

# THE PICKING TABLE

JOURNAL OF THE FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY

VOL. 55, NO. 2 – FALL 2014

\$10.00 U.S.



## IN THIS ISSUE

- BLUE LED FLUORESCENT MINERALS
- LAVENDULAN ADDED TO SPECIES LIST



# THE FRANKLIN-OGDENSBERG MINERALOGICAL SOCIETY, INC.

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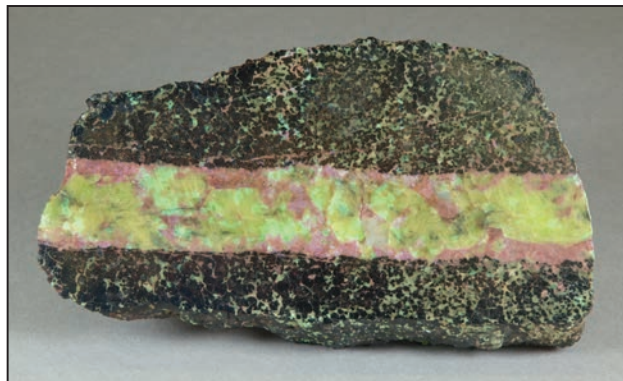
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<b>Nominating</b>	Richard J. Keller, Jr.
<b>Program</b>	Mark Dahلمان
<b>Swap &amp; Sell</b>	Chester S. Lemanski, Jr.



Coarse-grained pink leucophoenicite and green willemite in a vein 0.8 inch (2.2 cm) thick cutting granular franklinite-willemite-leucophoenicite ore. The front surface is polished. The specimen, no. 5024 in the collection of the Franklin Mineral Museum, measures 5.5 × 2.8 × 0.8 inches (14 × 7 × 2 cm) and was donated to the museum by Henry Althoen. *Earl R. Verbeek photo.*



# THE PICKING TABLE

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*The Picking Table* is the official publication of the Franklin-Ogdensburg Mineralogical Society, Inc. (FOMS), a nonprofit organization, and is sent to all members. *The Picking Table* is published twice each year and features articles of interest to the mineralogical community that pertain to the Franklin-Ogdensburg, New Jersey, area.

Members are encouraged to submit articles for publication. Articles should be submitted as Microsoft Word documents to Richard J. Keller, Jr. at: [PTMemberFeedback@gmail.com](mailto:PTMemberFeedback@gmail.com).

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## ABOUT THE FRONT COVER

The Ogdensburg Hotel on Main Street in Ogdensburg, in the early 1900s before the streets in town were paved. The hotel was owned by Patrick J. Dolan (1869-1927), Ogdensburg's first mayor. This year marks the centennial of Ogdensburg as an incorporated borough.



# FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY

## FALL AND WINTER 2014 ACTIVITY SCHEDULE

COMPILED BY TEMA J. HECHT

600 WEST 111TH STREET, APT. 11B

NEW YORK, NY 10025

thecht@att.net

### SATURDAY, SEPTEMBER 20, 2014

9:00 AM – NOON

#### FOMS Field Trip

Collecting at the Taylor Road site.

10:00 AM – NOON

#### Collecting at the Buckwheat Dump.

Meet at the Franklin Mineral Museum.

Park, and walk from there. Fee charged.

10:00 AM – NOON

#### FOMS Micro Group

Franklin Mineral Museum.

BYO microscope and minerals.

Call Ralph Thomas for information: 215-295-9730.

1:30 PM – 3:30 PM

#### FOMS Meeting

Franklin Mineral Museum.

Lecture: *The Blue-Light Special*, by Earl Verbeek.

3:30 PM – 4:15 PM

#### MINERAL OF THE MONTH – CLINOHEDRITE

Bring your specimens of clinochondrite for show-and-tell, and a discussion led by Bernard Kozykowski.

### SATURDAY AND SUNDAY, SEPTEMBER 27-28, 2014

#### \*\*58TH ANNUAL FRANKLIN-STERLING GEM & MINERAL SHOW

Sponsored by the Franklin Mineral Museum.

Franklin Middle School, Washington St., Franklin, New Jersey.

9:00 AM – 5:00 PM Saturday (indoors),

10:00 AM – 4:00 PM Sunday (indoors).

\$7.00 per day for adults, \$4.00 per day for children (6-16).

#### *The Pond Swap-and-Sell*, sponsored by the FOMS,

takes place outdoors on the school grounds

from 7:30 AM to 6:00 PM on Saturday, and

from 9:00 AM to 5:00 PM on Sunday. Show admission required.

The FOMS Annual Banquet starts at 6:30 PM on Saturday

**at the GeoTech Center, Sterling Hill Mining Museum.**

Tickets may be obtained at the FOMS show table for \$20.00.

The meal is an all-you-can-eat buffet;  
soda, tea, and coffee are included.

#### ◆BYOB◆

After the banquet, there will be an auction  
for the benefit of the FOMS.

Please plan on donating a good specimen, artifact, book, etc.!

\*\* Saturday and Sunday:

Events at the Sterling Hill Mining Museum.

For more information, please call: (973) 209-7212.

Or you can visit the website at

[www.sterlinghillminingmuseum.org](http://www.sterlinghillminingmuseum.org)

### SATURDAY, OCTOBER 18, 2014

9:00 AM – NOON

#### FOMS Field Trip

Collecting at the Braen Quarry

(a.k.a. Franklin Quarry) Cork Hill Road, Franklin, N.J.

If gate is open, drive through and park to the left of the gate.

Please don't block the roadway.

10:00 AM – NOON

#### FOMS Micro Group,

Franklin Mineral Museum.

1:30 PM – 3:30 PM

#### FOMS Meeting

Franklin Mineral Museum.

Lecture: *First Photos Ever Taken of  
Franklin-Ogdensburg Species*, by Vandall King.

6:00 PM – 10:00 PM

#### \*\*Nighttime Mineral Collecting:

Sterling Hill Mining Museum.

Collecting permitted on the Mine Run Dump and in  
the Fill Quarry, Passaic Pit, and "saddle" areas.

**For museum members only.** \$5.00 admission fee  
plus \$1.50 for each pound of material taken.



**SATURDAY, OCTOBER 25, 2014**

**\*\*25TH ANNUAL ULTRAVIOLATION,**

a Show-Swap-Sell Session featuring fluorescent minerals only.

First United Methodist Church, 840 Trenton Road,  
Fairless Hills, Pennsylvania.

9:00 AM – 4:00 PM, \$2 donation.

**“If your rocks don’t glow, you’re at the wrong show.”**

Table space available. For information, call 856-663-1383  
or e-mail <ultraviolation@yahoo.com>.

**7:00 PM – 10:00 PM**

**\*\*Night Dig on the Buckwheat Dump,**

for the benefit of the Franklin Mineral Museum.

Doors open at 6:30 PM for check-in and mineral sales.

Admission \$10.00 adult, \$8.00 children 3-12 years of age.

Poundage fee charged. **Call for details: 973-827-3481.**

**DATE CHANGE: SATURDAY, NOVEMBER 8, 2014**

**9:00 AM – NOON**

**FOMS Field Trip**

Collecting at Hamburg Quarry,  
Eastern Concrete Materials, Inc.

Meet at the scale house to sign releases.

Hard hats, leather shoes (preferably steel tipped),  
gloves and glasses required.

◆ **Specimen weight shall be limited to a maximum of 25 lbs.**◆

◆ **Bulk collecting/loading of specimens is strictly prohibited.**◆

**10:00 AM – NOON**

**FOMS Micro Group**

Franklin Mineral Museum.

**1:30 PM – 3:30 PM**

**FOMS Meeting**

Franklin Mineral Museum.

Lecture: *Permian/Triassic Extinction Event –*

*“The Great Dying” – The Worst Mass Extinction of All Time,*  
by Derek Yoost.

**SATURDAY, NOVEMBER 22, 2014**

**9:30 AM – 4:00 PM**

**\*\*FLUORESCENT MINERAL SOCIETY MEETING**

GeoTech Center, Sterling Hill Mining Museum.

Speakers include Donna Beaton, Hari Venugopalan,  
and Earl Verbeek.

Lunch will be served (\$10.00 contribution).

**◆BYOB◆**

Reservations necessary! Please contact Howie Green:  
royalp53@verizon.net.

**Scheduled activities of the FOMS include  
meetings, field trips, and other events.**

**Regular meetings are held on the third Saturdays of  
March, April, May, June, September, October, and  
November, and generally comprise a business session  
followed by a lecture. FOMS meetings are open to the  
public, and are held at 1:30 PM, usually in Kraissl Hall  
at the Franklin Mineral Museum, Evans St.,  
Franklin, N.J. (check listings for exceptions).**

**Most FOMS field trips are open only to FOMS members  
aged 13 or older. Proper field trip gear required:  
hard hat, protective eyewear, gloves, sturdy shoes.  
\*\*Activities so marked are not FOMS functions  
but may be of interest to its members. Fees, and  
memberships in other organizations, may be required.**

**Any information in this schedule, including fees,  
is subject to change without notice.**

**The FOMS Activity Schedule is compiled by Tema Hecht  
<thecht@att.net>**

**Thanks go to James Van Fleet, Mark Dahlman,  
Bernard Kozykowski, Richard Keller, Earl Verbeek,  
Ralph Thomas, Howie Green, the Franklin Mineral  
Museum, and the Sterling Hill Mining Museum  
for this information.**

# President's Message

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**JAMES VAN FLEET**

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Here's my last chance as president to say something useful about FOMS, so I'll briefly look back on the past two years, and look ahead a bit, too. We have made some important steps to improve communication among our membership. We now have a website dedicated to the Franklin-Ogdensburg Mineralogical Society. The Web address is <http://fomsnj.wordpress.com>. We also have an e-mail address: [fomsnj@gmail.com](mailto:fomsnj@gmail.com), and a presence on Facebook (along with a surprising number of our members, mineral dealers, and other mineral clubs and organizations that have Facebook pages).

We continue to cooperate with the Franklin Mineral Museum and the Sterling Hill Mining Museum to put together not one but two outstanding mineral shows each year. It may look easy, but that is only because of the many volunteers from FOMS, NJESA, and the museums' staff working long hours,

even days and weeks before the show, and putting in some really intense manual labor with setup and breakdown. More volunteers would be appreciated!

This year FOMS produced a club T-shirt, thanks to the efforts of Gary and Heather Moldovany and Tema Hecht. Our speaker program was excellent, thanks to our Vice President, Mark Dahlman, who will be stepping into the President's post in 2015. *The Picking Table* itself has sustained an impressive level of quality and interest, thanks to Rich Keller and a dedicated editorial staff, and the issue before you is another example. We can look forward to their continuing efforts, and we look forward to your participation, too. Get involved, attend the fall banquet, help make FOMS a dynamic and growing organization! ✂

## From the Editor's Desk

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**RICHARD J. KELLER, JR.**

13 GREEN STREET

FRANKLIN, NJ 07416

FranklinNJ@hotmail.com

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Yet another year draws to a close, but not without a new slate of FOMS activities, field trips, and exciting news in this new issue of *The Picking Table*.

It's always exciting when we have a new addition to the ever-growing Franklin-Ogdensburg mineral species list. This time around is no exception with the recently confirmed lavendulan from Sterling Hill. This is not a newly described mineral, just new to our area. This finding was previously published in the May 2014 issue of *Mineral News*. More in-depth information about the mineral analyses can be read in that issue of *Mineral News*. What we're doing here is condensing the essential data for our members' perusal. Only one specimen of this mineral from our area is currently known to exist, so we're both lucky and thankful that folks thought to analyze the specimen and find it to be from the Franklin area.

I believe our readers will also be thrilled to read the article co-written by Charles Mazel, PhD, and Earl Verbeek, PhD, about fluorescence of local minerals using a blue LED light. Anyone so inclined to invest in the necessary equipment to enjoy this phenomenon will find themselves re-viewing most, if not all, of the specimens in their collections to look for fluorescence not previously known to exist. As you will see, rhodonite (generally deemed to be nonfluorescent under SW/MW/LW UV, with only a minimal number of discovered exceptions) is just one example. There's no reason not to check ALL of your specimens! It'll be like you've obtained a completely new mineral collection!

So without further delay, we bring you the fall 2014 issue of *The Picking Table*. ✂



# Happenings at Sterling Hill

**WILLIAM KROTH**

PRESIDENT, STERLING HILL MINING MUSEUM

30 PLANT STREET

OGDENSBURG, NJ 07439

The spring and summer of 2014 brought a record number of attendees to Sterling Hill. Having expanded our daily maximum of school tours to ten, our facility was certainly functioning at full potential. Even on weekends, our typical 1:00 p.m. tours were bringing in around 150 visitors! In addition to tours, we've also had many Boy Scouts in to earn their badges in geology, astronomy, and mining in society. We have a total of three certified counselors ready to present the appropriate subject matter and verify that each candidate has met the applicable scouting requirements.

We are very proud of the fact that Sterling Hill Mining Museum is now offering continuing education credits for teachers. This summer, Jeff Osowski (Sterling Hill Vice President) and Missy Holzer (Executive Board Member of the New Jersey Earth Science Teachers Association) coordinated our first GeoSTEM academy. The two-day event was a stunning success and included up to five hours of instruction per day. It was presented to more than 35 school teachers striving to meet the standards for the STEM (science, technology, engineering, and math) curriculum. This STEM program is being heavily integrated into the school systems with hopes that it will make American students more competitive with other nations in these important fields of study. I joined Ron Mishkin, ex-miner and tour guide, and Dr. Earl Verbeek, our Curator and Resident Geologist, in presenting information on mining, refining, separation, and mineral properties that teachers can use in their classrooms to stress the importance of mining in society. Demonstrations were given on the reduction of ores, separation machinery, specific gravity, and solubility. Sterling Hill board member Mike Pierce was kind enough to bring his personal electrostatic separator to the event as a wonderful addition to the displayed exhibits.

As the Borough of Ogdensburg celebrates its 100th anniversary, the Sterling Hill Mining Museum is doing its part in showing town pride by painting the plate-girder railroad bridge. The bridge was once located in Franklin, New Jersey, where it was a main link for ore transportation. It was moved about 100 years ago to its current location near our museum entrance on Passaic Street. After the railroad spur to the mine was abandoned, the bridge sat unmaintained for decades. Sterling Hill's property manager, Tom Hauck, power-washed and painted the bridge, turning it into a beautiful historical attraction. Neither the town nor Sterling Hill owns the structure;

however, the town mayor and council were kind enough to provide police and traffic control as needed for a safe working environment for Tom.

Due to our museum's increased attendance, it was apparent that Sterling Hill needed to bring in new staff to meet the additional demands. Stephanie Messina, a Montclair State University graduate and teacher, has been introduced as our General Manager, and Liz Schneider, a Rhode Island University graduate, is our new Assistant General Manager. We've also hired a Franklin native, Katarina Seymour, who is a geology major at Rutgers University and has been working with our curator to document our specimens and artifacts. Finally, ex-Sterling Hill miner Doug Francisco has joined our organization as a volunteer tour guide. Doug worked in the mine from the 1970s until its closing in 1986 and brings a wealth of great stories and technical information to each of his tours.

Finally, our main parking lot has been paved and striped by a local contractor, Hardyston Paving. This will result in more efficient use of our parking lot and aid in keeping our buildings clean, since soil will no longer be tracked inside. Designed by engineer Mike Pierce, the 4.5 inches of asphalt pavement should easily handle the expected increase in bus parking.

Great things continue to happen at the Sterling Hill Mining Museum, and I would personally like to thank all of our hard-working staff and volunteers who are making our facility a focal point for education and historical interest in New Jersey. ✂



# Franklin Mineral Museum Report

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**MARK BOYER**

PRESIDENT, FRANKLIN MINERAL MUSEUM  
32 EVANS STREET  
FRANKLIN, NJ 07416

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As president of the Franklin Mineral Museum, I wish to express gratitude for all the supporters of our 49-year-old institution, which is dedicated to preserving the mineralogical heritage of this unique mineral locality. School kids, scouts, families, and visitors from distant lands come here to learn about Franklin minerals and local mining history, as well as other natural history. They have an opportunity to “play in the dirt” looking for gems and fossils, and—if they’re *really* serious—to collect specimens on the Buckwheat Dump. Our friendly staff consistently gets high ratings on numerous online tourism review sites. When I read what our visitors have to say about us, well ... frankly, I just beam with pride.

This year, a significant addition to the museum’s Hall of Fame was made honoring Amos and Julia Phillips, who were instrumental in getting Franklin officially designated as “the Fluorescent Mineral Capital of the World.” The full story can be read on the plaque in our Hall of Fame, which commemorates the contributions of people important to the local mineral culture.

With spring came fresh paint on the walls (thanks, Doreen Longo and staff!). Museum staffer and artist Lee Ann Armstrong painted a realistic rendering of a mine passage at the entrance to our mine replica. A new portable handicap ramp constructed of rugged diamond-plate steel makes access to the viewing shed possible for wheelchair-bound visitors. In June, the museum participated in a state-funded (i.e., “your tax dollars at work”) program that paid 70% of the cost of upgrading the lighting throughout the museum with energy-efficient lighting.

For a second year, the museum has had a presence at the NY/NJ Mineral Show, held April 11-13 at the N.J. Convention & Expo Center in Edison. This year’s show featured an exhibit room full of fluorescent mineral classics from the museum’s collection. Many thanks are due to museum staff and volunteers for their efforts, and a special big thanks to coordinator Steven Phillips for making it happen.

Miners Day this year was unseasonably chilly, with a threat of rain, but fortunately the partly sunny skies held out just long

enough until the festivities were over. As usual, our MC Richard Bostwick, the Franklin Band, the student science awards, the hearty all-you-can-eat buffet, and—most of all—the fellowship and honoring of former New Jersey Zinc Company employees continued to make this event a favorite tradition.

Once again the museum has had a summer-long mineral sale. This year, the sale featured fluorescent minerals exclusively, both “local yokels” and “foreigners.” Kraissl Hall was set up as a sales room, and special sales cases were constructed with wire mesh covers and painted black inside to allow convenient UV lamping of specimens.

Collections Manager Lee Lowell is continuing his work on cataloging and storing the museum’s geology and species reference collections. Lee has expanded the geology exhibits in Kraissl Hall, and Steve Sanford has assisted with writing the descriptive labels that interpret the “story” behind each specimen. At this time, the geology exhibits are not part of the general tour; however, requests made in advance to view this collection will be accommodated. Of course, FOMS members can always see the geology exhibits at their regular monthly meetings.

The curatorial department expresses huge thanks to Brad Jordan and Jim Van Fleet of Bucknell University for providing ongoing X-ray analyses of museum specimens. Jim is the current president of FOMS, and much of his research on our local minerals is published in the FOMS journal, *The Picking Table*.

There are two upcoming museum-sponsored events I wish to call to your attention: 1. The 58th annual gem and mineral show at the Franklin School—the one Franklin mineral event each year that should not be missed. 2. The fall night dig on the Buckwheat Dump, which will be held on October 25 and will have a Halloween theme. This should be a great, spooky/fun activity for families to hunt for fluorescent minerals in natural darkness.

Thanks again to all our supporters. Be sure to visit us often. And if you had a great visit, why not give us another great review on the travel websites? We’d sure appreciate it! ✂

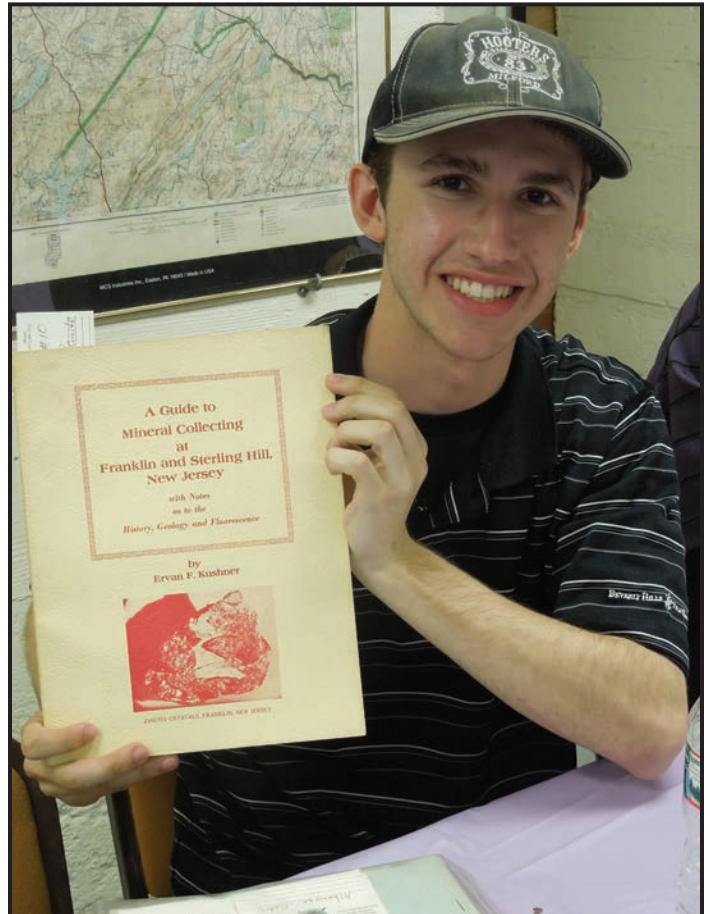


# Scenes From the FOMS Banquet

APRIL 26, 2014



Tom Hauck, yet-to-be-bronzed Sterling Hill mascot and operator of the Tom A. Hawk mine. *Tema Hecht photo.*



Lenny Lee, Jr. with one of his winnings at the show banquet: a bound copy of Ervan Kushner's volume on Franklin-Sterling minerals. *Tema Hecht photo.*



Mark Dahlman, FOMS Vice President, proud new owner of a toy copper dinosaur. *Tema Hecht photo.*



Dave Wooley after his winning bid for a CD containing every issue of Zinc magazine ever printed. *Tema Hecht photo.*

# The 42nd Annual New Jersey Earth Science Association Gem & Mineral Show

APRIL 26 AND 27, 2014

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**STEVEN M. KUITEMS, DMD**

14 FOX HOLLOW TRAIL  
BERNARDSVILLE, NJ 07924

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When I reflect on what the NJESA show represents, year after year, it can encompass the entire spectrum of the rock and mineral hobby. The mix of displays and offerings-for-sale at this show truly had something for just about every collector. The displays, as always, represented many possibilities within the hobby, and whatever might have been missing there could be found by rummaging among the items of the 24 indoor dealers and the many more dealers and swappers outside.

The white-light displays had two centered on the minerals of the Franklin mining district. Both were educational in nature. Steve Sanford's exhibit, "Paleocaverns," focused on two aspects of Sterling Hill geology: collapse breccias and plastic flow. Breccias are angular pieces of rock and ore held together by fine-grained debris cemented by mineralized solutions. Collapse breccias formed as caverns in the orebodies became unstable and "the roof fell in." Specimens from three different Sterling Hill breccias were on display, with explanatory text. Also on view were several examples of plastic flow in the ore, a fairly common phenomenon at Sterling Hill which lends support to Robert Metsger's "inverse diapir" theory that the overall keel-and-limb forms of the Franklin and Sterling orebodies come from their having sunk through the more pliant (plastic) Franklin Marble. The author's case, "Franklin Classics," had an unusual suite of rare, century-old specimens from the Franklin Mine's oxidation zone, including azurite, malachite, and aurichalcite.

From its Wilfred Welsh Hall of Minerals, the Franklin Mineral Museum displayed "Foreign Rocks" (a local term for rocks and minerals not from the Franklin and Sterling Hill area). Your author especially liked the eye agate from Rio Grande do Sul, Brazil. Dick and Elna Hauck presented "Fe + S = Pyrite," a case of fine crystallized pyrite from around the world. Brad Plotkin had a more local approach with "Minerals of Great Notch": classic examples of prehnite and orange-colored stilbite, with historic documents from this now extinct traprock locality. Brendan and Connie Dunn doubled down with two cases, "The Many Forms of Calcite" and "For the Love of Calcite." My favorite specimens were a scalenohedral calcite crystal on amethyst from Brazil, of stunning color, form, and

contrast, and a humble "sand calcite" from Rattlesnake Butte, South Dakota, a classic from my childhood collecting days.

Bernard Kozykowski presented three cases of showy international specimens, simply titled "Classics." Among the most eye-catching were a large green smithsonite from the 79 Mine, Arizona; sharp stibnite crystals in the shape of a cross from the Li Shu Mine, Hunan Province, China; and a stunning specimen of brassy pyrite cubes from Navajún, La Rioja, Spain. Marine fossils from a phosphate mine in Aurora, North Carolina, were displayed by NJESA's fossil maven, Arlene Castleman. Rudy Greipel had two cases, "Color and Form" and "All That Glitters." The former case's highlights were a fine fishtail selenite crystal and a remarkable Prospect Park, New Jersey, prehnite with finger-like casts. Rudy's "Glitters" case was dedicated to highly reflective minerals, from wire gold crystals out of the Olinghouse Mine, Washoe County, Nevada, to a shimmering velvet malachite from Katanga Province, Democratic Republic of Congo. Bob Horn rounded out the white-light displays by bringing the viewer back to New Jersey and a case chock-full of excellent specimens from Prospect Park: distinctive brown stilbite crystals, large specimens of calcite crystals, and many fine green examples of prehnite.

On the Franklin School's auditorium stage was the "Dark Side" of the show: a few dealers in fluorescent minerals and nine cases of fluorescent exhibits. Nearest the stage door was the Franklin Mineral Museum's display of "Rock Veins & Arteries," a theme made clear by such exotic Franklin specimens as an esperite vein in willemite, and a band of white-fluorescing barite in red-fluorescing calcite. Next was the Sterling Hill Mining Museum's "Christmas in Springtime," an extravagant assortment of the red-and-green pattern pieces made possible by the local abundance of red-fluorescing calcite and green-fluorescing willemite. Then your author presented two cases of "Franklin Delights," which to the discerning included some extraordinary and rare pieces such as a large cuspidine from the Buckwheat Dump, a very bright "fish-scale" margarosanite, and a larsenite specimen with good coverage of blue-fluorescing willemite (!). Each case, however, included a large sphere of willemite and calcite that drew even more oohs



and aahs from younger viewers than their perennial favorite, a willemite and calcite “picture rock” of Fozzie Bear.

“Look What I Found” was the title of Andrew K. Mackey’s display of personally collected specimens, including a very bright blue diopside, and a green-fluorescing synthetic zincite from the New Jersey Zinc Company’s smelter in Palmerton, Pennsylvania. George Durland, who has been coming to this show from Maryland for many years, put together a case of “Hardystonite, Esperite and Friends, and Some Others on the Side”; this case had a nice five-color Franklin piece that caught the eye, as did a particularly large esperite and hardystonite specimen that any local collector would be proud to display. Paul Shizume bravely went where other collectors have gone before (but not always with such care and good taste) by presenting “Fluorescent Minerals From Around the World.” Included were a cherry-red tugtupite from southwestern Greenland, and bluish-pink-fluorescing agrellite from the Kipawa alkaline complex in Québec, Canada.

Brendan and Connie Dunn’s case, “Longwave Classics,” gets better every time they put it together. (Franklin is a shortwave UV locality, so an eye-popping assortment of longwave-

responsive minerals is always a revelation for us.) Particularly choice were the Terlingua-type calcites; the hyalite opal from Spruce Pine, North Carolina; and several outstanding English fluorites. Pat Hintz, a first-time exhibitor at this show, rocked the stage with personally collected, multicolored “Fantasy Rocks” from the Ilimaussaq alkaline complex in southwestern Greenland. His talk about collecting in Greenland and the challenges of getting there enhanced the enjoyment of actually seeing these legendary three- to five-color pieces. The last case in line was another first, Andy Muir’s “Ridiculous Roster of Rolling Rocks”: spheres of cut and polished fluorescent minerals from all over. How these spheres stayed in place for the show is beyond our understanding, but we are assured they rolled home safely. All fresh, all new, all different: a gift of original and unusual beauty from a Marylander who is just as dedicated and fanatic in his love of spheres as we are in the pursuit of one more unique-in-some-way Franklin rock.

As always, it was a delight to see these fine exhibits, interact with friends, and look for something new. Please think about joining us to display your mineral treasures at next year’s NJESA show. ✂

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# FOMS Field Trips

## SPRING 2014

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An overview of the collecting spot at the Hamburg Quarry. *Mark Boyer photo.*



Franklin Quarry employee Mike Gunderman shows off his prized find of purple fluorite. *Mark Boyer photo.*

After an especially cold and snowy winter that just didn't seem to want to quit, our local mineral diggers themselves seemed slow to warm up to collecting. The first trip of FOMS's 2014 collecting season was on March 15 at the Sterling Hill Mining Museum. Winter temperatures kept many collectors away, but seven die-hards came out to put their picks and rock hammers to work. The pit and quarry areas were made available so collectors had ample opportunities to prospect for specimens. Material found included galena, willemite crystals in calcite, and a hydrozincite-aragonite mix.

By April 19, glorious spring weather had finally arrived and 15 FOMS members were eager to collect at the Taylor Road Dump in Franklin. Owned by the Franklin Mineral Museum, this site is opened for collecting only for FOMS field trips. This spring's dig turned up sphalerite, chlorophane-variety fluorite, and a little fluorescent quartz. An additional report of fluorescent norbergite likely means that material had been dumped here from local marble quarries along with waste rock from the Taylor Mine. In recent years at the Taylor Road field trips, it seems that more effort has been required and the diggings have been getting bigger and deeper, but the site still produces good material.

FOMS's trip to the Eastern Concrete Materials Quarry in Hamburg, N.J., on May 17 coincided unexpectedly with the field trip of another regional mineral club. This is the second time that this has happened. It would appear that it is the quarry operators' practice to lump together the field trips of different clubs on the same day, so FOMS members should expect this situation at future trips to this quarry. For this dig, the weather was perfect but unfortunately the mineral-collecting prospects were dismal. We were directed to the lower northeastern section, where little was collected other than some small pyrite crystals and epidote as slickensides, veinlets, and crystallized druses. Although this year's dig at Hamburg was disappointing, next year our field trip chairman will request returning to the upper western section that in years past had yielded abundant salmon-orange calcite and large crystals of apatite.

The highlight of FOMS's spring field trip season was the June 21 dig at Braen Stone Industries' Franklin Quarry on Cork Hill Road in Franklin. After presenting safety rules and offering us complimentary coffee and donuts, quarry manager Mark Deighan took us to the quarry's southwest workings. Recent blasting here had reportedly revealed large masses of purple fluorite. Braen employee Mike Gunderman proudly showed us a football-sized chunk that he had saved for himself.

Unfortunately, the freshly blasted material at this location was coated with white marble dust and the bright sunshine made it virtually impossible to find anything collectible. The only notable find at this spot was a pocket of smoky quartz crystals in a large boulder. The largest of the stout, terminated crystals was about ½" wide. Aside from this find, this area proved to be barren, so FOMS collectors were escorted as a group to a past-favorite location at the far northwestern corner of the quarry. As on many previous FOMS trips to this area, fairly rich pieces of yellow-fluorescing norbergite were encountered. Some of the norbergite was accompanied by sparsely distributed grains of longwave-fluorescent corundum as large as 4 mm across. Bladed crystals of tremolite were also fairly abundant, and one specimen had several blades encrusted with a druse of crystallized pyrite. One lucky collector found euhedral crystals of uvite, and several other collectors found large crystals of pyrite. One sheared cubic pyrite crystal cross-section measured 1½" on edge, in a hard, dark matrix.

FOMS thanks the Sterling Hill Mining Museum, the Franklin Mineral Museum, Eastern Concrete Materials quarry manager Michael Guida, and Braen Stone Industries quarry manager Mark Deighan for offering our club the opportunity to collect mineral specimens the good, old-fashioned way. ✂



The 4-cm-long smoky quartz crystal found by Steve Kuitems at the Franklin Quarry. Steven M. Kuitems, DMD, photo.

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# Mineral Notes

## LAVENDULAN ADDED TO THE FRANKLIN-OGDENSBURG SPECIES LIST

A feature article by Forrest Cureton, Tony Kampf, and Tony Nikischer in the May 2014 issue of *Mineral News* announces the recent identification of a new species to the area, lavendulan, from the Sterling Mine, Ogdensburg. This brings the total number of species found in the Franklin-Ogdensburg mining district to 359.

Lavendulan,  $\text{NaCaCu}_5(\text{AsO}_4)_4\text{Cl}\cdot 5\text{H}_2\text{O}$ , is an uncommon copper arsenate mineral. It was named for the lavender-blue color of the original but now discredited type specimen, which was determined in recent years to be a mixture of species not related to lavendulan as currently defined. Present-day lavendulan does not exhibit a lavender color but is characteristically turquoise or electric blue. Its revised type locality is Jáchymov, Czech Republic, and it occurs as a secondary mineral at numerous copper deposits worldwide.

Lavendulan is a dimorph of lemanskiite; i.e., they have the same formula but different structures: Lemanskiite is tetragonal, but lavendulan is monoclinic. (Lemanskiite, not

found locally, is named for Chet Lemanski, Jr., a former President of the Franklin-Ogdensburg Mineralogical Society.) Lavendulan has the same structure as sampleite, and the two minerals form a series.

The specimen from Sterling Hill was from the collection of the late Robert Trimmingham of California and had been purchased from Parker Minerals in 1979. The original specimen label had called it aurichalcite from the 1200 level of the Sterling Mine. Doubts about that mineral identification prompted further investigation by Tony Kampf of the Natural History Museum of Los Angeles (powder X-ray diffraction) and Tony Nikischer of Excalibur Mineral Corp. (energy-dispersive X-ray spectroscopy). Both of these analyses showed excellent matches for lavendulan. The Sterling lavendulan matrix is nonfluorescent calcite with franklinite and red willemite. The lavendulan is pale blue. No doubt more local lavendulan specimens exist, likely misidentified as other copper secondary minerals. ✂



The green paper arrow points to the pale blue area of lavendulan. Specimen measures approximately 1.5" x 1" (4 x 2.5 cm) and is currently in the collection of Forrest Cureton. Photo provided by Excalibur Mineral Corp. as published in *Mineral News*.



# Fluorescence of Minerals Under Blue Light

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## INTRODUCTION

The mineral community talks about specimens fluorescing under short-, medium-, or longwave ultraviolet (UV) light, but what does this really mean? Does it mean that these wavelength ranges are the best or only way to make the subject fluoresce? It does not. Were those wavelength ranges specifically selected as optimum bands to excite fluorescence? They were not. Although collectors are accustomed to looking for fluorescence in minerals with UV light, this is just a combination of convenience and historical artifact. In this paper, we explore what it means to say that a mineral is fluorescent, including consideration of the underlying physics and illustration of fluorescence using visible rather than UV light as an excitation source.

Many sources define *fluorescence* as the emission of visible light upon stimulation by UV light, but a more general and accurate definition is the absorption of electromagnetic radiation and its re-emission at a longer wavelength. UV and visible light are small regions of the much broader electromagnetic spectrum. It is completely possible for a material to absorb blue, green, or some other wavelength of visible light and fluoresce at longer wavelengths in the visible or infrared regions of the spectrum. With the recent proliferation of blue-light lasers and LEDs on the market, blue light as an excitation source of mineral fluorescence is an emerging aspect of the hobby.

In this investigation, we adopted an empirical approach to survey a variety of Franklin, N.J., area minerals for any notable response to blue-light excitation. We concentrated on minerals that are known to fluoresce under UV excitation but also explored minerals that have not previously been described as fluorescent. The choice of the particular blue light used for this study is in many ways as arbitrary and convenience-driven as the “standard” choices of UV wavelength, but it has provided interesting observations and will hopefully serve as an impetus to further investigation.

## PHYSICS

A *Jablonski diagram*, a schematic typically used to illustrate the electronic states of an ion in a crystal lattice and the transitions between them, is a valuable tool for understanding the fluorescence process. In the Figure 1 Jablonski diagram, electronic (energy) states are indicated by bold horizontal lines.

The thin horizontal lines above them represent vibrational/rotational sublevels. Electrons are normally at the lowest energy state, indicated by  $S_0$ . Photons—elemental particles of electromagnetic radiation, including light—are indicated by the blue arrow entering from the left. When a photon with appropriate energy interacts with an ion, the photon may be absorbed, causing an electron to jump to an excited state ( $S_1$  or  $S_2$  in the diagram) or one of its sublevels. By “appropriate energy,” we mean energy corresponding to the difference between the ground state and any of the sublevels in either of the excited states. Thus not all incident photons are equally likely to be absorbed. This transition process is very fast, on the order of  $10^{-15}$  seconds.

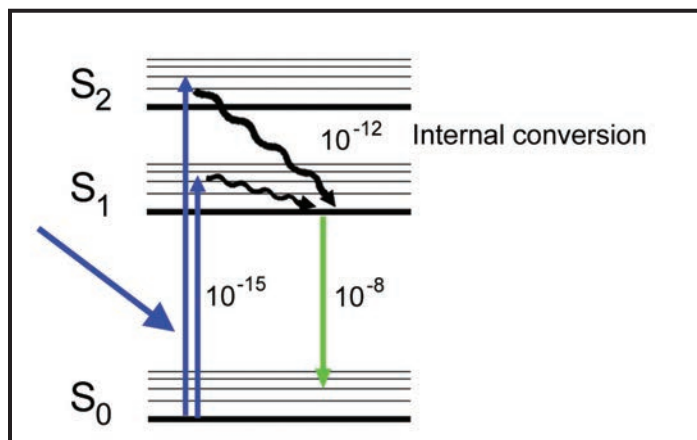


Figure 1. Jablonski diagram showing the electronic transitions involved in fluorescence.

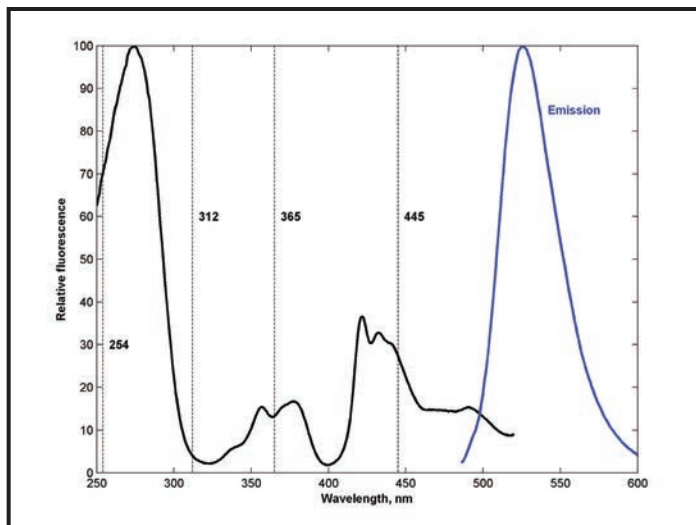
An excited-state electron rapidly loses some of its energy to vibration (heat), a process called *internal conversion*, and falls to the lowest level of the first excited state ( $S_1$ ). The time scale for this process is on the order of  $10^{-12}$  seconds. From there the electron may fall to one of the sublevels of the ground state ( $S_0$ ), emitting a photon with energy equivalent to the energy difference of the transition. This happens at a time scale of nanoseconds after the initial photon was absorbed. Since the emitted photon has less energy than the absorbed photon, it is at a longer wavelength. This explains the seemingly magical process of fluorescence that converts light of one wavelength to another, and transforms invisible UV light to the vivid examples of mineral fluorescence that collectors so admire.

For any given mineral, the probability that a photon will be absorbed varies with wavelength; moreover, the pattern of absorption as a function of wavelength varies from one mineral to another. This explains why different light sources (shortwave, medium wave, and longwave) will excite different minerals. Even for those photons that are absorbed, there are other processes that compete with fluorescence for de-excitation of the excited-state electrons. The number of photons fluoresced relative to the number absorbed is called the *quantum efficiency*. The higher the quantum efficiency, and the greater the absorption, the brighter the fluorescence. Note also that the Figure 1 diagram is a bit of a simplification. There may be other processes and internal energy transfers, but in essence this is sufficient to explain the fluorescence process.

The best way to document the fluorescence properties of a particular specimen is to measure *excitation* and *emission* spectra. The excitation spectrum is a plot of the relative efficiency of different wavelengths of light to excite fluorescence in the subject, while the emission spectrum is a plot of the relative distribution of energy released in the form of fluorescence. The emission spectrum is relatively easily measured with any spectrometer, but measurement of the excitation spectrum requires a more advanced spectrofluorometer, which monitors the intensity of emission in a very narrow wavelength band while scanning through a range of excitation wavelengths with high resolution.

Figure 2 shows excitation (black) and emission (blue) spectra for a sample of willemite from the Sterling Mine, Ogdensburg, N.J. Both were measured with a SPEX Fluoromax-2 spectrofluorometer, and for clarity in display the raw data are normalized to a peak of 100. The emission spectrum was recorded with excitation at 450 nm and shows a fairly narrow (~40 nm FWHM [full width at half maximum]) emission peak at approximately 525 nm. A viewer would perceive this as green to yellow-green. For the excitation spectrum, the emission detector in the instrument monitored the intensity at 540 nm. The nominal wavelength peaks of shortwave (254 nm), medium wave (312 nm), and longwave (365 nm) UV lamps are included for reference, along with the peak (445 nm) of the blue light used in this investigation.

The excitation spectrum indicates which wavelengths of light will make a subject fluoresce, and thus provides guidance on the selection of light sources and what response one might expect. In Figure 2, the data for the Sterling willemite sample show that its “ideal” wavelength for excitation is the peak at approximately 275 nm. This is interesting, but not very helpful because there is no practical light source that emits at this particular wavelength. For practical exploration, collectors are constrained by available technology. UV exploration has long been based on light sources that utilize mercury vapor, with major peaks at 254, 312, and 365 nm. Figure 2 shows that the efficiency at 254 nm is about 70% of ideal, at 312 about 4%,



**Figure 2.** Fluorescence excitation spectrum (black, emission at 540 nm) and emission spectrum (blue, excitation at 450 nm) for a sample of willemite from the Sterling Mine, Ogdensburg, N.J. The nominal wavelengths of shortwave (254 nm), medium wave (312 nm), and longwave (365 nm) UV lamps are included for reference, along with the peak (445 nm) of the blue light used in this investigation.

at 365 nm about 14%, and at 445 nm about 27%. So, for lights providing equal excitation intensities at these wavelengths, one would expect brightest fluorescence from shortwave UV, very little from medium, weak from longwave, and moderate from blue. If the potential to have lights with different intensities were added in, a given blue light that provides three times the excitation intensity of a given shortwave lamp would produce a brighter fluorescence. So, in comparing the apparent fluorescence brightness stimulated by any two lights, one would have to know the excitation intensities produced by each before concluding that one wavelength range is “better” than the other.

## METHODS

### Samples

This investigation was performed with specimens housed in the Franklin Mineral Museum, Franklin, N.J. We concentrated on specimens located in cases in the museum’s fluorescent minerals room but also made a quick survey of specimens in the local minerals room.

### Blue light source

We used a Sola NIGHTSEA (Light & Motion, Marina, Calif.) blue light to illuminate specimens in the dark. This light contains royal blue LEDs with peak emission at approximately 445 nm in combination with a custom interference filter (NIGHTSEA, Bedford, Mass.) to trim the spectral output. Figure 3 shows the output spectrum of the light.

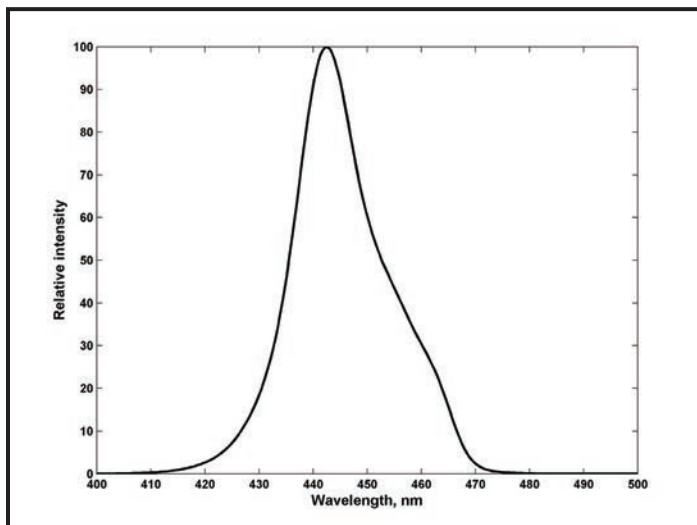


Figure 3. Relative spectral intensity of the Sola NIGHTSEA blue light used for this investigation.

### Viewing filter

The light leaving a fluorescing subject consists of two components: the light emitted by the subject (fluorescence) plus the excitation light reflected from it. To see only the fluorescence, the reflected light must be filtered out. When using UV light to excite fluorescence, it is not necessary to wear glasses to block the reflected UV light since the lens of the eye absorbs those wavelengths and prevents them from reaching the retina (although it is of course desirable to wear UV-blocking glasses for safety). When exciting specimens with blue light, it is necessary to wear barrier filter glasses that block the reflected blue light. Without this the reflected light will appear very intense and will either prevent one from seeing

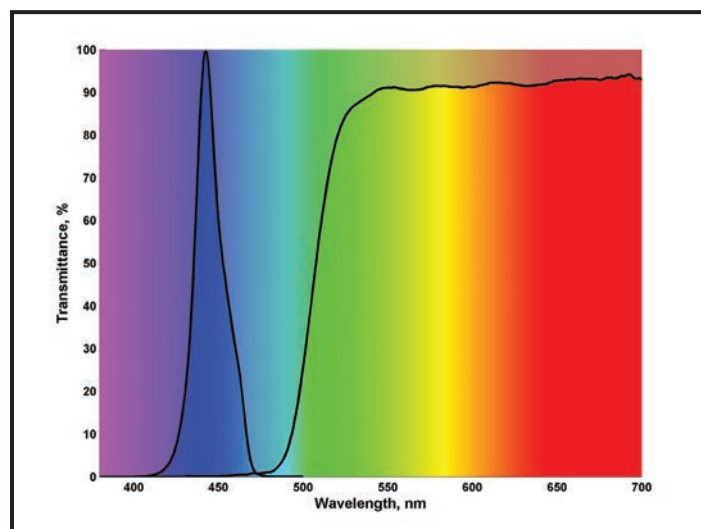


Figure 4. Transmission spectrum of the yellow barrier filter glasses used in combination with the blue light. Note that the blue LED output spectrum (with a peak at about 445 nm) is well within the wavelength range blocked by the yellow glasses.

the fluorescence at all or will cause a false-color effect due to the mixture of the reflected and emitted light. Glasses that absorb blue light but transmit all other wavelengths will appear yellow. Any random pair of yellow glasses cannot be expected to work in combination with an intense blue light source—the glasses must be spectrally matched to the light source to block all of the reflected light while transmitting the fluorescence with high efficiency. The transmission spectrum of the glasses used in this study (VG series, NIGHTSEA, Bedford, Mass.) is shown in Figure 4. It begins to transmit at wavelengths just shorter than 500 nm and rises rapidly to transmission greater than 90% through the rest of the spectrum. The output spectrum of the blue light is included for reference. Note that there is virtually no overlap between the excitation light source and the transmission band of the barrier filter. Figure 5 shows co-author Earl Verbeek exploring mineral cases with the blue light while wearing the yellow barrier filter glasses.

### Photography

Photographs were taken with a Canon Rebel T2i digital SLR camera with an 18- to 55-mm lens. The camera was mounted on a tripod. The custom mounting bracket also held two Sola NIGHTSEA lights on flexible arms (Figure 6), allowing adjustment to provide even illumination of the subject. Just as for observation by eye, it is necessary to use a yellow barrier filter in front of the camera lens to prevent the reflected blue light from reaching the camera sensor and overwhelming the fluorescence. For this study, we used a Tiffen Yellow #12 filter, the transmission spectrum of which is almost identical to that of the filter glasses used for visual observation. The Tiffen filter was mounted on a flip filter holder for convenience.

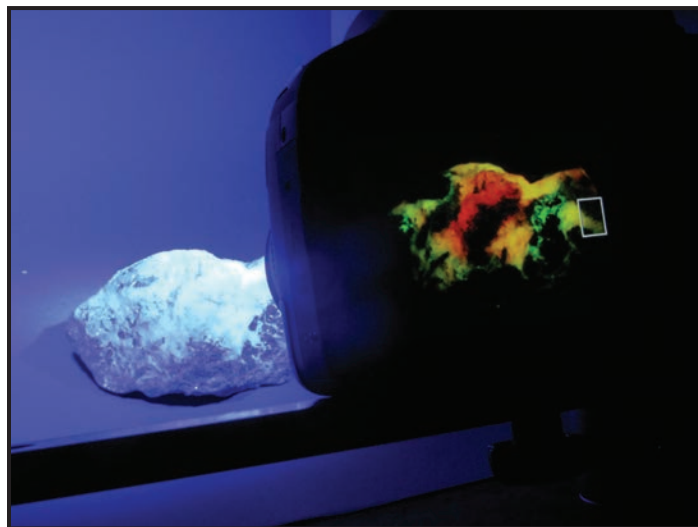


Figure 5. Exploring mineral cases with the blue light and yellow barrier filter glasses.





**Figure 6.** Camera/light configuration for mineral fluorescence photography. Two Sola NIGHTSEA lights are mounted on flexible arms. The barrier filter can be seen swung away from the front of the lens. Two compact fluorescent bulbs in reflectors provide white-light illumination.



**Figure 7.** Specimen containing calcite and willemite in the process of being photographed under blue light.

Short- and longwave fluorescence photographs were taken using handheld TripleBright UV lamps (UV Systems, Renton, Wash.). Exposures were set as described below for blue-light photography. No barrier filter was used. While it is sometimes necessary to use a UV-blocking filter such as a Tiffen 2A, we tested the camera/lens combination and found no effect on the photographs due to the reflected UV light. White-light photographs were taken using compact fluorescent bulbs (rated at 5000° K) in a reflector, with no filter in front of the camera.

A wireless trigger release was used to minimize the effects of camera shake. A high f-number (f/13) was used to provide good depth of field. Exposures were set under manual control. Exposure time was set in manual mode based on the appearance of the subject on the camera display. The camera was set to automatically take three pictures, one at the manual exposure setting and one each at plus or minus one f-stop. In some cases there was such extreme variation in fluorescence intensity within a specimen that we took additional images at settings that avoided saturation of any of the color channels.

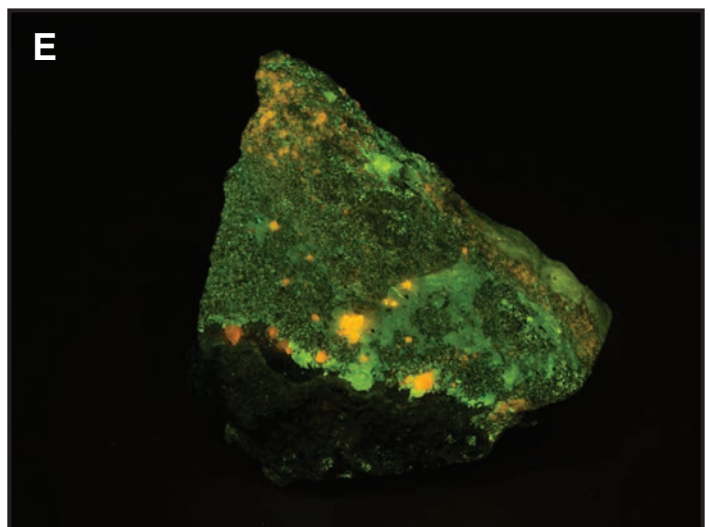
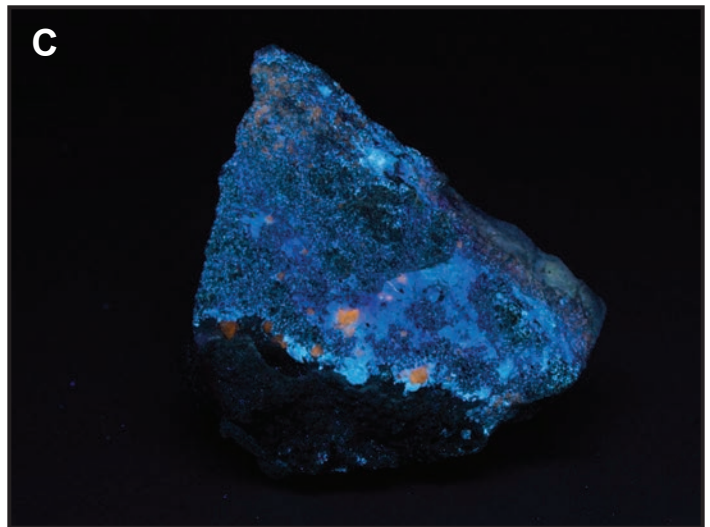
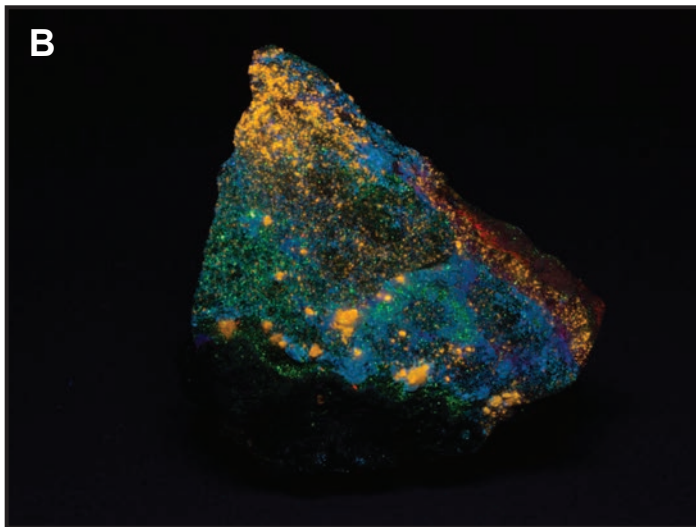
Figure 7 shows the Franklin Mineral Museum’s “Peaches and Cream” calcite/willemite specimen in the process of being photographed. The view shows the specimen illuminated by blue light, with the filtered fluorescence image seen on the camera display. Note how the bright blue light emitted by the Sola NIGHTSEA lights has been effectively removed by the barrier filter, thereby allowing the camera to record the actual colors of fluorescence.

## RESULTS

The current list of minerals known from the Franklin-Sterling Hill area stands at 359. Of these, more than one-quarter, or 91 species, are known to fluoresce. The list of local fluorescent minerals, maintained and updated annually by Richard Bostwick, is based on careful observation of validated specimens. For purposes of this study, we examined and photographed 38 specimens on display at the Franklin Mineral Museum. These specimens include 32 species already on the list of known local fluorescent minerals, plus another three for which fluorescence had not previously been recognized.

Figure 8 shows sample results for one of the 38 museum specimens examined, a specimen of charlesite with clinohedrite. Both minerals are rather unassuming in daylight (Fig. 8A) and are best known to collectors as shortwave-fluorescing minerals (Fig. 8B), where the clinohedrite fluoresces orange and the charlesite blue. The same specimen under longwave UV light (Fig. 8C) again shows the clinohedrite fluorescing orange, but much more dimly than under shortwave, whereas the associated charlesite shows a blue response stronger than that under shortwave excitation—thus the basic hues of fluorescence remain similar, but their relative intensities have changed. Under unfiltered blue light (Fig. 8D), the fluorescence of both minerals is overwhelmed by reflection of the light emitted from the Sola NIGHTSEA lights, and the entire specimen appears blue. When the barrier filter is used (Fig. 8E), the fluorescence of the clinohedrite under blue light is revealed to be orange to yellow-orange, similar to that under shortwave UV light, while the fluorescence of the associated charlesite now appears green. The reason for the color shift in

the charlesite fluorescence is due to the barrier filter, which removes much of the blue component of fluorescence (as seen in Figures 8B and 8C), thereby shifting the perceived color of fluorescence toward green. This effect is discussed more fully below. The key point here is that both minerals fluoresce under blue light as well as UV light, and the specimen appears different under each of the three excitation sources used. Far from being a mere novelty, the fluorescence of minerals under blue light occasionally reveals information not available through visual inspection of the same minerals under any of the conventional UV light sources. The following sections discuss observations and comparisons of the different types of responses to excitation by blue light and the conventional UV wavelengths.



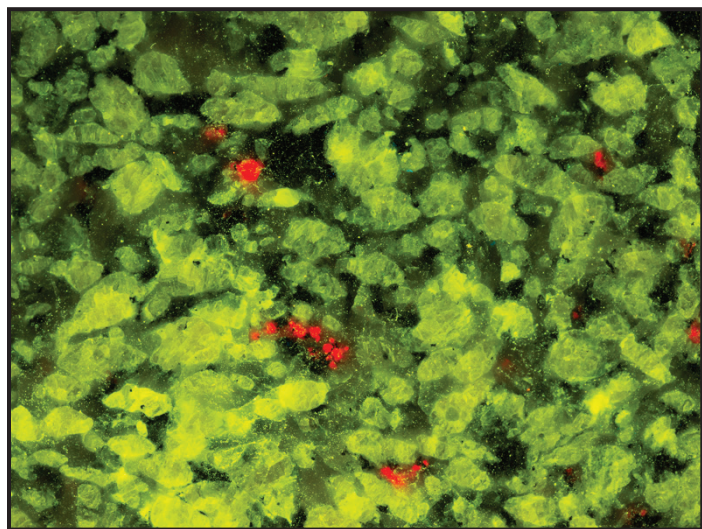
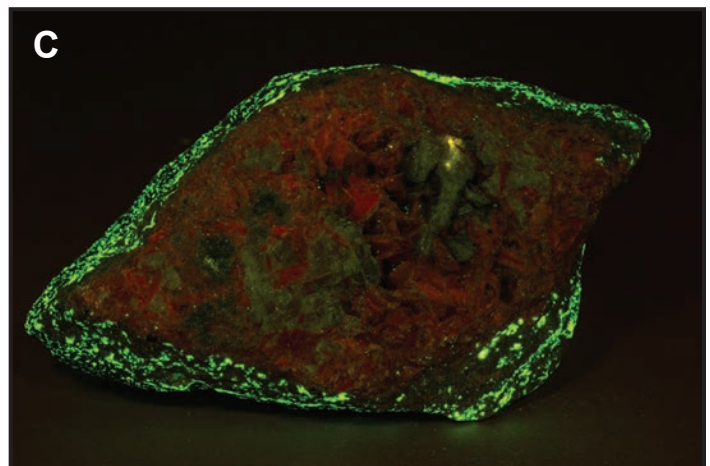
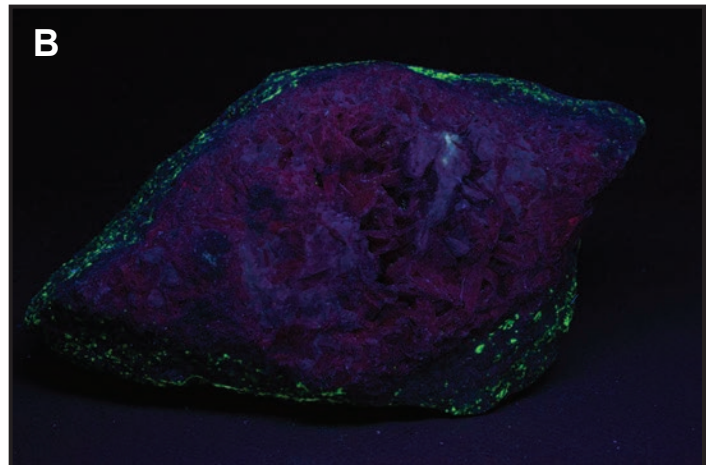
**Figure 8.** Specimen of charlesite with clinohedrite under white light (A), shortwave UV light (B), longwave UV light (C), blue light with no barrier filter (D), and blue light with barrier filter (E). Richard Bostwick specimen, 2 $\frac{3}{4}$ "  $\times$  2 $\frac{1}{2}$ "  $\times$  1 $\frac{1}{2}$ " (7  $\times$  6.5  $\times$  4 cm).



**Different brightnesses of fluorescence under different excitation sources**

Among the more than 700 mineral species known to fluoresce worldwide, the majority of them fluoresce most brightly, or solely, under shortwave UV light. Many fewer show any significant response under longwave excitation, and fewer still show a response under longwave brighter than that under shortwave excitation. One might thus expect that the comparatively lower-energy light emitted by blue LEDs would result in even less response. On a global scale this is probably true, but prominent exceptions exist among individual species, and some fluoresce more brightly under blue light than under short-, medium-, or longwave UV light. The same is true of the minerals of the Franklin-Sterling Hill area.

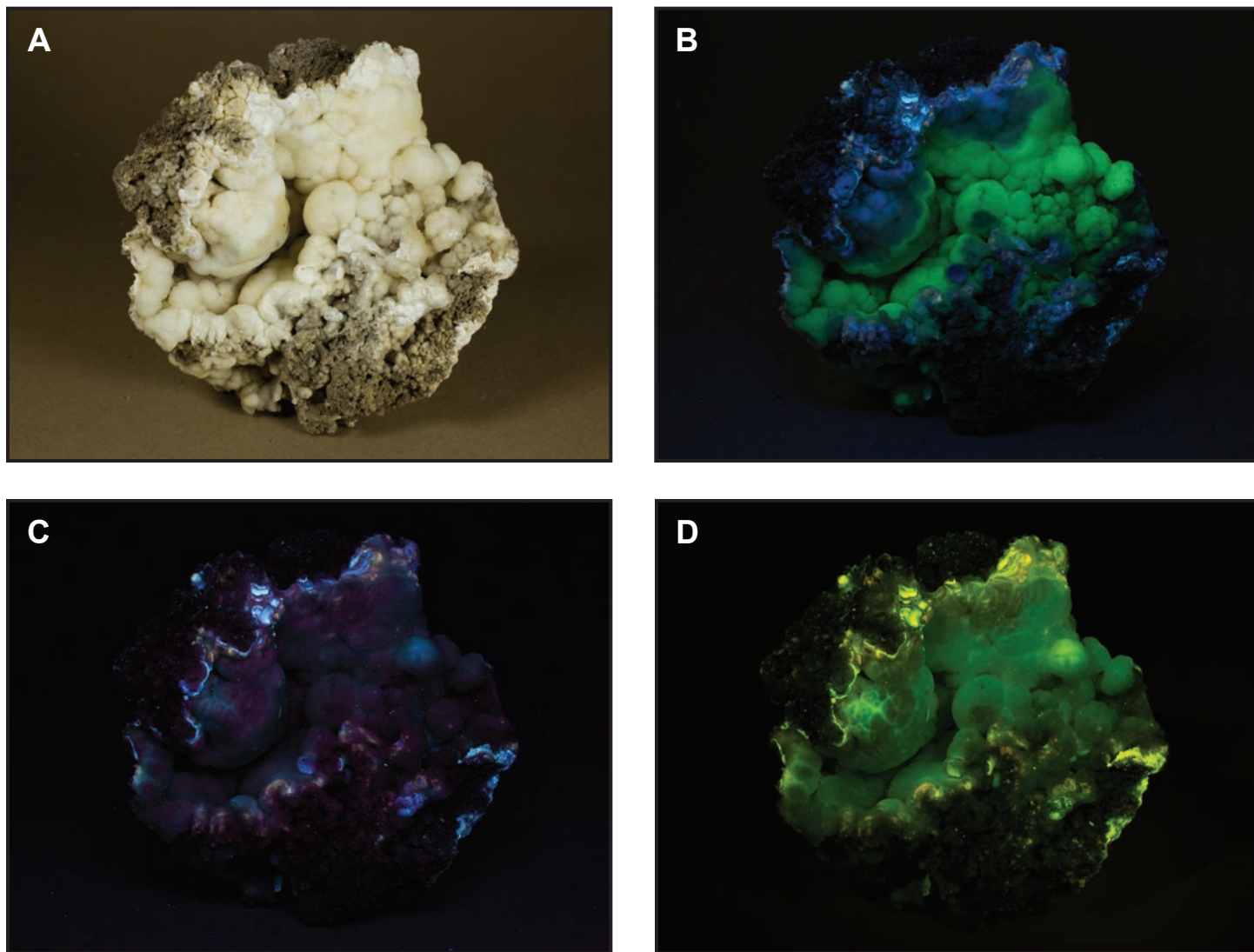
No matter the wavelength of an excitation source, a mineral cannot fluoresce unless it absorbs the light of those wavelengths. A mineral that either reflects or transmits most light of 254-nm wavelength will fluoresce only feebly, if at all, under a shortwave UV lamp; but that same mineral, if it is an effective absorber of blue light, may show a significant response. Ruby corundum from the Franklin Marble is one such mineral. Collectors know it as a longwave fluorescent mineral because good specimens show a deep red fluorescence under a longwave UV lamp but almost no response under shortwave UV. Under blue light, however, the red fluorescence is far brighter than under longwave UV (Fig. 9). Indeed, excitation spectra of ruby corundum from other localities confirm that blue (and green) light is far more effective at exciting fluorescence than is UV light of any wavelength. Spinel from the local marble quarries is similarly brighter under blue than UV light, as are some specimens of rhodonite (Fig. 10) from the Franklin Mine.



**Figure 9.** Detail of red-fluorescing ruby corundum grains in a specimen of norbergite, which itself fluoresces yellow under blue light. Field of view is approximately 1" (2.5 cm) across. Mark Boyer specimen no. 1262.

**Figure 10.** Specimen of bladed vein rhodonite from the Franklin Mine under white light (A), longwave UV (B), and blue light (C). The specimen measures 5¼" × 3¼" × 3¼" (14.5 × 8.5 × 8 cm) and is no. 571 in the collection of the Franklin Mineral Museum.





**Figure 11.** Specimen of hemimorphite from the Sterling Mine under white light (A), shortwave UV (B), longwave UV (C), and blue light (D). The specimen measures 4 1/8" x 4 1/8" x 2 3/4" (10.5 x 10.5 x 7 cm) and is from the collection of Richard Bostwick.

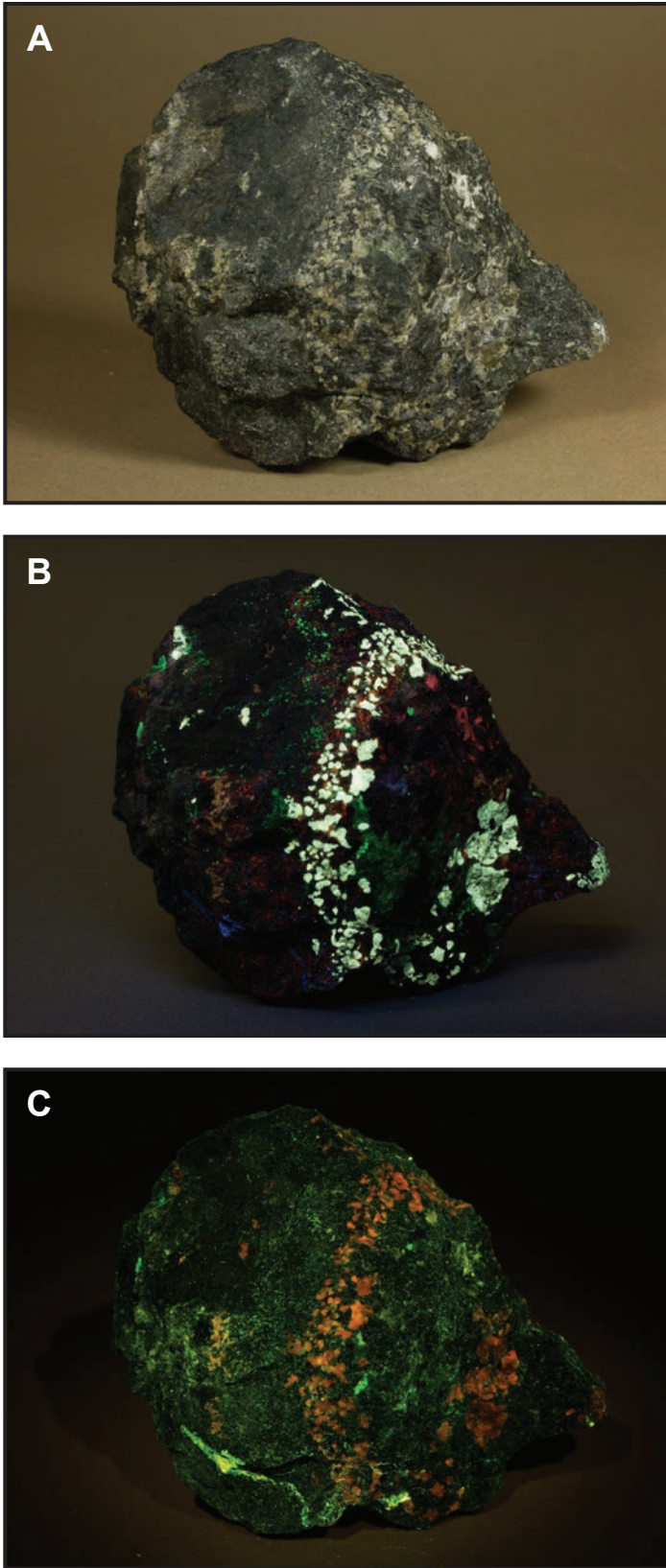
Another interesting example is hemimorphite from Sterling Hill, one specimen of which (Fig. 11) showed a green response under shortwave UV (probably due to uranyl ion impurities), almost no response under longwave UV, but again a moderate green response under blue light.

In general, then, without prior knowledge of a mineral or availability of its excitation spectrum, there is no way to reliably predict which excitation sources will produce the best fluorescence. Some minerals fluoresce well under shortwave and blue-light excitation, but markedly less so under medium-wave and longwave sources, while others show significant response under only one of these sources and none of the others. In reference to Figure 2, recall that the fluorescence for that particular willemite specimen would decrease in brightness from shortwave to blue light to longwave to medium wave—perhaps not an intuitive result until one understands the nature of the process. Numerous other combinations are

possible, again depending on the nature of the excitation spectrum of the mineral.

#### **Different colors of fluorescence under different excitation sources**

Some minerals show different colors of fluorescence under different wavelengths of UV or visible light. Undoubtedly the most familiar examples to collectors of fluorescent minerals are the “Terlingua-type” calcites, which show a beautiful blue fluorescence under shortwave UV, but a pink to apricot-colored fluorescence under longwave UV. The color shift from one excitation source to another is pronounced and dramatic. Such color shifts can arise when more than one activator of fluorescence is present in the mineral, or when the same activator (e.g., Mn<sup>2+</sup>) is present in two or more different crystallographic sites.



**Figure 12.** Scheelite specimen from Franklin under white light (A), shortwave UV (B), and blue light (C). This specimen, from the Sterling Hill Mining Museum collection, measures 4½" × 4" × 2¼" (11.5 × 10 × 6 cm).

The most prominent example found during our initial survey of Franklin-Sterling Hill minerals is scheelite. Under shortwave UV, the specimen shown in Figure 12 shows the familiar bright, white to cream-colored fluorescence common to much local scheelite. We noted no response under longwave UV, but under blue light a remarkable reddish-orange fluorescence appears. A red to reddish-orange fluorescence has been noted before in scheelite from several other localities, but under longwave rather than blue-light excitation. Though we have not yet measured the emission spectrum for the reddish-orange response, the shift in color of fluorescence from shortwave to blue excitation is quite strong, and indicative of fluorescence beyond that ascribed to the tungstate emission center.

A second example of color shift under different excitation sources is meionite (scapolite), a common mineral in systematic collections of the local mineral species (Fig. 13A). Much meionite shows a deep red fluorescence under shortwave UV (Fig. 13B), a response attributed to ions of trivalent iron ( $\text{Fe}^{3+}$ ) substituting for aluminum ( $\text{Al}^{3+}$ ). Nearly all hint of this red fluorescence is gone under longwave UV, where instead a pale blue fluorescence (Fig. 13C) appears. The activator of this fluorescence remains unstudied for local material but is possibly due, in part, to divalent europium ( $\text{Eu}^{2+}$ ) substituting for calcium. The pastel blue fluorescence is indicative of a broad-band emitter, one that emits light over a wide range of wavelengths. The same fluorescence, deprived of its blue component by the yellow barrier filter, appears shifted toward a yellowish cream color under blue-light excitation (Fig. 13D).

#### True versus apparent color effects

In using blue light in combination with a yellow filter for observation, one must take into account the filter transmission properties (Fig. 4). If a specimen's true fluorescence is entirely at wavelengths in the high-transmission passband of the filter, then the presence of the filter does not affect the apparent color. Green, yellow, orange, and red light are passed freely through the filter, so if one looks at green-, orange-, yellow-, or red-fluorescing subjects through the filter, they will appear unchanged. That is, a red object will not look orange through the filter, but red. We verified this with many individual specimens and with the 32-foot-long shortwave display in the Franklin Mineral Museum. The colors of fluorescence of calcite, wollastonite, esperite, willemite, clinohedrite, etc. were unchanged when viewed with the naked eye or with the yellow glasses. Figure 14, for example, shows a specimen of bustamite fluorescing under blue (A) and longwave UV (B) excitation. While there are small differences in relative intensity of the fluorescence responses, the colors are essentially identical.

If a subject has a broadband fluorescence that extends into the blue, however, then the filter *will* have an effect on the apparent color. One sees only that part of the emission spectrum



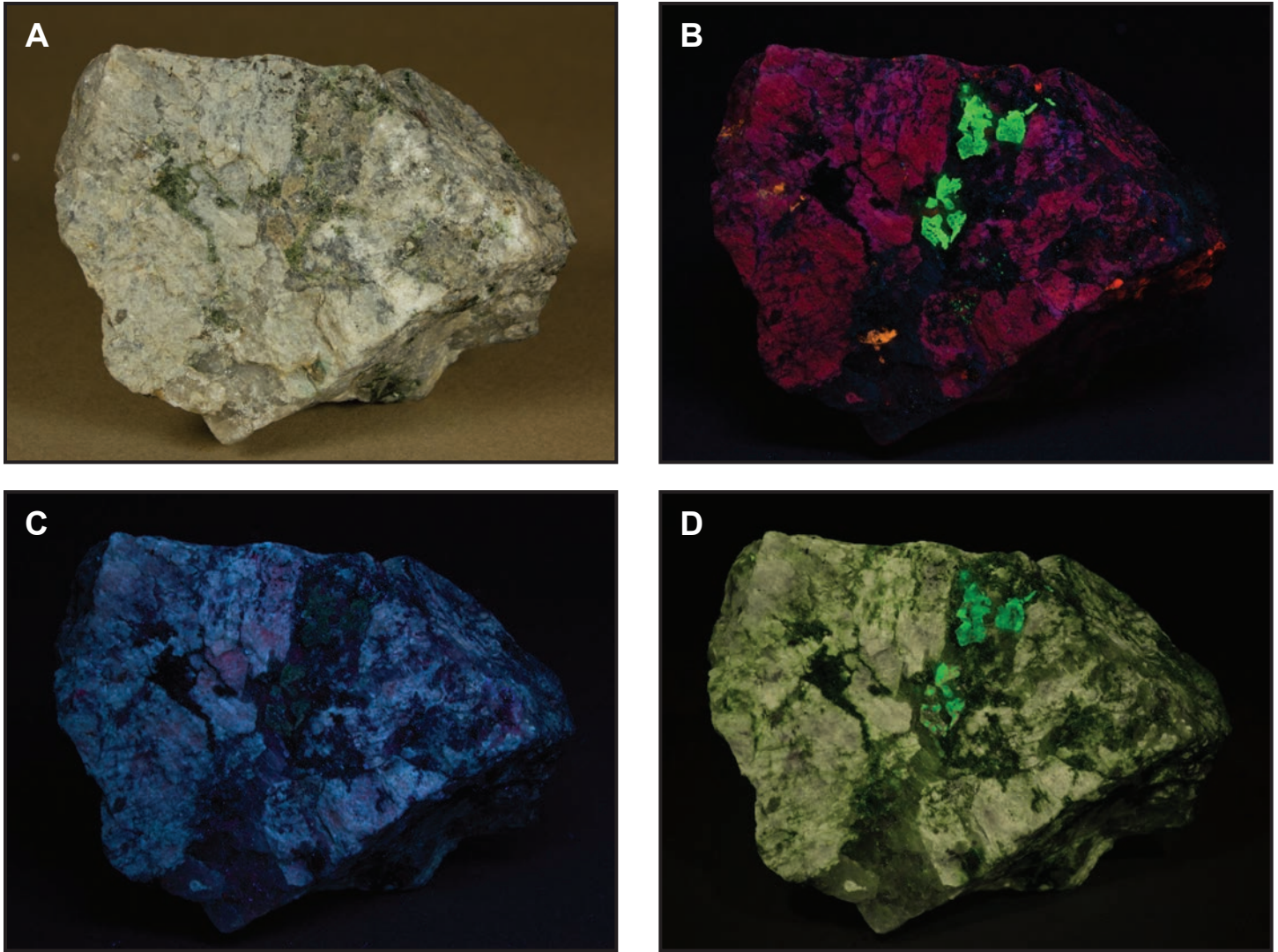


Figure 13. Franklin meionite shown under white light (A), shortwave UV (B), longwave UV (C), and blue light (D). The specimen is no. 764 in the collection of Mark Boyer and measures 3¼" × 2½" × 2" (8 × 6 × 5 cm).

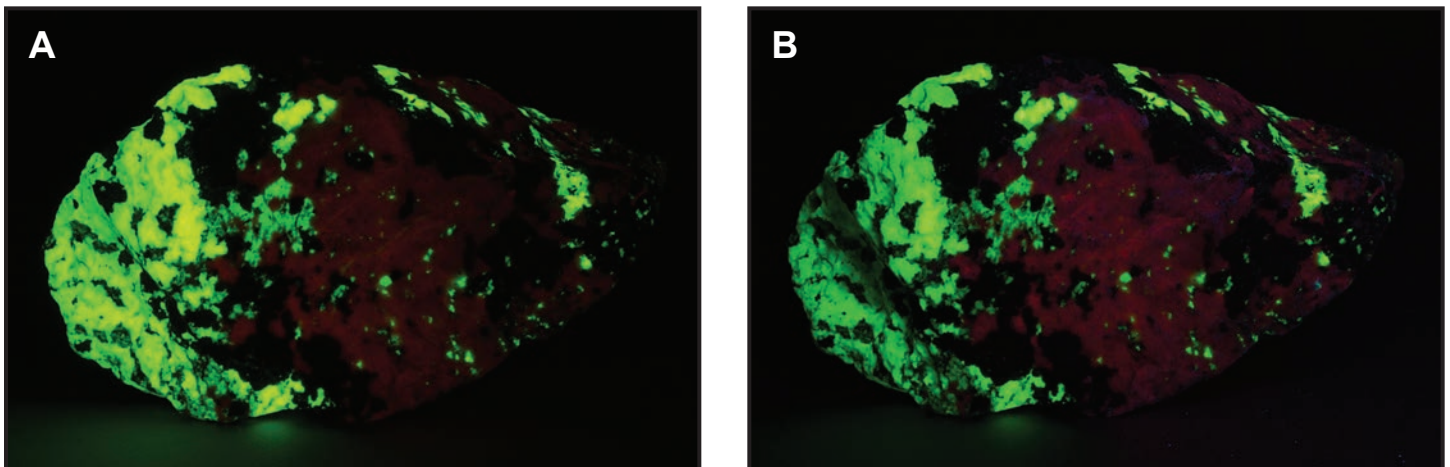


Figure 14. Bustamite fluorescing under blue (A) and longwave UV (B) excitation. Franklin Mineral Museum no. 612; specimen size is 6¼" × 3½" × 2¾" (16 × 9 × 7 cm).



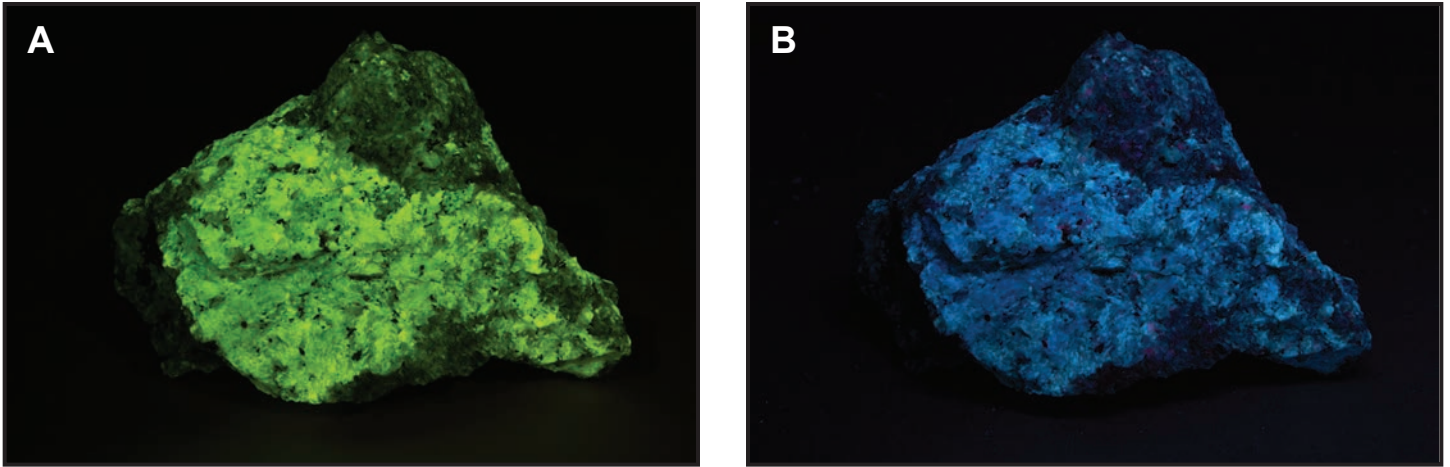


Figure 15. Margarite fluorescing under blue (A) and longwave UV (B) excitation. Franklin Mineral Museum no. 2067; specimen size is 4" × 2¾" × 1½" (10 × 7 × 4 cm).

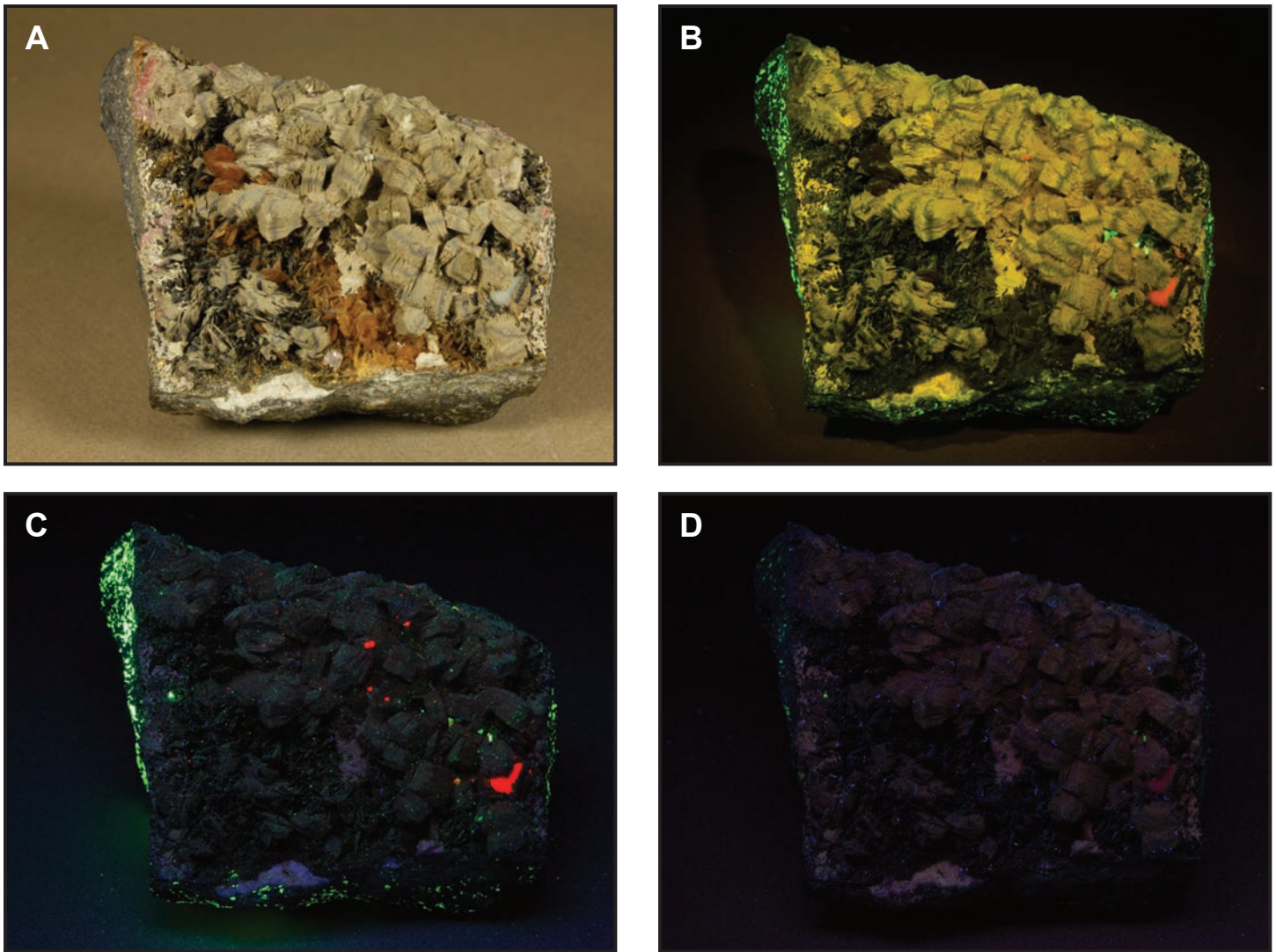


Figure 16. A specimen of johannsenite from the Franklin Mine under white light (A), blue light (B), shortwave UV (C), and longwave UV (D). Franklin Mineral Museum no. 1864; specimen measures 4¼" × 3¼" × 2¾" (10.5 × 8 × 7 cm).

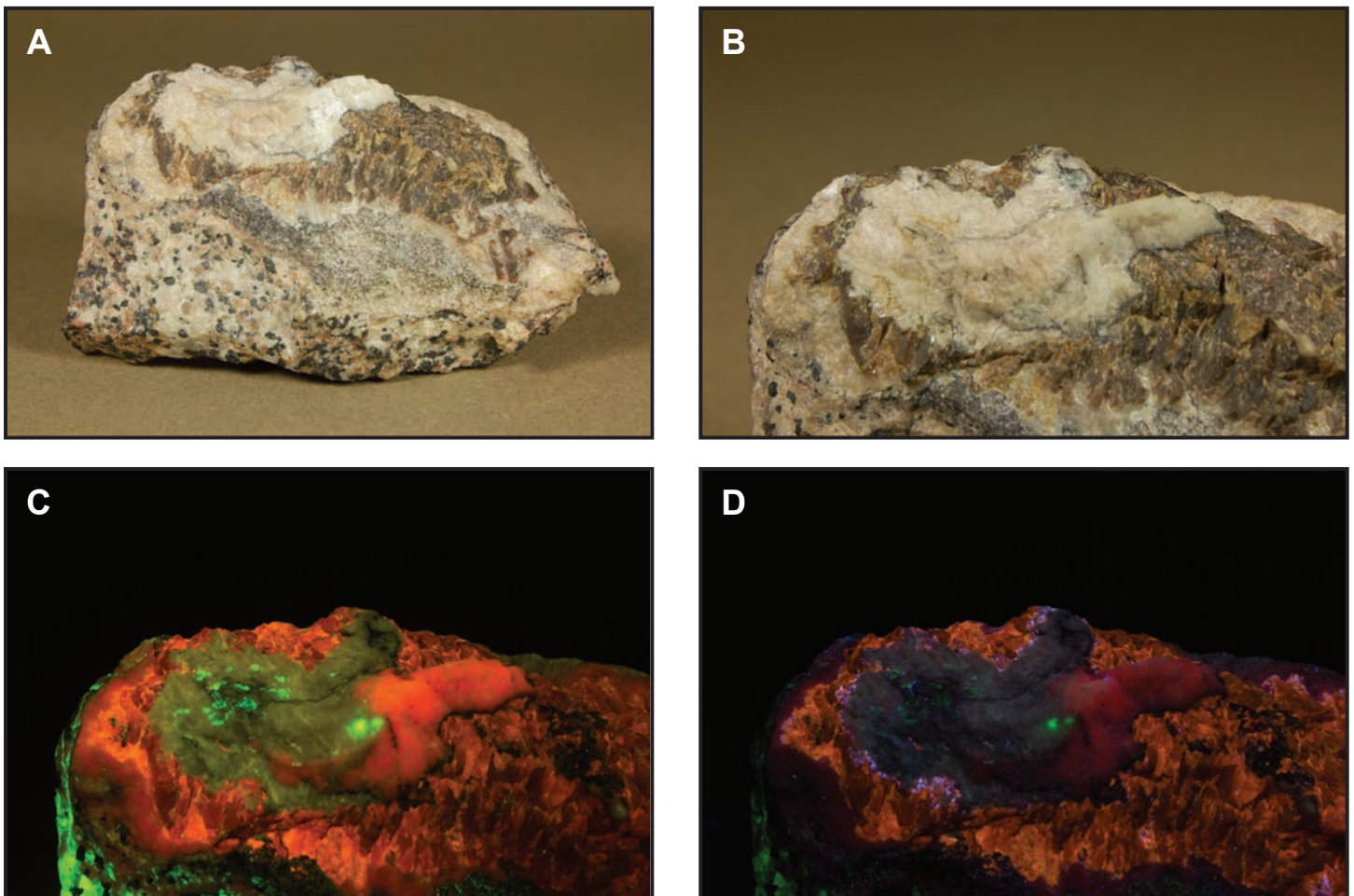
that passes through the filter. If blue light is subtracted from the broadband light emitted from the mineral, the perceived color will move toward yellow. Figure 15 shows a specimen of margarite fluorescing under blue (A) and longwave UV (B) excitation. Local margarite fluoresces blue under both short- and longwave UV light, with a brighter response under longwave. Under blue light, the specimen appears to fluoresce yellow because the blue component of its fluorescence has been filtered out. Other mineral species show a similar effect, among them hydrozincite, gypsum, margarosanite, aragonite, and some calcite.

The explanation above will hold for many specimens, but there remains the possibility that the specimen actually fluoresces a different color under blue than under UV light, and that the apparent yellow fluorescence is in fact the true fluorescence. The only way to sort this out completely is to use a spectrometer to measure the actual emission spectrum under the various excitation conditions.

**Additions to the list of local fluorescent mineral species**

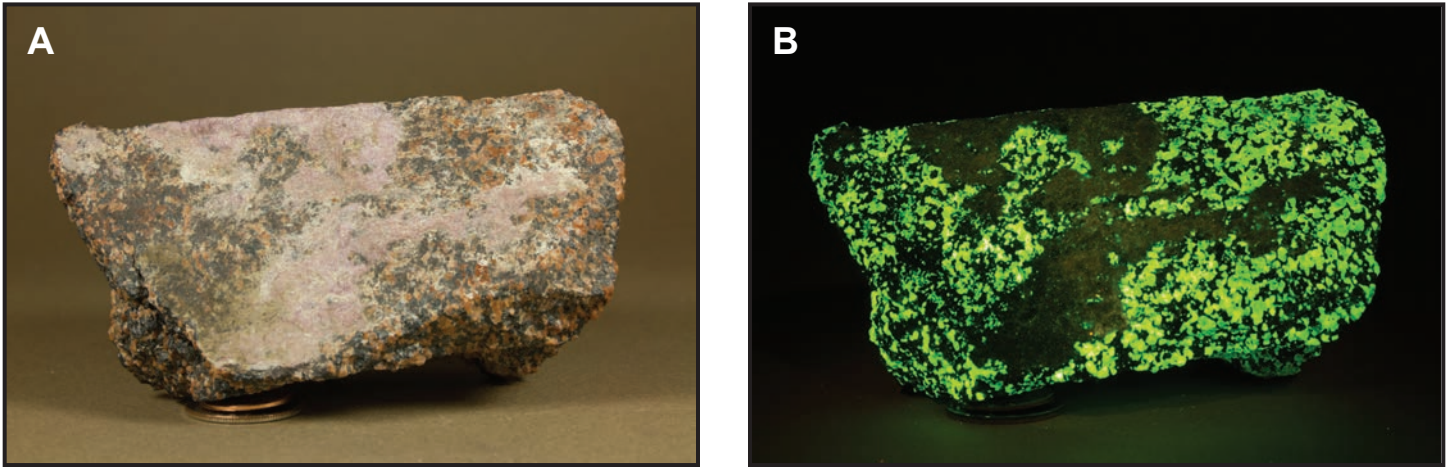
A considerable convenience to using blue light as an excitation source of fluorescence is that it passes freely through glass. Thus, numerous rare mineral species, represented sparingly or not at all in most private mineral collections, could be rapidly screened for fluorescence in the Franklin Mineral Museum without removing the specimens from the display cases. In less than 10 minutes, we discovered three local species not previously known to fluoresce, and investigations since then have added several more.

The first to be discovered is johannsenite, the variety that forms fibrous crystals epitaxial on rhodonite. Probably the finest example of this material resides in the Franklin Mineral Museum and was once part of the SPEX-Gerstmann collection (Fig. 16A). Under blue light (Fig. 16B), the johannsenite shows a bright, zoned fluorescence that mimics the zoning of the same mineral fibers under visible light. The response under longwave UV (Fig. 16D) is a muted dull orange, but nevertheless distinct. No convincing response was noted under shortwave UV (Fig. 16C).



**Figure 17.** A specimen of gerstmannite from the Sterling Mine under white light (A), white light, detail (B), blue light (C), and longwave UV (D). Franklin Mineral Museum no. 592; specimen measures 3¼" × 2¼" × 1¼" (9.5 × 5.5 × 3.5 cm).





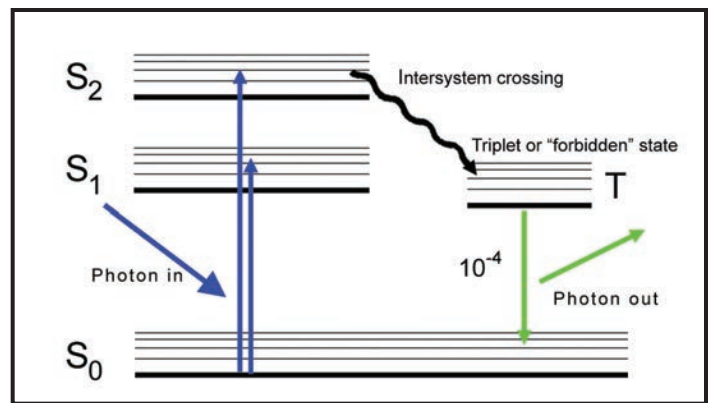
**Figure 18.** Holdenite from the Sterling Mine under white light (A) and blue light (B). The holdenite appears a smooth pink in white light and fluoresces dull orange under blue light. The bright green fluorescence around the holdenite arises from willemite, which in this image is overexposed to show the much dimmer response of the holdenite. The specimen measures 4½" × 2¼" × 2¼" (11.5 × 6 × 6 cm) and is no. 5314 in the collection of the Franklin Mineral Museum.

Gerstmannite was also shown to be fluorescent. In Figure 17A, taken under visible light, the gerstmannite is the faintly pinkish to pinkish-tan mineral at upper left, to the left of the small mass of white calcite. Both of these minerals are underlain by massive brown sphalerite, and all three are part of a vein assemblage in granular willemite-franklinite-calcite ore. Figure 17B is a detailed view of this area. Under blue light (Fig. 17C), the gerstmannite fluoresces dull olive-green, the calcite bright orange-red, and the sphalerite moderately bright orange. Similar but less bright responses were seen for each of these minerals under longwave UV (Fig. 17D).

Holdenite is an additional mineral that was observed to fluoresce under blue light. In Figure 18A, taken under visible light, the pale pink mineral at the left top and running through the middle of the specimen is the holdenite. The fluorescence of the single specimen examined was a dull orange under blue light (Fig. 18B), but the holdenite showed no convincing response under either longwave or shortwave UV. We look forward to viewing additional specimens of this mineral to further investigate its fluorescence properties.

### Difference in phosphorescence of willemite when excited by blue or shortwave UV light

Phosphorescence occurs when excited-state electrons transition to a triplet, or “forbidden” state, in a process called *intersystem crossing*, as illustrated in the Jablonski diagram of Figure 19. The re-emission time scales for this state in different materials can range from hundreds of nanoseconds to hours. During our investigation, we had occasion to turn on and off the shortwave UV lights illuminating the Franklin Mineral Museum’s 32-foot-long shortwave display. When power was turned off, a green phosphorescence of several seconds duration



**Figure 19.** Simplified Jablonski diagram illustrating electronic transitions from a higher to a lower “forbidden” excited state, from which slow emission results in phosphorescence.

was evident in many of the specimens of willemite. When we illuminated those same specimens with blue light, there was an emission that to the eye appeared to be of the same color and intensity as that produced by shortwave UV, but there was no phosphorescence when the light was extinguished. Pending further investigation, this observation suggests that excitation by blue light does not provide sufficient energy to cause the transition of excited-state electrons to the forbidden triplet state from which phosphorescence occurs.

### CONCLUSIONS

When one looks at something in a new way, one should not be surprised to see new things. Blue light is an alternative way of exploring this world and provides an opportunity to expand one’s depth of experience with it. Not only might one



see familiar subjects in literally a new light, but there is also the potential to make new discoveries and expand the catalog of fluorescing minerals. In the modest effort we have described here, we encountered three previously unknown instances of fluorescence—under any wavelength—in local minerals.

The empirical observation that a specimen fluoresces when excited by a source of blue light does not provide any detail about the underlying spectral properties, any more than comparable observations under short-, medium-, or longwave UV light. It does not say that there is a strong excitation peak in the light's output range around 450 nm, but rather that there is enough excitation to produce an observable response. Instrumental measurement of the excitation spectrum would be required to determine the "ideal" wavelength or wavelengths for excitation of any given specimen.

Blue-light technology and the required matched barrier filter glasses are readily available for observation by eye, as are filters for photography. We used continuous light sources for the photography described here, but it is also possible to

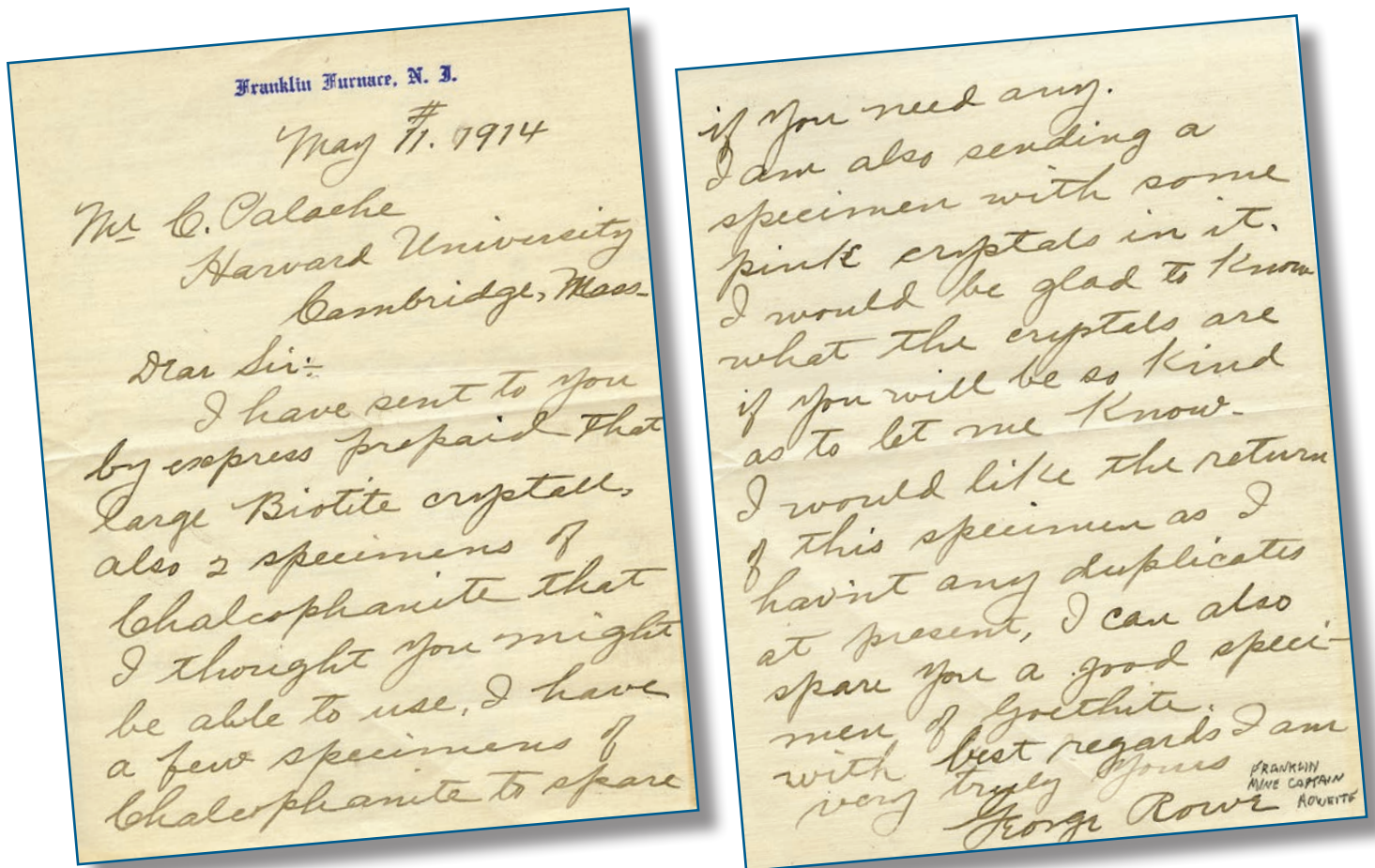
use electronic flash. And while special flash units are required if one desires significant UV light output, virtually any reasonably powerful unit can be filtered to provide blue light.

The spectral world of fluorescent minerals is rich indeed, and no doubt holds in store many surprises. There is still much to be learned, and blue-light observation is a readily available way to add to the mineralogical community's knowledge base. We are sure that the observations described here, accomplished in just one short, focused effort, are only a starting point in exploration of this spectral dimension.

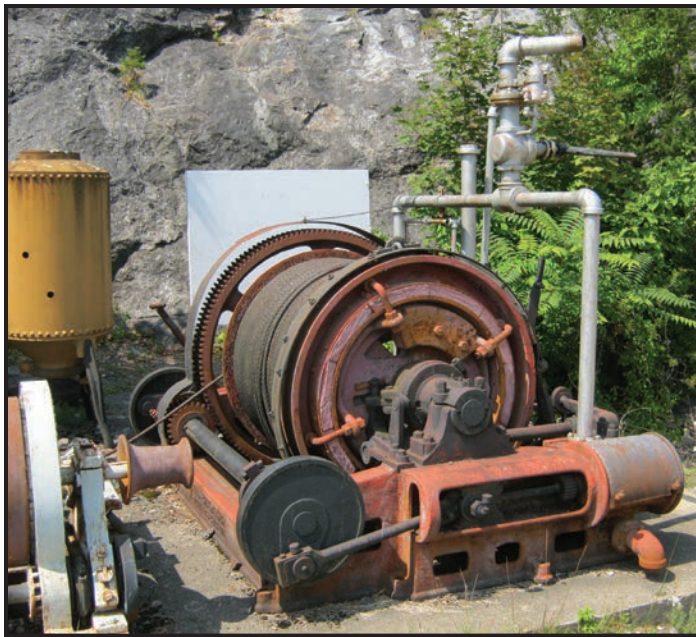
#### ACKNOWLEDGEMENTS

We thank Lee Lowell and Mark Boyer of the Franklin Mineral Museum for providing access to the museum collections and for their patience and counsel during the two days of our investigations. ✕

## Letters From the Past







Former Franklin zinc miner Nick Zipco at the retired Trotter Timber Shaft air hoist, March 20, 1976. For many years, Mr. Zipco was the overseer of the adjacent Trotter Dump when it was open for mineral collectors. The shaft at this site, known officially as the 1416S Timber Shaft, was sunk in the 1920s by Mine Superintendent C.M. Haight. It was 850 feet deep and was used to lower timber and supplies into the north end of the Franklin Mine. The capped shaft is visible today near the corner of the chain-link fence in the Trotter Dump area. Property owner Steven Phillips relocated the hoist to the Sterling Hill Mining Museum, where it is currently displayed along with other hoist equipment on a concrete pad next to the main parking lot. Photos courtesy of the Franklin Mineral Museum.

