



SMARTPHONE MINERAL PHOTOGRAPHY

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We may not all have big digital SLR cameras slung over our shoulder when visiting mineral shows, museums, friends' houses or just admiring our own collections at home. But we can still take remarkably good photos with our smartphones, even publication-quality photos and—incredibly—even multifocus stacked photos!

INTRODUCTION

There is a reason they say the point-and-shoot camera industry isn't what it used to be. Virtually every smartphone is now, in and of itself, a fully automatic point-and-shoot camera. However, smartphones are designed for portraits, landscapes and events in low light, not for most macrophotography and certainly not for publication-quality mineral photography. So if we want to photograph mineral specimens with a smartphone we have to do the best we can with what we have. Fortunately, smartphone camera technology and the accompanying software have come a long way in the last decade, and the emergence of the touch-screen smartphone (in 2007) with new applications adds a vast amount of flexibility for capturing high-quality images.

There is absolutely no arguing with the fact that the best way to view a mineral specimen is holding it in your hand under good lighting and moving it around. Equivalent video clips can be seen online at various social media and mineral dealer websites. However, since video is not possible in a magazine (unless you live in the Wizarding World of Harry Potter), we must default to taking still shots, which all mineral photographers know is trickier than it looks, even with a high-quality digital single-lens reflex camera.

For readers who have not yet perfected their ability to use a smartphone for mineral specimen photography, this article offers some guidelines that will help them get started and maximize the quality of their photos. And although my personal smartphone is currently an Apple iPhone—which I refer to from time to time in this article—the following tips are also applicable with regard to Android devices. Let's get started.

YOUR PHONE

Clean the Lens

Make sure your camera lens is free of fingerprints and debris. Clean it with a soft cloth as you would a camera lens, a pair of glasses or the screen of a smartphone or tablet.

Remove Any Covering

If your phone is in a type of case that has a piece of protective glass or plastic covering the lens, you may want to remove the phone from the case. ANY kind of transparent layer in front of the lens may cause distortion or diffusion, however slight, and although the difference may not be visible on your phone screen, the photo may suffer when viewed larger on a desktop or laptop computer screen.

Check Settings

You can check your setting through your phone's settings icon (the gray cogwheel symbol). Set your phone's camera on the simplest settings. Make sure you are shooting in JPEG (.jpg) format; not HEIC or any other format. Turn off the timer, the automatic flash, the HDR (High Dynamic Range) and any filters. Shooting with a flash can cause awkward shadows, low contrast and burnout. The HDR mode can cause the mineral to look "flat" and over-processed.

Your camera's automatic "white balance" (a color temperature feature designed to keep the photo from appearing too blue or yellow) should make color correction filters unnecessary. However, if filters are available on your smartphone (iPhone cameras have an assortment of nine filters you can shoot with—shooting options and features in Android phones vary with manufacturer) and you are having trouble getting the color of your specimen to look correct, you can try experimenting with the filters. Because most available indoor lighting is on the warm (yellow) side, you might try a filter (on an iPhone) called "Dramatic Cool" or whatever a bluer filter might be titled on your own phone camera.

Unfortunately, most camera phones do not have white balance settings (unless you're using a special camera app—we'll get to those later) so this may require experimentation with the filters, the lighting and background (up next). The most important thing is that *the color of the specimen is accurate*.



Figure 1. Tarnowitzite (lead-rich aragonite) crystal group, 6.5 cm, from Tsumeb, Otjikoto Region, Namibia. Photographed using iPhone SE camera software; edited with Lightroom and Photoshop on a desktop computer; no stacking, no background replacement. Wendell Wilson collection; Christi Cramer smartphone photo.

Figure 2. Scheelite crystal on muscovite, 4.5 cm, from Mt. Xuebaoding, Pingwu County, Sichuan, China. Photographed using iPhone SE camera software; edited with Lightroom and Photoshop on a desktop computer; no stacking; no background replacement. Wendell Wilson collection; Christi Cramer smartphone photo.

BACKGROUND

Background Color

Unless you are photographing a white mineral, always use a white background. I know that a lot of collectors absolutely love black backgrounds but shooting on a white background with a fully automatic camera will afford a better balanced lighting environment for the specimen. Minerals are difficult to light properly; a black or gradational background, if desired, can be added in desktop editing later.

For studio work I find the most ideal background for mineral specimens is a piece of non-reflective glass suspended above a pure white background (Jeff Scovil uses a similar technique, sometimes with filters to change the color of the background). I use this glass for all specimens up to cabinet size. However, in most situations where you would have only a smartphone, you are unlikely to have brought along a complex background set-up, so just go with what you have on hand.

Background Texture

Make sure the background is as smooth as possible. A large piece of white cardboard or paper will work, and even these may show faint texture. Non-reflective glass or plexiglass (Lucite) is ideal. I use a sheet of smooth, white vinyl for “What’s New in Minerals” photography because it is tough, can be rolled up for travel and has relatively little texture. Fabric has too much texture for close-up shots and easily collects dust and debris.

LIGHTING

Light Tents

The use of a light tent is not recommended because it diffuses the light too much, making the specimen look flat and unexciting. Rather, it is important to have highlighted reflections to make the edges of crystal faces stand out, and shadows that enhance three-dimensional depth.



Light Intensity

Fully automatic cameras allow no manual control over exposure times, so using bright lighting will maximize sharpness and will help avoid graininess in the photo. However, too much light can cause burnout, which cannot be edited out. Your phone will probably adjust, to some extent, but it is important to find a good balance between too much and too little light. And it is better to err on the

side of too little light instead of too much because it is easier to make an image brighter in editing, than it is to darken an image.

Lamp Types

Two or three positionable lamps are the most useful—for each side and an extra one to have on hand to shine on the top, back or front. The lights can be adjusted depending on the specimen's features. And if you need fill-in lighting, 3 × 5-inch plain white file cards can be folded and used for reflecting light on the bottom and sides of the specimen as needed. I have old tensor lamps that I use, but I also have cool-light desk lamps that I sometimes swap out for the tensor lamps, depending on the specimen. Cool white bulbs (more blue than yellow) are the best, and three lights at 60 watts each can be adjusted for ideal shots. And if you need a little diffusion, attaching white paper, coffee filters or plastic drafting vellum over the hoods and bulbs will help. Adequate lamps and bulbs can be found at Lowes, Home Depot, Walmart, Target, Ace, or at most hardware stores. And most places have delivery these days if you don't want to venture out.

Lighting Techniques

Specimens should be evenly lit, with few or no areas in black shadow and none burned out to featureless white. Highlights and soft or gradational reflections on certain areas are necessary to emphasize faces and the specimen's shape and depth while drawing attention to the best crystals. For detailed information on lighting techniques see the article by Wendell Wilson posted in the *Axis* section of the Mineralogical Record's website (Minrec.org or MineralogicalRecord.com): "Advanced Lighting Techniques for Mineral Photography."

Lighting the specimen will undoubtedly be one of the hardest parts of this whole process. Patience and lots of trial and error are required. At times, there are specimens that just refuse to cooperate no matter how you light them! At one time when I lived near a privately-owned camera store that also taught classes in photography, I asked the owner if classes in macrophotography were available. He replied "Yes. We call it 'Practice.'" Lots of practice. You will want to take a number of photos anyway—sometimes the editing process requires that photos be combined and/or stacked in order to create the perfect image.

Direct Sunlight.

A lot of people think that more light is always better but taking a mineral photo in direct sunlight causes burnouts and sometimes even in the shade outdoors, crystal mineral faces will reflect the color of the blue sky which is time-consuming to edit out. You'll have more control over lighting (and avoid other outdoor elements such as wind) with a studio set-up inside.

THE SPECIMEN

Handle with Care

To state the obvious: Move slowly and purposefully when handling specimens for photography. Watch what you are doing. Make sure the specimen is out of the way during equipment set-up. Damaging specimens can be heartbreaking and expensive!

Clean Everything

Carefully clean fingerprints off of shiny crystal faces with the kind of soft cloth used to clean a camera lens. Carefully blow dust off the specimen with a light dose of canned air if you have it. Put the specimen under low magnification and remove lint and cotton fuzz with tweezers. You would be surprised what the camera can see. And here's a fun tip if you're using the non-reflective glass: Spray the glass with a 2-to-1 mixture of water and fabric softener, then dry it with a paper towel. A microfiber cloth will help remove any streaks on the glass. This treatment, believe it or not, helps



Figure 3. Wulfenite, 2 cm, from the Red Cloud mine, La Paz County, Arizona. Photographed using iPhone SE camera software; edited with Photoshop Express application and color adjusted with Photoshop on a desktop computer; no stacking; no background replacement. Christi Cramer collection and smartphone photo.

the glass repel dust, at least for a little while. Smells nice too. But please, don't put it on your specimen!

Orienting the Specimen

In general, you want the best feature of the specimen front and center, either at or pointing towards the top. If you must use mineral tack, use just enough to make the specimen secure. Big globs of mounting clay are a nuisance to edit out. If it is going to be too difficult or dangerous to make the specimen sit the way you want, or if the specimen is too fragile or heavy for mineral tack, the best option is to just lay the specimen down in the most comfortable position. It can later be rotated in editing.

Like much of the advice in this article, these procedures and tips apply equally well to photography with a digital SLR camera, in any location where a studio setting can be created.

Color Considerations

Be aware that the color of the specimen may throw off the automatic white balance in your phone. Again, smartphones *are not* designed for mineral photography. The camera is fully automatic; it will do what it wants in response to different lighting situations, and unfortunately there isn't much you can do about that (no matter how many times you tap your screen) except control your lighting and your background. Just make sure that you check your image to ensure that the *color of the specimen is correct*. Visible color shifts in the pure white background as seen on your screen while framing the specimen will give a clue as to how the overall color should be adjusted. And don't get too frustrated. There are editing programs available for your phone and other applications that can help with white balance adjustment. We'll talk about those later in this article.

Handheld Specimen

If you want to hold the specimen in your hand while photographing it, hold it against your background and rest your hand on the



Figure 4. Azurite, doubly terminated, 2.8 cm, from the Milpillas mine, Cuitaca, Sonora, Mexico. Photographed using a ProCamera application; edited/stacked using Lightroom and Photoshop on a desktop computer; no background replacement. Christi Cramer collection and smartphone photo.

table to minimize movement. Showing part of a hand for scale gives a clear impression of specimen size and is sometimes refreshingly “real” if not used too often. But be aware that the presence of your hand may throw off the automatic white balance a bit, because the sensor software will be reacting to the skin tones. Again, just make sure that the color of the specimen is accurate. Normally, though, the best way to photograph a specimen is by itself.

SHOOTING

Steady as She Goes

The steadiest way to hold a camera during shooting is on a tripod, and a tripod (table top or standard) will need a smartphone attachment accessory (table-top smartphone tripods are available, but I find them difficult to position correctly). Tripods are available relatively inexpensively from Amazon.com. Shooting freehand will suffer from at least a little movement no matter how many tricks you have up your sleeve (calming your mind, holding your breath, etc.). At the very least, be sure to hold the phone camera in both hands and steady your arms/wrists on a small table or the back of a chair when you *very lightly tap* (don’t jab or punch) the shutter button. And here’s a tip with regard to positioning your phone camera in the tripod: If you are shooting in portrait view, put the shutter button *at the top* rather than leaving it on the bottom; there will be less chance for any awkward jabbing of the button. Just make sure that the automatic 180-degree rotation on your phone is unlocked.

Parallelism

Begin by making sure the plane of the phone is parallel to the front of specimen, or to the main feature of the specimen, before you tap the shutter button. This will keep the maximum amount of the specimen in focus. Adjust the lighting as necessary for reflections. It may be necessary to try to take the photo from different angles rather than from head-on—just make sure the axis of the main part of the specimen, or of the main feature of the specimen, is parallel to the plane of the phone.

Optimum Distance

This may sound obvious, but: get as close as you can, though not too close. Smartphones have a fixed aperture, usually at f2.2 or f1.8, which is fine for selfies, portraits, landscapes and photos in low light but not good for maximizing depth-of-field in close-ups. Some smartphone cameras have a “macro” setting, but often these are designed for very small objects such as insects. Taking a photo of a cabinet-sized mineral specimen using the macro setting is likely to leave significant portions out of focus. Since most mineral images taken with a DSLR or mirrorless camera are shot with a lens aperture anywhere from f16 to f22 or even higher, the limited depth of field with a smartphone camera is a shortcoming. The optimum lens-to-subject distance for sharp focus could be 3 to 4 inches or more depending on the size of the specimen.

The farther the specimen is from the camera, the greater the depth of field around it will be. It may be worthwhile to move your phone back to get more of the specimen in focus, even though the specimen will appear smaller in the field of view. Cropping the photo down (either by digital zoom or later editing) will yield better depth-of-field but lower resolution. Be aware that, while digital zoom crops off areas to make it seem like your subject is magnified, it uses software algorithms that discard certain pixel information resulting in more distortion. Even in a standard camera with a larger, more sophisticated sensor this is not yet a perfect process. Phone camera sensors are relatively small, usually with 8 to 12 megapixels whereas the sensors in DSLRs can be several times larger. You will have to experiment, but generally the less zooming you do, the less distortion there will be. In most cases it would be better to crop the image in editing.

Some higher-end smartphones do have cameras that have lenses with optical zoom (where the lens actually moves in and out)—from 1X to 5X. They generally have slightly larger sensors and do take better photos, but they are usually much more expensive and still do not rival an optical zoom lens for a DSLR or mirrorless camera.

Camera Apps

Instead of using the camera software that comes with your smartphone, you can download an app to open when you want to take a photo. These applications will work on full auto, partial auto (like Shutter Priority), or even full manual. Their advantage is that they give you control over your ISO (equivalent of film speed), your shutter speed, and most importantly the white balance. Just being able to control the color of your lighting so you don’t have to edit it later is of great benefit. In addition, some of the apps can shoot your images in TIFF or RAW format, either of which makes for better photo resolution (bigger and better photos) and allows more flexibility in editing. The one thing you still won’t be able to control is the aperture. This setting, unfortunately, is fixed and constant on all current smartphone cameras that I know of.

But be careful: not all camera apps are created equal. Free apps usually don’t have a lot of flexibility. I downloaded one called ProCam and was surprised (although I probably shouldn’t have been) that there was no zoom feature. So I purchased and downloaded (from the Apple App Store) one called ProCamera for \$5.99, and am very happy with it. I can zoom, it has a great white balance

slider, and I can shoot in TIFF rather than JPG format. I researched before I bought, because applications are not returnable, and this was the one most highly recommended for the iPhone for under \$10. There is also one called Manual Camera (available through Google Play) for \$2.99 that looks pretty good and should work well with an Android phone.

Multiple Images

Take more than one image, with slight variations. I was once told that the difference between a professional and an amateur photographer is the number of photos taken. Professionals take *many* photos. When photographing for “What’s New in Minerals” I take up to a couple of dozen shots for each specimen. When I take shots in studio, I have more control over the lighting and need fewer shots. Three to four shots are a good number to start with; study them, zoom in on critical parts and decide your preferences. Change the lighting position, change the angles, shoot again. Be happy with the images before you edit them or send them somewhere for editing and don’t be discouraged at first; mastering new techniques always takes practice, just as it did in the days of film photography.

TRANSFERRING PHOTOS

Phone to Computer

If you are shooting photos, either while traveling or just a few at a time at home, you may want to transfer them to your home computer. This can be done by attaching the appropriate USB cable (or drive) between the two devices and downloading from the phone. If your eventual plan is to submit photos for publication, this is a good idea, as they can later be sorted and processed as necessary, then the chosen ones can be labeled with the critical information (specimen size, locality and owner) as part of the file name or under “properties.”

When submitting a group of photos to the *Mineralogical Record*, each one should be numbered (as part of the file name) and accompanied by a corresponding list of captions submitted as a Word document. There are many ways to send them, but we prefer that people use **WeTransfer.com**. It is free and simple to use, and it is easier for us to download photos from than with most other systems.

Emailing from Your Phone

Perhaps you wish to send a photo from your phone to a friend or possible customer. Emailing is the easiest and fastest way to send a photo at the highest resolution. Make sure that you choose “actual size” when your email program gives you a size choice.

Keep in mind that most email providers can handle only up to 25 MB (megabytes) *per email* for both sending and receiving images. Most smartphone images shot in JPEG format will only be a couple of megabytes in size per image, so if you’re only sending a few images that should work fine. If you need to send a larger number of images, send them in groups in separate emails.

Transferring Many Photos

If you and your recipient both have Gmail, larger numbers of photo images can be sent via Google Drive. WeTransfer.com also works, but using it may involve figuring out how to coordinate your phone’s internet browser with the photo folder, and that can get complicated. There are also techy tools available to extract images from smartphones—we will cover those below in the editing section.

PHOTO EDITING

The complex and subtle skills and techniques that can be used to digitally edit mineral photographs are a subject worthy of a separate article and are beyond the scope of this one. However, if you are planning to submit photos for publication to the *Mineralogical Record* and do not have many years of professional experience in

photo editing, it is best to submit them unedited and leave that task to the editors. The only thing you need to fine-tune is the color accuracy. This is because you have seen the real specimen, whereas the editors have not and can only guess.

In-camera Editing

The software available with a phone camera tends to be very limited. You can crop and you can change the exposure, brightness, contrast, sharpness and warmth (white balance). But you cannot edit the subject and background separately or remove blemishes like dust or fuzz. Any editing you do applies to the whole image.

If you’re going to use a single editing app in your phone, I recommend Photoshop Express. I have the Adobe Creative Cloud Photography Program for \$9.99 per month and it covers my desktop, my laptop, my iPad and my iPhone. I get the Lightroom, Photoshop Express and Photoshop Fix apps—quite a bargain. Of the three, I use the Photoshop Express app the most on my devices. You can download these apps separately for free but be aware that you may have to pay for certain features (in-app purchases). You get all of the functions that you get with your regular phone editing software and more. There is also a host of other image refinements possible, including the ability to remove blemishes and the ability to edit the background and subject images separately. All Photoshop apps are also available via Google Play for Android.

Computer Editing

For editing with a desktop (or laptop) application, once again, the Adobe Creative Cloud Photography Program seems a very good value to me. On my desktop computer I use both Lightroom and Photoshop. There are other, less expensive desktop web applications, like PicMonkey (\$47 per year; I use this one too sometimes) and GIMP (free, Open Source). But, once again, there are limitations to some of the editing functions on these programs.

If you prefer to edit your photos on your desktop or laptop computer there are several ways to get them there: emailing from



Figure 5. Goethite (iridescent) 2.9 cm, from the Ojuela mine, Mapimi, Durango, Mexico. Photographed using iPhone SE camera software; edited with Lightroom and Photoshop on a desktop computer; no stacking, gradational background inserted. Christi Cramer collection and smartphone photo.



Figure 6. Bournonite crystals on matrix, 3.5 cm, from Potosi department, Bolivia. Photographed using iPhone SE camera software; edited/stacked with Lightroom and Photoshop on a desktop computer; no background replacement. Tom Gressman collection; Christi Cramer smartphone photo.

Figure 7. Elbaite with lepidolite, 2.3 cm, from the Jonas mine near Itatiaia, Minas Gerias, Brazil. Photographed using the ProCamera application. Multiple images have been edited together with the Photoshop Express application, then edited/stacked in Lightroom and Photoshop. No background replacement. Christi Cramer collection and smartphone photo.

your phone, running your USB phone charging cable from your phone to your computer, transferring wirelessly, or copying to a flash drive. Emailing to yourself is by far the easiest—just make sure you choose to email at “actual size” to get the best image resolution for editing. Most smartphone charging cords now have a USB end; if yours doesn’t or if you have a wireless charger, you can get one inexpensively. If you have your devices synced with your desktop or laptop, you can transfer photos all wirelessly through WiFi or “Airdrop” (between Apple devices). There are also plug-in flash drives available for your phone, where you can download your images through an app, and then plug the flash drive into your desktop or laptop computer to transfer the images. I use one made for iPhone called a HooToo by iPlugmate. These drives are available for both Apple and Android phones through Amazon.com and other sources, and they are relatively inexpensive. But if you are not technology savvy, the easiest way to get your photos from your phone to your computer for most people is via email.

MULTIFOCUS STACKING

Multifocus stacking is all the rage right now, and for good reason: It frees mineral photography from the constrictions of the depth-of-field formula. Once used mainly for photographing microminerals, it is now used for virtually all sizes of specimens, with great results. Even cabinet-sized specimens can be captured in razor-sharp focus throughout!

But Multifocus stacking on a smartphone? Yes, it can be done! Most standard digital cameras and smartphones come complete with touch screens that make image-stacking possible. But there are three special restrictions for smartphones:

(1) Unless you are a statue, you should use a tripod. In order for all of the photo images in the “stack” to be aligned and blended



seamlessly, there must be absolutely no movement between shots. So handholding your phone is not an option.

(2) The best way to create a multifocus photo with a smartphone is to use a phone camera application. You *can* use the camera software that comes with the smartphone and just take multiple images for stacking, which does work, but with the standard phone camera software, tapping at different points on the screen to select areas of sharpest focus, also changes *the exposure* at each point. With a camera app, when you tap on a particular screen area, the camera automatically focuses on that area with no change in exposure. Then you tap the shutter button to take the picture. Do this several more times, dragging the focus lock (box) to different areas of the view that may not be in perfect focus, then tapping the shutter button to shoot the refocused image and presto!—you have your images for stacking.

(3) Stacking editing (combining the sharpest parts of all photos into one image) must be done on a desktop computer or laptop. Currently I'm not aware of any application programs that will do stacking on smartphones and tablets.

IPAD PHOTOGRAPHY?

I have seen people at a number of shows taking photos of minerals and mineral displays with their iPads or Android tablets. These are great for reference, but to date, there isn't a tablet I would recommend for taking publication-quality photos. Tablets are more awkward to hold, and there seem to be no tripod mounts designed for tablets. Although iPads and Android tablets are regularly updated, the aperture is still small and fixed and generally these devices are only 8 megapixels instead of the smartphone's 12 megapixels. Smartphones are simply designed to take better photos.

SHOOTING MINERALS IN CASES

With regard to taking photos of mineral displays at shows, many of us do this regularly with our smartphones, snapping images to put on Social Media or to send to our friends and family via email or text. But I don't advise using a tripod at shows because it is annoying and discourteous to others who are trying to view the cases, it is time-consuming and it is sometimes even forbidden (as a tripping hazard).

To photograph mineral displays with a smartphone, hold your phone as steady as possible (or steady it against the showcase glass if you are shooting a particular specimen in the case), shoot on full auto, zoom in only if absolutely necessary, move around a bit for successive shots to work around burnout reflections on the specimens, be quick and be courteous. Of course the glass will cause some distortion, and there will be almost unavoidable reflections from lighting fixtures and other exhibits in the show hall, and even from your own body (wear a black shirt if possible), unless you are privileged to shoot during set-up or tear-down while the glass is not in place. Display cases often have multiple colors of lights (varying from case to case) throwing your white balance off; this may require some fine-tuning with filters and white balance modes. These same limitations usually apply to photography in mineral museums.

Always ask permission to take photos in a dealer's room or booth

at a show—some dealers prohibit it. Extra care is required if the specimens are not behind glass, as nothing good happens if you clumsily drop your smartphone on a dealer's specimen!

ACCESSORIES

If you are interested in doing photography, including multifocus stacking images, through a microscope using your smartphone, Amazon.com, as well as companies like Amscope and Gem-A (U.K.), can supply you with a smartphone attachment for a microscope in a modest price range of \$10–\$25. Once again, a phone camera application is recommended and stacking editing would have to be done on a desktop or laptop computer.

Lens attachments such as Ollo clips will only enhance what the smartphone camera already provides: just producing *better* selfies, landscapes, low light and extreme macro photos. And such attachments may (like smartphone cases that cover the lens with a layer of plastic) cause some distortion, so be aware of this possibility if you decide to try using them. I experimented with an Ollo clip lens that I have for my iPhone SE using the wide-angle lens (because the macro lens is for *very* tiny items) and there was indeed some distortion, especially with regard to the curvature of the lens.

CONCLUSIONS

What I hope to have conveyed in this article is a set of “best practices” for photographing minerals with a smartphone—the best we can do with the technology we always have with us.

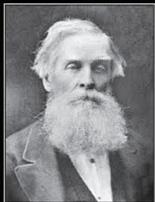
If a smartphone seems too unsophisticated for respectable usage, remember the old story about the great photographer who goes to a dinner party. During dinner, the host compliments the photographer on his craft by saying: “you must have a fantastic camera to take such beautiful photos!” To which the photographer replies, “And you must have a wonderful stove to have crafted such a delicious dinner!” Happy Shooting!

NOTE

All tests and experimentation for this article were done using a first generation iPhone SE.

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The Biographical Archive

1,940 entries and counting

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