have plenty of things to investigate.

I need the strainer. We will dye this already washed piece, so that's very easy. How to proceed? Normally we wait for the whole seed to be discolored. It takes some time. By anticipation I will show you. We can strain one part of that. Of course, if you like to calculate accurately the weight. Well, that's just a process. And then my silk is taking naturally. And then I should not forget, of course, to neutralize this, because despite I would dry it, it is still not soluble in water. Of course, because it is alkaline. I will neutralize the alkalinity with acid, as we did before. That's interesting to see how easy it is. I will save one pale shade and then I will have a darker shade. Let's go.

We must be patient. I will prepare the fixing agent here for the circumstance. I will use the same citric acid. And then the citric acid will decompose the soap. It will generate a kind of fatty substance inside of the fiber together with the annatto, which is a good protection against light. So that's very interesting because, you know, we come back to the Amazonian style, Amazonian knowledge that we don't really know in detail, but we are creating the Western style with the soda ash just to get that of soap so we can include some fatty substances. If I had enough time, I could do that also with the safflower. Well, you will be really astonished. This has been proved that those fatty substances can act as a very good anti-UV. I need just one minute more, and then I will fix it inside.

Anti-UV. What does that mean?

It means protection against the injury of the light. Ultraviolet. We say that because we don't say light fastness. But I say, okay. So ready to fix the color here in the citric acid solution. When you see that, it turns beautiful. That's how we fix it. I will also fix the second one. And you see it's not really bleeding. It is not bleeding and it's giving an attractive shade. people did love that in the past. So, you know, those colors from traditional, they are brilliant. They're very much 18th century style. You can find very, very beautiful shades in the palette. Okay. Second one. We will have the two shades. This one is a bit more orange. Of course, you understand that if I was patient, I would have very, very saturated colors. What is interesting that is that this annatto was also used to saturate the blue. People were doing that. Then they were rinsing correctly, and they were overdyeing in blue. And surprisingly, it was giving kind of greenish blue, very dark, because they said it's improving the uptake of the traditional indigo.

Michel showed you an innovative way to solve a and today using Marseille soap. And now he will show you how to solubilize the dyes with alcohol.

Dyes can be of two kinds. Some of them are directly soluble, soluble in water, some others are non-soluble. We already have seen non-soluble colors. Remember the Annatto, the safflower, even the indigo. They were not soluble in pure water. We have different tricks. Annatto was extracted with fatty alkaline substance, which is the soap, safflower was extracted was sodium carbonate, indigo was dissolved with lime and sugar. Others cannot be used by those means. We will have to dissolve them in alcohol. Among all traditional dyes, the very interesting that we can cover today, is alkanet. We have seen that alkanet can be also used when combining with citric acid and tannin. We have seen, but we can also dissolve in alcohol. So those non-soluble dyes need alcohol, a solution of alcohol. Alkanet and so-called red woods. But that's interesting to say that among these red woods, we have sandal. Which is a kind of general term for many different woods, including what we call

African sandalwood, which is a Pterocarpus santalinus. This is interesting because it is very well used by woodworkers to make furniture so you can save the chips. We have some chips here I want to show you so we can even make powder from these chips and have a very good dye to dissolve in alcohol. Let's start with the non-soluble thing. I put some of this powder, sandalwood powder which is Pterocarpus in alcohol. This is alcohol, ordinary ethanol. And as it is not soluble in water, but in ethanol, it gives some color.

So this is how to process. We can consider that this is an extract. I will take some hot water. This is the Pterocarpus. I put some extract in water, it smells good because it's kind of sandalwood. But then I immediately get a very attractive shade so people like it and then if I like it more saturated, I just put a bit more. So that's very easy. Alkanet was extremely popular in Lyon for dyeing silk until the moment they came back to the lichens, and they found a good method for making lichen extract long time ago around 1860. Then they abandoned the alkanet. Alkanet is also very interesting, I would say you. So now you can see that you get very interesting purples. And this shade was extremely popular for silk. People did like very much this alkanet. And they were combining alkanet with different colors to get all kinds of shades. You see, that's interesting because the water is super clear. That was the way, of course, if we evocate this world of polar dyes, we will also have an interesting range of shades. That's funny that we can even mix all those things. If you are patient, dye requires about one hour. We will come back to this demo in another tutorial, the Big Silk Workshop.

Episode 10. Indigo

Indigo is not a name of only one plant. Indigo is a coloring matter that we can make from a diversity of plants, for example, what we call Japanese indigo, which is Persicaria tinctoria.

Or Isatis tinctoria, the woad, European indigo. Or Strobilanthes tinctoria, which is the Chinese indigo. And there are many others, of course, including the tropical indigo, which popular name is just indigo, Indigofera tinctoria. Indigo is not ready made in the plant. You can see they are not blue. But by observing sometimes, when drying the leaves are turning blue like is here, the Strobilanthes leaves or Persicaria leaves here. You see, they can give the idea of something happening. When drying these are kind of oxidizing, the sap is oxidizing and appears a new color which was not really made in the plant. From that indigo is taken as a general term for the extract from this diversity of plants, indigo was considered as a very, very good blue for all natural fibers and especially for silk.

I will show you. This oxidization can come from the plant to the to the fabric. But first, I would like to point out that the woad is a special indigo plant, which is not turning blue when just drying. There's a kind of enzymatic process, we must crush very carefully the leaves and prepare them to make the blue. Taking some stable piece of wood, I can make a demo by using the fresh leaves. So that's bourette silk. Let's experiment with some of these leaves here, and you will see that the sap by itself is just ordinary green sap by the chlorophyll, which is in. But after some oxidization, we can convert it onto a blue shade, which is highly stable and washable. Let's experiment first with a few of these leaves. Maybe one more. We are very late in the season, so I'm not sure of having the most brilliant result, but at least we will have a trace. So first, let's transfer the sap to the fabric.

There's not so much sap left in the leaves in this season. We have a trace. And then of course, this trace is consisting mostly of chlorophyll, of course, which is the green component of the leaves. But chlorophyll is not stable. Chlorophyll cannot be a dye by itself. There's something behind the chlorophyll that we must reveal. So that's the program of the dyer. You see, nature is not making dyes, nature is making coloring matters. And then by art the dyer can convert the coloring matter onto dye. So, we have seen on some dried leaves of other plants that by oxidization it's turning blue.

But the woad is a bit more difficult to process. I will use some oxidizing solution which is made of water, a bit of hydrogen peroxide and a bit of lime. And here is the lime. By reacting, these two together will generate a very, very oxidizing solution. It will eliminate the chlorophyll because chlorophyll is super fragile. Chlorophyll, I would say it is just a spot or stain. It's not stable enough to make a dye, but the dye, you will see by the time this will oxidize gradually and this will be extremely stable. The blue behind will be gradually generated. You see that the very little leaf. is almost ready. It will take a bit of time to get the rest. But please consider we are in November. In November the plant is very weak.

But let's finish this and we will see. So, the very corrosive lime will eliminate the chlorophyll and reveal the precursor of indigo, which is in the plant. This precursor, we call it indoxyl, and you will see that the dyers never use this method of hammering, of course, because it will damage the fabric. We must extract the sap and process the sap to make a special preparation. Let's see that in a couple of minutes. But from here, you can get the idea that little leaves have much more than the big ones. So, I must let it soak for a while and then I will rinse, and you will have a real, real good dye. That will be washable. So, the Indigo has been considered as the very best blue dye all over the world in pre-Columbian America and, of course, in Asia, in Europe, in many, many places. We will be focused on this indigo and we will have to prepare a special combination of matters called the vat. The VAT is not only naming the container we will use, but also the content. We will have the indigo extract and different things. But first, I will present you some traditional approach quickly and then we'll prepare our own vat to dip the silk in and get a full range of blue shades.

See the result of this model experiment. What happens? The colorless glucose indican transforms to colorless indoxyl and by oxidation indoxyl transforms to blue indigo product, poorly soluble in water.

We have seen that the woad can give a blue stain on the fabric by just transferring the sap and oxidizing the sap. But people did prefer to concentrate the matter to get a kind of extract which was looking like a compost. These bowls are made of woad, so the woad leaves are crushed, which is extremely important for the enzymatic process and then they are dried. People were trading these, and the dyers were using this woad. But the woad as it is, did require very strong alkaline solution, I mean lye from ashes plus lime to get caustic potassium hydroxide to reveal the color. The dyers were using it for wool. And then when the silk arrived in Europe, they start to grow silk in the south of France, for example, during the very, beginning of 17th century, the dyers were complaining because the compost vat was damaging the silk. They were focused on some new, imported matters which were looking for like stones. And this is indigo, indigo extract, which was made in America or in Asia. Silk dyers could not use this compost. They prefer to use this one. In 1601, the King Henri the Fourth decided to that this important matter was forbidden. They were keen on local production. They said, you know, cultivation and growing animals, they are the two main goals of the country, we must produce everything. It was a kind of protectionism. But then the dyers in Lyon, they said," No, we can't, because if we use this, we will damage this precious silk. So please pay attention to what we ask. We need this exotic thing because the silk by itself is an exotic fiber. The king was agreeing partially with that. Silk was an exception. They did never use the fermenting vat with the compost as they were doing for wool or as they were doing even for cellulose fiber. This is the one, the Japanese compost from Persicaria leaves, which is also available for cellulose. But the silk dyers, they were preferring those strange stones that is called just called indigo. So indigo is not naming a plant could be made from all these plants like here, for example, it's a local French indigo made from Persicaria. I have others made from woad. It could be any of these plants, of course. From these special stones, we must prepare a combination of matters to make it soluble again. Because it was soluble in the plant under the form of kind of precursors, and now it must be dissolved again. But under this pure form, it is not soluble in ordinary water. We will have to prepare everything to make the vat for silk.

Vat for silk now. I will prepare everything and show you. Let's prepare the indigo vat for silk. We will use this bucket, that size, which is 8 to 10 liters. And then we need three things to mix to generate a special reaction. We need indigo finally crushed in powder. Well, this one is from Persicaria, but of course, we can use the one from woad or Indigofera of course. This is local one and we need sugar and lime. So not any kind of sugar. Fructose, fruit, sugar. Lime. I will use the quick lime and show you how to make the hydrated lime, homemade easily. By reacting these two we will generate a kind of hydrogen in the water which will associate with the indigotin molecule and dissolve it. It seems it's very complicated. But remember, if you understand what you are doing, you will not fail as frequently as if you don't understand. I will try to enter in detail about how to make an easy made vat. Let's prepare the lime first. I did choose the quick lime which is sold for agriculture, and I will make the hydroxide first. I will calculate or so I will calculate first. Quantity here. Okay. I would say 150. It's quick lime. I will not dissolve because, you know, the pH is related to a solution.

If it's dry, there's no risk. There's nothing happening. Of course, the thing is happening in water and not just as it is as a permanent risk. 150 grams. I put this in a strainer, and I will pour a little bit of water. By adding water, you will have a reaction and you will see some fumes appearing. Maybe you can see the fumes already. So that's the steam because it's an exothermic reaction means the temperature is increasing and then the quick lime is converted onto calcium hydroxide. This is important for me because I'm living in Brittany. There's lots of humidity in the air some days and, of course in the studio when boiling some colors, you know, when preparing some hot water. There's lots of humidity in the studio. My calcium hydroxide cannot be stored for long. The calcium hydroxide I'm doing must be used immediately. If I keep it for very long, it will be damaged soon, as we will see later. So first, we put more water and you will see the lime will expand. This is not the best quality. It is from agricultural stock, so it doesn't matter. You see, my powder is appearing just like it is.

And it appears because you put water onto that?

Yes. By putting water on the stone, I am generating powder, that's life. A bit more. So that's my quick lime. I will wait for the reaction to be total, and I don't need that anymore. I will fill my vat with very hot water and then I will put my sugar and indigo and then I will put the lime. I need the stick to start this type of vat. We need very hot water. Which is about 80 degrees Celsius. We also need the quick lime we did. Not everything, maybe I will save one part for later. Use only this one at the beginning. And then I will have some of this precious indigo. If you like it dark, put more, if you like it pale, put less, of course. But the indigo, it doesn't matter what is the quantity. It is up to you. But I will take one part. So that's about 45 grams to remember. How much is not determinant sometimes, it could be for some chemical reaction, but it's not always as determinant as we think. I will just turn it not to dissolve the indigo, to put it in suspension. That's very important. The difference is suspension means little particles kind of floating in between. And then I will put my sugar. 150 grams. And of course, the indigo doesn't dissolve. We need the lime to generate the reaction now. I'd like to get an idea of how much I will take. Of course. When hydrated, the lime is heavy, of course, but this is very, very good quality.

45 grams of indigo, 70 grams of freshly hydrated lime plus 150 of sugar. And then we must wait a bit. You will see some signs. I'm still stirring by generating a kind of vortex. So that's important because then the whole sediment is put in suspension, much easier. Foam is coming and then the coppery cover, can you see that? The coppery cover that you can see at the surface, you can even break it,

you see like it is actually and it will regenerate. This coppery cover is kind of very pure indigo which was dissolved and then by the effect of the surface oxidized again and then it appears as a kind of coppery cover because that's a complementary color of indigo. The second thing is related to bubbles. These bubbles means that, of course, the indigo is already dissolved, maybe not 100%. And then I might add a bit more water. And then we must be patient because it is too hot for dyeing. I will wait for 10 minutes and test with a non-fragile fabric. For example, cotton. I will just have a test to show you. And then we must be patient because the vat must be cold. Warm to cold for dyeing silk. Remember, silk doesn't like very alkaline solutions, so it's far less alkaline than pure lime, of course, because lime was reacting with sugar, making some lactic acid, and then it is kind of calcium lactate generated, which is lowering a bit the pH.

But despite of that, it is not ready. We need it cold and a bit aged. Like for example, the very best could be to prepare the vat today to use it tomorrow. But we will see in few minutes, because now I would like to come back to the board and explain you about lime, because people are very concerned by this effect of lime changing by the time a lime is component made of calcium. So different types of lime will be commented here. Calcium is the raw material of lots of rocks, any sediment could contain some calcium. For example, the calcium, written like this calcium carbonate. This is the genuine rock of any calcareous rock. And, the shells are made of that, you know, shells of seashells and snails and so on, and even the eggs of the hen, of course. Calcium carbonate is natural. We cannot use it for the indigo vat, we must transform it. So since remote times, probably several millennia, people understood that by burning this calcium carbonate, you can separate it as I told you, to make the quick lime. That's a kiln like this. Imagine that you put some rocks. Well, calcium carbonate here. And you make a fire here, a beautiful fire, you know, gradually from the calcium carbonate, some steam will escape, which is maybe a little bit of water which was in but most of it is the CO2 will be separate leaving, after cooking it will leave calcium oxide. You can see that calcium oxide plus CO2 is this. But by decomposition we have the calcium oxide that we call the quick lime. This is rather stable unless you put that in water, of course, but it is rather stable, and you can store it. But the craft people don't like to prepare the hydrated calcium, so they prefer to buy the calcium hydroxide. When the cooking process is finished at the industrial level, they add some water. Which is another form of steam. Steam it and then this is generating calcium hydroxide. That's the one we are preparing by putting the small amount of water. But of course, at industrial level it is just steam and it makes the powder. They don't have to crush it. The powder is generated by itself. This calcium hydroxide has a special property. It will catch the carbonic acid of the air again and be converted onto calcium carbonate. Everybody know that they put the white cement with calcium hydroxide together with water, and they coat the wall and by the air by the carbonic acid of the air, it is generating the genuine rock. So that's a very virtuous thing because it's not because you use a very alkaline thing that you will pollute necessarily, because very soon it will absorb some CO2 and make a neutral thing.

It means Ca (OH)2 plus CO2 will generate again calcium carbonate plus the water. Of course, this is the rock again. For handymen, it's very good because the soft paste they put on wall became kind of hard as a stone because it is generated stone. But for us we must consider that life is not that stable that we could imagine. Because if you store this one at humid air, it will catch the CO2 and generate a neutral thing. Your old bag, the old lime bag you did buy last year, if you didn't pay attention to store it in the super dry place will be converted onto something which doesn't work anymore. We must be careful storing the calcium. The second point being, you also must protect your vat from the injury of the CO2, because by the surface of the VAT, the VAT will dissolve the CO2 of the air and generate the calcium carbonate inside. And then your vat doesn't work anymore. That's the only crucial point, which is very, very important to know about keeping the vat for long. This is calcium carbonate, this is CO_2, this is a carbonic acid, this is water. This is quick lime and this is calcium hydroxide, which is also called hydrated lime. It can be also called calcium hydroxide or pickling lime.

- Do you recommend buying quick lime if possible? Yeah.

If you live in a humid place, you will have this trouble. If you are very sure that you can store your lime in a dry place in a plastic bag, super well closed, it's okay. But if not... After years and years of teaching and of visiting some fellows, I did notice that in fact they only have one problem, that of lime. Then because there is a misunderstanding about this, they consider that the vat doesn't work anymore because it's not reduced. Because most of the books that talk about oxygen. "Take care of oxygen. How is oxygen? No, oxygen should not enter the vat. Oxygen is the enemy." Of course not. Because they think that's a problem of oxygen, they put massively reducing agent, so they achieve to kill the poor content of lime which was remaining. And the diagnostic is so important. So back to the vat. Let’s test the vat. Normally we shouldn't use the hot vat still hot for silk. We say that there's something remarkable is that silk contains some matter from the mulberry that will turn yellow when heated with some alkaline solution. We will see that. This is cotton, this is silk again. I will wet it for a while. Maybe the silk will have difficult to take color. I will start with the cotton. You will see how easy it is when the vat is ready. You just dip repeatedly your fabrics, and you get your color.

The vat is not ready, but it is just to show you how it is. You dip your piece and then you rinse it immediately. You dip again, so you get a darker shade and so on. If you like pale colors, you will do it repeatedly, but with a diluted vat. But it's a very bad idea to have only one quick shot dip to get a pale thing because it will stay at the surface. Let's see how it is on cotton first. You see that the color is starting kind of yellow by including some stain. To remove the stain as soon as possible, you rinse it. And then because there is oxygen in the water, it will turn gradually blue. It is a bit greenish here, but you will see that by the time it will be blue and then you will have to repeat and repeat. You will have a darker shade. Let's do a kind of scale very quickly. And then we'll be back to the silk. Silk doesn't like hot, and you will see maybe that it will be a bit damaged by this hot solution and being just kind of greenish. People like green, sometimes they say: we prefer to save it green. But in fact, I'm not very sure of the interest of that.

I will show you how to protect silk by having an addition in the vat. And of course, we will be patient enough to wait for the vat to cool. And now it will be cool. we will dye. Last point will be about the carbonic acid of the air because I told you that the surface just right now is absorbing the carbonic acid of the air. My lime is gradually neutralizing. I would like to stop it. I will show you how to stop it by making a kind of floating lid. So that's a very important point also. Let's see the silk. So of course, it is coming green from the beginning. Then I must rinse it as much as I can before. And in fact, you know this well, this bourette silk is quite strong. It's not that damage. Maybe the very delicate silks will be more damaged. I was expecting something a bit ugly, yellowish. But this one is giving good. I will have a second dip here. And just have a look at the cotton again, you see. So what's the difference in between the different fibers? For cellulose, the vat must be a bit alkaline. No matter the temperature. Do not exceed 60-70 degrees Celsius of course, but no matter the temperature. For wool, it must be warm. 35 to 40 degrees Celsius is perfect until it's 50, not very much more because you will damage your fingers anyways.

And for silk the optimal vat is cold, or I would say at room temperature. I will come back to the reaction. Third dip will be that side. And then during the time, if you are interested, I can present you the molecule of, I would say, what is in the plant. In the plant there is a little alkaloid. This is in indoxyl. That's what we generate by crushing the woad leaf, for example, by hammering and exposing to the air, you have the indoxyl. But if you like to generate the indigo, indigotin, the pigment, the blue thing, you must oxidize strongly. It means to eliminate this hydrogen. And then you will have something generated during the oxidization. If you eliminate that, the balance of the molecule is composed by association with another molecule like it is here. From the indoxyl we will make the indigotin, which is a dimer of indoxyl. So that's the indoxyl here. And the indigotin here is like this. So that's the one we already know. But here this is oxidized. It means the double bond is not linked with hydrogen. It's linked with the carbon of the molecule. And then surprisingly, another molecule of the same is linked together. And this is the indigotin. That's very interesting because this is not soluble in water.

It is we call it oxidized because it's oxygen in a double bond. And then we can precipitate while oxidizing the indoxyl and filter it and keep it as a powder. Okay. But when doing the vat, we need this indigotin. We need lime, calcium hydroxide, so we need fructose. And then that's kind of sugar, but not any kind, of course. The reaction in between these two is generating hydrogen. This hydrogen will automatically stick here. It will generate hydrogenated indigotin, which is called leuco indigo written like it is here. From the plant, we generate this and transform, transform it out of this by oxidization. This is from the plant to the extract. The extract is indigo. This is from the extract to the vat because the vat is a solution of leuco indigo. What we call the vat, is the special preparation of these three things. Fructose, calcium and indigotin. Fructose can be replaced by many things, but whole antioxidant matters like, you know, fruits, vegetables, and pectin. All these things, sugars, pectin, they are called antioxidants because they generate hydrogen, which will saturate the oxidation, the oxidization site. That's why they call it antioxidants. We have a huge list, but we focus on that. So back to the vat.

And you will get, of course, another color that's easy to see, that it was left a bit longer in the vat, so it will take a bit longer to oxidize, but I will not oxidize it as it is from the vat to the air. I prefer to rinse because it's much cleaner first and the oxidization is better. Let's see the silk. You can see that after maybe 3 minutes in the vat, the brand-new vat, the silk is taking quite a lot of color, so we rinse it in the second part. And you can see that it is turning much stronger. So being patient, you will have it quite dark after some time. So now we have a special program. We really like to dye all kinds of silks, including very delicate silk. This one was not delicate, so I recommend adding some more ingredient in the in the vat, which will kind of sweeten the vat. And my favorite for that is pectin, skins of lemon, orange, pomelo. This is pomelo and I will just put that in hot water and this solution will be added. Don't ask me how much, I have no idea. Don't be afraid of lemon being acidic because of course the poor acidity of citric acid is not balancing the super alkalinity of the lime. No worry about that. Pectin. It smells very good. WE will have a very fragrant vat.

I will have a good pectin extract very soon that I will add in the vat, and that pectin is very famous to make the jam thicker. A bit thicker. It would be enough to make what I would call the sweet vat. So that's very important because then the lime is not damaging the silk when doing this because it's kind of protecting the fiber. Some people use gelatin, you know, gelatin from animal bones or animal skins. But by the way, I found that the pectin is giving a kind of similar effect by combining with the lime. Lime is not that corrosive. But that's interesting. Don't follow those books. All those things. Forget that... Because they are not paying the material. They are just giving good advice that would ruin your production. You see, it is very regular, because I did rinse immediately. So, my silk is probably a bit more greenish, but it's not that dramatic. So now we can leave the vat until it is cooling. We will be ready for using it later. The color is regular. Of course, it is not bleeding. I need a word about that, about fixing after.

We do not fix after dyeing. We prepare the vat, which is a kind of fixing system. So that is the reason why we have several components, and the air is keeping oxygen, the color oxidized under the oxidization form. No worry about kind of coating with some fixing something. It's not for indigo. We'll discuss the point with other colors, but we don't need to fix. This is my 300 liters vat that I prepared in March 2018. It's more than three and a half years old. It's doing well. I did prepare it with one part of indigo, two parts of lime, and three parts of sugar. And of course, I'm keeping it safe by putting a floating lid. So that's my big floating lid here so I can save the vat for a long time. Now you like to awake the vat, you must stir a bit to mix what is below with a stick. By making the vortex, so doesn't matter if it's 300 liters or a couple of liters because you know, the liquid will move as well, then it's not that difficult, you see. I will observe the color. The color is kind of greenish. The bubbles are quite dark in the middle, so it means the vat is quite okay and it is staining the fingers. It is said that if your vat is staining the fingers, even cold, it means that the reduction is enough.

So that's important. Now let's prepare the silk for dying, plain die. So that's one piece of silk I like to dye in this vat. So first, I must wet it in hot water. Very hot, because that's very important for the fabric to be hydrated. For this reason, we must correctly wash the silk first and to hydrate it before dipping. Now we will test the resist paste to make some patterns in this vat. We will have a problem. We cannot print, resist, and wet the piece afterwards because then we will wash out resist. In that case, for the resist system, we must clean the silk as much as we can. It must be exactly cleaned as well as we can do. I will show you that. But first, we need to prepare a full range of shades. Oh, that's super-hot. I will put my silk in. And I will open it inside and I will duplicate the dips. You will see that it's taking readily. Okay. So that's my first dip here. The first one is not necessarily very long because the first one is just to, I would say, alkalinize the fiber. It means the alkaline solution must go inside.

So that's kind of a preparation. You see the greenish blue appearing and you see all those marks which are not very regular. They will disappear. They will disappear when oxidized. The best should be to oxidizing water, of course, and to repeat the dips. We'll prepare some cold water here and repeat the dips. Okay. Silk is rinsed. I will press it to avoid very cold water, fresh water, you know, oxygenated water to be in the vat. Then I will have a second dip and the third dip. The first one must be regular. If it is not for some reason, it is not dramatic because you had a very short dip but don't have your first dip very long because in case you have a bubble prisoner, well, of course it will be impossible to repair. But by having a pale color, it's good. I will have, for example, three tips. And then I will cut a piece and put the second put the rest inside to get it darker. And I will I'm expecting three different blues. We will be able to have three different greens and even more depending on the yellow we put. We are starting a kind of sampler of different shades we like on silk. So that's the first experiment. And then remember we got this idea of using the resist paste for silk screening.

We will have the screen and now it will be perfectly dried. We will be able to over dye the piece to dye the piece in. But first, let's do let's do the sampler. Three blue. Is still green. Of course. Appearing green. And you see it's a bit darker, but by rinsing it's turning better blue. And then the third one. I will cut a piece, or maybe even like this, I will cut a piece after two because we need to pale one. So okay, so that will be my pale because when I even pay locals some samples of pale blue plus different greens and this bigger piece will be over dyed to get darker. When working on big pieces, I put my fingers in because I must move the piece inside of the liquid by just, you know, circulating, hanging the border and moving the piece by the border. So that's very important because then you do not take any risk of having any bubble, or any stain. So how can I keep this vat for long? The only thing I know is that after some time because I'm working, I'm opening the vat frequently, I'm sure I will have a lack of lime, not of reduction, because any water that you store in a barrel will be de-oxygenated after some time. The problem is not the oxygen.

The problem is the carbonic acid of the air. The floating lid is helpful. And the second thing is adding sometimes a little bit of lime. Then the secret of a very lasting color. You see the different colors here. We have two different ones. And when I will finish, when I will be finished, I will put those pieces in water, in plain, clean water, and I will store it in water for some time. That's very important, because if it is drying and not totally oxidized at the heart of the fiber, it will not be very lasting to the light. So that's a big secret. People think, that's a question of how much something, no, no. It's a question of keeping it slowly oxygenated in water instead of drying it at the air. Because if sometimes you dry it, but it is dried but not fully oxidized. If it's the case, you can be sure that everything which is reduced and dried will not be lasting at all. So that's one of the big, big secrets. When finished, we'll put that in plain water and be patient enough for the silk to be fully oxidized. It could be even overnight in water, all night. You see, my three different blues here will give, of course, very different parts, every frame.

Michel will talk about printing with indigo on silk and combining indigo with other dyes in Tutorial III, Big Silk Workshop. In the next episode, Michel will talk about the soluble indigo dye, sulphonated indigo or **indigo carmine**.

Episode 11. Indigo carmine

Michel will tell us about a legendary soluble indigo, Indigo carmine. Indigo carmine, the acid dye **Saxony blue** was invented by Johann Christian Barth in 1743. It is made from natural indigo, converted with a strong sulfuric acid to mimic an acid type dye. First, people used it very acidic, and it was not good for silk, but then they learned how to neutralize Saxony blue obtaining indigo carmine. It is not a vat dye, and you can use it as a direct dye for wool and silk. Unfortunately, indigo carmine is not stable on cellulose fibers, but it can be useful for blue and green prints on silk and wool and of course, for one bath techniques. Having this direct blue dye, you can compose your green and violet one-bath color compositions means you do not need two steps. Michel will show you the synthesis of Indigo Carmine. It is very exciting to show, but please never try to reproduce it. This process is very dangerous.

This was discovered during the 18th century. In Saxony, they were familiar with acidic solutions to prepare the cobalt blue on different things, and one got the idea of experimenting with this strange blue stone that was coming from Holland by travelers. It was the Indigo. It was not really a stone; it was looking like. I will tell you about Saxony Blue indigo carmine. Indigo carmine is very easy to find as a solution or as a powder because it is a food additive. It is accepted by European Community being non-toxic and well done. You can buy the sulphonated indigo, also called indigo carmine. But for information, I will tell you a little bit about and we will make it so you will understand that it is not easy to make. It's sometimes better to buy it than to take a risk because we will use a very corrosive acid, which is sulphuric acid, very we must be very prudent. First, we put the acid. Gloves. I should wear gloves, of course. About 600 milliliters, so I will have one quarter of indigo inside. I will stir and wait for tomorrow. So here is my best indigo.

I will put 150 grams of good indigo. Okay. And then I will stir with the plastic stick because the plastic will not be damaged by the acidity, of course. And now it's given kind of very thick paste. But by the time the paste will be more liquid. It is taking a bit of time dissolving that. And tomorrow, now, I will have it 100% in solution, fluidic, and carefully put that in water to increase the pH and then when it will be in the water, I will neutralize it with a solution of soda or potassium or something basic. So by the way, I will have a neutral solution and some particles of soluble indigo will sediment. So I will filter and keep my carmine as a paste, which will be soon converted onto chunks and then easy to make and to into powder. And then the liquid will be the Saxony blue, but neutralized, so we can use it for silk without any damage. So now we must wait for about 8 hours. That's the minimum. So we put that in a very safe place. So here is my acidic solution. Remember, I put one part of indigo plus four parts of sulphuric acid.

Next day. That's a dangerous operation. Because indigo carmine is very easy to buy, I suggest if you are not an expert, if you do not have any lab, I just suggest you buy it somewhere. I will pour some of this solution in water. Not the opposite. Never put the water on acid because it will jump on you. And then I will neutralize as soon as possible with caustic soda. You will generate sodium sulphate, which is neutral, and then you will be able to work on your silk. For example, I will take 100 grams of this. In the past, people were using that solution. They were just diluting that, and they said, okay, we have the dye stuff. Of course, it did work a bit for wool, but on silk it was not very clever because it was a kind of changing the consistency of the silk to get kind of yellowish matter, which is a picric acid. So that was not very beautiful. And then here we had very carefully added caustic soda. So even better to dilute the soda, to be sure. But I will try like this if it works.

Of course, we are doing everything very slowly, very clever to show. But the most important will be to understand how this is done. So now I want to know where I am. We'll use the Ph paper, which is not easy because it's super blue. But I will try rinsing that immediately. Anyways, it must not be basic. So basic should be kind of a disaster. We'll add a small amount and then I will show you how to take the pH. Just a small amount first. During the big industrial period they were using this, but they were preparing accurately. There were the two types. On wool, it was just the acidic solution. Of course, it was not convenient for anything else. But after once they learned how to neutralize it and they could even include some preparation with a mordant because they were neutralizing with acetic acid. They were doing kind of acetate and that was interesting to combine. We should not condemn one product because at the very beginning they were not experienced. So that's very interesting to consult the industrial text. Let me test and then I will show you the following step. No, this is yellow. Coming to tree, so I must add a little bit more basic. It must be around four. And then to be sure of that, I will put just a bit in this. So it could be, for example, 1/10. Not very much, but just enough to check the PH on the diluted solution. You see how beautiful it is. So now, considering that I did dilute ten times, I will have the measurement of PH to be adjusted to one number. For example, if this one has pH five, it means that this one has pH four because it was diluted. And this one is kind of still acidic. Still acidic. I need to add a bit more. Sorry, I'm very slow just to show you.

Almost done. A little bit, and that's it. When finishing to adjust the pH, we must filter. We must filter because there are some particles generated in liquid that we can separate. We will have two different products from this operation. First one will be in the filter, which is indigo carmine. This is normally dried and used for printing, but you can also use for plain dyes if you prefer. And the liquid will be set for plain dyes because it is diluted. We don't use it for very strong colors. I need to filter it, to put a cloth and to strain. But then I hope you will see the particles. Yes. There's something that you will maybe not see, but there's a kind of very dark paste which is coating. This very dark paste is the indigo carmine. Carmine will be ready afternoon and we will also use the solution which is called saxony blue. It will take a bit of time. Then after some minutes, you will see the coat, the good repartition of this blue paste, and we will keep this paste to print on the fabric. This is not what people call a mordant dye. You can print it directly even better if combined with a little bit of citric acid, which is not the same type of acid in the paste.

In the paste. Yes, we will see that later. So, we are in progress. I think we can put that somewhere else. Indigo carmine is ready. It looks like a kind of paste, and we can store it, of course in a pot with one drop of essential oil of thyme. Or we can have little lumps of it on the radiator to dry it carefully and make it onto a powder. It depends on the project. You will see that it is highly soluble in water. By just diluting it you can have an interesting dye with no need of mordants. So that's interesting. It's kind of direct dye like it is the Indigo, of course, but this one is highly soluble in pure water. So that's interesting for silk. You don't need to add anything else. It means that you can also add that in many different dye pots. Like remember, for example, this pagoda tree and alum preparation, we can also add a little bit of that to get greens. The number of combinations is so, so important that we cannot develop everything. But this will be a very interesting tool. So that's my pale version. And if I like it darker, I will put more, of course. I will wait for this to be finished, and then I will put a second one with a bit more and so on.

You see how it how it does. The bath is cold, but it's taking something. Sometimes there are some texts mentioning that you can finish by a little bit of alum, I guess that there were not so many things in the studio at the time in the manufacture. All the leftovers were combined for mixed colors and for fixing effect. Alum is not doing systematically best fastness to light, but it is kind of coating to make kind of waterproof effect and a bit of protection at the same time. People did appreciate this effect. It takes time. I will let it inside for some time if I want to speed the uptake on the silk, I can add a little bit of sodium sulfate. In the past they were using ordinary salt from the kitchen. Sometimes it's just a question of being patient and waiting for the uptake to be perfect. Okay. So that's a spot because, you know, the problem with the campaign is that we really need to dissolve it perfectly before you put your seat. If there's a little app of that, it will generate a spot of.

As Michel said, the procedure of Indigo Sulfur nation is dangerous. Please don't try to reproduce it yourself. You may buy Indigo Carmine and try it in different applications on wool and silk. Just remember that it makes almost no sense to use it on cotton. You may use indigo carmine and wool and silk as direct dye for blue shades, but in fact, indigo vat gives more stable results. Indigo carmine is very interesting and promising for using in one-bath technique and printing pastes as a blue component for greens and violets. With this soluble blue dye, we have the possibility to mix color freely according to the rules of color wheel. We have yellows, reds, and blues for an easy color combination. You may mix indigo carmine with rhubarb, cochineal, madder, and many other dyes in one-bath process and in printing pastes. We will come back to these printing pastes and printing on silk in tutorial 3, Big Silk Workshop.

Episode 12 A word about lichens.

Let's talk about lichens and mushrooms. Michel will show us a short demo about one-bath dyeing with lichens.

Lichens do not belong to plants. Lichens represent a mysterious co-existence of fungi and green algae. The algae part can photosynthesis and produces "food", means, sugars and so on, while the fungal part produces other chemicals, among them also colorants, some of them being unique and not found in plants or other organisms.

Lichens were very important for dyer of the past.

First, one important fact: lichens cannot be cultivated and grow very slowly. It is very interesting to experiment with them, but they cannot be considered as a serious source of natural dyes today.

Do not be predators, collect windfall lichens. Gathering windfall does no harm, since these lichens are not able to continue growing anyway.

In the past, people used lichens for two dyeing methods, first, for orchil purple and second, for traditional mordant process for yellows, beiges, olives, and browns.

Orchil purple is a complicated process and Michel does not recommend it to modern dyers, as this process cannot be considered as being eco-friendly and "green".

Let's anyway mention the chemistry of this process because it is interesting.

The dyeing of wool with orchil is mentioned in the "Stockholm Papyrus," a document from the third century A.D. Interestingly, that orchil purple is mentioned as imitation of an expensive Tyrian purple. The production of the dye was in Levant and then in Florence; the name of the manufacturer, Orichellari, gave name to this dye. Later, orchil production came to Lyon, where they developed a very complex industrial process.
Like indigo, orchil dye does not exist in the plant in the colored form.
It exists in a form of colorless orsellinic acid and its precursors. To produce the dye, dry lichens are crushed to powder and soaked in a warm water containing ammonia (in old times, they used old urine). The further process included prolonged steeping and oxidation. During this process, different compounds are hydrolyzed giving colorless orsellinic acid, enzymatically converted to colorless orcin, which gives purple orchil, reacting with ammonia and oxygen. Orchil dyes are very beautiful on wool and silk, although not very fast. This is a direct dye, which does not need mordants.
However, as we told, this method is not eco-friendly.
But lichens contain also quinone dyes, anthraquinones, which can be used either as mordant dyes or in one-bath process.
They give beige, yellow, golden tones, see beautiful botanical illustrations made by Swedish scientist Johan Peter Westring.

Michel shows us one-bath process with lichens. May be, similar process was used by Vikings: lichens, tannin from the bark and citric acid from wild berries.

It was a short demo; we did not have enough time to make a range of colors but take a look: we can have nice beiges with this simple method.

You are cordially invited to Michel's Facebook group. Ask questions, show your work, and welcome to the Tutorial TWO "Mordants. Creating affinity".