

# A Method for Cleaning Ancient Bronze Coins

With a long introduction, and much annoying detail

Plus some commentaries on bronze disease

To which is added a Bitter Afterword

And a Bitchy Epilogue, followed by an Appendix of coin photographs

*Saül Roll*

*www.romanorum.com©*

## BIG SMALL PRINT:

**Disclaimer:** This is meant to accompany the "[Ancient Coin Cleaning Kit](#)" sold on my web store. This is a publication that is housed on my own website, and therefore it is copyrighted. However, you are free to use for educational, non-profit purposes, and of course for your own purposes with your own tools, and to download it and share it, as long as you don't alter the document in any way. What I explain here are all my personal opinions, based on my personal experience, and they are not meant to convince the reader of anything. You are welcome to try these techniques on your own coins at your own risk, as I cannot be responsible for accidents, damaged coins, personal injury, or any other catastrophes that may result from following these steps. And of course I expect none of that will happen, but you never know when someone is going to poke their hand with a cleaning tool, bump the distilled water with the coins on the new rug, and react with a rapid movement that will knock down the microscope on the dog's head, who was distractedly licking the sodium sesquicarbonate spill, rendering him unconscious, all which would incite the coin cleaner to sue whoever suggested the cleaning method in the first place. So please be careful, as I am not liable for your mistakes, accidents, acts of Apollo, etc. Also, cleaning coins kills your back and your neck. So get a good posture and take breaks often.

**ABSTRACT, sort of:** Just so that you know whether or not reading this whole thing is worth it for you, I have to say that what follows is a long general introduction to cleaning ancient coins, followed by painfully detailed description of a very simple method, which can be summarized as follows: Rinse the coin, dip it in acetone, dip in distilled water for a few weeks, changing the water often, carefully remove dirt and encrustations under a microscope with diverse instruments during several sessions over several days, treat it with sodium sesquicarbonate for bronze disease if needed, dry the coin, dip it in acetone again, coat with Micro-crystalline Renaissance Wax. There are a lot of digressions throughout; that's because I believe that the more you understand about the nature of coins, the better decisions you can make to treat them properly.

## Introduction

The following are recommendations for cleaning ancient bronze alloy coins. These general guidelines reflect the method that works for me after having spent over two decades cleaning and conserving ancient coins. I am not advocating here that you don't try any other methods; I am simply explaining my own. If I don't discuss other methods it is either because I don't know about them, or because I have tried them and found them wanting for my purpose.

And said purpose is to clean coins in order to:

1. Remove most or all encrustations on the coin so that the original designs and legends are visible again, if they are still there, and always without damaging the patina or the metal, and
2. Conserve the coin so that the decaying processes are reduced as much as possible, thus extending the lifetime of the coin.

Besides the aesthetic reasons for removing the encrustations, there are many instances in which these hide ongoing processes that affect the coin negatively, such as bronze disease. Earthen deposits can collect humidity from the air, and the combination of oxygen with the minerals and metals will cause reactions that are damaging to the coin. This is not speculation on my part. The reason I know this is because oftentimes I have removed such encrustations only to find that underneath there is an ongoing reaction happening, usually having caused damage to the coin already. These reactions can have effects and consequences in the short term (a few weeks or months), or in the long term (years, decades). Many collectors don't have the ideal non-humidity conditions to maintain their coins, and that's why conservation is essential.

Most people don't think about these issues simply because their lives tend to be shorter than the life of the coin and they might not live to see the coin disintegrate because of corrosion, which doesn't mean they will not.

You may follow these recommendations at your own risk. There are absolutely no guarantees that cleaning an ancient coin will have positive results. Ever. There are many factors at play, and you only have control over a handful of them.

Although I own a given coin right now, it has been around for a couple of millennia or so, and hopefully it will be around for another few centuries. So I feel a certain degree of responsibility, as the temporary care-taker, to ensure that it endures for the next generations.

## **Cleaning Ancient Coins**

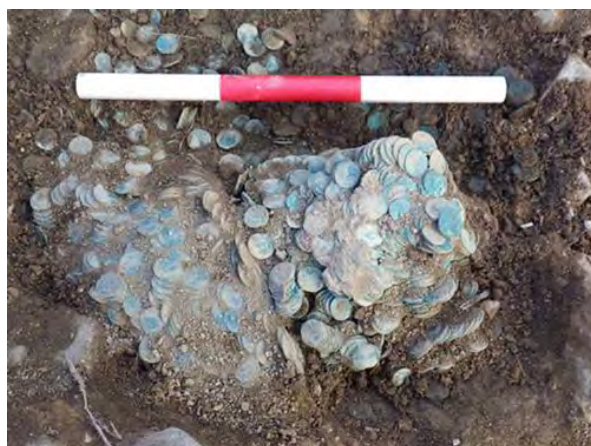
### **I More Introduction**

The most valuable skill for cleaning coins is patience. If you don't think you are ready to spend a long time crouched over a microscope picking at milimetric lumps of very hardened dirt during several days, weeks, or months, I don't suggest you try this method. There's no such thing as instant gratification in coin cleaning if you are aiming for good results and proper conservation. You will also need a lot of patience to read this whole thing, as I digress much and often.

#### **"Uncleaned" Ancient Coins.**

If you are reading this, chances are that you might have purchased so-called "uncleaned" ancient coins on Ebay and other venues. It is important to remember that, in a way, they might be "uncleaned," but they are certainly not "unwashed." All ancient coins have been washed or cleaned at some point. When coins are dug out of the ground they are covered in dirt, encrustations, and different types of oxidation. Therefore, as nice as it is to think that some coins in your collection are in the "original condition," there is no such thing in ancient coin collecting. The coin you buy is simply in the condition in which it was left by the last person who cleaned it (and in some cases even worse, if the cleaning was done hastily or carelessly, or if the coin hasn't been conserved properly).

Even "uncleaned" Roman coins have been rinsed and brushed thoroughly in order to separate valuable items from the lot. As anyone who has purchased "uncleaned" Roman coins knows, a large majority of them will not clean well. Depending on your luck, and depending on how much you pay per coin, you will usually find any or all of the following: slugs, a certain degree of detail, some dirt encrustations, lots of encrustations, chunks of mineral deposits, bronze disease, etc. This is not to discourage anyone from buying "uncleaned" coins. After all, I do just that all the time, and that's how I decided to learn how to clean them in the first place. But you have to remember that disappointment can be the one feeling most closely associated with cleaning "uncleaned" coins. This is pretty much what ancient coins look like when they are found:



As you can see, it is obvious that these coins will be thoroughly washed and cleaned before they get to wherever they are going, whether it is a museum or the market.

The fact that your coin has survived 1800 years doesn't mean that it's just going to automatically survive the next 1800 years. Coins are not immortal, even if they might still be alive after so many centuries. Most "uncleaned" coins in the market today have been found within a few years, months, or even weeks from the day you purchase them. The instant a coin is dug out of the ground and becomes exposed to air again it will begin decaying at a faster pace than when it was buried. Having been washed by whoever found them, "uncleaned" coins often retain some of the

humidity, which in combination with oxygen only accelerates the decaying process. The elements that make up a bronze coin (copper, tin, zinc, trace amounts of lead and other metals, etc.) have been reacting with the different elements and metals on the ground (often Fe, Ca, Al, Mg, among many others) and with water from several centuries of rain seeping into the ground. To this you must add, of course, whatever the rains of the last two centuries of human pollution brought (i.e. acid rain, identified in 1852 by Robert Angus Smith, but which had been already wreaking havoc since the Industrial Revolution in the previous century). To this mix, add a few chemical nitrate fertilizers and all kinds of pesticides, which have been widely used in recent centuries throughout what used to be the Roman Empire. This is what coins have been exposed to for a couple of millennia, give or take a few centuries. So if you buy a lot of "uncleaned" coins that was dug out last year and slowly made its way to your cleaning desk, the chances of them being in decay mode are high. This might be the case as well for a coin that was dug out 10 or 20 years ago and was partially cleaned but kept under not so great conditions. Hence the importance of cleaning and conservation.

## II

### List of primary tools and supplies that I use

- A. A 20x stereo microscope with top illumination.
- B. Top quality dental drill bits coated with diamond micro-dust.
- C. Tungsten carbide tip engraver pen.
- D. Brass brush.
- E. Gel finger protector
- F. Disposable non-powdered gloves.
- G. Q-tip brand cotton swabs.
- H. Bamboo toothpicks and fine grit sandpaper.
- I. Glass bowls with lids.
- J. Paper towels.
- K. Distilled water.
- L. Pure acetone.
- M. Sodium sesquicarbonate.
- N. Wood chopsticks.
- O. A piece of cardboard.
- P. Camera.
- Q. Micro-crystalline Renaissance Wax.

A. If you are serious about cleaning coins, the microscope is very much an essential tool. The stereo vision and the 20x power give you a view of all you need to see in order to clean a coin properly. If you're using less magnification than that, it is easier to damage the coin unwittingly and to clean it improperly. Nowadays an excellent microscope can be purchased for about US \$100. If you're in the US, Gorilla Scientific carries the SJM-02 model, which is the one I use. The beauty of a stereo microscope is that you have the ideal depth of field view for cleaning an object that has relief. Stereo vision allows you to see a tridimensional image so you can actually perceive the distance between, say the top of the letter and the field. I know there are many people that clean coins with loupes, 10x magnifiers, etc., but I have no doubt that the moment you see a coin under a stereo microscope you will understand what a huge difference it makes.





B. There are literally thousands of types of diamond dental bits in the market, but an extremely small number of them fulfill the requirements for cleaning coins. Some can be very damaging, as the diamond grains are too thick and sharp, and will easily scratch the patina and the metal. The ones I use and sell are of ridiculously high quality, made of very strong, brutally fine diamond dust, firmly bound to virtually unbreakable shafts.



I don't recommend you use rough diamond coated drill bits, which are ok for dentistry but not for coins. Even though it might seem fine to the naked eye, when you look at it in the microscope you can see how rough it is. It will easily scratch metal and patina. Even if you're cleaning an extremely encrusted coin, there's always the danger that you might scratch the high-points. Most of the diamond coated dental drills in the market are not fine enough for cleaning coins. They look like this; avoid them:



C. The tungsten carbide engraver is very useful for breaking extremely hard encrustations. However, it is very very very sharp, and if your hand slips you can puncture and/or scratch the living daylights out of your finger, or worse, the coin (the finger will heal). It is also very useful for gently cleaning ridiculously tiny crevices, but you have to have a very very very steady hand, otherwise you will scratch the coin very very very easily.



D. The brass brush doesn't really remove encrustations, no matter how hard you try. Rather, it is used to brush off the remaining particles that are left on the surface after cleaning. You need to limit the use of the brush, as it might create or enhance metal high points on the coin. Be warned

that the little bristles can poke you through the glove (see F, below). But it doesn't hurt that much and you'll eventually develop a natural immunity and a callus.

E. The gel finger protector does just that, it protects your middle finger from the pressure and rubbing of the cleaning tools. Anyone who has cleaned ancient coins knows that after a while your fingers can get very sore. They still will, but at least you won't rub the skin off them.

F. I use a non-latex, non-powdered glove on my left hand (if you're a leftie, use on your right hand). If you're cleaning for a long time, the water, residue, etc. will get on your skin and under your fingernails, and even though that's likely not going to give you toxic shock syndrome or a stroke, the less your skin gets exposed to all that stuff, the better for it. Coin alloys might contain lead and other metals and minerals in tiny quantities that are most likely not too dangerous in minute quantities, but better to be safe. And be careful when using acetone, as it might melt the gloves. It also protects your fingers a bit when you're using the brass brush.

G. Q-tip brand is preferable because the stick is very strong and doesn't bend as easily as other brands. Also, the stick is made out of rolled and compressed paper not plastic, so it will not melt with the acetone when you need to use it for that purpose. They are extremely useful during most of the cleaning steps.

H. Toothpicks are extremely useless for most encrustations but excellent for testing the hardness of the dirt before you try other tools. They can also be used to remove extremely soft dirt. The tip of the toothpick is actually very thick under the microscope, so it must be sharpened. How on earth do you sharpen a toothpick? Actually, pretty easily: by rubbing it at a very low angle on a very fine grit sandpaper sheet. The lifetime of the toothpick is limited to a few strokes, so you have to either sharpen it again quite soon or simply discard it and sharpen a new one.

I. Glass bowls, about 415ml, 14 oz., should be used to dip the coins. Make sure they have lids, otherwise dust, pollution, etc. will be absorbed by the water (see "Distilled water," below), plus it will evaporate if left exposed. Get a few bowls in case you're cleaning batches of coins.

J. Paper towels are useful for many reasons. But most important, when you place the coin on the microscope plate it shouldn't come in contact with the actual hard surface. Make a little "cushion" by tearing a one inch wide strip from the paper towel, fold it in 3 or 4 parts, and place the coin on it. This will protect the coin from being rubbed against the microscope plate. I actually have a favorite type of towel, Viva brand. They are thick and cushy, and very resistant.

K. Distilled water is what I use to dip the coins. I never use olive oil or other dips, except for bronze disease (see Sodium sesquicarbonate, below). Olive oil, for some reason, is very popular for coin cleaning. I have no idea when or where that fashion began, but it became very popular when "uncleaned" coins came into the market in large quantities during the 90's. But in my experience it doesn't do much and it might be harmful for the coin in the long term given that it has acids, etc. Plus it's messy. Distilled water is simply H<sub>2</sub>O with a purity of up to 99.9%. That means it has no mineral particles, unlike all other waters found in the world, and no chemicals, such as chlorine and fluoride, all of which can add new contaminants to the ones already in the coin. It's not simply that the encrustations need to be wet in order to soften them. Water is

hungry for minerals, and it's constantly absorbing minerals and contaminants, even though this occurs at a molecular level. That's why distilled water, which has no minerals at all, will be more effective. Of course, it is a slow process. The water should be changed every two days or so, since the effectiveness of the distilled water diminishes somewhat. But most importantly, when exposed to air distilled water will rapidly absorb carbon dioxide, which will produce carbonic acid, and all acids are harmful to bronze alloy coins. In the US you can buy distilled water in supermarkets and drugstores by the gallon.

L. Acetone: Extremely flammable, skin irritating, lung irritating, etc. Use with care and don't get anywhere near an open flame, duh. If you happen to spill it on your Hawaiian polyester shirt it will dissolve it. Your rug too. And basically anything that is plastic, latex, or similar, including your non-latex gloves. It can be purchased in most hardware stores, and can be found usually in the paint section. Acetone nail polish removers should not be used, as they usually contain a lot of other ingredients that are probably not good for the coin (i.e.: Propylene Carbonate, Dimethyl Glutarate, Dimethyl Adipate, Dimethyl Succinate, Glycerin, Fragrance, Denatonium Benzoate, Citric Acid, Gelatin, Benzophenone 1, FD&C Blue 1, FD&C Yellow 11, to quote one label).

M. Sodium sesquicarbonate is sometimes used in archaeology to stabilize ongoing processes that have resulted in bronze disease, a blight that appears on the coin due to chemical reactions that occur on the surface and that might literally obliterate the coin in a matter of years. I use it because it's the best treatment I've found so far, even though it doesn't guarantee a perfect result. Then again, nothing does. There are other treatments recommended by archaeology conservation experts, but they involve dangerous chemicals; plus they are also not perfect.

N. Wood chopsticks. What? Well, yes, chopsticks. They are the best thing to use whenever you need to remove the coin from acetone, distilled water, or sodium sesquicarbonate solution, given that you don't want to use your fingers, gloved or not. But make sure they're disposable wood chopsticks, preferably bamboo, and not decorated or lacquered ones. If that's a pain in the fingers for you, use instead two Q-tips to pick it up and take the coin out of the acetone dip. Just don't drop it on your lap.

O. A piece of cardboard. Out of an old cardboard box make a rectangle of approximately 12 x 20cm (5" x 11") or whatever size fits your needs. With a paper towel on top, this is useful to protect your working table when you use acetone. If the table has a coating of paint or varnish, acetone will strip it if you spill or splatter. You might want to add another layer of protection underneath if you really want to protect your table.

P. Camera. It is extremely useful to take pictures of the coins before you begin cleaning them. The slow process of cleaning makes you forget what the coin looked like when you started, especially if you are cleaning a few coins over a period of a few weeks. You want to know what worked and what didn't on what type of dirt and encrustations, and having a picture leaves you with a record of what the coin looked like before. When you finish conserving the coin, take a picture of it so that you can compare them and see the results in a more objective way.

Q. Micro-crystalline Renaissance Wax: A product developed at the British Museum in the 1950's, and used in museums throughout the world for conservation of diverse artifacts,



including ancient coins. It's used on leather and wood book bindings, statues, artifacts, you name it. The wax protects the coin against environmental threats that could shorten its already long life, such as oxygen and human contact.

### III Cleaning. Finally.

"Uncleaned" coin disappointment warning: Don't expect that you're going to find a fantastic coin underneath the dirt. This might happen sometimes, but when you clean the dirt and encrustations off the coin, what you have left is the coin as it was when buried, plus whatever patination or decay it has undergone. So after all the work you might find that the coin was already very worn when buried, or that since then it has decayed brutally. You cannot resurrect a dead coin.

The method explained here applies to either "uncleaned" coins or any other coin in your collection you might think needs cleaning and conserving. It is assumed that you have read the tool descriptions above and you understand the purpose of all the elements involved. The instructions are given for a single coin, but dipping in water, sodium sesquicarbonate, and acetone can be done for several coins at the time. All these steps involve wearing a latex glove on your left hand (lefties on your right hand). You can wear them in both hands, if you want, but it's easier to handle the tools with an un-gloved hand, plus it's less bothersome.

These instructions are written with excessive detail just in case you've never cleaned an ancient coin before. If you have, some of these instructions might be somewhat cumbersome. So feel free to skip the steps you find annoying, such as focusing the microscope, etc.

Think of the dirt and encrustations on a coin as having different layers. The process of cleaning a coin involves eliminating these layers in different steps, and that's part of the reason why you will need a lot of time and patience. These layers are not always visually discernible from one another, but rather they are "tactile" as if were, and you might be able to identify them as you clean the coin. After 2000 years or so, the dirt and deposits on the coin might be as hard as concrete, quite literally. Don't let your dirty coin fool you: as easy as it may look, that dirt is not easy to clean.

**1. Rinse.** If you're cleaning an "uncleaned" coin, rinse it in running tap water while rubbing it with your (clean or gloved) fingers. A quick rinse with regular tap water not affect the coin, but I don't recommend you use soaps or detergents. This gets rid of the first coating of light, dusty dirt, though you won't notice much difference in most cases. If the coin looks absolutely fantastic after this step, there is a possibility you might have a fake coin with fake dirt in your hands. 1800 year old dirt doesn't come off that easily. Dirt is sometimes glued to fake coins in order to make them more authentic looking, but it's very unlikely you'll find that in an "uncleaned" coin lot. Pat and squeeze dry with a paper towel. You can skip this step if you're cleaning any other coin in your collection, as they are not supposed to have a layer of dusty dirt.

**2. Acetone.** Again, use with care and in a well-ventilated area. Avoid inhaling, spilling, touching. I use acetone because there might be oils from previous cleanings still on the surface and into the dirt, such as olive oil, finger oils, etc., most or all of which are eliminated by

acetone. Acetone is inert to coins, but also for wood, so that's why the chopsticks are useful, as we'll see.

If you're cleaning a coin other than "uncleaned," I especially recommend this step. Oftentimes a coin you purchase might have a coating of beeswax or other waxes on top of the dirt. The problem with this is that wax, when applied to a coin that wasn't properly cleaned, dried, and conserved, might trap humidity and contaminants in the coin, and the corrosion processes will simply continue to happen under the wax. If you want to test it, you can dip it in water and see whether the coin repels or absorbs some of it. If it repels the water, it might have a coating of wax or oil. Also, your coin might have a fake or artificial patina (see my comments on that below, in the Epilogue).

Carefully pour acetone in the glass bowl (don't spill!). Eye protection is recommended. The amount varies, but pour enough just to cover the coin. Cover immediately with the lid, as acetone evaporates very rapidly. Dip for a couple of minutes and swish around gently a couple of times. Put a piece of cardboard on your working table and put a folded paper towel on top of it.

Extract the coin with chopsticks and place on top of paper towel. Dip a Q-tip into the acetone, replace the lid, and pin the coin down with yet another Q-tip, pressing it vertically on the coin surface to hold it down while you rub it with the first Q-tip. Hold the Q-tips from the middle of the stick so you have more leverage and can rub harder without bending or breaking it. Avoid getting acetone on your glove, if you're using one, or on your skin. The coin will dry as soon as you stop rubbing it, as acetone eliminates all the water and evaporates almost immediately. Rub both sides of the coin. The Q-tip will likely stain because you're actually cleaning off yet another layer of dirt and contaminants, microscopically thin as it may be.

**3. Distilled water.** Fill a glass bowl with distilled water to about 3/4. Hold the coin with your gloved fingers, dip a Q-tip in the water and wipe the coin with it several times until the dirt is saturated with water. The reason for this is that if you just drop the coin in the bowl there will often be tiny bubbles adhering to the surface of the coin, and you don't want these little pockets of air. Place the coin in the water and stir a bit with a clean Q-tip to make sure there are indeed no bubbles on the coin. Some believe that you should dip only one coin at a time because the process would be faster (not by much, in my opinion). But I usually put four or five coins in at the same time. I tend to clean them in batches of about 10 to 40 coins, and I would have to find room for as many bowls, which is not only impractical for me but simply impossible because of the size of my table. You don't want to crowd the bowl, so limit it to four or five coins. I always make sure that the coins are separated and not touching each other or on top of each other.

**4. Removing dirt and encrustations.** If you haven't cleaned many coins, or none at all, I strongly recommend that you practice with lesser "uncleaned" coins that you are not afraid to damage before moving on to coins that matter to you.

Ideally, leave coin in distilled water for two to four weeks and change the water every two days or so. Of course, as you work on the coins you will be able to assess whether or not they need to be in water more or less time. All coins are different. All dirt is different. These general guidelines should be adapted to each coin as you see fit and as you acquire experience.

When you do the first water change, do the first round of cleaning with the microscope in order to see how it is responding. The following explanation applies for all subsequent cleaning sessions. Your first cleaning session might be a short one. The coin has only been in water for two days or so, and some or all of the layers of dirt might still be very hard. Don't try to go all the way to the surface of the coin itself at this point. Remember that you are cleaning an area that is just a few millimeters wide, and in some cases a few nanometers deep, and that because of the precision of the instrument you are only scrubbing the top layer of the dirt. All this, of course, varies greatly from coin to coin, and depends on how dirty the coin is and how hard the encrustations are. So don't rush to try to clean the whole coin at first. Dirt and encrustations will in most cases become softer and more workable as the days go by.

Take the coin out of the water (either with chopsticks or with your gloved fingers, as long as they are not dirty, since you don't want to add contaminants to the water, tiny as they might be), and pat it with a paper towel so that the coin is still damp. Place the coin on the microscope plate, on a folded paper towel square (see microscope illustration, above), and hold it down gently but firmly with your left index and middle fingertips (see illustration below). At this point, focus the microscope while pressing down on the coin. The microscope's focus, of course, is very precise, and if you focus without pinning down the coin you will have to focus again, since you naturally press down on the coin while cleaning it in order to keep it from moving. Also, as you move along, you will need to re-focus on different areas of the coin. The bust is raised, so of course the focus will be different than the focus on the fields or the letters. This seems rather obvious, but I'm explaining it because it's easy to be lazy and not re-focus as you clean different areas; this defeats the purpose of a precise cleaning, given that you might not see the exact detail on the surface and might scratch the patina or the metal.

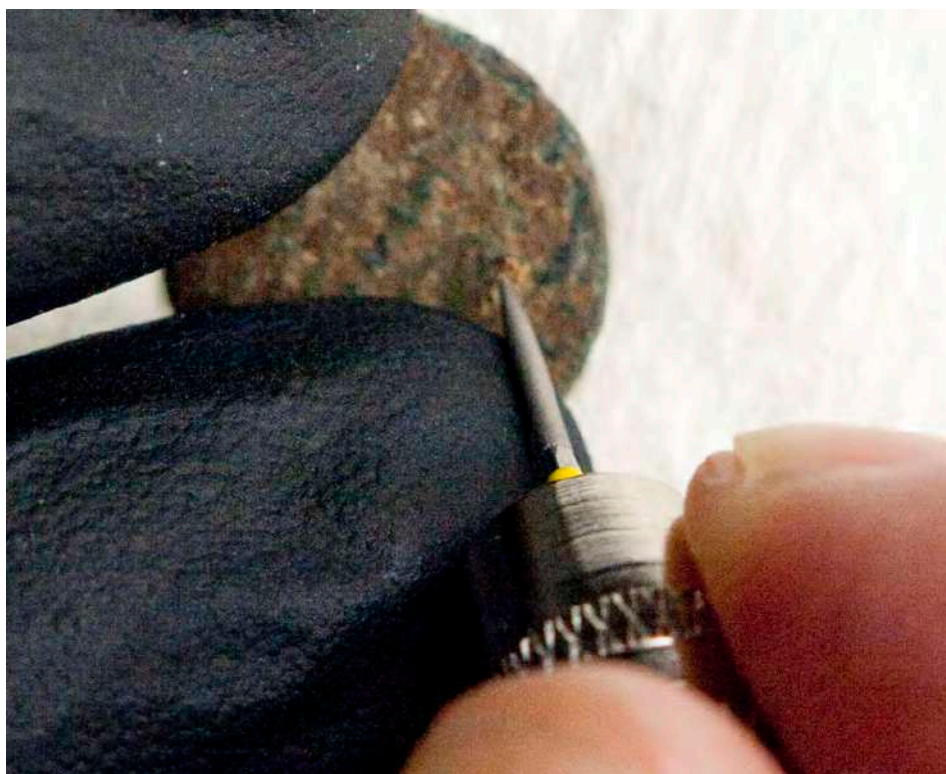
You will realize that whether the coin is damp or dry when you place it on the microscope does make a difference, and with practice you will learn which one is better for different purposes. If you dry the coin with the paper towel and then blow on it gently, you will see that it dries quite fast (it's not really dry, of course, as there's some humidity still in the dirt and crevices). You can see that the dirt looks different than when it was wet, of course. When you use the cleaning instruments initially it's better that the coin be slightly damp, as the water helps lubricate it and you might reduce the risk of damage to the coin. However, when the coin is dry under the microscope, it's usually easier to discern which areas are patina, metal, or dirt, given the color contrast, and therefore it is safer for smaller details. At the same time, when a very dirty coin is slightly damp you will see that the dirt remains wet a bit longer, and thus it's easier to identify it and work on it.

Pinning the coin down in focus, take a sharpened toothpick and test the hardness of the encrustations. If some comes off, keep doing it until you get as much dirt as possible out of the coin. But toothpicks really suck for this, so don't get too frustrated. Wipe the coin with a moistened Q-tip. You may skip the whole toothpick step if you're too lazy or if you can tell that the encrustations are pretty hard to begin with.

The ideal way to use the straight diamond tool is as follows: Put the finger protector on your middle finger, in the area where the tool would be in contact with it, usually right above the fingerprint. Hold the tool exactly as you would hold a pen (adapt these instructions to whatever

way you hold a pen). Writing is a very precise task, so it should come naturally to you when you try to guide the tool with great precision. You may or may not have a steady hand, but either way, I recommend you use your left index finger as support, as explained next and illustrated below.

Place the coin on the microscope, pin down with left index and middle fingers, focus, and take the straight diamond tip tool. Make sure your right hand is leaning on either the microscope or your table, and not just floating in the air, as you need a point of support for your wrist, elbow, or both. Carefully place the tip of the tool on the dirt area you want to clean. Put the shaft of the diamond bit against your left index finger (I lean it against the fingernail, but whatever works for you; that's the other good reason for using a glove on your left hand). This provides support for the diamond tool, otherwise it is very easy for it to slip and scratch the coin. Plus it gives you a lot more control over the movement of the tool. You can also use your left finger to push the tool back and forth, as you lean the tool on it. In other words, you're using both hands to scrub in tiny movements. Since I used the writing simile already, imagine that you are writing teeny tiny o's and i's, or whatever letter you need to write to clean a given area of the coin. Notice that the coin is blurry in the illustration because the focus is on the tool and fingertips; it should never look blurry in your microscope.



In most cases, you can see the devices, bust, and letters in an "uncleaned" coin, unless it's completely covered in dirt. If you can't see anything beneath or around the dirt, start by scrubbing the areas that look or feel softer very carefully, and try to identify some sort of shape or feature as you scrub carefully and patiently. If you can in fact already see something that is not dirt, such as an area of patina or metal, work around that area until you figure out whether it is the reverse or the obverse. This will help you make a decision about where to continue

scrubbing. The fields in the reverse tend to be larger than on the obverse, as the bust usually can take a lot of the space. Try to figure out what type of coin it is, as this will help you decide which areas to clean first. Even in a coin that is very dirty, like the one pictured above, you can often see some detail that might help you identify it. The coin above is very likely a Gloria Exercitus reverse of a Constantinian Dynasty coin, with two soldiers and one standard between them. If you're already familiar with that type of reverse, you will know where to scrub first. So in this case, scrub between and around the soldiers and the standards. You know they are holding inverted spears which are very thin, so you scrub carefully around them, and so on.

Don't use all your strength when you scrub. In fact, start by scrubbing with the minimum force possible in order to test the hardness of the dirt. If the dirt is coming off relatively easy, keep doing it, slowly and carefully, and without much pressure or force. You want to make sure that you file the dirt away, rather than scrape it off, lest you might scratch the coin. As you scrub very lightly, very little dirt might come off; what you are doing is wearing down a layer of dirt, not the whole thing, so don't rush. You can wipe with a damp Q-tip as you clean so you can see the progress, but remember that the progress might be a whole 2sq mm of the letter "A," so don't get discouraged. Also, when you wipe with the Q-tip you have a clearer view of what you've done, so you will reduce the risk of scratching the patina or the metal.

Note that you can also use the side of the shaft of straight diamond tool to gently remove dirt from the edge of the coin, which is otherwise one of the most annoying things to clean because it's very hard to see what's on the edge unless you stand the coin up. And even then you can only see a small portion of the edge. With this tool you can just scrub the edges as the coin is flat on the microscope. Just place the shaft of the diamond tool against the edge of the coin and scrub lightly.

If you deem it necessary because of heavy encrustations, you may choose to use the carbide tip engraver (re-read the description above about how dangerous this thing is). You can penetrate into the hard encrustation with the very tip while you wiggle it a bit in order to loosen it, or you can use it at a low angle to exert pressure on it until it cracks. But don't ever overdo it with this tool. It will really damage the coin. Why do I use it? Because it breaks through tough encrustations like nothing else does. Paradoxically, you can also use it for extremely detailed work. For example, if you need to clean a tiny crevice or the unreachable tiny corners of the letters, you can very carefully and lightly rub it with the carbide tip a couple of times, wipe with Q-tip so you know the result, and repeat if necessary. But do follow the instructions about leaning the tool on your index finger for precision and steadiness. If you're using this tool for detailed work, you need precision here more than any other time in your life (unless you're in the space program working with lasers).

If you have several coins in the bowl, repeat the process with all of them. Discard the water, rinse the bowl with tap water, wipe with paper towel, rinse again, fill with fresh distilled water, and put the coins back in.

Repeat this entire process every two or three days as you change the water. Do it for about a couple of weeks or until you are satisfied with the results. It has happened to me that I had to leave the coin in distilled water for a few weeks longer.



The rounded tip diamond dust tool should be used to scrub any area, but it's especially useful for the fields; that is, the flat areas of the coin that don't have relief. Use by scrubbing with a tiny circular motion, also very lightly and without much pressure or force initially. If you feel confident after assessing the hardness of the dirt and encrustations, you can experiment with being more forceful, but always trying to control the pressure. As you acquire experience, you will be able to decide what kind of force to use. Don't use the Dark One.

If you have very hard encrustations that you believe you want to remove (sometimes you might choose not to, if they are stable and are not obtrusive, and don't detract from the coin), you can also use the round tip diamond tool for this purpose. They can be broken off with pressure, but do it very carefully, as it is easy for the tool to slip and scratch the coin. The advantage of the round tool is that it's more stable and it gives you more leverage for exerting pressure than a pointy tool. Using your left index finger as support, place the round tip on the encrustation. With light pressure, roll back and forth on the encrustation as you press down. You may increase the pressure as you see fit, but it happens often that encrustations begin to crumble within a few seconds. Wipe with a moistened Q-tip, assess the condition of the encrustation, and repeat if necessary. Usually some fragments of the encrustation remain on the coin, and they can be carefully scraped off with the round tip tool, or with the regular straight tool, as you see fit.

This rolling method for removing hard encrustations can also be used when you encounter layers of dirt that appear to crack away when you put a little pressure on them. Try it both when the coin is damp and when it's dry, as the deposits behave differently under different conditions. As above, make sure you don't use too much force when doing this. If they do crack, repeat the rolling back and forth in all similar areas gently. The fact that you were able to crack the dirt in one area doesn't mean you'll be able to do it in the whole coin. Some dirt might be more engrained on the fields than, say, on the edges of the coin or the designs. Once the dirt cracks, you still might have some residue under it, so wipe the coin and assess whether or not you need to go back to the straight tool in order to do more detailed cleaning, which is usually the case. It does happen sometimes that the patina cracks as you do this because it might have crystallization underneath. It's a tough decision, because if the patina is in fact that weak and crystallized, it might mean that it's rapidly decaying or beyond mending. But you can try to keep filing the dirt away gently to try to avoid further damage to the patina, and hope that you can salvage as much of it as possible. The risk remains that perhaps the patina is that weak because something is going on underneath so, as always, keep monitoring the coin after you finish.

When you are satisfied that you have removed all dirt and encrustations you wanted, it's time to use the brass brush. I don't recommend you use it before that, as it doesn't remove much dirt from an uncleaned coin. And whatever dirt it removes, it's not worth the risk of shining the high points, such as bust and letters, or any other exposed metal areas before you clean the coin.

It is actually not easy to scratch the patina or even the metal with a brass brush. In order to reduce that possibility, you should dull the bristles by firmly brushing several times an uncleaned coin that you've given up on because it's nothing more than a slug. Examine the bristles under the microscope to make sure they are not sharp. To further smooth the bristles, you should also brush a modern coin out of your pocket, such as a copper penny or similar. This will also allow you to better understand the effects of the brush on metal.

To brush a coin, hold it firmly with your gloved hand, with three or four fingers, and brush in a circular motion. So that you brush all the areas evenly, rotate the coin in order to brush the areas blocked by your fingers in the first brushing. If you want to avoid brushing the bust or devices too much so that they don't take the blunt of the brushing, you can angle the brush at about a 45° angle so that the bristles don't rub them as much.

I brush coins in front of a HEPA air filter intake in order to reduce the possibility of inhaling the particles that come off. You might not think that's much, but you can never be too safe. If I had inhaled the particles of all the coins I've brushed throughout the years, I could probably mint a few coins with whatever was in my lungs. So do it in a well ventilated area and maybe hold your breath. But not so much so that you pass out.

When you brush a coin before you clean it is possible that you might end up with a lot of brassy-colored areas on top of the dirt and encrustations, as the brush might leave behind a micro-coating of brass. In some cases, your coin might look golden, which is not good. Even when you brush a cleaned coin, you might still have some brassy colored spots. Don't panic. Most of the time you can rub that off with a moistened Q-tip. In some cases, you have to rub very hard in order to wipe it off. In some extreme cases, the brassy color will not come off with the moist Q-tip. If that happens dip the Q-tip in a sodium sesquicarbonate solution (see below) and try rubbing the coin again. If that still doesn't do it, dip the coin itself in the solution for a few hours or overnight and rub with a Q-tip moistened in the solution. That should take care of it in most cases, if not all.

Silvered bronze coins behave in various ways under cleaning conditions. You have to remember that most if not all the coins of certain eras were silvered at some point. This is the case for the bronze coins of the III and IV centuries, and even some Byzantine coins. Most of them have lost the silvering, but some still have remnants or even full silvering in some cases. Silvering contributes a whole new list of elements that interact with the bronze and the environment. You can use both diamond dust tools on dirt and encrustations that are on the silvered areas, but you must do it very lightly in order to test the response. Cracking encrustations with the rounded diamond tip can be done over silvering areas as well, but if your hand slips you will scratch very easily. When you dip silvered coins in distilled water, do check them a couple of times every day. Sometimes the silvering begins to come off the coin. This is might be because there's a corrosion process going on with the bronze that doesn't necessarily affect the silvering as fast or at all. If that's the case, you have to make decision about whether to continue and lose some of it, or whether your coin needs more cleaning and you have no option.

Regarding the so-called "desert patina," I have to say that it's not always great for the coin. I must clarify that I'm not trying to discourage anyone to stop liking "desert patina." I just distrust it due to what I have seen. Firstly, it's dirt, not really a patina. It's pretty dirt in some cases, for sure, but dirt it is. It's not necessarily that the coin neatly acquired sand in the fields, leaving the high points untouched. Granted, that might be the case for some coins. But what happened most likely is that someone stopped cleaning it once the high points were visible and you could identify the coin. Second, there are people who actually glue sand to coins to recreate the "desert patina" in order to sell them as such, which is pretty bad for the coin and quite unethical. Third, I have seen a lot of bad things happening under the dirt when I clean these coins. It is possible that

you won't see any changes in these coins for decades or even in your lifetime, but it has happened to me that in a few years or less I've seen decay on a few coins of this type. In forensic or scientific terms, I can't demonstrate this, since I cannot present valid proof to satisfy experts in those fields. I can only say that my opinion is based on my own experience of cleaning many coins over the years, to which is added the logical conclusion that you can draw from analyzing what's going on with the coin: the dirt is collecting and maintaining humidity, and the dirt might have minerals that will react with the humidity and the air, and therefore with the bronze, ergo decay is a real possibility. Whenever I clean a coin with "desert patina" I often see either signs of bronze disease in different levels of progression, or actual corrosion on the metal under the dirt. These are minimal in some cases, but they point towards impending future decay. So yes, I do clean coins with "desert patina." It's up to you if you want to do that as well, but better to do it when you have a lot of experience. Unless you're treating bronze disease, you can now skip down to "6. Conservation" section, below.

## 5. Bronze Disease

**a) About Bronze disease** (treatment is explained below, after this long digression about BD).

Bronze disease: you won't catch because it is not a disease but a chemical reaction. There are many internet resources on the subject, so I'm not going to go into much detail here about the nature of it. Suffice it to say that BD is caused by chemical reactions that produce cuprous chlorides; when these are exposed to moisture and oxygen, they produce hydrochloric acid, which attacks the metal and at the same time produces more cuprous chlorides, which in turn produce more hydrochloric acid, which produces more cuprous chlorides, and so on, until you hear a creepy voice that says "this coin will self-destruct within the lifetime of your pet iguana". And yes, the coin will eventually be obliterated from the face of your coin tray and of the planet.

You should know that you cannot fix a coin that has been eroded by BD. Whatever damage has been done to the coin is 110% irreversible. Period. Period. Triple period. The metal is not going to grow back out of the pits carved into the coin by BD. The reason you treat a coin that has been eroded by BD is to stop or slow down the corrosion process so that you can save whatever is left of the coin. And there are no guarantees. Ever.

The other reason you treat BD is to prevent a coin from being eaten away if the BD is just in the early stages. BD doesn't happen spontaneously. It is a process, and therefore it has various stages. We are mostly familiar with the one at its more advanced stages, when it's blatantly visible to the naked eye (see illustrations below). This is often characterized by a bright, chalky, light green powdery looking substance. But the color can vary greatly within the green spectrum and beyond. Sometimes it's almost white, others quite dark, almost black. It can also manifest in grayish lead, brownish reddish, and other pretty hues. One of the biggest dangers of early BD is that it's easy not identify it on time and to assume that your coin is safe. That's because it's often easier to be in denial, wishing that a tiny bright green dot on the face of Maximianus is not BD at all, and even if it is nothing bad is going to happen because it's so tiny. Again, BD has many different manifestations, not all of them readily visible. BD does not come in two shades: "Really-bad-hugely-obvious-green-nasty-stuff" and "Oh-this-coin-is-so-pretty-and-healthy." But for some reason that's how people seem to look at it every time.

Assume that the coin details pictured here reflect what the whole coin looks like: a coin covered in dirt and deposits, with some tiny spots that may or may not be visible BD.



(Un)fortunately, the whole picture, as it were, makes it rather obvious that most of the coin is compromised because there's BD in every chipped or pitted area of the coin. You can see it clearly in these two examples, but it does happen that a coin might be completely covered in dirt and you can't see the BD underneath. It hasn't manifested visually because nobody has removed a layer of dirt, or because the BD hasn't yet caused the top layer to cave in.



Call me a BD hypochondriac, but in my experience, a good number of "uncleaned" coins do have some ongoing BD process, if only in the early stages in some cases. This is due to the fact that such coins for the most part, if not always, have been hastily washed, and improperly dried and kept. Here are a few more examples of bad BD in different manifestations:





BD is, in a way, patination that kept company with the wrong element and followed the wrong chemical path to become something else. The patina is the natural coating formed by stable oxidation of the coin as it reacts to its environment, and once formed will protect the coin against further damage. Therefore, it should never be removed. But even a firm patina is still vulnerable. If there are any areas of it that have some weakness, BD might develop eventually. Hence the importance of conserving coins and keeping them in a dry place. Any collector that happens to live in a high humidity part of the world knows perfectly well what I'm talking about.

In almost every instance of advanced BD, some areas of the patina might be blended into it. That is, BD is slowly eating away the edges of the patina, and it might continue underneath it for a few mm or throughout the entire area, as is probably the case with these coins:





So you have to give up some or all of the weak patina sometimes, otherwise the coin will eventually erode away. Good patina is very strong and very hard. In fact, it is as hard as the metal. If you have a weak patina, in my opinion, there are ongoing process underneath that have affected it. SSQ will easily eliminate weak patinas in a few days. If that happens, it is because your coin was chemically unstable and the patina was weak. Strong patina will be eaten away by SSQ also, but that would take several months of soaking. So a strong patina is relatively safe if soaked in SSQ for a couple of weeks, in my experience. And yes, sometimes you might have to dip a coin with a strong looking patina because there might be spots of budding BD.



There are voices out there crying out to defend patina against all evil forces in the world. I agree with them, but only when they talk about healthy patina. When someone claims that coins like the ones illustrated right above actually have patina worth defending, I have to say that it is a pointless outcry. As much as you might want to think that there is some patina left on these

coins, it's mostly BD in many pretty shades of green. The surface is extremely soft, and after SSQ it will only have spots of actual patina left in random places. But if left like this, they will continue to deteriorate rapidly and turn into pock-marked slugs sooner rather than later.

#### **b) Treatment for bronze disease.**

There are many methods for treating BD, but most of them are for professional archaeology conservators who have an entire laboratory with all the necessary supplies at their disposal. Many of these methods involve dangerous chemicals and a lot of expertise, and some are very complicated and might take years. I avoid them completely. I use sodium sesquicarbonate, which in my experience is a safe and relatively easy method. SSQ is basically baking soda on steroids. It is not dangerous or harmful *per se*, but as always treat with great care, don't inhale, don't rub on your wounds, etc. It's used industrially for water treatment, as a food additive, for bath salts, etc. It can produce carbon dioxide when it reacts with the acid on the coin, so use in a ventilated area. Then again your own body produces 1 kg. of carbon dioxide per day, so don't freak out too much.

I mix a solution of 5% SSQ with 95% boiled distilled water. Boiled water allows for the SSQ to dissolve better, and it might even have an effect on allowing the solution to penetrate more efficiently. Before you put the coin in the solution, test with sharpened toothpick, then gently with diamond tool, and remove whatever appears to be BD. Aim initially for the areas that are bright, light green, and any areas that appear to be soft or powdery. It is painful when you realize that in some cases the BD just keeps going into the coin, or that what you thought was firm patina just crumbles. But that's what happens with BD. There's nothing you can do about recovering what's lost. After you remove as much BD spots as you can, dip a clean Q-tip in the solution and wipe the coin on both sides. Carefully drop the coin in the solution without splashing. Depending on how badly affected the coin is, the solution will begin to turn green within a few hours or by the following morning. Leave soaking for a week, stirring or swishing every couple of days and flipping the coins over when you do it.

After a week, take the coin out with the chopsticks (less dripping, less contamination, etc.; the solution might stain your clothes and your desk, so be careful; also, it might be toxic once it has dissolved some chemicals off the coin). While holding the coin with your gloved hand, wipe the coin with a Q-tip on both sides and see what comes off. Get a new Q-tip and just dip it in the solution, then wipe the coin again. Repeat as long as the cotton is stained by the residue coming off the coin (not by the solution, which might be greenish). Now pat the coin dry and examine it under the microscope. Try to identify what areas are still affected, and use the tools again to remove soft and powdery areas carefully. Wipe with Q-tips. Discard the solution and prepare a new one. Dip the coin again for another week, and repeat the whole process until you think the coin is stable. When is that? Well, that's the tricky part. You never know. The average for early stages of BD is just a couple of weeks, in my experience. Sometimes you have to do it for months. You don't know what's lurking under the areas you can't see, so it's a matter of acquiring experience while doing it. I could give you an easy answer and say "soak the coin for 17 days, 5 hours, and 42 minutes, and time it so that the full moon appears in the 12th day" but it doesn't work that way. Remember all BD is different, just like the coins, so your acquired experience as you work on them is ultimately what will give you the right answers for your specific coin.

In some instances, for weak patina, you can try to dip the coin on SSQ and check it every day. When you check it, rub it with a Q-tip and see if the cotton is stained with residue. When you feel that it's staining less, rinse under running tap water and then dip it in distilled water for at least a week if you want to try to save what's left of the patina. Take it out, pat dry with paper towel, dip in acetone, and store it safely for a few weeks or months, monitoring it often. It does happen that weak patinas might stabilize. If that happens, conserve the coin following the conservation guidelines below. After all, SSQ does sometimes neutralize the evil chemicals. Unfortunately, you never know when that's going to happen given that, again, all coins are different. If it begins to deteriorate, treat it again if you want to save what's left, even without leaving much of the patina behind.

When you finally decide you are done with the treatment, it is recommended that you stabilize the coin chemically. Rinse the coin thoroughly with running tap water, wipe with Q-tip soaked in distilled water a few times, then soak in distilled water for one to two weeks, changing the water every day. This will get rid of most or all contaminant residue, and even if it might not be perfect, the resulting coin now has a better chance to survive. Monitor the coin every day or two, and wipe with a Q-tip if you see the need before returning it to the water.

If the entire non-metal surface of your coin got basically dissolved by the BD, don't feel too bad. That means that it was in a terminal state, and that it was only a matter of time until it happened on its own. In fact, it means that you saved whatever was left of the metal before it deteriorated any further.

Many people warn about the fact that SSQ will darken the patina. I don't understand why they are so surprised or so worried about it. Anytime you clean a coin it is obvious that you are likely to end with another tone or color, given that you're in fact cleaning the coin, an action that implies removing layers of dirt and diverse types of deposits or coatings that have obscured it. Second, if the coin gets darker it might be because you removed a top layer of BD, so obviously it's going to be darker; maybe it does change the color of the patina itself, but why is that wrong? What tone should patina be? It's whatever it is, and a darker patina is the least of your problems when you have a coin with BD that's in danger of being obliterated. I think the important thing is to save the coin and prolong its life. After that, you can pine about not liking the tone of the patina all you want.

If your coin is silvered, it's only a guess whether or not the silvering will survive the treatment. Sometimes it does, sometimes it doesn't. If you have a silvered coin with BD, you can try treatment with close monitoring. It has worked for me on a number of occasions.

As it is always a risk to treat for BD, it's a decision you have to make by evaluating your coin. I am a dealer of ancient coins, and I know it would be easier and more profitable for me to just wipe a coin that I know will not survive much longer and make it look pretty and shiny, or mask it with artificial patina (see Epilogue) in order to sell it and let it dissolve in someone else's coin tray. But I simply don't do that, and I assume and hope that most people reading this won't do that either.

**6. Conservation.** Without it, you run the risk of letting your recently cleaned coin go astray. Conservation is essential to try to prolong the coin's life. It implies cleaning the coin so that you know you have done your best to eliminate dirt, contaminants, and/or BD, and then protecting the coin against further environmental insult. There are always risks that the coin wasn't cleaned properly or that there are reactions that begin after you cleaned the coin. This is why it's very important to monitor your coins for as long as you have them.

After you finish cleaning the coin, dip it in fresh distilled water for a few days. After that, take it out and dry it gently with a paper towel. When the coin is dry, leave it overnight to dry further. If you live in a high humidity area, store it overnight with silica desiccant packets. Once you're confident the coin is dry, dip in acetone following the instructions above (2. Acetone). When you wipe the coin with a Q-tip and acetone you might still get some stains on the cotton. Keep dipping the Q-tip in acetone and wiping until the Q-tip doesn't stain. After the acetone evaporates, which is almost immediately, let the coin acclimate to room temperature for a few minutes (it will be cold from the acetone). The acetone eliminates the water or humidity that might be in the tiny crevices and "pores" of the coin, which can be microscopic in width. Wipe lightly again with a clean Q-tip, in case the cold coin collected some minute condensation. Then, take another clean Q-tip, scoop up a small amount of Renaissance wax, and apply a thin coating to the coin. The Q-tip might still pick up some stains, as the wax also has cleansing properties that differ from those of the acetone. When the staining stops, give another light coating and rub in a circular motion several times. You can shine with a clean Q-tip by rubbing it on both sides and on the edges. If you have a Dremel tool, you can shine it in low rpm's with a soft felt disc. Examine the coin under the microscope to make sure that there aren't any little globs of wax accumulated in the hairlines of the bust, inside the letters, etc. If there are, you can remove them with a sharpened toothpick and rub again with Q-tip. Repeat as necessary. This is actually the one time when the toothpick is the most ideal tool.

Now your coin is ready to be photographed and stored in your tray. And, suddenly, we're done. Sort of. Here's some additional stuff.

### **Bitter Afterword**

If you're thinking of doing this to make a profit I'm sorry to say it doesn't work out very well. Sure, I've gotten some coins for \$5 that turn out to be fantastic. But that's one coin out of a few dozen, or a few hundred in most cases. If I factor in the man-hours spent cleaning a coin, I would have to sell a common Constantine II soldiers with banners coin for \$275 in order to get my time's worth, not considering the effort, the years of learning by trial and error and error, the supplies and tools, etc. But I still have to sell it for whatever the market price for that type is, even though the coin has been carefully stabilized and conserved, and will likely outlive its rivals. Sadly, most people truly don't think about where the coin will be in 100 years.

I recommend that you only clean ancient coins if you enjoy it and if you want to be the first person in 1800 years to see what's under that dirt.

## Bitchy Epilogue

### What not do to a coin.

As a final note, I'd like to give my personal opinion on what I would never do to a coin, which I therefore recommend that you don't do either. Of course the coin is yours, and you're free to do with it whatever you wish with it, but if you do any of these things I believe it's only fair that you tell the next owner of the coin.

All of the following go against the point of cleaning and conserving a coin so that it is protected against future decay and damage. Of them, only artificial patina is sometimes reversible—although that's also not good for the coin. The others are permanent changes that deface the coin.

**a. Patination.** I never apply artificial patinas to a coin. There are many methods to reproduce the patina, and all of them involve chemicals of different sorts. In some instances, paints and varnishes are simply applied to the coin which, of course, traps humidity, all contaminants, and ongoing reactions inside the coin. I am completely against artificial patinas of all kinds. Although I'm sure sometimes it might be done without an ulterior motive and only for the sake of having a prettier coin, it is often done by people who want to get a better price for it. I think that is unethical, but then again that's just my opinion.

Any chemical you use on a coin is going to have a reaction sooner or later. Acetone and SSQ are chemicals, of course, but they have been proven to not harm the coin if used properly. Most artificial patination solutions in the market contain a number of acids, such as phosphoric and muriatic, and many other ingredients such as selenium dioxide, ammonium chloride, copper sulfate, cupric nitrate, sodium hydroxide, silver nitrate, etc. Acids of any kind are absolutely not good for bronze coins, and they tend to appear often in the list of ingredients for these solutions. All the chemicals for artificial patination in the market today are meant to be used for "antiquing" furniture knobs, handcrafts, jewelry, sculpture, etc. They were concocted for the purpose of ageing newly made objects specifically. But at some point someone had the brilliant idea to use them for ancient coins, and it became commonplace to do that.

I firmly believe these chemicals should never be used for an ancient artifact unless you are an expert conservator in a museum attempting to repair a damaged bronze object in order to protect it. Even the experts in the field of museum conservation aren't sure about the consequences of artificial patinas, as evidenced by many scholarly articles on the subject. Better not to do it to an ancient coin.

**b. Smoothing.** I never smooth a coin. Smoothing involves flattening a defect on the metal of a coin, usually a scratch, by grinding the metal with a tool until it's even. This is done to the fields for the most part, but sometimes it's done to other features such as the bust and the devices. When you even the surface by removing encrustations that had attached to the original surface it is not smoothing, it's cleaning. When you alter a part of the original metal of the coin by grinding it down, it is smoothing.



**c. Tooling.** I never tool a coin. Using tools to clean a coin does not constitute tooling. When a coin is cleaned you are not altering the metal but removing whatever has grown out of it or on it that is not solid patina. Tooling is the alteration of the metal in order to recreate details that have been corroded or worn away. Another definition: Tooling is faking an area of the coin that had ceased to exist and is now being resurrected artificially. This is, in my opinion is unacceptable.

In my very personal opinion, I don't think these practices are ethical, and in some cases they are blatantly fraudulent. Some collectors might not mind buying a coin that has been altered by these means (rare and pedigreed coins that have been tooled and smoothed do come up for auction sometimes). If they do so knowingly because they have been informed, that's their prerogative. And if they inform the next buyer, that's fine too. But at some point in the chain it might happen that someone "forgets" to mention it to the next customer. I suspect there are many coins in the market today that have forgotten what happened to them. Unfortunately, such is the danger of collecting anything. Unbeknownst to the seller, you might buy a coin that has suffered one or more of these modifications. Therefore, it's better to reduce the odds of that happening by sticking to dealers you know and trust whenever possible.

Ok, time for you to go clean some coins.

Below, an Appendix with some examples of coins I've cleaned.

## APPENDIX

Below, some examples of coins I have cleaned. They all took a long time, some several months. I have included examples of different types of coins with different encrustations and types of dirt. Also, there are a couple of coins that didn't turn out that great. I didn't include any of the ones who turned out ok, so-so, or horrible, which does happen a lot. As discussed, most "uncleaned" coins will not clean well, and more often than not you will find a very worn or corroded coin under the dirt.

The ones that did turn out quite nice are not at all the typical results you get from your average lot of "uncleaned" coins. However, these examples are very much the typical result of cleaning a lucky coin patiently and properly. Luck is a factor, of course, but if you don't clean it and conserve it properly, you might never find out if your coin was indeed a lucky one.





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM







ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM





ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM



ROMANORUM.COM