What You Need To Know About: Grading

Or: Tying it all Together – The Science and Art of Grading
By Jason Poe

The single most important thing a coin collector needs to be able to do is to grade a coin. A seller and a buyer must agree on a price – and that price is determined by the grade. Once the basics of grading are mastered, only the subtleties of a series or issue must be learned. I think most would recognize that learning to grade coins quickly, accurately, and consistently can be somewhat challenging. And so, after a journey spanning almost two years, the sixth and final article in this ongoing series will conclude our discussion on grading. I highly recommend you go back and review the entire series, which I've linked below. To properly grade, you must understand each aspect, and be able to judge how to weight each in a holistic view of the coin. An experienced grader is able to quickly judge each aspect without counting the number of marks or using a photometer to measure luster.

It was not until the 19th century that numismatists began categorizing coins in the broad groups of poor, good, fine, and uncirculated. The publication of William Sheldon's*Penny Whimsy* brought about the 1-70 point scale that we use today. The ANA used the Sheldon scale as a basis, but adapted it to other series besides the large cent. When the Third Party Graders came on the scene, the grading scale was still not quite in its present form. In the first edition of the ANA guide, only MS-60, 65, and 70 were recognized. In 1986, PCGS was founded; NGC started grading coins in 1987.

The Sheldon scale is divided into two separate overarching categories. Uncirculated coins comprise numbers 60 continuously through 70. These are coins which show no signs of wear. Their details are as struck, showing no trace of metal being removed from their high points. Basic descriptions below of several grades are taken from the ANA Grading guide, 5th edition:

MS-60: below average to average luster and color, numerous noticeable marks, obvious mishandling, below average eye appeal

MS-63: below average to above average luster and color, some noticeable marks, minor mishandling, below average to average eye appeal

MS-65: average to above average luster and color, light marks, no signs of mishandling, good eye appeal

MS-67: exceptional luster and color, virtually no detracting marks, no signs of mishandling, exceptional eye appeal

The problem with grading is that almost every descriptor for a grade is subjective. What I think is exceptional eye appeal might be to you quite unattractive; what I determine is above average luster you might think is just average. Learning all these subtleties is what makes the grader's job so difficult. With practice, and examining hundreds or thousands of coins, anyone can come to learn the qualities of a coin, and what makes certain coins grade higher than others. Looking at coins already graded by experts (such as the TPGs) will certainly promote good grading skills.

Coins in the Circulated category range from Poor-1 through About Uncirculated-58, and are broken down as shown in this chart adapted from the ANA Grading guide, 5th edition. As you can see, only certain numbers are used – the scale is by no means a continuous gradation from 1- 59:

Poor (PR-1) – Identifiable as a coin.

Fair (FR-2) – Extremely heavily worn, outline of major devices visible.

About Good (AG-3) – Very heavily worn with portions of lettering or date worn smooth, date barely readable.

Good (G-4, 6) – Heavily worn, Major designs visible, but with faintness in areas. To qualify for G-6, coin must have full rims.

Very Good (VG-8, 10) – Well worn, major designs visible but with faintness in areas. Head of Liberty, wreath, and other major features visible but without center detail.

Fine (F-12, much less common 15, 18) – Moderate to considerable even wear. Entire design is bold. All lettering, including LIBERTY (on coins with this feature on shield or headband) visible, but with some weakness.

Very Fine (VF-20, 25) – Moderate wear on the high parts

Choice Very Fine (VF-30, 35) Light even wear on the surface, design details on the highest points lightly worn, but with all lettering and major features sharp.

Extremely Fine (EF-40, 45, also called Extra Fine, also abbreviated XF) With only slight wear, but more extensive than AU, still with excellent overall sharpness. Traces of mint luster may still show.

About Uncirculated (AU-50, 53, 55, 58) – With traces of wear on nearly all of the highest areas. Half to all original mint luster remaining.

These brief descriptions are merely a guide to the scale – far more detailed, series specific criteria can be found in a guide

such as the ANA Grading Standards or Photograde. Another resource I highly recommend is [the PCGS Photograde website.]

Once you have determined the numerical grade of a coin, you can then apply any descriptors or qualifiers to the grade. Many of the strike designations are discussed in my article on Strike. Other qualifiers you will see on a coin are *, +, CAM, UCAM, DCAM, PL, DPL, and any number of other descriptors as the grader sees fit. The Star (*) is a designation only used by NGC, and it designates the coin has exceptional eye appeal. Plus (+) is a new designation for the TPG's, but has been in use in general grading by many sellers for a while. It designates a coin which is in the high range of certain grade (for example, a 64+ is a coin which just barely misses being a 65). Prooflike (PL) and Deep Mirror Prooflike (DMPL or DPL) coins are incredibly beautiful, mirrored coins which were made as Business Strike coins, but have the appearance of proofs. If the coin you are grading looks to be a very nice EF-40 coin, except for a large scratch across the obverse, there is no way the coin will sell for an EF-40 price. Someone who just saw the coin described as EF-40 would be expecting a problem free, original coin. In this case, you must add a qualifier to the grade to describe the problem. The coin would properly be graded as "EF Details, Scratched." Both NGC and ANACS will describe problem coins on the slab this way; PCGS does not offer a details grade but labels the coin Genuine, with a "Designation Code" attached to the serial number. You have to then go look up the code to see what the problem is.

(NGC MS-64 FBL PL Franklin)

The mint also makes Proof coins (throughout its history, it has made proof coins in a number of different surface finishes, but the ones made today are Brilliant Proofs). Proof is not a grade – *it is a method of manufacture.* Proof coins are made from specially prepared dies, using specially prepared planchets, and struck at least twice using higher pressure. Proofs are graded using the same 1-70 point scale, but designated as PF by NGC or PR by PCGS (in contrast to the MS grades listed above). Proof coins have the designations Cameo (CAM) and Ultra Cameo (UCAM) at NGC, or Deep Cameo (DCAM) at PCGS. Different levels of contrast are required to achieve each designation, with Cameo coins being slightly contrasted and UCAM coins heavily contrasted.

(1962 Proof Franklin, NGC PF-67UCAM)

Before you start grading a coin, the right tools are essential. Your study area at home will have a very different environment than your local dealer or a coin show. I personally use 15W helical fluorescent lights in my desk lamps; this same lighting is used for all pictures I take. Other lighting sources to be aware of: incandescent bulbs, which are quickly going out of style. These produce a large amount of heat, and their light is generally more yellowish than other light bulbs. Halogen lights are very harsh, and can make the coin look much worse than it really is. In some cases, such as at a flea market, sunlight is the only available option. Sunlight is highly variable based on the season, time of day, weather, etc., and is generally a softer light. experiment performed by the legendary Mark Goodman.

The other tool you will need is some sort of magnification. While your initial grade should be based on a "naked eye" appraisal, it is often important to examine the coin closer. Evidence of cleaning, hairlines, die polish lines, puttying, or any number of other problems may only reveal themselves under magnification. Further, a close-up will give you a better idea of certain details of strike, such as the head on the Standing Liberty Quarter. For grading, you probably shouldn't use anything much stronger than 5x magnification. Many suggest a simple 2x or 3x magnifier for grading. Professional graders, such as dealers or graders at the TPGs, will usually not use any magnification at all when grading, only taking a closer look when something catches their eye.

Alright, are you ready to grade a coin with me? When you are first starting out, having a method is good. Take the time to be slow and follow the same steps each time. Most of all, take your time. For this discussion, we are going to be grading this 1960D Franklin.

(The 1960D Franklin we will be using for this discussion)

The first thing you notice is the luster. Turn the coin under the light, and the luster will present itself to you. What do I mean by that? Hold the coin firmly between your thumb and forefinger, and rotate the coin so that you see the cartwheel of luster move around the coin. Carefully watch what I do in the video below. The movement takes some practice, and is awkward with a slab, but just move the coin under the light and you will see the luster move. Moving the coin, you can see the luster travel around the coin, and how it behaves on the high points. These high points are where you must look for luster breaks, a key indication of wear which would mean the coin was AU. The luster of this coin would be strong enough for a 65.

[video=youtube;FgfHpM36u6s]http://www.youtube.com/watch?v=FgfHpM36u6s[/video]
(Video demonstrating cart wheeling luster)

Next, I usually look in the fields and prominent focal areas for large marks. Large marks in these areas will kill the grade. You don't see any large marks, but there are a number of fine tickmarks. Look next at the secondary focal areas – places like the hair, bustline, in the mottoes, or on the bell hanger. Marks in these areas are less important, but a sizeable mark here will again rule out a high grade. Again, you notice no large distracting marks, but a number of smaller tick marks. The marks on the obverse would warrant a 64 grade, the marks on the reverse would be at least a strong 64.

Now we want to look at the strike of the coin. From the luster and marks, we are trying to decide if this is a 64 or 65 coin, so we definitely need to pay close attention to the strike. Look at the fine details of the coin, such as Franklin's hair. Look at the eagle's feathers and the wood grain on the bell hanger. Finally and most importantly, look at the bell lines. The strike is pretty good on this coin, and the bell lines are clear and full. However, there are a number of small marks across the lines. The strike on this coin is worthy of a 65 grade.


(Closeup of the bell lines on the coin in question)

Finally, you evaluate the eye appeal. In reality, you've been evaluating the eye appeal all along. The first thing you noticed was how the coin looks; it's what first caught your attention. When I look at a coin, I generally formulate an opinion of the

coin within seconds. The rest of the analysis is to determine whether my first impression was correct or not. By turning the coin in your hand, looking at it from different angles, seeing how the light plays off the surfaces, you are looking for things you might have missed in your first impression. Back to the Franklin in question – there is no toning, so that part of the evaluation is not important. There is minimal spotting on the reverse which is going to hold the grade back some, and the die polish lines on the obverse slightly impede the eye appeal. So, the eye appeal of this coin is consistent with a 64.

After evaluating all these characteristics, what is the final grade? Well, everything seems to be pointing to either a 64 or 65 grade. Contact marks and luster are more important than strike, and eye appeal I use as an adjuster in borderline cases. I would give this coin's obverse a 64, and the reverse is a 65. The obverse is considered to be the more important side for a grade, and the grade of the obverse will usually be the grade of the coin. I would grade the coin a strong 64 overall, with Full Bell Lines (FBL). NGC agrees with me. If I submitted this coin several times, it's entirely possible it would come back as a 65 at one point, but it would be a low end 65. However, if I do get a 65 out of it, why would I ever submit it again and run the chance of getting a lower grade?

There are two major schools of thought when it comes to grading: Technical and Market grading. There has been discussion in the past about what each means, and I will attempt to clear up any confusion. Jim Halperin, founder of Heritage Auction Galleries, defines technical grading as "A system of grading which only takes into account that which has happened to a coin after the minting process (i.e. the state of preservation). Technical graders often ignore strike and eye-appeal." The technical grade only takes into account the marks, rub, and hits that the coin has suffered – it nearly completely disregards the other factors we have been discussing. This is in stark contrast to market grading, which noted author Q. David Bowers describes thusly: "Under this philosophy, a coin is assigned a single grade number which reflects its market price, not necessarily its technical grade. This is a departure from the grading systems outlined in the 1970s and 1980s in Photograde and the Official ANA Grading Standards for United States Coins books." The Third (and now also Fourth) Party Graders practice market grading to its fullest extent. It is important for the collector to notice – *The TPGs VALUE coins, they don't GRADE them.* This is quite a shocking concept to many when they first hear it. The TPG will attempt to place a grade on a coin corresponding to the *value* a coin should have in the marketplace. Thus, a strong 64 with great eye appeal will get a bump up to a 65 or even 66, because that is the price level it would be expected to trade at. A coin with flawless surfaces and a strong strike, but with spotty, splotchy toning will be downgraded to a 65 because it should trade at a discount to a normal 66. For two excellent and exemplary discussions of market vs. technical grading, see two very old posts here and here.

So what does the future hold? Grading is definitely still an evolving art form, as evidenced by the advent of decimal grading even as recently as last year. Some proponents argue for the adoption of a 100 point grading scale, instead of the current 70 point scale. The key is to be able to accurately be able to evaluate a coin, assess its qualities, recognize its flaws, and be able to determine if it is worthy of being in your collection or not. Once you can quickly and skillfully grade a coin, the world of numismatics is opened to you in a way that it never was before. As the well-worn adage goes, "Buy the coin, not the holder." You must be able to grade the coin in order to do this. So, time to start grading!

Jason Poe

What You Need To Know About: Wear

By Jason Poe

This is the fourth in an extended series I am writing about the basics of grading. Whereas contact marks are far more important on higher grade coins (especially Uncirculated coins, which by definition have no wear), the level of detail remaining becomes much more important as a coin passes through circulation. For people just entering the hobby, terms like Uncirculated may have already lost you. Don't worry! I'll explain it all here in this article.

To begin, coins are divided into two broad categories: Uncirculated and Circulated (I use capitals here for emphasis). The dividing distinction is that the first have no wear, the second have wear visible. Coins displaying any wear, even if only the slightest trace of rub on the highest points of the coin, are called circulated. It also doesn't technically matter where the wear came from – whether it's from actually changing hands in circulation or from sitting in a velvet coin cabinet, wear is wear. This is a matter of some debate, and I will discuss it below. However, the main point is that once a coin is circulated, it can never again become uncirculated.

An uncirculated coin, however, will exhibit no wear. It may have numerous contact marks, dim luster, a weak strike, or any number of other problems, but as long as there is no wear present, it is technically uncirculated. Here is another point of debate: a coin can change hands several times in circulation, if well protected or lucky, and still show no signs of wear. Is this coin still uncirculated? It has actually circulated, but by the technical definition (remember, it shows no wear) – the coin is indeed uncirculated. The grade of a coin is independent of its history: coins can only be graded by the visible signs evident on the coin. If you cannot tell just by looking at it that the coin has circulated, then it must be called uncirculated. As you can see below, both uncirculated coins (left) and circulated coins (right) can be quite beautiful. They are very different, and must be approached and graded differently – but the same basics apply.

The left Walker is graded MS-65, the right one is EF-45

Old collections were often stored in coin cabinets. Before the days of plastic slabs, coins were displayed on trays (often covered in velvet for softness). Over a century of being placed in a display and taken out, the coin may have picked up just the slightest amount of rub on the highest points. The coin never circulated – it sat in a display for many years. Incidentally, the velvet may have encouraged very attractive toning on these coins. This case is the flipside of the coin above – it never circulated, but shows some wear. Because we can only grade based on the evidence seen on the coin, this coin must be graded as About Uncirculated (AU).

The price difference between an About Uncirculated coin and a truly Uncirculated coin can often be quite significant. However, a host of factors play into this – marks, strike, eye appeal, scarcity, etc. A truly gorgeous coin with just traces of wear on the high points may be worth far more than an ugly, dull, lifeless coin with no wear – despite the higher technical grade. Third Party Graders (TPG's) will thus often slab coins as high as MS-63 despite having slight rub on the high points. Old-school graders despise this practice. Because a TPG is *valuing* a coin, not truly grading it, the incredibly nice AU may be worth a true MS-63's price – and thus it is slabbed with a 63 grade. This is market grading, versus the technical grading I favor.

So, with all this discussion of AU versus Unc coins, how can you actually tell the difference? On some coins, it is quite easy. However, many coins can be quite deceiving. Only under certain lighting conditions or angles of viewing will the wear become evident. On most coins, wear is evident first as a discoloration of the high points. A Lincoln cent which is otherwise cherry red will show browned high points. Look for the very slightest flattening of the high points – cheekbones, thighs, arms, or breasts are the best places to look, depending on the coin's design. Telling the difference consistently and accurately between an AU-58 coin and an Unc coin is one of the hardest aspects of grading, so as always, practice on coins graded by PCGS or NGC to learn. The coin shown below on the left is an AU coin (although undergraded as EF-45 by PCGS). Note how the highest points are a duller grey than the rest of the coin – her cheek, breasts, and certain spots in the hair. The coin below on the right is a somewhat darkly toned half dollar, but the worn high points show very well. I call this look "gem circulated cameo" – a gem circulated coin with smooth, darkly toned fields, lighter high points, and eye appeal to spare. It creates a cameo effect that I consider to be highly desirable (though some disagree).

Left: 1831 CBH graded EF-45 (should be AU-53). Right: 1832 CBH also graded EF-45

As a coin continues to circulate, the higher points continue to wear down. The luster will wear away quickly, since the fine ridges which create the diffuse light patterns are easily damaged. Soon, important details may be worn down until eventually the coin progresses to a simple round piece of metal. A circulated coin's value is largely dependent on the amount of detail still visible. Eye appeal, surface smoothness, and a host of other factors play into it – but the primary driver is the amount of wear on the coin.

Different coins have different areas which are particularly useful in judging a coin's grade. Certain designs also have areas which are notorious for wearing very quickly. Two that most rapidly come to mind are the buffalo's horn on the nickel, and the date area of the Standing Liberty Quarter. The date of the SLQ disappeared very rapidly, especially on the early years before a redesign in 1925. A coin with no date is essentially ungradeable. For several series (such as the Barber and Seated Liberty series) the word Liberty appears on a headband or shield and lower grades of the coin are largely dependent on the number of letters which remain clearly visible. The ANA's Official Grading Standards or Photograde both provide a good general outline of the level of wear allowed on each grade level, and each book also provides pictures of every series in every grade level.

1877 Seated Liberty Half Dollar, graded EF-45

If you've followed this series, or know me at all, then you can probably guess where I am heading next. I wanted to know – exactly how much circulation does it take for a coin to show wear? What exactly is the mechanism for this? After all, this series is attempting to show the scientific background of coin collecting! So, I took two cherry red Uncirculated Lincoln cents and commenced a little experiment. I theorize there are three principle ways circulated coins receive wear: hand to hand exchange, bouncing against fabric in a pocket or purse, and coin to coin friction in a bag or drawer. The first two were easy to simulate.

I started by taking the cent, getting my hand a little wet and dirty in some potting soil on my back patio to accelerate the process, and thumbed the coin to the beat of a song for approximately three minutes. I washed the dirt off, and what you see is below. The coin on the right is the untouched cent – notice the full luster, and how the high points are rounded and the same color as the rest of the coin. Now, compare that with the "circulated" coin on the right. The first big difference you can notice is the color – the cherry red patina has been stripped away and left the bare pink copper underneath. Next, look at the field in front of Lincoln. The bare patch which shows as a darker spot in this picture is where the luster has been quickly worn away. If the simulation were to progress, the luster would quickly recede to only the most protected places, such as in between lettering. On the bottom comparison, notice how the left coin has full, bright luster, whereas the right coin has a dull appearance. Notice also how the dirt accumulated in the lettering. The presence of dirt and grime in the cracks and crevices is a good indication of circulation. Finally, look at the high points of Lincoln's cheekbones. Even in this short amount of time, there is noticeable flattening of the high points of the design.

The left coin (top and bottom are different views of the same coins) is Uncirculated, the right one has been rubbed for about 4 minutes

I then progressed to the next major type of wear – coin against fabric. To simulate this, I took the coin and rubbed it on my jeans for approximately three minutes. As you can see below, the high points are now significantly worn.

The same coin, after being rubbed on cloth for an additional 3 minutes

For further demonstration, look at the two barely circulated cents below. The left coin shows little wear, but the fields are noticeably dull and fingerprinted, and the high points have toned over from the oils in a person's hand. The right coin has luster only in the protected areas – the rest has toned over. The high cheekbones and coat jacket have noticeable flattening.

So what does this tell us? After just a few hand to hand transactions, the coin may still retain most of its uncirculated characteristics. It will pick up some fingerprints, but the first signs of circulation will be in the open fields and the highest points of the design. A coin riding in someone's pocket or purse has the potential to quickly become noticeably circulated, especially if that person is active. The third primary method of wear, coin to coin friction in drawers, would be harder to simulate, but is actually more significant. If you think about it, that makes sense – a coin is harder, and will inflict more damage. For example, a rock tumbler is a very quick way to simulate circulation and wear down a coin.

The final point I'd like to make about wear is one I've mentioned before in previous articles. It is sometimes difficult to tell the difference between wear, strike, and the state of the die. This is something that practice, knowledge, and experience will help you determine. For example, the Capped Bust Half dollar below was struck from worn dies, but also exhibits significant wear. The worn dies shows as weakness in the lower, protected areas. The wear shows as flattening of the higher areas. I discuss this issue far more fully in my article on Strike: What You Need To Know About: Strike

1812 CBH graded EF-40

Collecting circulated coins can be extremely rewarding. Many collectors thrill to the idea that their coin was actually used for its intended purpose – trade and commerce. It didn't sit in some ivory tower for hundreds of years as a collector's relic. Their coin changed hands hundreds of times – these collectors like to think about all the historic people that may have used the coin. George Washington may have once spent that 1796 dollar; Abraham Lincoln may have spent that 1860 half dollar. Next time you hold a VF quarter in your hands, think about the hundreds of people that have held that very same quarter, and how many times it must have changed hands to get to the level of wear it has.

Jason Poe

What You Need To Know about Strike

By Jason Poe

If you've hung around these boards for any length of time, and if you've even remotely paid any attention at all to what I say, then you probably know that strike is a big deal for me. A well struck coin is a beautiful thing, with full, bold details bringing out every strand of hair of feather that the engraver intended. Indeed, strike quality is one of the basic aspects of a coin which is used to assign a grade – and yet it is so often overlooked. The five basic aspects of grading: luster, strike, wear, bagmarks, and eye appeal, all combine to produce the grade of the coin. For more on the first of those, Luster, see my article here: What You Need to Know About Luster

There are three very different things which can happen on a coin, but which can often confuse observers. These three things generally control the level of detail on a coin, and often produce somewhat similar appearances, but they are very different and should be considered differently when grading a coin. The first of these is wear on the die, also known as a late die state. The second is wear on the coin from circulation. Surface preservation and the subtleties thereof are beyond the scope of this discussion (but may be forthcoming in a future article). Finally, strike also influences the amount of detail on a coin.

(An incredibly well struck Franklin half dollar – don't worry, I'll show plenty of different kinds of coins in this article)

Creating a Weak Strike

So, lets quickly review how a coin is made. A planchet enters the coining chamber, and rests on the anvil die. The hammer die comes down with a certain amount of pressure, and strikes the coin. The metal of the planchet cold flows up into the recesses of the die, and the coin is ejected from the chamber. The amount of detail that is transferred from the die to the coin depends on numerous variables – the amount of pressure used to strike the coin, the type of metal the coin is made of, the amount of detail on the die, the time taken to strike the coin, the spacing of the dies, and others. All of these variables must come together exactly right to produce a well struck coin.

The design of a coin is important in producing a well struck coin, especially the balance between the two sides. Having a high relief element on the obverse directly opposite a high relief device on the reverse will generally result in a weak strike. The metal will not properly flow into the devices. Type I gold dollars had this problem, which was somewhat ameliorated by the redesign to Type II. Many of the coins which have strike designations (discussed below) suffer from this problem – the key area is a high point directly opposite the high point of the design on the opposite side.

Metals and planchet shapes are also very important. Nickel is a very hard metal, and thus is very difficult to strike properly. The mint had a hard time with die life in the early days of striking nickel coinage. Copper is a much softer metal, and thus easier to strike (note that no TPG strike designations are on copper coins). Silver is softer yet, and of course, gold is the softest of all commonly used coinage metals. Thus, finding a well struck nickel coin is going to be more difficult than a well struck silver coin, all other things being equal. How long and to what degree the planchets are annealed is also important. Annealing is a process metallurgists use to soften metals by heating them. It's a very interesting process and used in numerous places throughout the mint, but a full discussion of it will have to wait for another time. Suffice it to say that improperly annealed planchets are the biggest reason that New Orleans mint Morgans are often poorly struck.

(A well struck Morgan Dollar, and a well struck Mercury Dime)

The actual shape of the planchet entering the coining chamber plays an important part in determining the final strike. A planchet has a measurably smaller diameter and larger thickness than the final product, to allow metal to flow properly into the die. As the dies come together, the pressure of striking causes the metal to flow, compressing the planchet and causing it to flatten out – just like pressing a burger with a spatula will cause it to flatten. It is this flowing process that also creates luster. Insufficient metal at the edge of the planchet will cause peripheral lettering to be weakly struck, because there is not enough metal to fill the die at that point. I don't want to overwhelm the reader, but the shape of the rim raised in the upset mill, also known as the "planchet upset angle," also plays an important role in determining metal flow.

The third major factor in producing a strong strike is the actual coining process. Note in the list above that several of the things I mentioned all come together in an instant – pressure of the strike, the time taken for the strike, and the spacing of the dies. The pressure of striking is different for each series and denomination, but pressures somewhere between 50 and 200 tons per square inch are used on modern presses. A phenomenon known as a Die Adjustment Strike occurs when the operator is first setting this pressure – he has to adjust the operating press in increments, striking only a coin or two at a time until the correct pressure is found. If the pressure is set too low, the product will be a weakly struck coin. Once the operator has found the proper pressure, he locks the "ram pressure locking device" in place – essentially a large bolt. If the bolt isn't tightened properly, the vibrations of an operating press may cause the bolt to loosen – adjusting the pressure and causing weak strikes. At other times, a slightly lower striking pressure is a conscious decision of the mint. Lower pressures translate to longer die lives, and cheaper operations – one of the leading causes of weakly struck coins from the San Francisco mint during the 1940's and '50's.

The spacing of the dies during striking is of comparable importance. The mint operator changes this spacing, and improperly set dies will cause a weak strike. Similar to the pressure, more widely spaced dies will result in a longer die life. More closely spaced dies will result in a higher pressure of strike, and longer contact with the planchet. Further, the dies must be level and parallel to each other (known, oddly enough, as die leveling). This is also adjusted by the press operator, and misaligned dies will produce a weak strike, or the error known as Vertically Misaligned Die if severe enough.

(Die adjustment strike on a South Carolina State Quarter)

Certain mints in certain eras were better at gettings things right. Two of the classic examples of generally poor strikes are New Orleans Morgans, and San Francisco mint coins of the '40s and '50s. There are a dozen different reasons why a strike might be poor, but each reason will leave telltale signs. The New Orleans mint improperly annealed the planchets during some eras, causing them to be harder. Harder planchets make it more difficult for the metal to flow properly, and thus the details will not strike up correctly. The San Francisco mint used too little pressure, too widely spaced dies, and used dies for too long.

Knowing the characteristics of strike for your chosen series will help you choose only the best coins for your collection. Each series is different, each mint is different, even each date is different – only through careful study will you learn the vagaries of strike for your series. For example, as you all know, I have studied the Franklin extensively. The 1948D and 1952D are two of the best struck issues – the 1952S, 1953S, and 1962 are some of the worst struck.

From the Theoretical to the Practical

Now, as all good scientists should, let's progress from the theoretical to the practical side of things. How exactly do you recognize a weak strike, and how do you differentiate between that, worn dies, and wear?

The easiest to tell apart is a worn die. As a die strikes coins, the highest parts of the die come in contact with the planchet first. The low regions of a design are struck first, and then the metal flows up into the lower regions of a die (which correspond to the higher parts of a coin). Thus, just like a coin in circulation loses detail on the highest points first, the die likewise begins wear on its most vulnerable areas. Always remember, the high points of the die are the lowest points of a coin! Die wear will affect all parts of the coin, but a weak strike will affect the higher regions more strongly. If you are trying to decide if a coin is weakly struck or from worn dies, look at the low points, or the hidden areas of a design. If they are clear, crisp, and sharp, you have a weak strike. If the low points are soft and indistinct, you probably have a worn die. Everything you need to know about die states, and the appearance of die states on a struck coin, can be found here: Die States.

A differentiation must be made between a good strike and full details for a series. On many series, due to the deterioration of the master die, a good strike does not imply full details – it only implies good details for the date and issue. The 1948 Franklin, being the first in the series, almost always comes with full details, even with a weaker strike, but the vagaries and variabilities of striking still remain. Thus, a coin not fully struck will exhibit far more details than its counterpart from ten years later, but will be somewhat below its sister 1948 coins. This is why a very large percentage of 1948 Franklins are FBL, because even with a weaker strike, the bell line detail is still present. As time progressed, the details began to wear off the

master – even brand new dies lacked the finer details of that first year. This is a fate shared by almost every series. The first year that a master was used, the details are sharp and crisp. As time goes on, the details will become softer, until they get to the point where a new master was made.

A common indicator of a weaker strike is called "high point pitting." When the force on the planchet is insufficient to cause metal to flow into all the deepest recesses of the die, the high points of the coin appear shiny or uneven. The places to look for this are, for example, towards the bottom of the bell, and on Franklin's cheek and jawbone. This is an indicator of a weaker strike, and will tend to limit the grade and any FBL designation. Severe high point pitting will limit the grade to 64, but minor pitting is allowable on a 65. Avoiding pitting is difficult because it is so common. When the metal flows into a die, it is the high points of the design which are last to be filled – and thus the high points are the most subject to high point pitting. In the picture below, note the myriad ticks and marks on the cheek and jawbone of Franklin, and how in the picture it appears to be darker. In hand, with the light on it, these darker areas are actually quite shiny. This is a rather extreme example, showing high point pitting at the base of his bust as well. This is a 1953S – notorious as the most weakly struck in the Franklin series – and the coin received a grade of 65.

(A Franklin with extensive high point pitting, and a Walker with softness on the high points – especially her hand)

Telling this high point pitting apart from wear may seem difficult, but with practice and experience, as in all things, it is possible. The key is their different appearances. High point pitting due to a weak strike will appear as a region of tick marks on the high points, but generally will still be bright and shiny. The tick marks are handling marks from before the planchet was struck – the contact with the die due to striking pressure smooths out any marks or ticks that a planchet may have received during handling. Wear, however, will generally appear smooth. It will generally appear first as a discoloration on the high points. As more wear occurs, the highest points will begin to rub off, leading to a flattening.

The Capped Bust Half shown below is an excellent coin to use in a discussion of wear versus strike – because it displays both. The coin itself is graded XF-45, although many feel it is an undergraded AU. There is only light wear on the highest points, which you can see as a different color in these pictures. Notice how her neck is one color of silver, but the highest point of her cheek is lighter. Notice also how the high points of the curls of her hair are a lighter grey. This is due to wear. Now, look at the drapery around her bosom. The amount of detail missing here is incongruous with the rest of the coin – so we look at the discoloration of the high points as a clue. The drapery is mostly missing due to a weak strike, which is common in this area on these coins. This is where experience and study play a key role in trying to determine if your coin has weak strike or wear.

(A coin with wear on the highest points. Note the discoloration on her cheek and hair. Notice also that the drapery at her bosom is weak due to a weak strike.)

So What Does This All Mean to Me?

Strike should play an important factor in the grade of a coin. The basic aspects of grade are strike, luster, technical preservation, and eye appeal. Technical preservation, or how many marks and dings the coin has, is easy to assess. Luster is similarly easy to assess, although considerably more subjective – what I think is beautiful luster deserving a high grade, you may think is merely average. Eye appeal, of course, is the most subjective of all. The gorgeous rainbow crescents on that Battle Creek Morgan may appeal to me strongly so I will bump the grade up a point, but you may view it as damage and downgrade it a point. Strike, I believe, is one of the harder aspects of grading, and is thus often overlooked.

A coin grading 65 should have a full strike, if not exceptional. Learning to tell what a full strike looks like simply comes through practice and experience, and viewing hundreds of coins. Alas, many if not most collectors do not have this practice and experience. If the strike is less than full, it should be downgraded. A coin should be well struck to receive a grade higher than 65. Unfortunately, even the TPG's seem to place less emphasis on strike than they should. This leads us to the final area of strike we will discuss today: the ever-contentious strike designations.

Knowing the scarcity of well struck coins, a collector who values strike is willing to pay a premium for a coin well struck. Certain series are known for their weak strikes in particular areas of the coin, and thus a coin which shows all the detail in that area will garner a premium. The TPGs recognize several strike designations: Standing Liberty quarters have a Full Head designation (abbreviated FH), Jefferson nickels have Full Steps (FS), Mercury Dimes have Full Split Bands (FSB or FB), Roosevelt Dimes have Full Torch (FT), and Franklin half dollars have Full Bell Lines (FBL). Other coins which are sometimes sought specifically for their strike, but which are not designated by TPGs, are Walking Liberty Halves with full thumb (or full skirt lines), and Susan B. Anthony Dollars with full talons. I am not going to go into detail on each of these designations, as they have been covered elsewhere.

(Picture of well struck WLH – note the full thumb and knuckles, full skirt lines, and overall crispness of the design.)

The theory behind these strike designations is that these are usually the highest points of a coin, and are the most common areas to be weakly struck. Often, the high point of one side is directly opposite the high point of another, so these details require the fullest strikes to be completely impressed. If this area is fully detailed, then the coin is probably well struck. While this sounds good, in practice it is often quite different – a Walker with a full thumb may have poor detail on the eagle's feathers, or a Franklin with full bell lines may lack detail in Franklin's hair. The strike of a coin must be taken as a whole to be properly evaluated. Further adding to the complications, it seems like every collector (and more importantly, every TPG), has their own definitions for each of these designations. The confusion detracts from the coins.

Whether you agree with the strike designations or not, there is no denying that they generally bring large premiums over their non-designated counterparts. A 1953S Franklin graded 65FBL may bring upwards of $20k, whereas a regular (softly struck) 1953S such as the one above will be lucky to break $100. This is an extreme example of one of the scarcest strike rarities, but even commonly well struck coins will bring premiums. Other strike rarities to be aware of include the 1953 Jefferson, 1945 Mercury, 1926D Standing Liberty, and 1941S Walking Liberty. Well struck examples of these coins all receive astounding premiums above their normal counterparts.

Besides the series which are collected specifically by strike, be on the lookout for well struck examples of whichever series you choose to collect. A strong strike brings out all the details of a coin, and produces a much more beautiful coin. It may take a while to find an eye appealing coin with a good strike, strong luster, and all the merits you seek – but it will be worth it in the end.

Jason Poe

(I leave you with a trio of incredibly well struck Classic American coins.)

What You Need to Know About Contact Marks

By Jason Poe

The third in an ongoing series of articles about the basics of grading, this article will hopefully be interesting and help you understand one of the key aspects of grading uncirculated coins. Contact marks cover a wide area of dings, scrapes, marks, and ticks that will reduce the grade of a coin. Bagmarks are a specific kind of contact mark caused when coins impact each other, often leaving reeding marks on the face of a coin. The term "bagmarks" is often applied to the wider meaning of marks in general. Contact marks are incredibly important on uncirculated coins, but lose importance for circulated coins, where wear becomes more important. However, even on a lower grade circulated coin, a smooth unmarked surface is considerably more attractive than a heavily marked coin – and commands an understandable premium.

(A 1832 Bust Half Dollar displaying incredibly smooth surfaces).

Several criteria are used to judge the impact of a mark on the grade of a coin. The size and depth of the mark, especially with relation to the size of the coin, are important. A mark which appears very severe on a dime may go nearly unnoticed on a large silver dollar. For example, assume a mark is 1 millimeter long. On a dime (roughly 18 mm diameter) that is 5.5% of the coin's width. On a silver dollar (roughly 38 mm wide) that same 1 mm mark is only 2.6% of the coin's width – a significant relative difference.

Even more important is the location of the mark. Most coins are divided into about three different levels of importance: primary focal areas generally include large open fields, the cheek, the eagle's breast, and any areas of a coin where your eye is naturally first drawn. Secondary focal areas are less important – areas such as complicated designs like hair details, wreaths, or less important areas. The tertiary areas are those around the edges, and areas similarly outside the main focus of the coin. Any divisions beyond 3 levels add unnecessary complexity.

To illustrate this point, let's look at a couple of coins. The 1962 Franklin below is accurately graded at 64, due to the large mark on Franklin's temple (well within a primary focal area). The rest of the coin is very nice, but the mark occurs in a prime area – so it is downgraded a point. The 1934D Walker reverse, on the right, however, is graded 65 because the mark occurs in a secondary area – despite it being of similar severity as the mark on the Franklin. The remainder of the coin is technically superb, but the one (somewhat severe) mark brings it down a grade. The number and severity of the marks which are required to bring a coin down a grade are subject to opinion. I could show you dozens of coins with similar marks, but which received different grades. This is due to variations in the other factors we have discussed (and which we will continue to discuss) – primarily luster, strike, and eye appeal.

(Contact marks on a 1962 Franklin and 1934D Walker)

So how are these dreaded bagmarks formed? Well, the obvious answer is when the coins are in bags. The more complicated answer is any time between striking and delivery of the coin to the collector. After striking, a coin is ejected into a large bin with hundreds or thousands of other coins, each falling and jostling on top of each other. The coins are sent through machines which weigh and sort them, further jostling. They are put into bags, rolled, dropped, heaved, shipped, transported, jostled, and subjected to all sorts of treatment we numismatists would find deplorable. But to the mint, they are just a product. Their mission is to get as many coins to as many people to facilitate commerce, while looking reasonably decent. They really don't care about preserving the ultimate perfect coin in MS-70. For this reason, bagmarks are the norm. Different mints and different eras tended to produce coins of differing quality. Knowing the series you collect will help you evaluate the marks on your coin. For example, for the Franklin, S mint coins were generally very well treated and display few bagmarks; D mint coins were generally badly mistreated and show tremendous amounts of bagmarks.

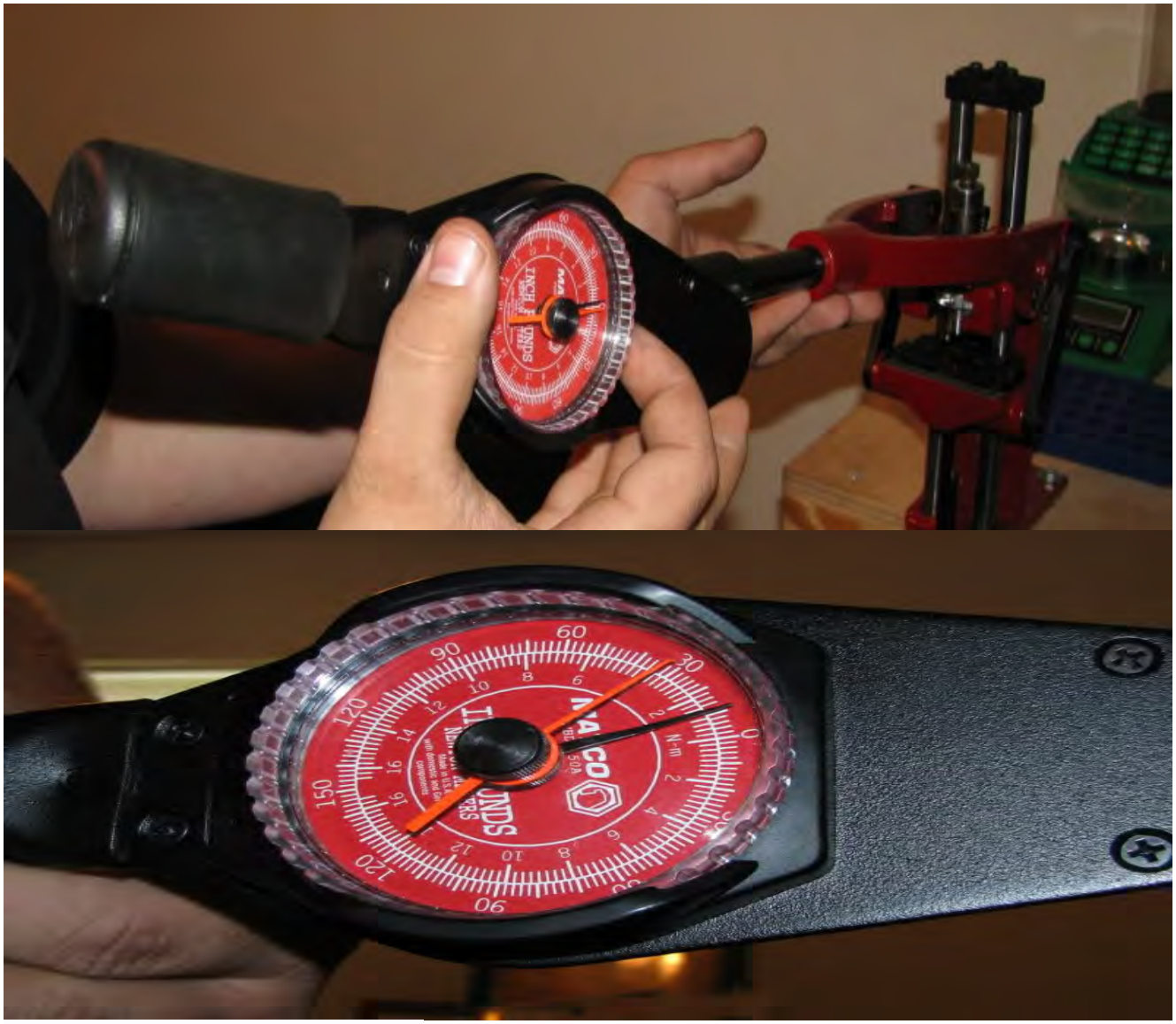
The other important factor affecting bagmarks are the material properties of the metal with which the coins are made. Coins are generally made of four metals. Ranked in order from hardest to softest, they are: nickel, copper, silver and gold. What this means is that it is much easier to produce a severe mark on a gold coin than a nickel one. The same force applied to each coin will tend to produce a much larger mark on a gold coin, because it is softer (the metal is easier to move).

So, after thinking about bagmarks for a bit, my curiosity was piqued. Exactly how much does it take for a coin to show a bagmark? What sort of mistreatment will produce the marks and scrapes that I see on all my coins? A little research was in order. I took a few bright and shiny Lincoln cents (low value coins, perfect for experiments), and did everything I could to beat them up. I performed a series of semi-unscientific tests to show exactly what sort of damage will occur to your coins with mistreatment.

I took a couple of pennies in rather good shape (I would grade most of them MS-65 before my abuse), and subjected them to tests. In the first image below, you see the original cent. The first test I performed was using my brother's ammunition press, to which he has attached a torque wrench. (He reloads his own ammo, for an interesting diversion, read his website here: www.rifles-shooting-reloading.com) We put a penny in the press, and attached a pin to the shaft to make small circular depressions. After four such tests, we produced the depressions as shown below. The torques used were 10, 30, 45, and 60 inch-pounds of torque (the smallest being the lowest depression, closest to the date). It is quite reasonable to say that the first mark is similar in severity to many marks we see on coins. Using several conversions to put it in terms a scientist can understand, this is a little over 1 Newton of force. For reference, gravity acts with a force of roughly 9.8 Newtons.

(The un-marred cent)


(The ammunition press used for testing)



(The gauge-meter, reading 30 inch-pounds)

(The results – the lowest depression is 10 inch-pounds, increasing to 30, 45, and 60 inch-pounds)

Next, I performed a drop test. I dropped a penny from a height of approximately a foot onto another penny on my desk. After several tries, I finally hit the target, and produced the mark you see in the obverse field below. During the minting process, it is entirely reasonable to believe that the coins are subjected to drops of a foot or more traveling from the striking chamber to the bin, or into a bag, or any number of other places. While the severity of the mark will depend on the weigh, size, angle, and hardness of the coins, I'm sure this mark is a representative example. For reference, these solid copper pennies (dated 1961D) each weigh 3.11 grams.

(The mark produced by dropping a penny from a height of one foot onto another penny is clear)

There has been a recent discussion about contact marks, with some wild claims being made about marks. Let's examine the mark I just created on this coin and see if we can't dispel some of these arguments. First – notice the mark on the coin is straight. Yes, the curved edge of a coin can create a straight mark for the simple reason that it is curved if you look at it from

the obverse, but completely straight if you look at it from the edge. There is more than one perspective for everything. Notice next how the mark appears tapered. The tapering is due to the curvature of the coin. If the impacting coin had hit the target coin at a different angle, the tapering would of course be different. Further evidence that a round coin can indeed make a straight mark is provided by the Franklin below. Notice the series of reed marks across the top of the bell on this 1961D Franklin – which are perfectly straight. Again, the angle of impact plays an important role in the shape, severity, and appearance of the marks. I hope we can all agree that these marks are caused by the impact of one coin on another (as has been generally accepted by numismatists).

(Reed marks on the reverse of a 1961D Franklin.)

Still not content with my trials, I took the penny you see at left, with relatively clear surfaces, and placed it in a bag with 4 other pennies. When a mint bag is filled, there are $50 worth of pennies – or 5000 pennies. The weight of these coins is tremendous, and will severely affect the pennies below them. However, I don't have a mint bag or 5k pennies to test, so this will have to do. I simulated the rough treatment a mint bag of pennies will receive by vigorously shaking the pennies in my Ziploc bag for approximately a minute. In a mint bag, there is far less room for the coins to travel as the bags are densely packed, but the vibrations last much longer, are often more severe, and have a lot more weight to damage coins. After one minute of shaking, the cent came out well marked, as shown below right. This is very similar to the appearance of many coins fresh from the mint. Again, this test is highly un-scientific, but it will give you an idea of what sort of mistreatment is required to produce the bagmarks we see on coins. The corollary, of course, is that you will come to highly appreciate MS-65+ coins for the scarce gems they are.

The final experiment I wanted to try was another drop test. You always hear horror stories about rim bruises due to dropping coins on concrete or tile, so I wanted to see just how bad it could be. I took the penny you see at left, with a relatively unmarked edge, and dropped it from a height of about 5 feet onto my concrete patio. As you can see, the edge is considerably marred.

(An unmarred penny at left, dropped 5 feet onto concrete, shown right).

There are numerous variables associated with each of these tests, and they are by no means conclusive as to predicting the size and shape of marks. However, it should be perfectly clear that a small coin, dropped from a relatively short height, can indeed produce significant contact marks. The size and weight of the coin, composition of the target coin, angle of incidence, and a host of other factors will of course change the size and shape of the marks – but they can and do happen.

Learning to evaluate the marks you see on a coin will help you determine the grade of that coin. Although marks are the easiest factor of grading to see and identify, the severity of these marks are often subject to opinion. A mark that downgrades a coin to 64 in the eyes of one numismatist may be acceptable on a coin graded 65 to another collector. Also remember that marks are not the only criteria for grading a coin – strike, luster, and eye appeal also play important roles.

I hope this engenders some interesting discussion,
Jason Poe

What You Need To Know About: Eye Appeal

By Jason Poe

Of all the aspects of grading, eye appeal is the hardest to define. That is why the 5th in my series on the aspects of grading is sure to be one of the more controversial. It is by far the most subjective, and each person's opinion is equally valid. Strike can easily be quantified, marks can be counted, and wear can be measured. Luster, while more subjective than these, can at least be categorized. Eye appeal, however, is basically determined by how much a person likes a certain look – I like Rembrandt, you prefer Van Gogh (or heaven forbid, some modern "art"). You may think Dali is the coolest thing since Sputnik, I disagree. Neither of us is wrong – and the same goes for coins. A discussion of eye appeal is thus going to draw far more controversy than a discussion about strike or wear. Very little that I can say about eye appeal is going to be new or groundbreaking, so I am simply going to try and present various points and open the floor for discussion.

Most discussions of eye appeal need to be divided into two categories, uncirculated and circulated coinage. On uncirculated coinage, there are two camps: white is right, and toning is cool. The White camp prefers their coins bright, looking like they did when they came from the mint. Even on centuries old coins, this camp likes the coin to be lustrous and clean. There is nothing wrong with this – but one must be aware of the drawbacks: bright white old coins have often been dipped, cleaned, or treated to restore them to their white state. Dipped coins will have less luster, and can be reduced in grade. They may also appear stripped and naked (a description that is hard to explain, without seeing the coin in person). An original white coin will have a patina, a natural skin on the metal, which can be quite eye appealing.

(An eye appealing white coin – notice the strong luster covering the coin, as well as the strong strike).

The other side of this debate is the Toning crowd: they like their coins with attractive, colored toning. These coins can often

be quite spectacular, showing various shades of the rainbow in complex patterns. But toning can often be quite ugly – the vast majority of coins don't acquire smooth rainbows. Instead, they are brown, spotty, dull, or otherwise unattractive. These coins have negative eye appeal – and will likewise receive a deduction in grade. The difficulty is that while most of the numismatic populace doesn't like this sort of look, there are definitely some people who appreciate the originality of the coin. They would rather have an ugly, darkly toned, or spotted coin that is original than a white coin which has been dipped. And there is absolutely nothing wrong with that! For more information on toning, what causes it, and what it looks like, see my article here: What You Need To Know About: The Science of Toning

(An eye appealing rainbow toned coin, which earned NGC's star designation)

Other aspects of a coin which play into eye appeal can include die polish lines, cameo effect (for proof coins), water spotting, prooflike or semi-prooflike reflectivity, or various other characteristics. Many people don't like die polish lines (even though they are mint made), and will subtract grade for them. A very strong cameo may add to the grade. Prooflike coins are often incredibly eye appealing (in my opinion!), but they show marks more clearly, so it's a tradeoff. Water spots, depending on the severity, can often significantly detract from the eye appeal.

(A proof coin, showing eye appealing strong cameo contrast)

Many of the same points can be made about eye appeal when discussing circulated coins, but here the issue of originality becomes even more important. For AU coins, a certain amount of luster is expected, and toning similar to UNC coins can be present (the coins can also be white and not look too out of place). However, lower circulated coins almost certainly will begin to take on a darker look, as the dirt of circulation begins to fill in the crevices and substances the coin comes in contact with accelerate toning. A white (or even light colored) VF coin looks garish, and an experienced eye can tell it has been cleaned. The most desirable circulated coins have a smooth, even look. Eye appealing circulated coins are natural, original, dark in color, and smooth. Excessive marks detract from the eye appeal, even if they are expected after circulation. For my own personal use, I like the look which I call "gem cameo circulated" – coins with smooth, even, dark grey fields, dark highlights in crevices, and lighter high points. The 1812 Capped Bust Half dollar shown below illustrates this look perfectly.

(An eye appealing circulated coin which draws extremely positive comments from a number of different people every time I show it – even though I consider many of my coins more attractive)

So how can someone use eye appeal to grade a coin? This aspect is most reliant on experience. Over time, and discussion with fellow collectors, and looking at coins, a grader learns what the majority of people like – and your opinion often conforms to that of your peers. The majority of us can agree that the spotty coin is less desirable, and the coin with clean smooth surfaces is more desirable. But how much should the grade be reduced for the coin with ugly toning, and how much should it be increased for a coin with fabulous toning? Should the grade be changed at all based on eye appeal, or is the grade solely dependent on other factors like marks, strike, and luster? There is no definite answer on this topic. I personally believe that eye appeal plays into the grade – there is a measurable change on the surface of the coin, so it must factor into any technical aspects. Certain groups prefer to grade based on "surface preservation": the presence or absence of corrosion, films, spots, or toning. Surface preservation also includes cleaning, dipping, polishing, or otherwise altering a coin's surface.

Imagine three coins with exactly the same strike, marks, and luster. Now imagine that one of them has ugly spotty toning, one of them is blast white (but original), and one of them has multicolored rainbow toning. How differently would you grade them? Most experienced numismatists would probably deduct a point (at least) for the ugly one, call the white one the middle grade, and add a point for the rainbow one. It is not unheard of for a two point bump for absolutely spectacular toning (i.e., a coin which would normally grade 64 being slabbed as a 66). Is this right? Unfortunately, only you can decide for yourself whether you agree with this or not. I would highly recommend that you all read the excellent related article by TomB: What You Need To Know: One Numismatist's Experience with the Toning Premium

An important point in a discussion of eye appeal concerns NGC's Star designation. On certain coins, NGC includes a * in the grade description. Un fortunately, this star has two different and distinct meanings. On some coins, it means the coin posseses exceptional eye appeal. On some other coins, however, it simply means that the coin just missed the next higher grade or designation (coins with some cameo contrast, but not enough to garner CAM will receive the star, for example). Coins which are reflective, but not enough to be called fully Prooflike will also receive a Star, as is shown below. The star designation is subject to some controversy, however, because not all starred coins are created equal: many ugly coins have received the star, many incredibly attractive coins have not. Most of the coins which have received the star are quite attractive, such as the almost-prooflike Walker shown below, or the gorgeously rainbow toned Morgan dollar shown above. Because of this, the Star is often subject to large price premiums. I myself am largely in favor of grade designations such as the star over wild gradeflation based on a coin's eye appeal. A single point bump up is acceptable, more than that is excessive.

*(A 1943D Walker which earned NGC's coveted *, both for exceptional eye appeal, as well as being very close to a higher designation (in this case, PL))*

The best way to learn about eye appeal is to view as many coins as possible. Learn what you like, learn what other collectors like and why, and learn how the TPG's treat eye appeal. Eye appeal is all about experience. I realize I just wrote nearly three single-spaced pages in Word without saying much, but hopefully this stirs some good conversation about eye appeal and its place in grading.

What You Need to Know about Luster (No Pictures)

Ok, first we're going to start with seeing the cartwheel. This can be tricky at first, because it takes just the right wrist movement to be able to move the coin and get the fluid cartwheel effect on the luster. Once you get it though, you will appreciate the beauty of it! Go get a slabbed, uncirculated coin (by a Top TPG - PCGS or NGC) and a strong light source. Hold the coin at an angle, so that it reflects the light. You should see the coin shining. Now, slowly and gradually, turn the coin. Notice the shine move? That is what we call cartwheel luster - if you turn the coin in the right way, the "spokes" of luster will appear to rotate around the coin like a cartwheel. Practice at this until you can see the cartwheel luster. Practice at this before reading the rest of this thread. Practice at this before buying anymore coins. If you can't see and discern luster, you can't properly grade, evaluate, or purchase coins.

Now, what causes this luster? When a coin is struck, the metal flows up into the recesses in the die, filling out the details and causing raised areas, which we see as devices, letters, etc. As it flows, the metal wears on the die; because the metal flows the same way each time, it will wear "grooves" into the die. I say "grooves" because I can't think of a better way to describe it - in numismatic parlance we call them flow lines. These microscopic lines reflect light in every direction, causing the diffuse shine that we call luster. Because luster is caused by wear on the die, later die states often have better luster. A brand new die will occassionally even be prooflike - having a mirrored surface and no cartwheeling luster. These prooflike coins are highly prized by collectors. As the die wears, the flowlines become etched into the die. The striking of coins wears the die down, often softening the details, until finally you get a late die state coin. By this point, the flowlines are strongly etched into the die, and you will sometimes get incredibly flashy luster.

When a coin is cleaned, this microscopic surface of the coin is disturbed. Depending on the method used to clean the coin, different disturbances are noted. This is one way we can tell how a coin was cleaned - baking soda or dipping will affect a coin differently than a wire brush or polish or whizzing, some of the most common ways to clean a coin.

There isn't really a single definition for a polished coin, its more of a catchall phrase, and can include wire brush, baking soda, or other methods. Whizzing, however, has a very specific meaning and a very specific look. Whizzing refers to when someone takes a rotating tool, such as a dentist's drill or a dremel, attaches a wire brush, sander, or polishing head, and goes at the coin. It gets its name from the "whizzing" sound this makes. If you are familiar with these tools, you can imagine the look this creates on a coin, although an expertly done whizzing can be hard to detect.

Taking a brush to a coin (wire or otherwise) creates a much different look. It usually has a large number of parallel lines, or groups of parallel lines in different directions. Usually, these polish lines will go over devices - if a line goes from the field, over a device, and back into the field uninterrupted, you can usually safely bet that it is a post-mint hairline or cleaning mark. Notice also that cleaning lines are recessed into the surface of the coin - the wire brush is intended to move and remove surface metal. Distinguishing raised versus recessed lines in the surface of the coin is tricky, but with proper lighting and experience, you can do it.

Both polishing and whizzing a coin have the same intended affect - to simulate original luster. This is why understanding luster, how it looks, and how its created, are so important - if you don't know what real luster looks like, you will never be able to discern artificial luster.

When you hold and rotate a polished coin under the light, in the same way you held your slabbed coins, you might at first see something that strongly simulates natural luster. But continue to rotate, and notice how differently it behaves. On a cleaned coin, because the polish lines all go in the same direction, quite often the luster will apear very strong in a particular direction. You must hold the coin just right to see it sometimes, and sometimes it is immediately obvious. It will glow unnaturally, and I'm sorry that I can't explain it better - but being familiar with natural luster, you will notice that it just doesn't look right. Experience is one of the best aids to determining this - hence my recommendation to examine and study numerous slabbed coins, to understand natural luster.

As you begin to learn and understand luster, you will see differences in the luster between different coins. I am going to use Franklin halves as an example, since that is the series I am most familiar with. There are several different kinds of luster - there is flashy, booming, dripping luster. This sort of luster makes the coin look like it is wet almost, with strong reflection and great luster. In the old school technical grading, better luster like this is required for a higher grade (it really begins to be important in differentiating a 64 from a 65 or higher). The 1950 Franklin half is known for this booming luster, as illustrated on my coin below.

Next we have average luster. This type of luster definitely cartwheels, and is pleasing to the eye. Its not booming though, like the coin above. My 1952D is a good example of average luster.

Finally, we have the creamy, subdued luster of my 1950D. Some coins just never have the great luster of other dates. These differences are important to a specialist in a series, because when you can find a 1950D with booming luster, you know you have a special coin.

Well, I hope that helps you. The best thing to do is examine as many coins as you can. Good luck!

What You Need to Know About: The Science of Toning

(Roosevelt dime, photo by Bob Campbell)

In response to a recent question by a member on another thread, I present here the science of toning. This article is adapted from an article I posted a couple years ago on the NGC chat boards. Save it, print it, reference it, use it in discussions of toning. While some simplifications have been made to make it easier to understand (BadThad – I know!), the basic science is all here.

The science of toning is very interesting. Sometimes delving into the details of something takes away the mystery of it, but to a scientist and numismatist, it only serves to heighten the wonder of a coin. Toning on silver coins appears through something known as thin film interference of a layer of silver sulfide (Ag2S) on the surface of the coin. This silver sulfide is formed when the silver alloy reacts with hydrogen sulfide (H2S) in the atmosphere. Often, heat and humidity hasten this process. Hydrogen sulfide in large concentrations is very toxic and flammable, but small doses are almost always present in the environment. Hydrogen sulfide is responsible for the smell of rotten eggs, and is also present in flatulence, volcanic and natural gasses, some wells, and swamps. Other sources of sulfur which can affect coins are paper and cardboard holders, such as the mint sets issued in the 40's and 50's or early albums. The increased concentration in close proximity to the surface of the coin heightens the toning effect of these sulfur containing holders.

The chemical formula for the reaction process is:

$$4Ag + 2H_2S + O_2 \rightarrow 2Ag_2S + 2H_2O$$

The reaction is accelerated by heat. As you can see, oxygen is essential to the toning process, and water is a byproduct. The combination of heat and humidity in close proximity to a sulfur source will produce toning the fastest – but no amount of meddling can replace the simple element of time.

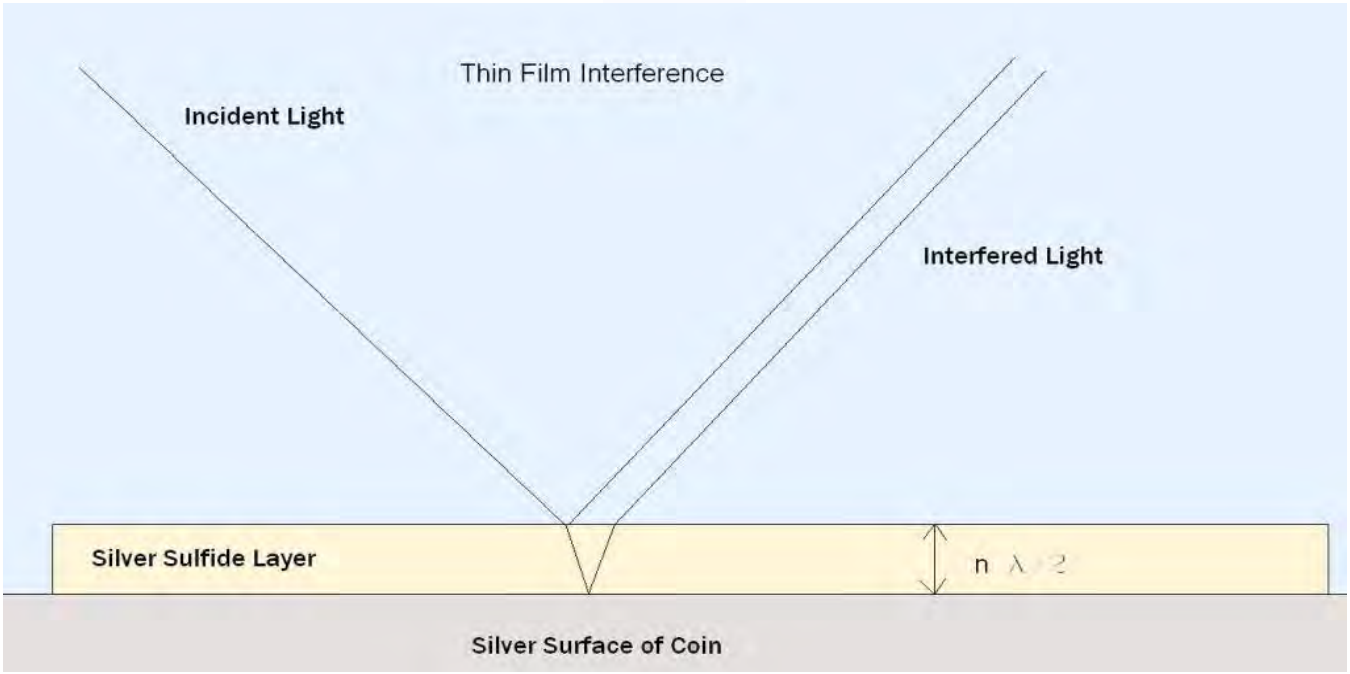
(A beautifully toned 1958D Franklin, image by Bob Campbell)

As the layer of silver sulfide is formed on the surface of the coin, it gradually thickens. Different thicknesses produce the appearance of different colors. Note that silver sulfide in itself is actually black – this same compound is known as tarnish on silverware. The amazing colors are caused through a phenomenon known as thin film interference. You are probably familiar with the rainbow-like sheen of an oil slick on water, or the appearance of iridescent colors in a soap bubble. These manifestations of color in an otherwise colorless object are also due to thin film interference.

(Thin film interference in a soap bubble, image from Wikipedia)

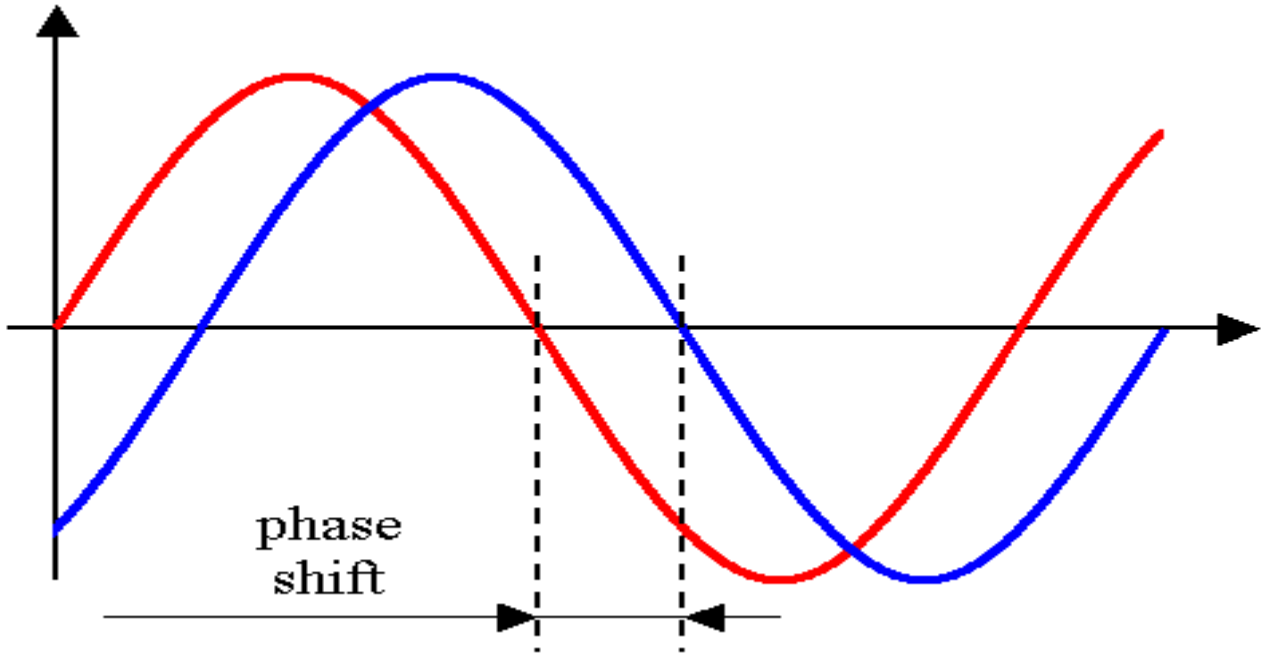
The science and mathematics of thin film interference are beyond the scope of this discussion. Suffice it to say that a thorough analysis requires advanced calculus, geometry, physics, and optics. However, I will attempt a simple explanation. Imagine the surface of a coin, on which is a thin film of silver sulfide. Now imagine a beam of light striking the surface of this film at an angle. At this point, the beam is split in two – half of the beam is reflected directly off the surface of the film. The other half will penetrate the film, but it is refracted a certain amount. Whenever light enters another medium, it is bent according to the material's index of refraction. This is why when looking at a fishbowl, the contents often appear distorted. The speed of light is actually slower in water than it is in air, so the image is bent. When the beam of light in the film strikes the surface of the coin, it is also reflected and exits the film. However, the two halves of the beam are now in different phases. Because the half of the beam that traveled through the film took a longer route, it lags behind the half of the beam which was reflected off the surface. The phase is shifted relative to the first beam, and this is the key to the colors.

Interference:



(diagram by the author)

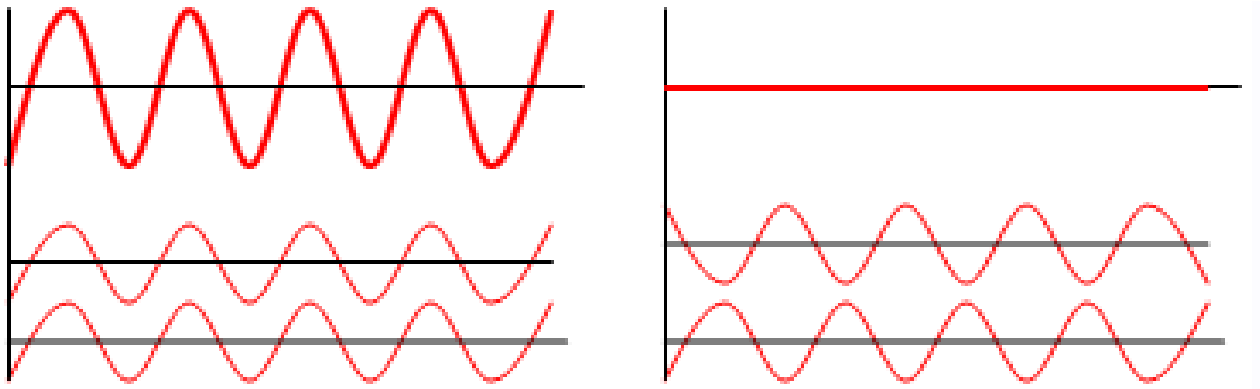
Phase shift:



(diagram from Wikipedia)

Light is one of the mysteries of the universe. Sometimes it acts like a particle, and at other times it acts like a wave. In the case of thin film interference, light must be thought of as a wave. When two waves interact, sometimes funny things can occur. When two waves are perfectly in sync, they can combine to magnify their intensity, known as constructive interference. However, if the two waves are perfectly out of sync with each other, that is, when one wave is peaking, the other wave is at its bottom, the two waves cancel each other out. This is known as destructive interference. By taking a single beam of light, splitting it, and recombining it in just the right way, darkness can be created.

Constructive and destructive interference:



(diagram from Wikipedia)

It is this destructive interference which produces the colors we see. Destructive interference occurs when the thickness of the film is nλ / 2, which is to say, any multiple of one half the wavelength. Conventional notation among physicists is to denote wavelength with the Greek symbol for lambda, and it is usually measured in nanometers (abbreviated nm) when talking about light. Assuming you start with white light, the color you see will be the complementary color of the cancelled wavelength. For example – if the thickness of the film is such that it cancels yellow (with a wavelength approximately 580 nm) then you will see blue. This film would be approximately 290 nanometers thick. For reference, an atom of silver is about 0.16 nm thick, so these films are on the order of a couple thousand atoms thick. Toning layers cannot be more than about a wavelength thick, or else the light is absorbed by the film and will not produce colors. These thicker films of silver sulfide will appear brown or black.

The rainbow effect is caused when the film is not uniformly thick. Remember, different thicknesses produce different colors, so a film which gets gradually thicker towards the edges of a coin will appear to have a rainbow effect. It's the same idea as

when you get a gradual progression of colors when you refract light through a prism.

(1886 NGC MS-65* Morgan Dollar showing rainbow toning – in other words, a non-uniformly thick layer on the surface, photo by the author)

When a toned coin is dipped, it is the thin film that is removed. Using a precise enough scale, a coin can be weighed and then dipped. A perceptible amount of silver (or rather, silver sulfide – most solutions do not affect the underlying silver) is removed in the process. It is precisely because of this that proponents of white coins consider toning harmful to a coin. Also present on the surface of coins, and also on a microscopic scale, are tiny flow lines created when the metal flows during striking; it is these flow lines that cause the diffuse reflectivity we call luster. Because toning builds up substances on the surface, it can often overwhelm these flow lines. Toned coins often have somewhat muted luster depending on and due to the thickness of the toning. When these coins are dipped, the flow lines (and thus the remaining luster) are also eliminated in the process. The result is a dull, lifeless coin that appears unattractive and undesirable.

So there you have it, an introduction to the science of toning. One thing I love about this hobby is that I can sometimes foray into very different fields - optics and physics being one of them. I am a rocket scientist by degree, and now I am a nuclear physicist with the Navy, so I have a certain passion for physics. I hope you enjoy your toners, and I hope you enjoy them even more with a certain understanding of how they are formed.

~Jason Poe

References:
"Coin Chemistry"by Bob White
"Fundamentals of Optics" by Jenkin and Harvey

"Thin Film Interference" Boston University
Physical Optics

I'll leave you with a final toner, an NGC MS-67 Mercury Dime, photo by the author.