Micscape Presents The Output Of The Photographic Science Program at Rochester Institute Year Ending 2022.

CONTENTS

Overview

Photographic sciences is an RIT New Economy Major. This collection of degree programs is forward-thinking and future-forming, and helps prepare you to excel in the multidisciplinary nature of our modern, dynamic economy.

By combining interests in both science and the arts, photographic sciences features unique course work found at no other U.S. institution. Upper-division classes focus on high-speed photography, micrography, ophthalmic imaging, image analysis/quality, among other topics.

Students complete a required co-op-full-time, hands-on, paid work experience related to their field of study. Recent co-op placements include opportunities at Carl Zeiss Microscopy, Edmund Optics, the FBI, the Flaum Eye Institute, The Mayo Clinic, and Smithsonian Institution.
Carl Zeiss Microscopy and NASA are two of the biggest employers of our graduates. Canon, Fujifilm, Leica Microsystems, and the National Retina Institute also employ our graduates.
Alumni, students, and faculty are regularly recognized by industry competitions like Nikon's Small World and the BioCommunications Association's BioImages competition.

For more information on the Photographic Science Program at Rochester Institute of Technology please visit : https://www.rit.edu/study/photographic-sciences-bs

Please contact Daniel Hughes, Department head for particular questions at dahpph@rit.edu

Fulgurite

Photographs and article
by Anna Yingst

What is Fulgurite?

Fulgurite is the result of lightning striking the ground and fusing together silica sand or rock to create crusts of glass. It is found worldwide and just about every strike has the potential to produce it.

These particular samples were found underneath a utility (telephone) pole and may not have formed from lightning, but rather by electrical wiring damaged during a storm. It is also possible that lightning struck the pole and made its way down to the concrete below.

Right: Image captured at 1:2
Above: Image captured at 5x depicting the top left portion of the same sample.

When fulgurite is entirely made up of silica sand it is called lechatelierite. The exact composition of this "fossilized lighting" is unknown. These samples were likely created from silica sand found in the concrete as well as impurities from the concrete and soil. These impurities create the beautiful greens, reds, and browns.

Collecting The Samples

Above: *Source: Mark Yingst* Image taken before collecting the samples. It depicts the lightning-like pattern created in the concrete.

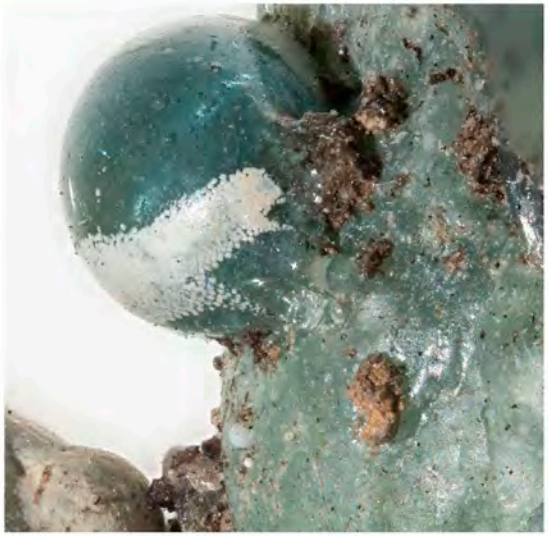
These samples were collected after a severe storm in Geneva IL. They were located in a back alleyway near a damaged powerline. Mark Yingst, a jeweler and lapidary, saw the scar pattern in the concrete and began finding small perfect spheres in the nearby flower bed. He returned multiple times to collect buckets of the dirt. After tediously sifting through all the soil he gathered, with the help of a few friends, he was left with a beautiful collection of fulgurite consisting of hundreds of spheres and assorted shards of green glass.

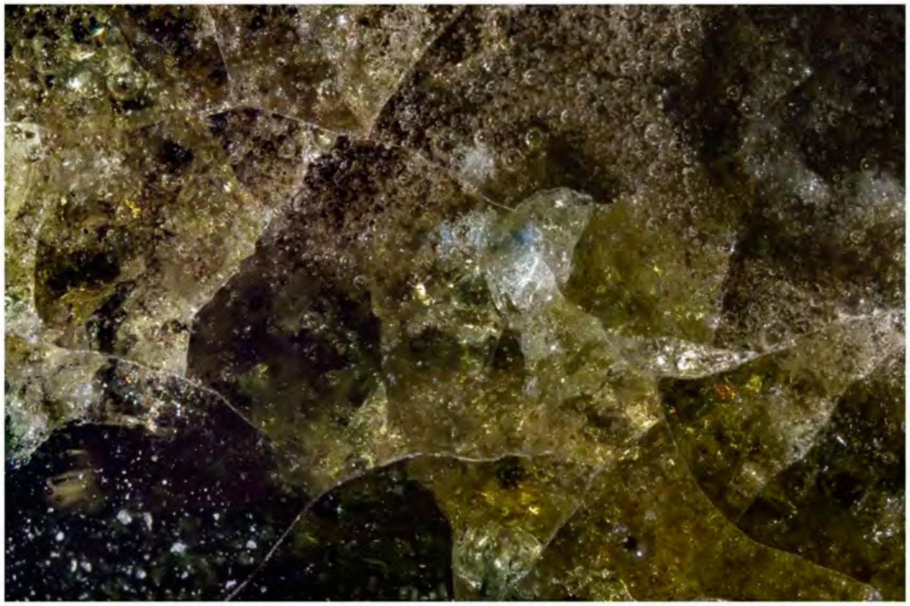
A small portion of the fulgurite was shipped to New York where the images in this article were captured in the Hi-Mag Lab at Rochester Institute of Technology.

Above: *Source: Mark Yingst* Image depicts a large sample of glass spheres found in the dirt.
Right: This image depicts five small spheres that had been fused together captured at 4x

Fulgurite Up Close

Top Right: Image captured at 5x
Top Left: Image captured at 4x
Bottom Left: Image captured at 4x
Bottom Right: Image captured at 4x



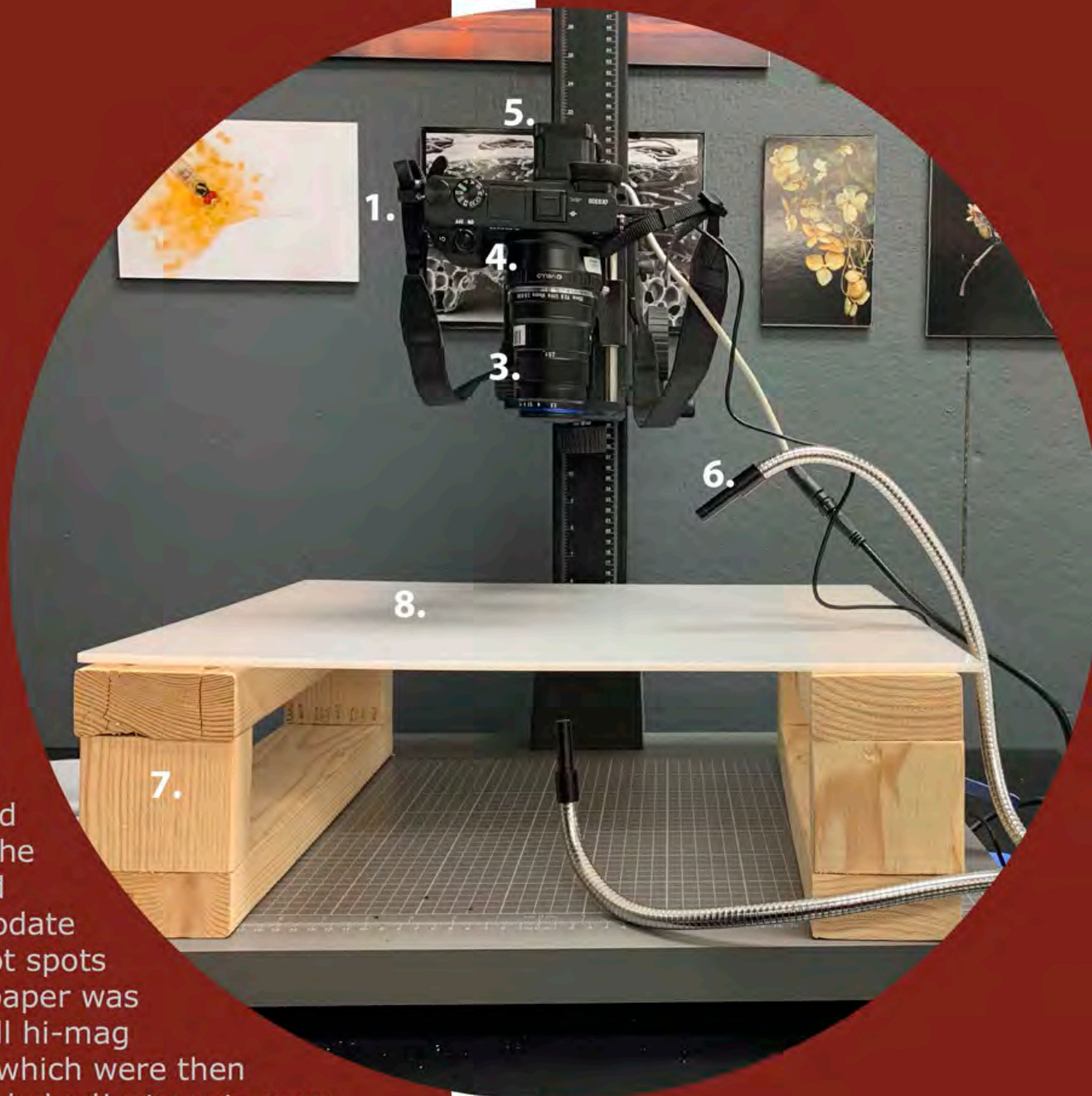


The Set Up

Equipment used:
1. Sony a6300
2. Sony 90 mm F/2.8 Macro Lens
3. Laowa 2.5-5x Macro Lens
4. E-Mount Adapter
5. Stack Shot
6. Fiber Optic Lights
7. Wooden boards
8. White Plexiglass
9. A piece of white paper for diffusion

Technique:
The samples were first inspected under UV light to attempt to find any fluorescent minerals within the glass. No fluorescence was found and so the shoot continued using only fiber optics to light the scene.

The wooden boards and Plexiglass were used to create a bright white background and allow for partial transillumination. The fiber optics were used at 45° angles and shifted slightly between shots to accomodate the shape of the fulgurite and reduce hot spots and peaking. When needed, a piece of paper was also used to diffuse some of the light. All hi-mag composites are stacks of 15-40 images which were then combined using Helicon Focus. Small global adjustments were made to the final images in Lightroom.



About the Photographer

Anna Yingst is a fourth year student at Rochester Institute of Technology in New York. She is graduating in May 2023 with a degree in Photographic Sciences (BS).

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Special Thanks
Mark Yingst
Ted Kinsman

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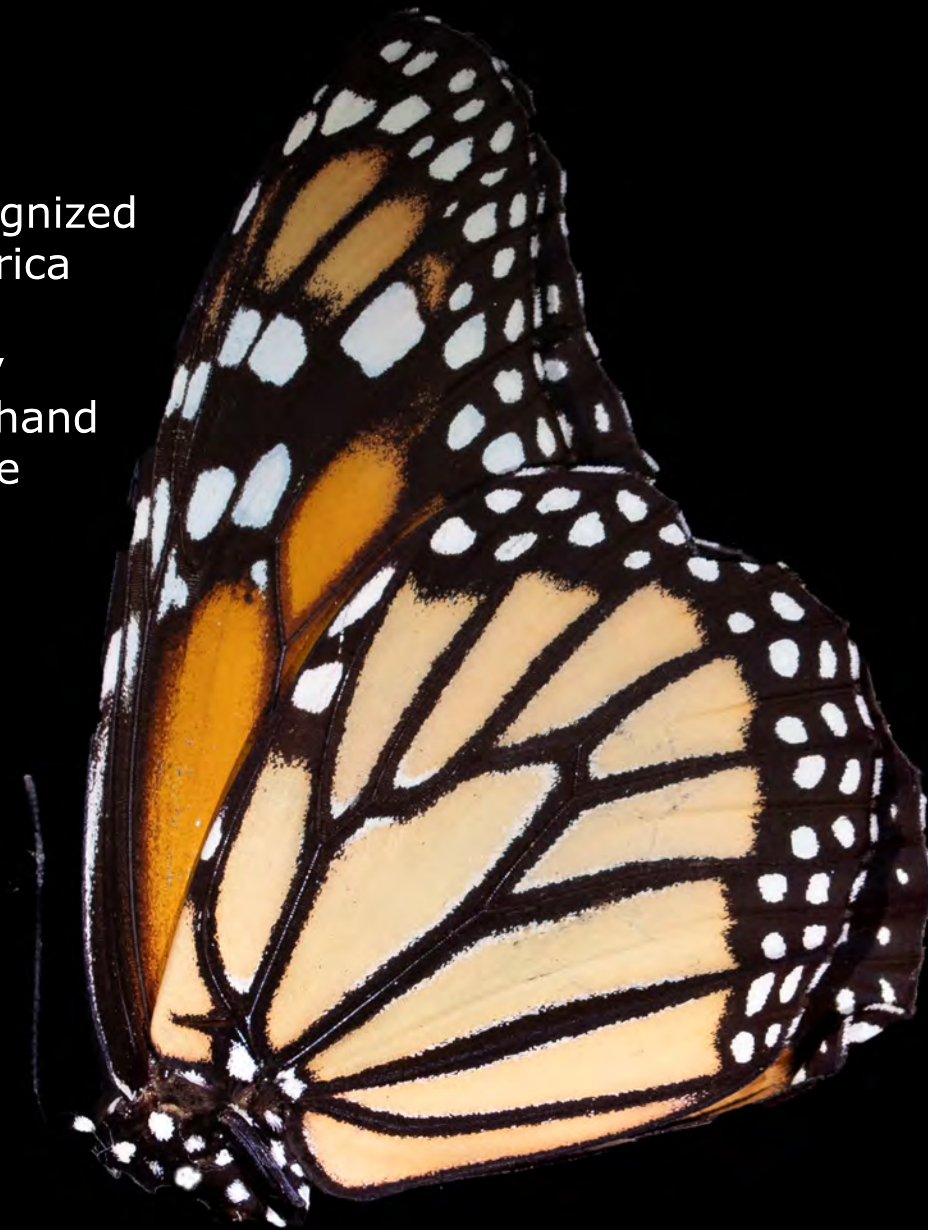
Above: Image captured at 1:2

The Anatomy
of a Monarch Butterfly

Introduction to Monarch Anatomy

Monarch butterflies are arguably the most well-recognized of their species. They reside primarily in North America and have been proven to have very interesting anatomy. A monarch's anatomy is made up of many different components, however, they all go hand in hand with each other. The main components consist of the head, the thorax, the abdomen, the forewings and hindwings, and the wing veins.



1:5 magnification

The thorax of a monarch contains three parts, all fused together, known as the prothorax, mesothorax, and metathorax.

The prothorax is located closest to the head and contains both a pair of legs and a pair of spiracles.

The mesothorax, located in the middle, is the largest part of the thorax. It contains yet another set of legs, another set of spiracles, and the forewings.

The metathorax is located at the bottom of the thorax. It contains the final pair of legs and the hindwings.

1:1 magnification

The Thorax

2.5x magnification

On the outside, it does not appear that there is much to the abdomen of the monarch, however on the inside, some of the most important organs can be found. The abdomen contains the digestive tract, spiracles, and the reproductive organs.

The digestive tract acts very similarly to our digestive tract, in the sense that it helps the monarch process its intaken food and waste. The spiracles, on the other hand, are an interesting part of the monarch's anatomy, given that they aid in the breathing of the species. These spiracles are small holes along the sides of the abdomen, allowing air to travel to the respiratory system so the monarch can breathe. Finally, the reproductive organs are located toward the tip of the abdomen.

The Abdomen

Forewings and Hindwings

Forewings, also known as anterior wings, are located on the middle segment of the thorax. They are essential in the flight of the monarchs and are considered to be one of the most fragile parts of the anatomy.

3.0x magnification

Hindwings, otherwise known as posterior wings, are located on the final part of the thorax. Unlike the forewings, monarchs do not require hindwings to take flight, however they are extremely important in helping in a normal evasive flight pattern.

3.0x magnification

The Head

A monarch butterfly's head generally has four main components: two antennae, two compound eyes, two labial palps, and one proboscis. Each of these components aids the monarch differently, however, they all contribute to the species' sight.

The two antennae, present on the top of the monarch's head, help it to perceive chemicals present within the air, like the smells of different flowers or the presence of a possible mate, and help it to maintain balance and detect motion in its surroundings.

2.5x magnification

The compound eyes, present on each side of the monarch's head, provide the butterfly with vision just under 360 degrees. These eyes are comprised of ommatidia, or smaller eyes, each having its own lens. When information is collected, the monarch's brain can take it and stitch it together, creating a panoramic image.

The labial palps, present on the top of the monarch's head, help to determine what food sources are edible and which ones are not. Finally, the proboscis, or the mouth for the monarch helps it to consume the liquid nutrients it needs to in order to survive.

Wing Veins

Most species of butterflies, monarchs included, have veins located on the top pair of their wings. These veins do not serve the normal purpose of transporting blood, but rather give the wings structural support. There is also speculation among some scientists that the more bloated veins, like the one pictured, may help the butterflies hear.

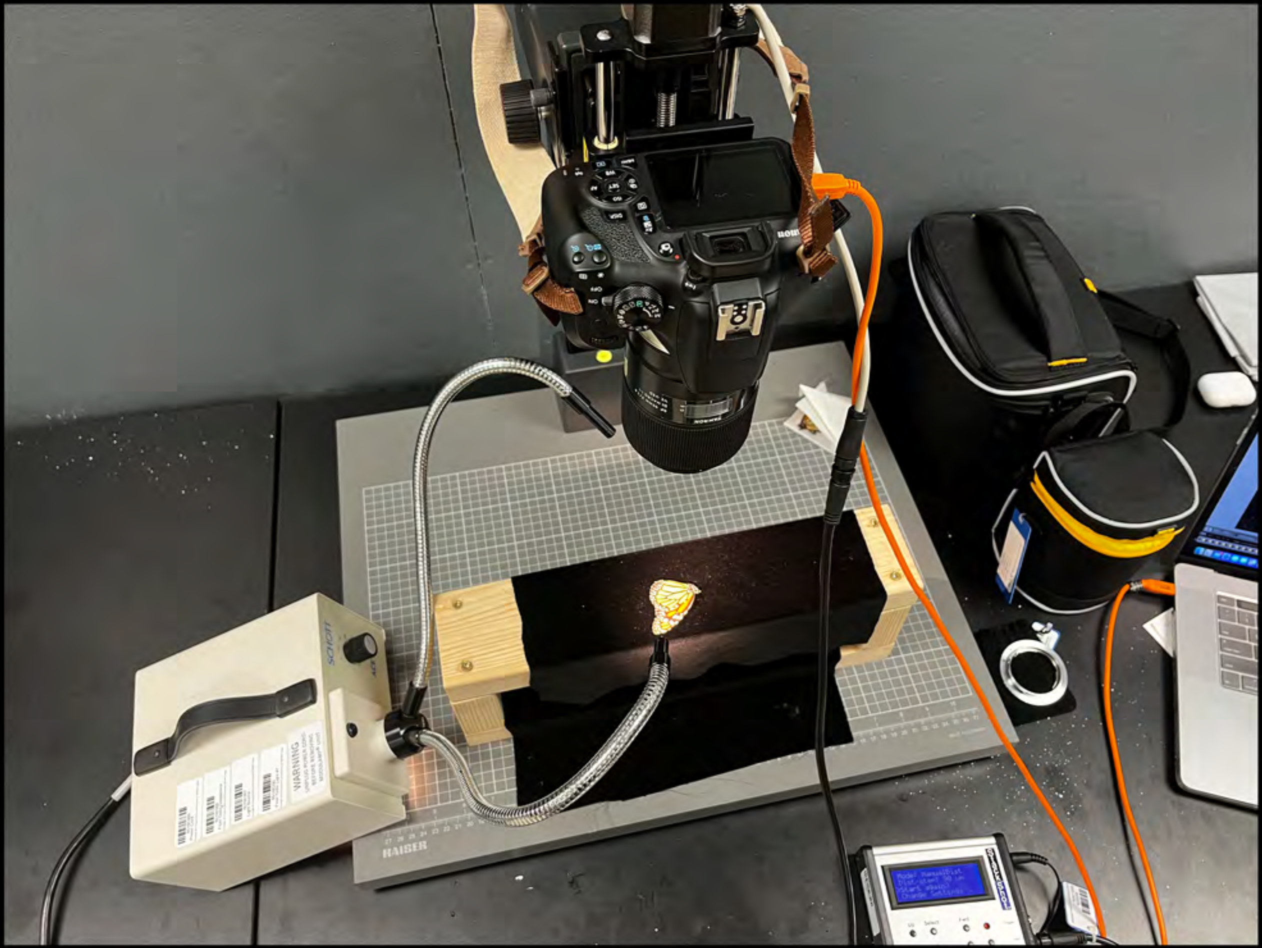
Certain species of butterflies, like monarchs, have stretched-out membranes at the base of their wings that act as an ear. When vibrations hit these membranes, electrical signals within the monarch’s nerves are activated, allowing them to hear the things around them.

Since these bloated veins run so close to the ears and there have been speculation that they aid in hearing, a study was conducted where the amount that a butterfly could hear was recorded with the vein intact, and then recorded again when the vein was cut. Through this, it was noticed that the ears became less sensitive, especially to lower-pitched sounds, proving that the wing veins help with hearing sensitivity.

3.0x magnification

Additional Information

All images were shot using a Canon Rebel T6 camera. Both a 25mm f/2.8 Macro for Nikon-F lens and a TamronSP 90mm f/2.8 Di Macro lens were used, depending on the part of the subject being imaged. A copy stand was used to hold the camera and a set of fiber optic lights was used to illuminate the subject. A StackShot Macro Rail was used to focus stack all of the images.



About the Author

Madeline Dowe is a current third-year Photographic Sciences student at the Rochester Institute of Technology in Rochester, New York. Upon graduating in May 2024, she hopes to pursue a career in medical or forensic imaging. For questions or comments about the article, please contact madelinedowephotography@gmail.com

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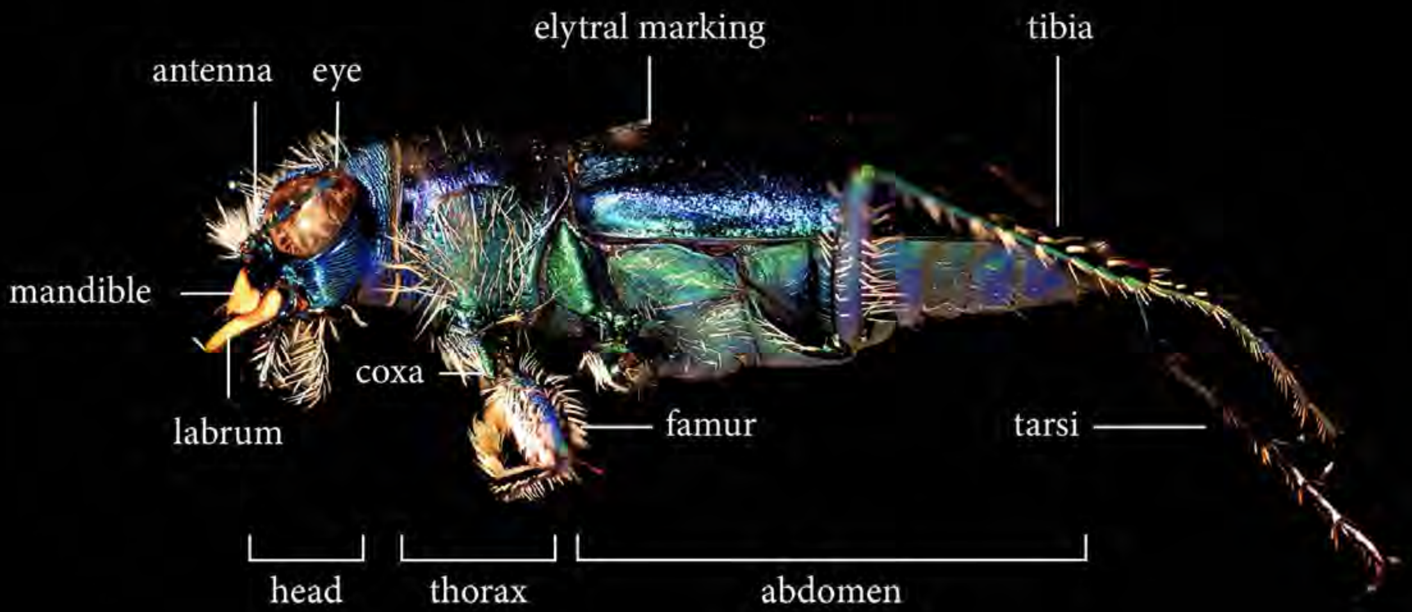
TIGER BEETLES

Different parts of tiger beetles and how it hunts utilizing its body parts.

Anatomy



The Tiger beetle, also called Cicindelidae, is a family of beetles. They are small to medium-sized predatory beetles. Approximately 2,600 species and subspecies were known with the most diversity in the Oriental region, followed by Neotropics. They are found in green, blue, orange, and red colors.

Tiger beetles have body parts found on most insects - six legs and two pairs of wings, and the body consists of a head, thorax, and abdomen. They have distinct characteristics from other beetles. TIger beetles have large bulging eyes, long and slender legs, and large curved mandibles.

The head consists of the eye, antennae, palpi, mandibles, and labrum. The large eyes are susceptible to movement along with the antennae that detect barriers and food. The palpi serve as fingers to manipulate food into the mouth. The mandibles process the food while the labrum helps.

Thorax is dedicated to locomotion. Six legs and two pairs of wings are attached. Trochanter and coxa connect the body and the legs functioning like hinges. This allows the tiger beetles' running movement. Spurs on the legs are for grooming and adhering against the ground. The tarsi touches the ground and help the beetle to move forward while running.

The forewings serve as protective covers for the back wings. When it is extended forward, the back wings are unfolded to their full length. Each species of tiger beetle has a different colored forewing to camouflage into its surroundings.

The abdomen is made up of many pieces, including the organs for breathing, digesting and reproduction.

Mandibles

Tiger beetles are named for their voracious eating habits. They use their formidable speed and large mandibles to hunt smaller insects and other terrestrial arthropods. Tiger beetles are characterized by diurnal activity using their sight to locate their fast-moving prey. However, they can also capture in complete darkness using chemoreception, audio reception, and mechano-reception. Hunting behavior differs based on the type of prey and its movement ability and escape potential.

The Tiger beetles' hunting strategies consist of four main phases: identification, pursuit interspersed by short stops, attack, and consumption or abandonment. In some cases, they release the prey and then follow with secondary attack.

Tiger beetles could also wait in a shaded area to attack when prey is approaching.

Once the attack is successful, the beetle grabs the prey with its mandibles. Before consuming, the beetle tests the prey to check whether it is edible. It test the prey in terms of size, hardness, and noxious chemicals. The prey is abandoned if it is too large or inedible due to some kind of chemicals.

If it is edible, the mandible chews up and crunch food so that body liquids can be sucked in. The labrum helps hold and manipulate food.

Eyes

The tiger beetle is known as the fastest running insect in the world. Its speed is recorded as 2.5 meters per second, equivalent to 5.6 miles per hour.

Although they have an extremely sharp vision for insects, the world smears into featureless smudge when running. This is because of their fast speed, and not enough photons comes into their eye to locate the prey. So, when pursuing the live prey, they pursue a course of active running along with pause-and-look behavior. They cannot detect which direction the prey is going without stopping. They have to stop for milliseconds to relocate the prey and pursue again.

To overcome this, tiger beetle holds their antennae directly in front of them in a V-shape to mechanically sense the surroundings, avoid obstacles, and change courses.

In research by Cole Gilbert, a professor of entomology from Cornell University, a runway with a hurdle was set up for tiger beetles to run. It ran the track negotiating the hurdle by the antennae. They would tilt their bodies up when their antennae touched the hurdle. They reacted similarly when the beetle's eyes were painted over to limit their eyesight while running. However, when their antennae were clipped, tiger beetles ran into the hurdle. This research shows that while running, their eyes are rather useless. In fact, their antennae navigate them.

Legs

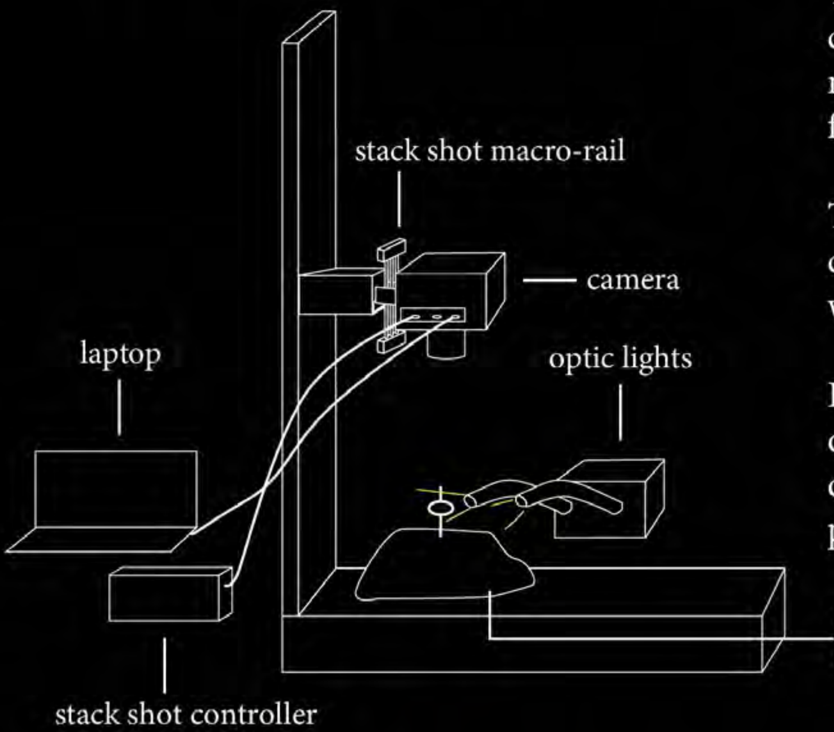
Tiger beetles have six jointed legs with a femur, tibia, and tarsus. Beetles bear claws on the end of the last tarsal segment of each leg. These claws are called 'tarsal claws.' It is accountable for clasping onto pitted surfaces. Tarsal claws move through different angles, assisting grip. Just like others, beetles use legs for walking, but they could also be modified and adapted for other uses.

For example, some aquatic beetles' legs are modified for swimming, and their long hair is to aid this purpose.

Other beetles have fossorial legs adapted to digging and underground life. Fossorial legs are widened, and the spine is more effective when digging.

The hairs on the legs and underside of the body are to cover them from the heat emitted from the surface of the sand. Tiger beetle species lives in extremely hot environments, like sand dunes and salt flats. Their thin legs are stilts to lift them from the ground and allow air to flow around their bodies.

Process



The camera was attached to a stand to capture a stable image. A stack shot macro rail was also attached to the stand for focus stacking.

The subject was fixed in styrofoam, covered by black velvet, with a pin. It was lighted evenly using optic lights.

Focus stacking was done in manual distance mode with 90 um as the distance. In total, a range of 32 to 72 photos was taken.

Raw photographs stacked into a single image

Final edited photograph of tiger beetle

The captured images were brought into photoshop and then edited in three steps: merging and aligning, removing unnecessary parts, and color editing.

All images were set to the same angle by the auto-aligning feature. Then it was merged into one single photograph by the auto-merge to one stack feature. After doing so, it was merged into a single photograph, and the stamp and patch tool removed unnecessary parts that distract the viewer. Lastly, the photo was corrected through the level, curve, vibrance, and brightness/contrast features to emphasize certain parts of the subject.

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Author

Sue Kim is a junior studying Photographic Science at Rochester Institute of Technology. Her main interest is in medical photography, focusing on ophthalmic imaging as well as biological photography.

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Photographing Petrified Wood

Wyatt Hyzer

Petrified wood is the fossilized remains of trees that were unable to organically break down due to conditions that inhibited decomposition from bacteria. Most known samples of petrified wood were alive between 15 and 375 million years ago. Examples can be found all over the world in areas where sedimentary beds allowed for trees to become trapped.

The Sample

Although this sample has not been identified by its place of origin and material, there are some clues about what it's made of. The brown and yellow in the wood show a presence of iron and manganese oxides, with quartz filling cracks that were formed later. The rest of the structure is silica which quickly fill the open gaps in the wood.

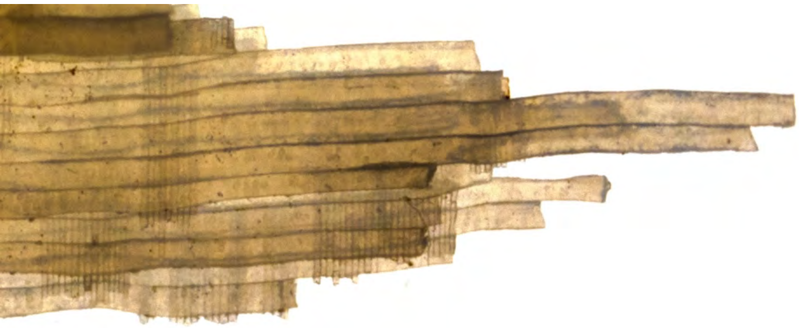
How petrified wood is formed

- Lack of oxygen
  Oxygen helps bacteria and fungi break down wood, which destroys the wood before fossilization can occur.

- Pressure
  Trees have a short period of time to start fossilizing, so wet sediments or mud create pressure and contain the minerals needed to replace the wood.

- Time
  The process can take as little as 5 to 10 thousand years but can be further shaped over millions.

Preserved cells in the sample



Tracheid cells

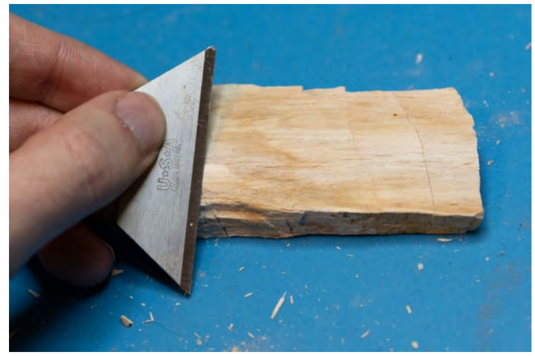
Found in all vascular plants, tracheid cells transport water and provide structure for the trees. They make up most of the tree's plant matter.

Ray Cells

Ray cells run perpendicular to the Tracheid cells, and are used to store nutrients and minerals, as well as transport them outward from the center.

Photographic Process

To be able to photograph the individual cells without a microscope, a high magnification macro lens was used along with transmitted light. The advantage of this lens is the ability to capture images at 5x magnification, which was used for all transmitted light images.



Pieces of the sample were removed with a razor blade, examined, and carefully chosen to display certain characteristics such as the ray cells. The samples were placed on a plexiglass diffusion panel and directly photographed.

Equipment Used:

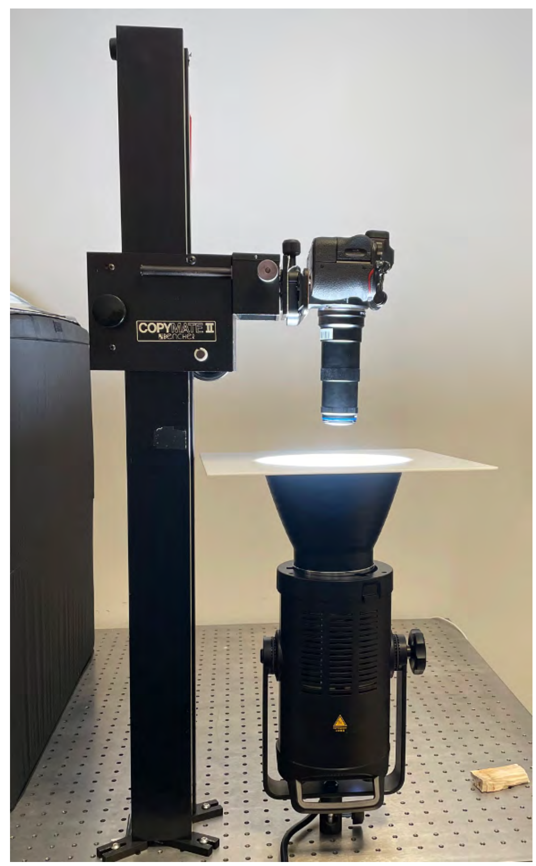
Copy-stand for precise focusing

Nikon Z7

Laowa 25mm f/2.8 Macro lens

Diffusion Panel

LED Light Source



About me

I'm Wyatt Hyzer, a senior studying Photographic Sciences at the Rochester Institute of Technology. My interests span across the entire topic of imaging, and I hope to work in the development of imaging processes and optics. You can find contact information and some of my work on my website wyatthyzer.com.

This article was created as a final project in the Photomacrography course at Rochester Institute of Technology.

Special thanks to my professor Ted Kinsman for lending the sample and teaching techniques and methods for capturing these images.

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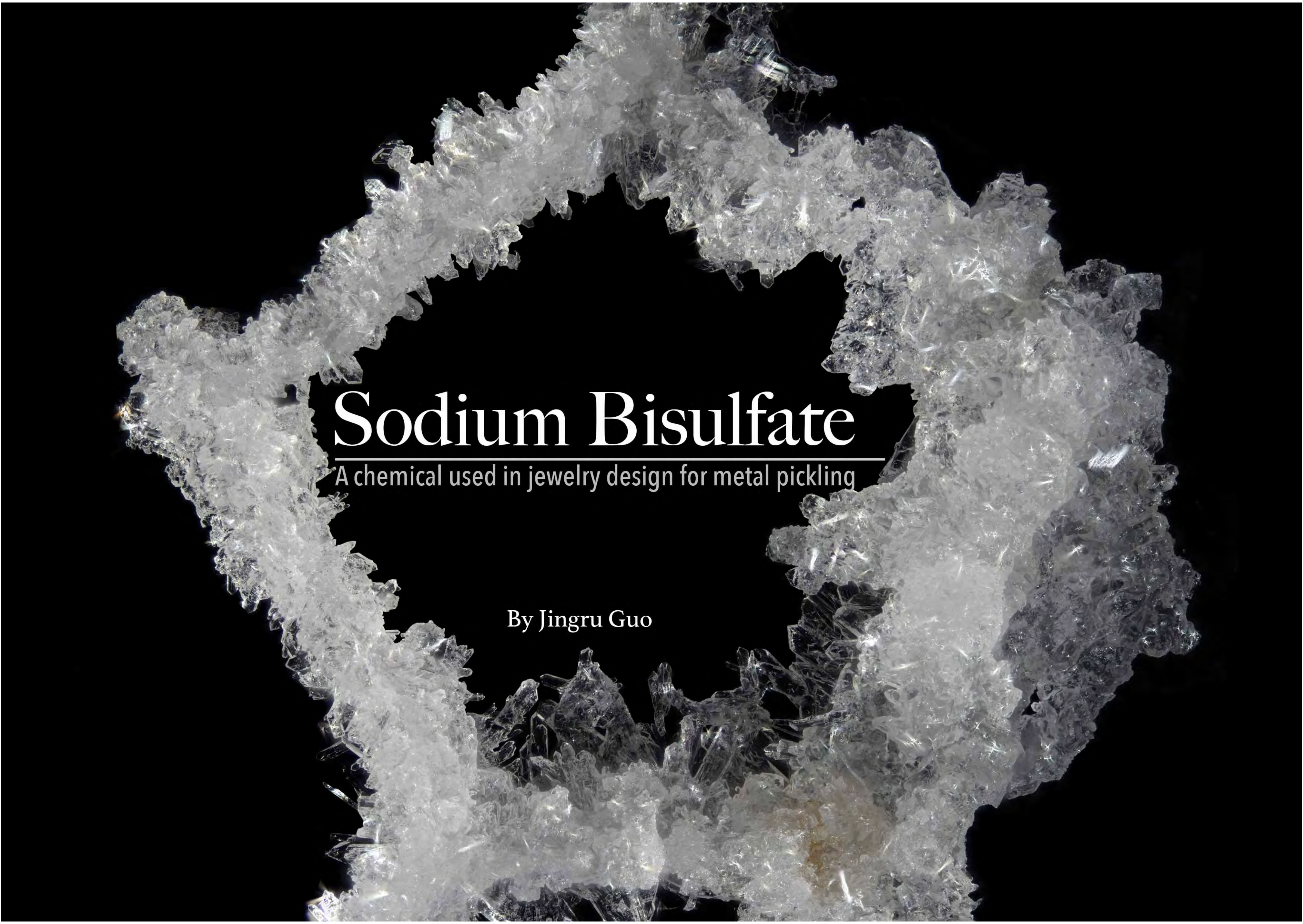
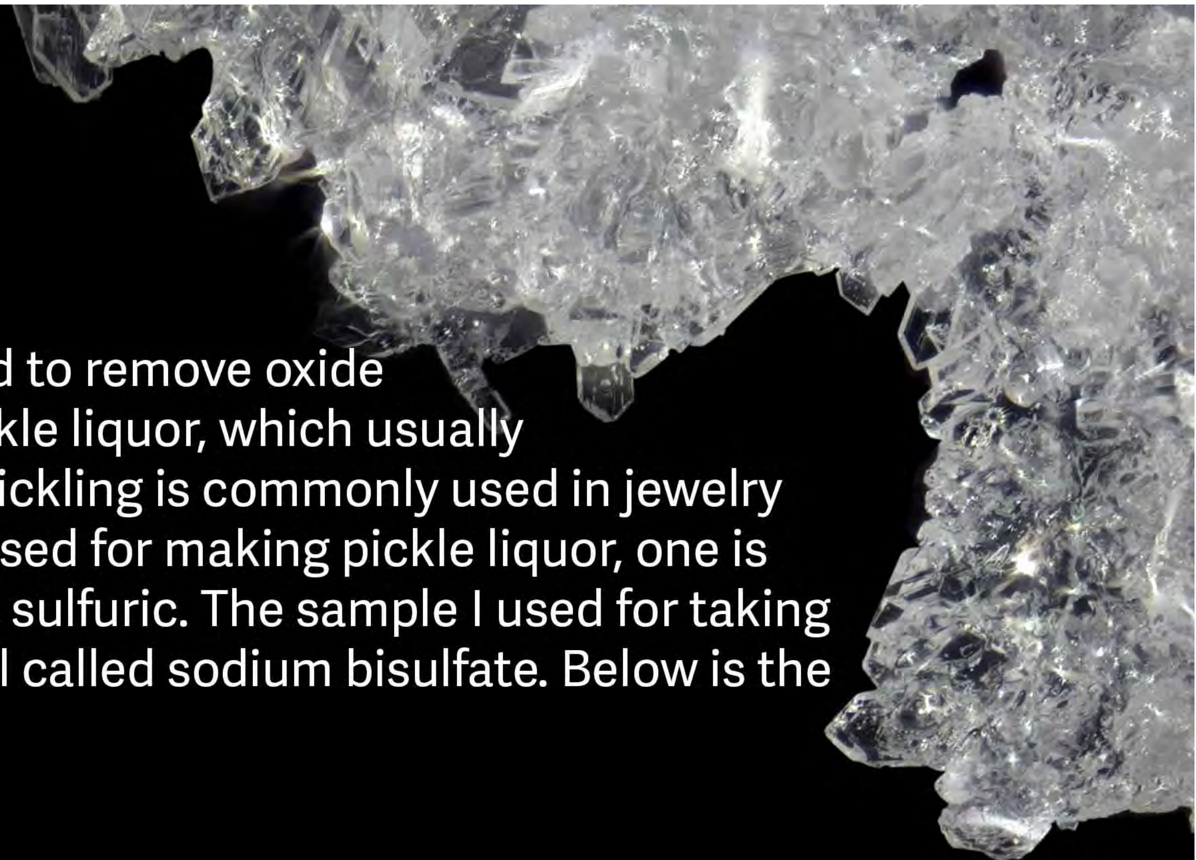
Sodium Bisulfate

A chemical used in jewelry design for metal pickling

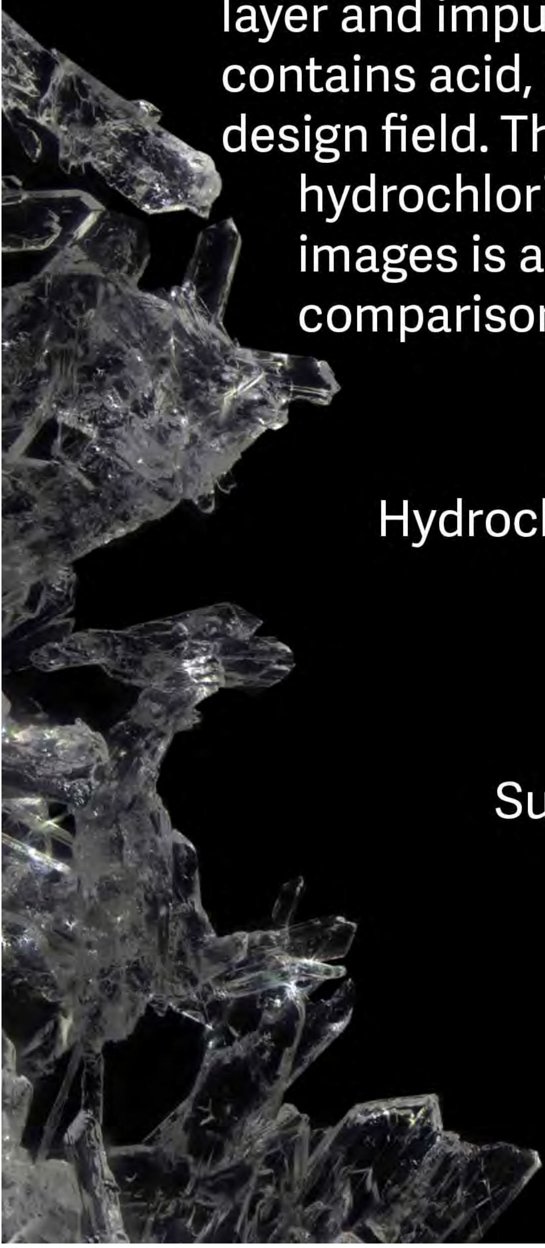
By Jingru Guo



Metal Pickling



Pickling is a metal surface treatment used to remove oxide layer and impurities. A solution called pickle liquor, which usually contains acid, is used in this treatment. Pickling is commonly used in jewelry design field. There are two types of acid used for making pickle liquor, one is hydrochloric acid and the other one is sulfuric. The sample I used for taking images is a type of sulfuric acid crystal called sodium bisulfate. Below is the comparison of two types of acid.



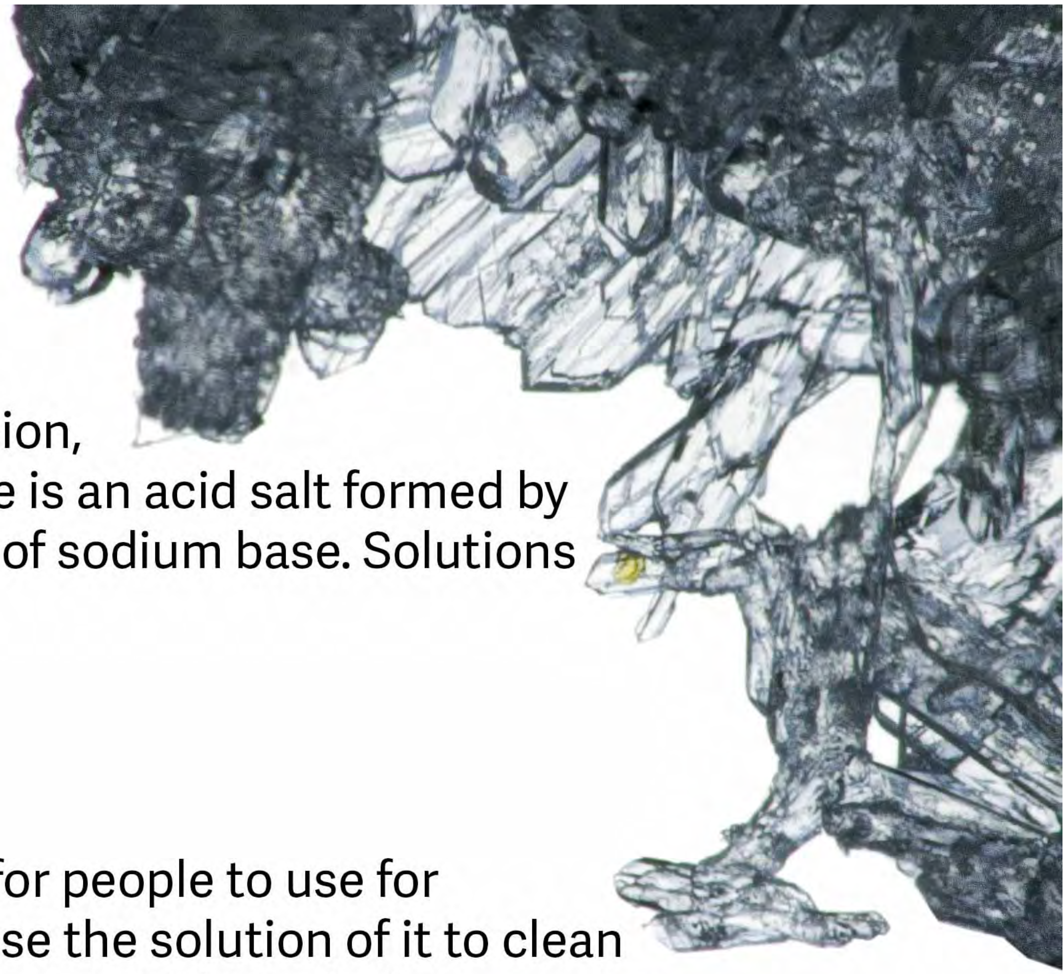
Hydrochloric

- Reduce heating costs since pickling solutions are used at room temperature
- More extensive scale removal
- Less penetration of hydrogen by diffusion
- Less deposition of iron salts on the pickled surface

Sulfuric

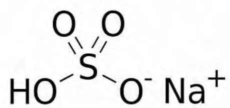
- Acid can be renewed more frequently
- Raising temperature will allow lower acid concentrations to pickle effectively
- Ease of recovering iron sulfate
- The rate of pickling can be controlled by varying the temperature

Sodium Bisulfate



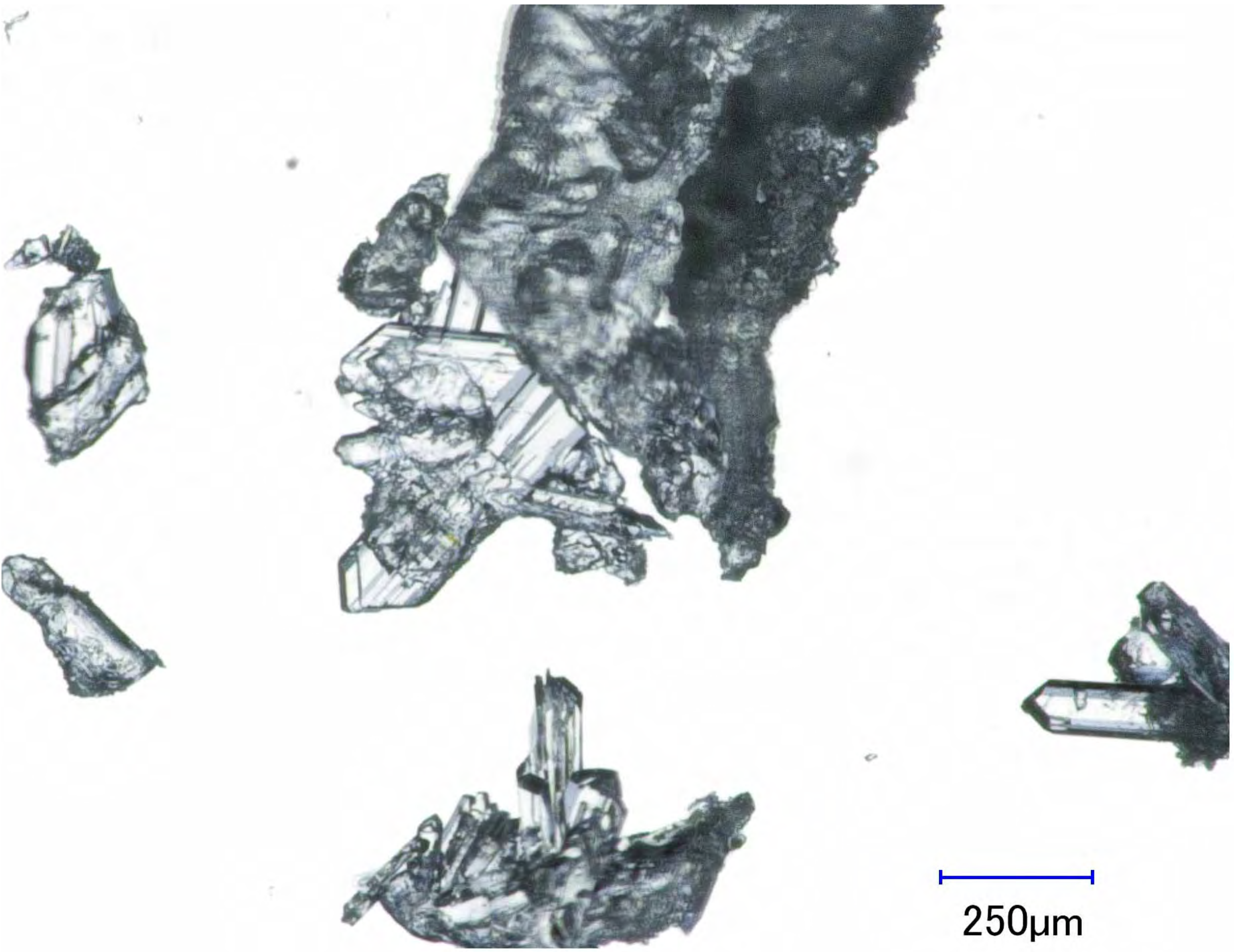
Sodium bisulfate is the sodium salt of the bisulfate anion, with the molecular formula NaHSO4. Sodium bisulfate is an acid salt formed by partial neutralization of sulfuric acid by an equivalent of sodium base. Solutions of sodium bisulfate are acidic.

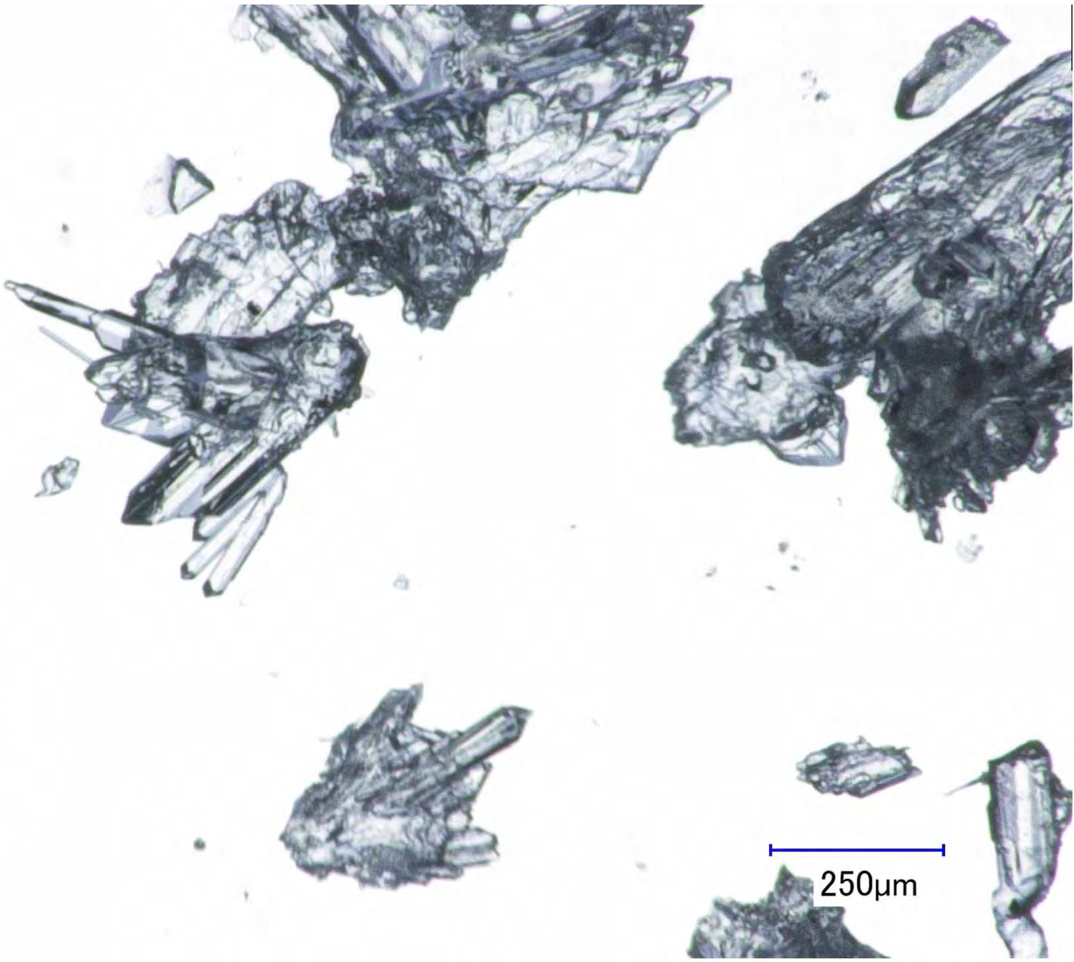
Sodium bisulfate is a dry granular solid which is safer for people to use for practical purposes. In jewelry design field, designers use the solution of it to clean up the oxidation layer and heat scale after burning the metal. This solution can be used for silver, gold, copper, and brass etc.

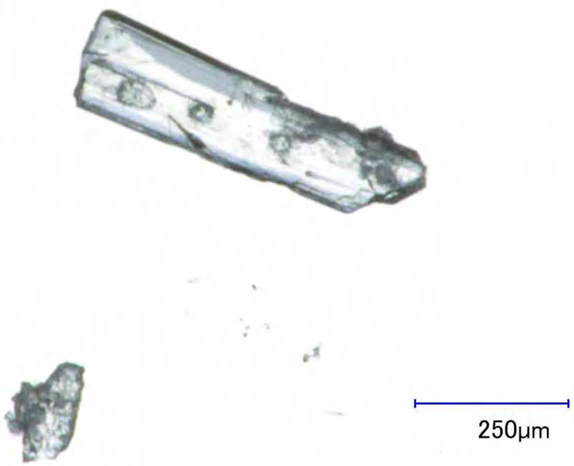


structural fomula of NaHSO4

200x Magnification



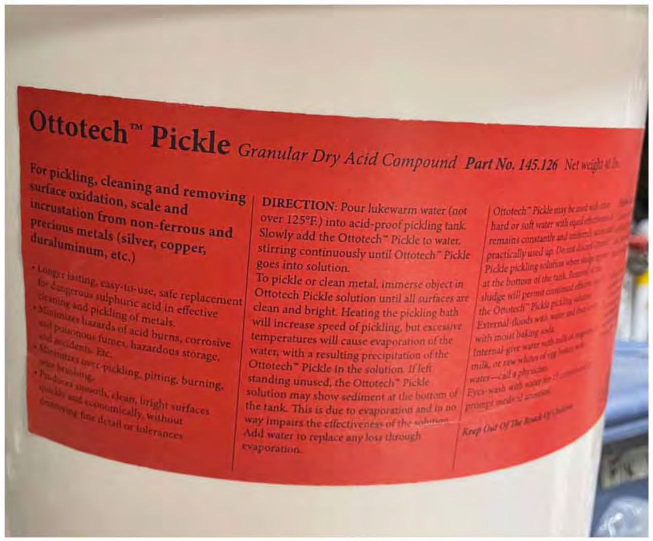




200x Magnification
KEYENCE Digital Microscope
By Jingru Guo

Sampling

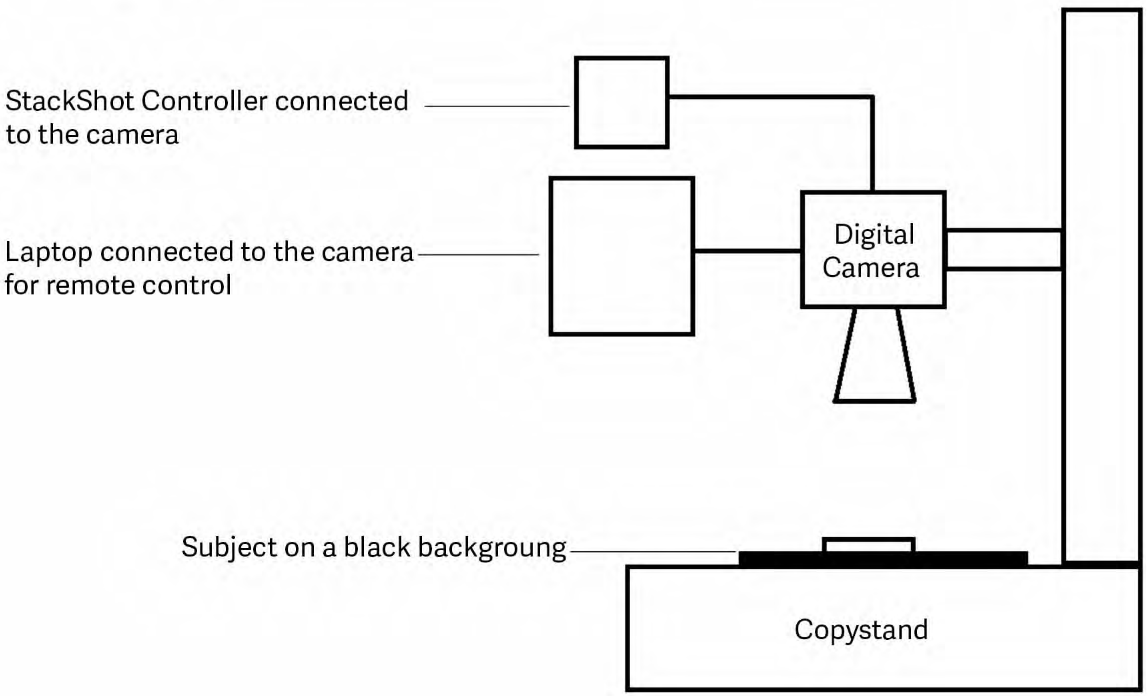
I collected my image subject from a table in RIT jewelry design studio. These crystals formed when water evaporate from the supersaturated solution. The substrate used to make the solution is Ottotech Pickle.

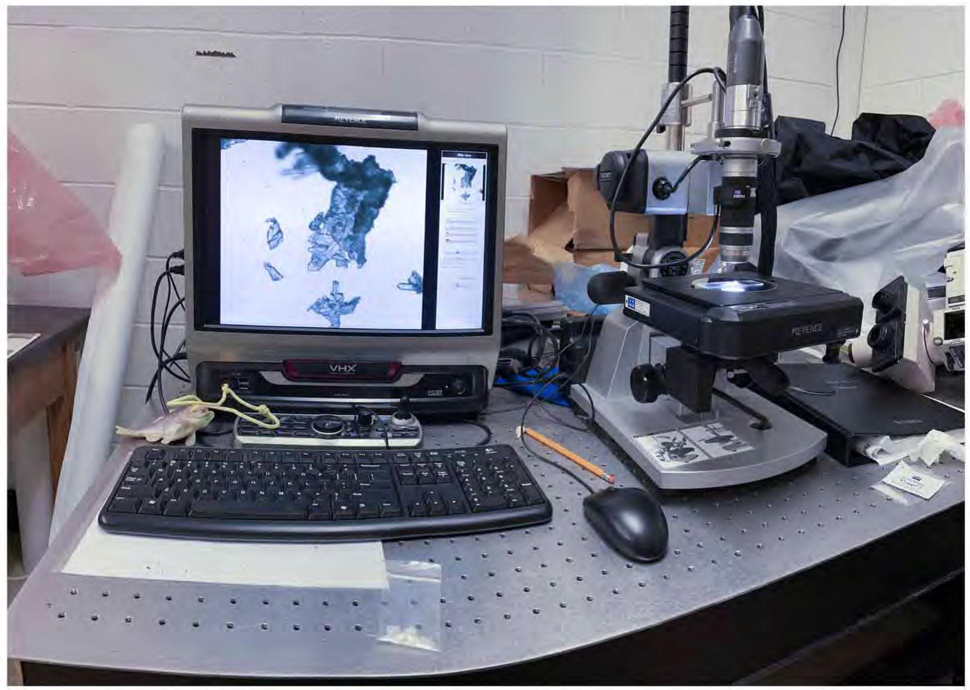


Photography Setup

The dark-field images I presented in the first two pages were taken by Sony a7rIV with Laowa 25mm Ultra-Macro lens under 5x magnification. The setup diagram is on the bottom left.

All the bright-field 200x magnification images I presented were taken by KEYENCE digital Microscope. I put the subject on a microscope slide and turned on trasmitted light under it. This microscope did photo stitching and focus stack to make a full composite while taking images.





About the Author

Jingru Guo is currently a senior photography science student in Rochester Institution of Technology. She is expected to graduate and have a Bachelor of Science degree in 2023. She has a great passion in taking high magnification images of wildlife and ores.
And she loves insects.

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The science behind perfect french fries.

Jared Redington

Introduction

No other food achieves the same balance of crisp exterior and fluffy interior without the need for any sort of external breading or batter as the French fry. It all has to do with the natural balances of starches and moisture in the spuds. Making a perfect French fry is not as simple as dropping potatoes in hot oil for a few minutes. The intricacies involved in taking two ingredients—potatoes and oil—and applying science, heat, and a bit of blind faith are so complex it boggles the mind. This abridged article is an explanation of how to make the perfect French fry.

When you picture a French fry, what comes to mind? For me, the perfect French fry has a substantial, crisp, grease-free crust that cracks open with a fluffy, tender interior.

There are four basic criteria that define a perfect French fry...

Crust: The exterior of the fry must be very crisp, but not tough. To achieve such crispness, the surface of the fry must be riddled with microbubbles. It's these tiny crisp bubbles that increase the surface area of the fry that add crispness. Ideally, this layer should only be as thick as it needs to be to add crispness. Any thicker, and you start running into leathery or tough territory.

Fluffy Interior: The interior of the fry must be intact, fluffy, and have a strong potato flavor. Fries with a pasty, mealy, or gummy interior automatically fail.

Crisp and Tasty: The fry must stay crisp and tasty for as long as it takes you to eat a full serving. Fries that come directly out of the fryer are almost always perfectly crisp. The true test, however, is to see whether it is still the same a few minutes later, after it's been sitting on your plate.

For potato variety, russet is what you want. Its high starch content means that it'll fry up crisper than waxier varieties like Yukon Gold or red skins.

Cooking Technique

Classic French techniques will have you believe that the road to perfect fries involves frying once at a relatively low temperature (between 275° and 325°F), followed by a resting period and then a second fry at a higher temperature (between 350° and 400°F). The most common explanation I've heard for this is that the first low-temperature fry allows the fries to soften through to the center, while the secondary fry crisps up their exterior. I decided to put this theory to the

The first I cooked per the French technique (a two-stage fry, the first at 275°F and the second at 375°F).

For the second, I replaced the low-temperature fry with a trip to a pot of boiling water, then followed up by frying at 375°F as usual.

For the third, I skipped the primary step altogether, simply dropping the potatoes into 375°F oil.

If the only purpose of the first fry were to cook the potatoes through to the center, then potatoes parcooked via another method should work just as well. Conversely, a potato that is not parcooked should not be evenly cooked to the center.

Results

Single-Fry

The single-fry potatoes were quite similar to the boiled-then-fried potates, though slightly less fluffy inside. Still, they were cooked through no problem.

Boiled-then-Fried

The boiled-then-fried potatoes were crisp, but the layer of crispness paled in comparison to the double-fried potatoes.

Double-Fried

The double-fried fries had a substantial, thick crust that stayed crisp for a while, proving that there's something more going on during that initial fry than simply softening...
I was so intrigued by this that I used a set of calipers to determine that the crust on this fry was more than twice as thick as the one on the boiled-then-fried fry.

Blanching is a technique that is often used in the process of frying French fries. Blanching helps to remove excess starch from the potatoes. When potatoes are cut into slices and then fried, the starch on the surface of the potatoes can cause the fries to stick together and become mushy. By blanching the potatoes before frying them, the excess starch is washed off, which helps to prevent the fries from sticking together. To really get to the bottom of this, we need an even closer look at the potato. A view at the microscopic level.

Anatomy of a Potato

Like all plants and animals, potatoes are composed of cells. The cells are held together by pectin, a form of sugar that acts as a glue. Within the cells are starch molecules; large sponge-like molecules composed of many simple sugars bundled together. Starch molecules, in turn, stick together in starch granules.

When starch granules are exposed to water and heat, they begin to swell, eventually bursting and releasing a shower of swollen starch molecules. This water can come from the outside (in the case of a boiled potato) or from inside the potato itself in the case of a double-fried potato), and that bursting of starch granules is essential to forming a thick crust: it's the sticky, gelatinized starches that form the framework for the bubbly crust.

So the path to perfect fries seems easy--just burst a ton of starch granules, and you're home free, right? Not that simple. If your potato contains too many simple sugars, it'll brown long before it crisps.

Starches and simple sugars will naturally convert their forms back and forth, depending on storage conditions. You can see this effect most dramatically with spring vegetables like peas and asparagus, which come off the vine packed with sugar but become noticeably less sweet and more starchy even twenty-four hours after they've been picked.

If potatoes have too much sugar, they won't crisp properly, and they'll become an unattractive dark brown as the sugars over-caramelize in the fryer, developing acrid, bitter flavors.

The other difficulty in bursting starch granules is that if the pectin glue holding the cells together has broken down too much before the starch granules have had a chance to burst and release their sticky innards, they will fall apart and crumble before they get a chance to crisp.

It's the breakdown of pectin that in some cases, nearly too horrible to mention, causes the dreaded condition known as "Hollow fry"

So, how do we wash away excess simple sugars while keeping as much pectin as possible?

Add vinegar.

Acidic enviornments have been proven to reduce or even prevent the breakdown of pectin. To test this theory, I brought two pots of potatoes to a boil side by side, the first in plain water, and the second in water spiked with vinegar. Here’s what I saw...

Water

Vinegar-water

While the plain-water-cooked fries had broken down by the time they were cooked through, the fries cooked in the vinegar-spiked water stayed perfectly intact, even after boiling them for almost double the time.

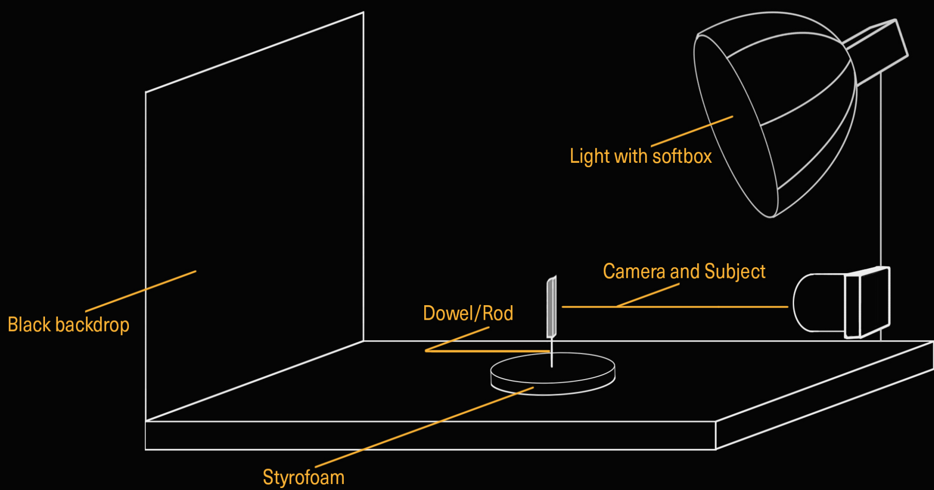
Despite their smooth looking exteriors, I knew that by boiling them for so long, I would burst plenty of starch granules. With the excess sugars washed away and the pectin strengthened, all that remained was to give them an initial fry at 275°F and a second fry at 375°F:

Water

Vinegar-water

Photographic Techniques Used

The images in this article were created using HDR focus stacking. The setup for the photos is as follows:



These photos were then processed in Helicon focus stack, and Adobe Photoshop.

About the author

Hi, I'm Jared Redington! I am a third-year university student at Rochester Institute of Technology studying Photographic Sciences. I like to use my skills in photography to illustrate the various facets of science the world around me!

In my free time, I like to play videogames with my friends, go to the gym, and I also love cooking! I've been a home-cook for the past 6 years where I've made just about everything. Whether it's making something simple like breakfast in the morning, or making a complex dish, I love the whole process. Everything from the chemistry to tasting the food.

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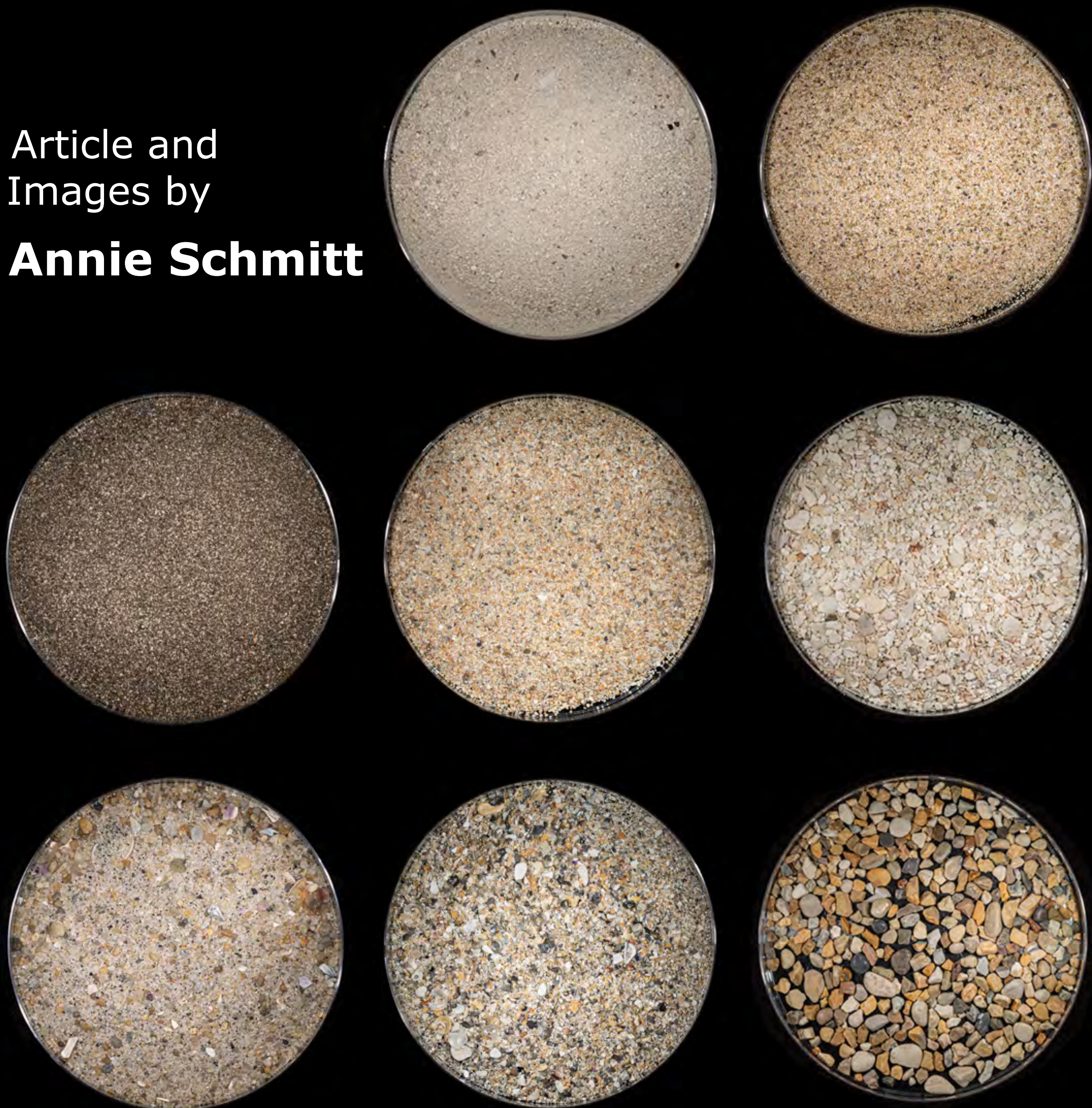
Article and
Images by

Annie Schmitt



A Macroscopic Exploration of **Sand**

Sand

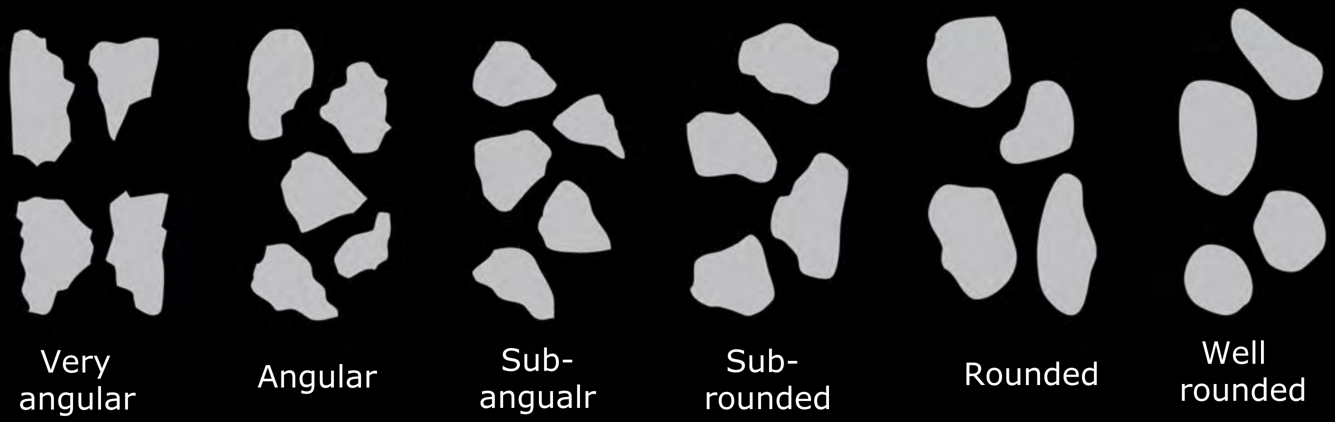
A sample of sand can be described in terms of its color, texture, composition, morphology, and grain size. Several factors can determine grain size, including; weather conditions, coastline shape, distance from the water, and seafloor features. Despite its uniform appearance, the composition of sand is a complex mixture of various substances.

Classification

Biogenic sand: the result of the transformation of living organisms into sand grains. The components are the living or once-living parts of an environment such as skeletons, shells, coral, and forams.

Abiogenic sand: the result of the weathering of rocks and minerals by waves, wind, and rain. The components are the non-living chemical and physical parts of an environment.

Six Fundamental **Grain Shape** Types



manoa.hawaii.edu

For this exploration, multiple samples of sand from around the world were collected and photographed. However, only four are highlighted in this article. For each sample, a brief description of its characteristics are discussed and noted.

5x magnification

Queens, **New York**

The types of minerals found within sand determine its color. The sample below is continental sand, with the most abundant component as quartz. It also contains other minerals like feldspar, mica, and biogenic grains. The shell above is an example of the biogenic grains that may be found in this type of sand. Continental sand usually appears as a light brown or yellow, but with a closer look its true colors can be seen.

2.5x magnification

5x magnification

Okinawa, **Japan**

Foraminifera, or forams, are the skeletons of protozoans, one-celled animals. They are typically white, dull or shiny, or covered in other sand grains. Their shells, mainly used for protection, are intricate and built from the calcium carbonate they collect while drifting through the water. The hundreds of tiny holes in the shells are called foramen, which are openings used to gather food. Forams are found in various shapes including; coils, discs, and even stars.

2.5x magnification

5x magnification

Northwest, **Ireland**

Biogenic sand is composed of the skeletal remains of plants and animals that use calcium carbonate minerals as part of their body. The parts that remain are either whole or broken up and range in their size, color, and shape. Size of the skeleton is dependent upon the skeleton they came from and the amount of exposure to wind and waves. Some of the skeletons seen below include; sea urchin fragments, coral, and forams. Sea urchin spines may be white, purple, black, beige, or green.

2.5x magnification

5x magnification

Corfu, **Greece**

The size of the particles on a beach are often a reflection of the energy of the waves that hit the shore. Sandy beaches are found in locations where the water is shallow and the waves have less energy. The larger, more pebble-like particles shown below are a characteristic of higher-energy beaches. The shapes of the grains range from very angular to well rounded. While the majority of the sample is pebble-like particles, there are some biogenic grains present, which are displayed above.

2.5x magnification

Photographic **Process**

Various samples of sand were collected and placed into Petri dishes for easy, uniform containment and transportation. When taking images of individual pieces of sand, a tweezer was used to place the piece on a sheet of black velvet for a dark background.The Petri dish images on the cover page were taken using a 100mm macro lens at a reproduction rate of approximately 1:5 to capture the entire sample. All other images were taken using a 2.5-5x lens.

Set-Up

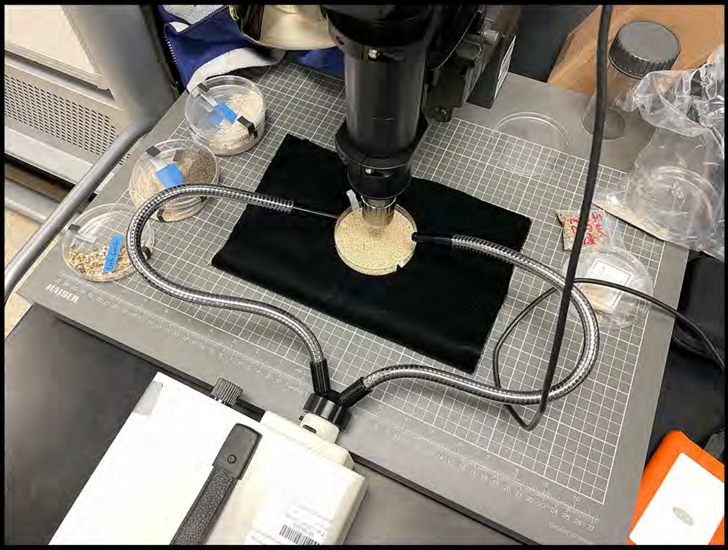
The camera and StackShot device were placed on an adjustable vertical copy stand with the lens of the camera facing downwards pointed towards the sand samples. The fiber optic lights illuminated the samples from above. The camera was tethered to a laptop through Adobe lightroom for live image review.

Post-Processing

Each image was created using the technique of focus stacking. The StackShot device was responsible for moving the camera in minute increments, therefore changing the focus for each image in the series of images. With an approximate range of 10-20 images for each final image, the series of images were combined, or blended together in one layer using either Adobe Photoshop or HeliconFocus. Once the final image was exported, any necessary exposure, contrast, or color adjustments were made.

Equipment

Canon 7D Mark II
Canon 100mm macro lens
Nikon 25mm 2.5-5x macro lens
Copy Stand, Fiber Optic Lights
Stackshot Device



About

Annie Schmitt is a photographer from Queens, NY. A current Junior at Rochester Institute of Technology, Annie is pursuing a BS degree in Photographic Sciences with an immersion in visual culture. She approaches her work with attention to detail and with the importance of self-expression in mind. With a passion for both the arts and sciences, Annie has created a diverse and unique portfolio of work that draws in an audience with a range of interests.

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Cataracts and the Intraocular Lens

Cailey Shaughnessy - Rochester Institute of Technology

Introduction and Background

Cataracts are an issue that many of us will experience. A cataract is a clouding of the eye's natural lens. With age, the eye's natural lens hardens, and it can yellow or become hazy and cause visual impairment. Some cataracts can also be caused by trauma to the eye, or someone could be born with one. In order to remove the cataract, the entire natural lens of the eye must be removed. In order for someone's vision to be restored, the natural lens is replaced by an artificial intraocular lens, or an IOL.

The first cataract surgeries were believed to have taken place as early as 600 BC. Many early procedures were not as safe or effective as today's, with some of the best success rates to be only 50%. Even though today's success rates are around 95% in the United States, some of the same techniques are still used. Extracapsular cataract extraction, or ECCE, is one of the most common techniques used today. The natural lens of the eye is encased in a capsule, similar to an M&M candy with the lens being the chocolate inside the shell. ECCE would remove the lens with the cataract while leaving the lens capsule in place. This technique allows the incision to be smaller than other techniques, which helps the healing process to be much easier for the patient. By keeping all or most of the lens capsule in place, the patient is able to receive an IOL. In some cases, the patient may not even have their lens removed. Some people with very poor vision could also receive an IOL as an alternative to other corrective procedures.

IOLs

IOLs come in many varieties for all types of eyes. They are very similar to contact lenses in some ways, except they are surgically inserted into the eye instead of being placed on the surface of the cornea. They are much smaller than contacts, though, being only a few millimeters wide. Like contacts and glasses, they have a prescription strength in diopters. IOLs are made of silicone, acrylic, or sometimes Collamer, so they can either be hard or more flexible. Some are inserted while folded, or they could be placed without being folded. IOLs also come in different shapes, having thin arms, loops, or a plate style extending from the central optical area. These three basic designs have countless options for how each piece is specifically shaped. Many follow a spiral shape, like a galaxy, but some are more rectangular and symmetrical.

Intraocular Lens Examples

Figure 1. An Alcon MTA4U0 lens. This is a 10 diopter lens, 13.0 mm wide, with the optical center being 5.5 mm in diameter. This lens is made of Polymethyl Methacrylate and cannot be folded to be inserted.

Figure 2. An Akreos Bausch and Lomb AO60 lens. This is a 3 diopter lens, 11.0 mm wide, with the optical center being 6.2 mm in diameter. This lens is made of hydrophilic acrylic. It is stored in a solution, where it is very flexible, then it hardens as it dries.

Surgical Preparation

Once you and your doctor have decided that it would be best to get cataract surgery, you will go to the clinic to get some scans and measurements taken. Depending on the doctor and certain results, the types of testing may be different for each person. IOL measurements will definitely be taken, which include the anterior chamber depth, or how long the eye is from the cornea to the iris and pupil, the corneal thickness, the cornea's diameter, the total eye length, and the amount of astigmatism. This is all done on one machine called an IOL Master with only a few images of the eye, and it usually only takes a few minutes.

The next machine will usually be a corneal topography. The cornea is responsible for about 70% of the refraction that gives your eye a focused image. Because it is such an important part of sharp vision, a map of the cornea's surface is usually very helpful when selecting IOLs. The cornea is also responsible for any astigmatism you might have. The topography would be able to locate where the astigmatism is, and it can get a more accurate reading of how much astigmatism there is than the IOL Master can. In cases of high astigmatism, there are special lenses, called toric lenses, that are able to correct for that.

Lastly, you may get an OCT, which stands for optical coherence tomography. This machine scans your retina, which is the back of the inside of the eye where all of the light detecting cells live. This type of scan is important because the doctor is able to look at how healthy your retina is. This could show them any additional reasons why your vision may be blurry. It is also important to know your retinal health because the surgery may put you at risk for a retinal detachment.

The surgery itself is short, and you will be going home the same day. It is usually done with a sedative rather than general anesthesia, so you will most likely be conscious but not remember too much. This helps with the stability of the eye during the procedure and allows it to go quicker. Recovery may be different for everyone. Depending on the lens your doctor has selected, the size of the incision needed, and the surgical techniques the doctor uses, you may or may not need stitches at the end of the procedure. You will most likely be given a protective shield or patch to wear after the surgery, and your doctor will discuss follow-up appointments to make sure there are no complications and to remove your stitches if necessary.

Observations

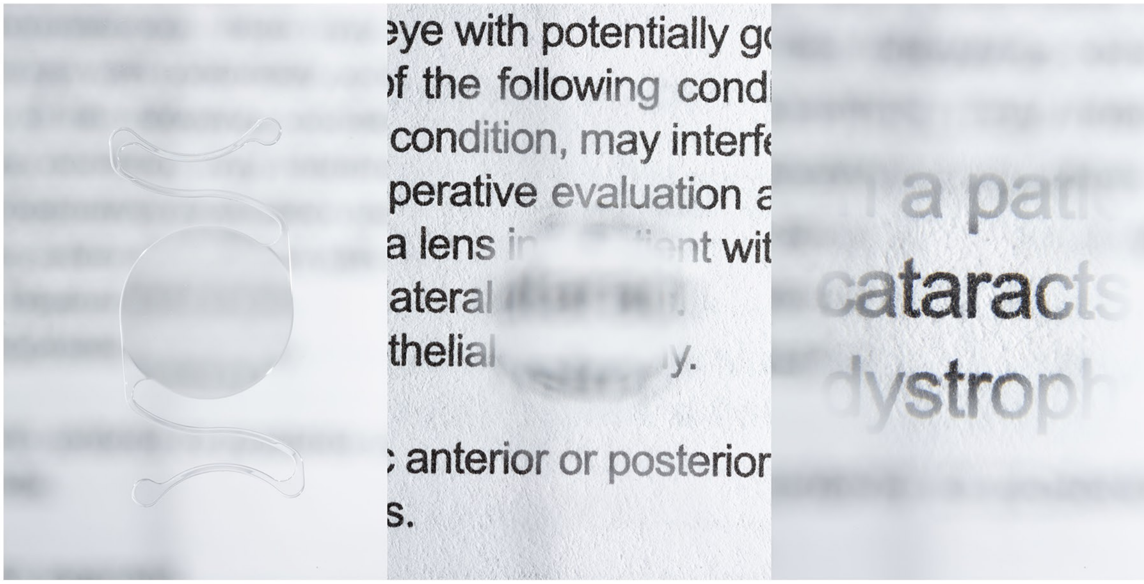

Figure 3. Alcon MTA4U0 10D lens demonstrating how something may appear with and without a corrective lens. The focus was changed by adjusting only the object distance, with the lens resting on a glass slide about 1.5 cm above the paper.

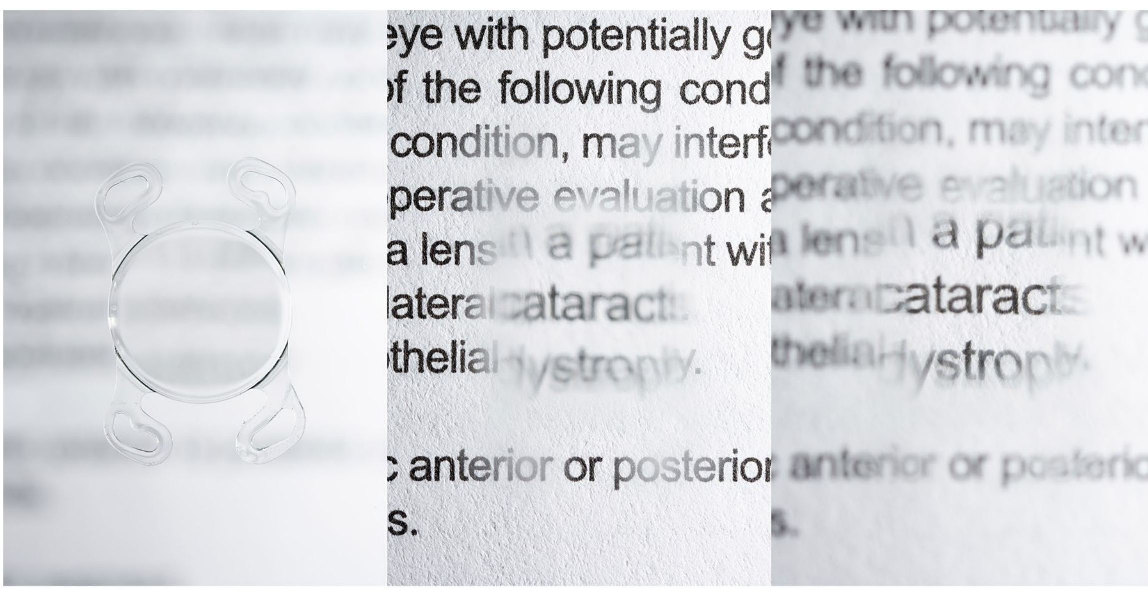

Figure 4. Bausch and Lomb AO60 3D lens demonstrating how something may appear with and without a corrective lens. The focus was changed by adjusting only the object distance, with the lens resting on a glass slide about 1.5 cm above the paper.

Figure 5. Alcon MTA4U0 10D lens haptic detail.

Figure 6. Bausch and Lomb 3D lens haptic detail. Shows scratches on surface due to handling after hardening.

Setup

The images used in this article were taken in a macro photography setup. I used a Canon 5D Mark III with a Canon 65mm 1-5x lens. The stage was created using a white sheet of plexiglass resting on wooden blocks. The samples were prepared by placing them on a clean glass microscope slide that was elevated about 1.5 cm by resting each side on small petri dish covers. Tungsten lights were used by illuminating the subject from below through the plexiglass. This is demonstrated in Figure 7 to the right. For Figures 3 and 4, the paper was placed beneath the slide, and the paper and sample were illuminated from above.

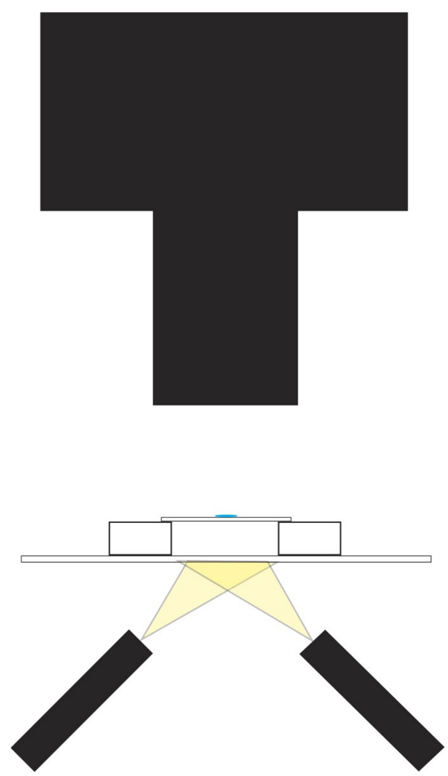

Figure 7. Camera setup.

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About the Author

My name is Cailey Shaughnessy, and I am a senior majoring in Photographic Sciences. I will be graduating in May 2023 with a Bachelor of Science. I originally started in a BFA Photography program at Lesley University before transferring after my sophomore year in 2020. I have always loved science and wanted to find a way to incorporate it into my work. At RIT, I have taken many interesting classes in ophthalmic photography, macro photography, programming, and optics. I was able to do my co-op at the Flaum Eye Institute, where I am still able to work part-time as a diagnostics technician. I also enjoy the technological side of my major, and would also be interested in pursuing a career in imaging technology.

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Ratcheting Wrenches

By: Travis Wagner

Introduction

Background:

Ratcheting wrenches, commonly refered to as ratchets, socket wrenches or ratcheting spanners, are a type of wrench used to reduce the time to install or remove fasteners. These wrenches feature a spring loaded tooth and pawl ratchet mechanism, that allows them to spin in one direction but not the other, allowing force to be applied to spin on a fastener, but for the wrench to slip and move freely to reposition.

The wrenches looked at here are socket wrenches, where there are attachments that change the size and/or type of fastener the wrench can be used on. Another common type of ratcheting wrench is a box end combination wrench, with a fixed size ratchet one one end and a fixed open end. These are steadily replacing fixed combination wrenches as sizes get smaller for the mechanism. Ratcheting openended wrenches exist, but are uncommon.

Since ratchets are directional, there are 2 main ways to change the direction of the wrench, flippign the wrench over, or a built in switch. This change is classified as on/off, or left/right, which all is a way of saying clockwise/counterclockwise.

Five wrenches were photographed, 2 used wrenches and 3 new wrenches. The new wrenches were purchased from Harbor Freight, and represent a spread of three different pricelines, a low, medium and high. Of the used wrenches, the Crescent branded one is a mirror image of the mid-line wrench from Harbor Freight, with fewer teeth. The other is an old wrench from Syracuse wrench. This wrench looks the most out of place and different, despite being a socket wrench like the rest. This wrench uses a separate square shaft that the sockets attach to as opposed to having an integrated square anvil to hole the sockets. The Syracuse Wrench is a fixed direction ratchet, so to change direction, the wrench must be flipped over. It is the oldest wrench here, and the most used and it shows.

A large sell point in the wrench industy is number of teeth, which over time has increase in conventional socket wrenches. The more teeth a wrench has, the smaller the swing arc can be while still making progress in adjusting a fastener. The smaller the teeth are, the less angle it takes to click over to the next position. The drawback to more teeth, is reduced strength, and increased manufacture cost. With more teeth, at the same size wrench, the teeth would be smaller, and smaller teeth cannot support the same load. What companies do to counter this is to have multiple pawls engaged into many teeth at the same time, this may the click over angle is smaller, but the strength is preserved.

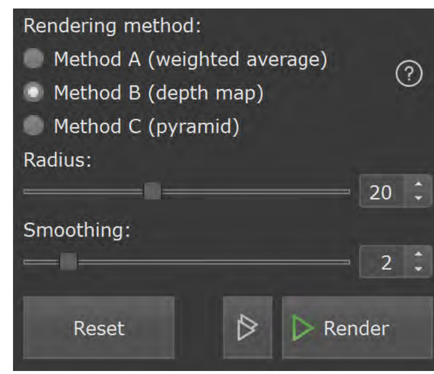
Technology Overview

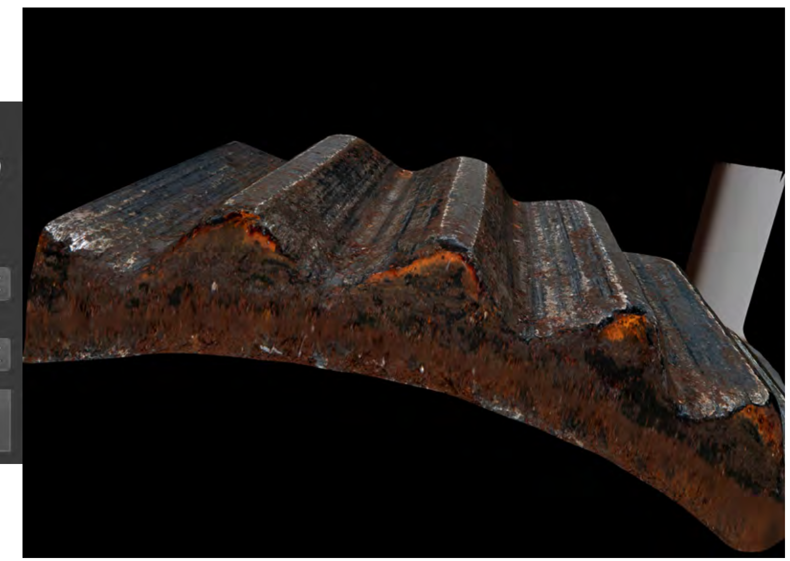
Equipment:

The Photographs for this lab were taken on a Nikon D7500, a copy stand, a stack shot, and one of 3 lenses: a Laowa 25mm 2.5x-5x, a Laowa 100mm 2x, or a Nikon 50mm f/1.8. A fiber light was used for event illumination, with either a ring light modifier or a light bar modifier. The wrenches were placed on the copy stand, backed by felt. The ring light diffuser was attached to the lens, and the light bar was held with a friction arm. Only one of the two were on at a time. The camera was attached to a stack shot for the focus stack images. The stepdown varied from 50µm to 100µm.

Software:

Photographs were taken and color corrected with an X-Rite color checker (now Calibrite). Profiling was done with that software and applied in lightroom. For the focus stacks, The images were exported to .jpg and imported into Helicon Focus. The stacks ranged from 120 frames to 250 frames. The settings used for the stacks were consistent for each set, given consistent geometry of the pawls and ratchet wheels. The Method that performed best was B, Depth map, with settings of Radius 20 and Smoothing 2. This yielded the best results, and the resulting stacks created a fairly accurate 3D moder of the part from a single view.





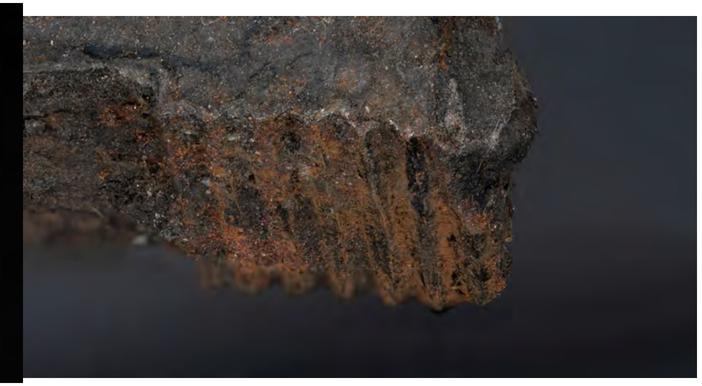
Harbor Freight Pittsburgh Pro Composite

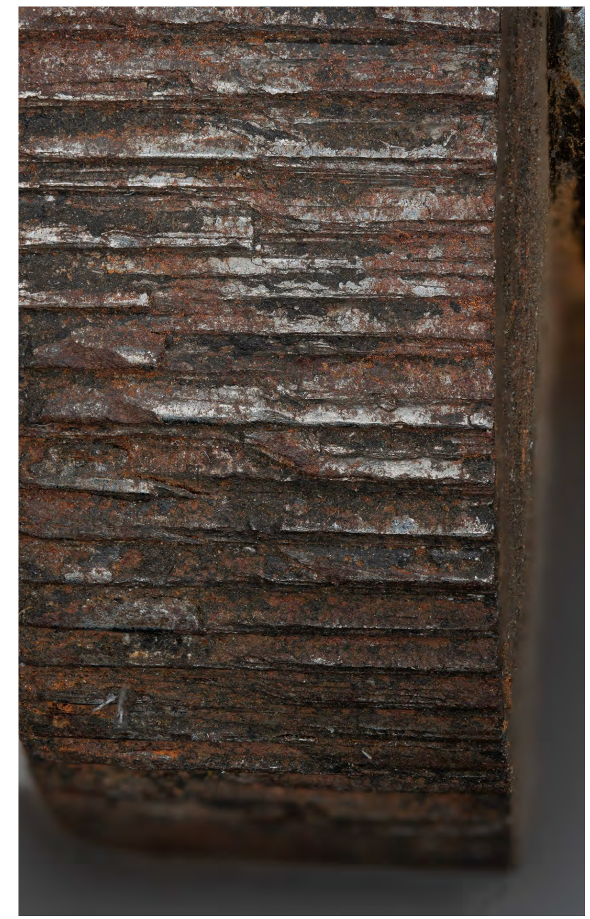
Harbor Freight Pittsburgh Pro

Harbor Freight Icon Professional

Crescent

Syracuse Wrench Co.





About the Author

Travis Wagner is a fifth year Mechanical Engineering student in the Dual Degree program in Kate Gleason's College of Engineering At Rochester Institute of Technology. He is pursuing his Masters of Engineering and Bachelors of Science in Mechanical Engineering. He is Minoring in Photography, with the Photo Science option.

A Comparison of Scorpions: Visible Light vs. Ultraviolet Reflectance

Jameson Wright

Scorpions are a type of invertebrate that fall within the class Arachnida, making them closely relate to spiders, mites, and ticks. They are carnivorous creatures that typically survive 3 to 8 years in the wild. As for their size, they have been known to be anywhere from less than an inch up to 8.3 inches. Although there are almost 2,000 individually identified species of scorpions, only 30 to 40 or so have strong enough poison to kill a person.

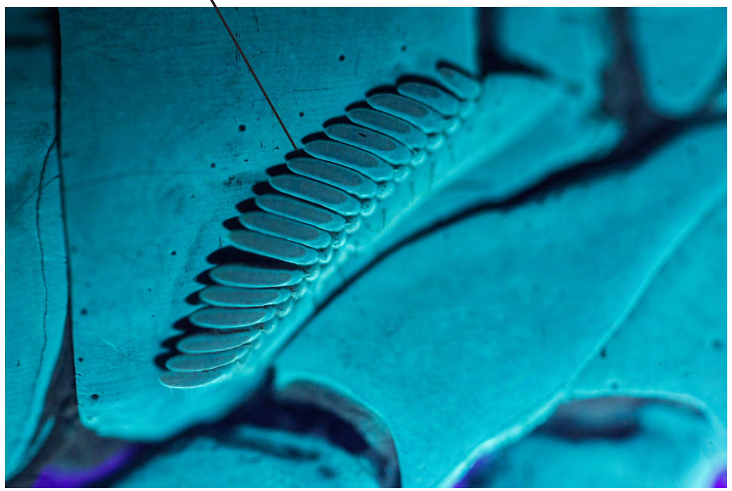
Visible Spectrum

Both of these images were created using the StackShot and are compiled of over 40 total shots each to capture all the different planes of focus.

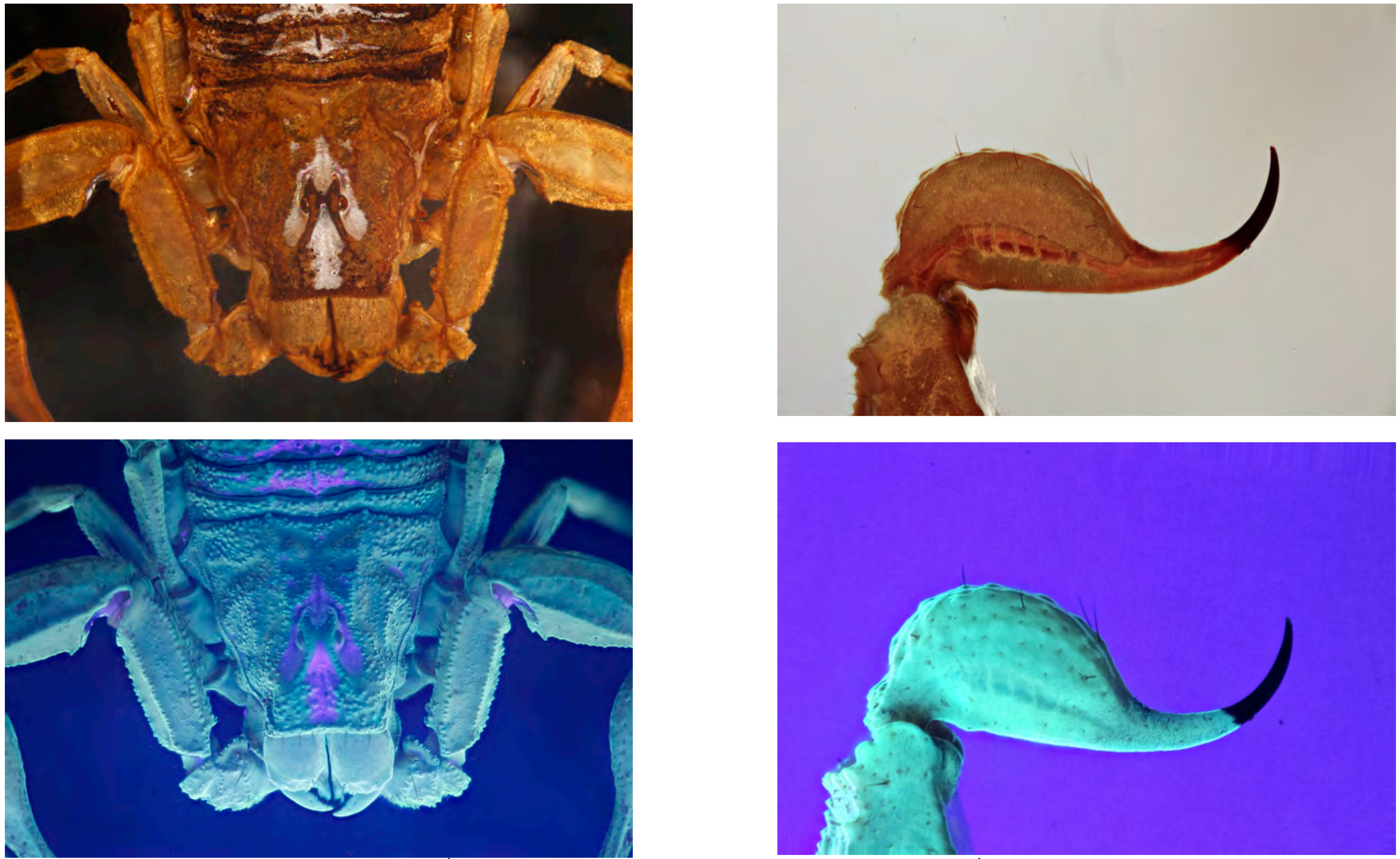
Ultraviolet Light

Another bizarre and intriguing fact that inspired this project is that when illuminated under ultraviolet light sources, scorpions' bodies fluoresce to reveal and entirely different looking creature to the naked eye. The glow comes from a substance found in the hyaline layer, a very thin but extremely tough coating in part of the scorpion's exoskeleton called the cuticle. As for the purpose of the fluorescence, scientists are not fully certain but some theories include that it helps protect them from sunlight, find each other, and even potentially confuse their prey. Considering that scorpions are primarily noctural hunters this could play a key role in how they go about catching their food. Another intriguing detail involving the molting process is that when a scorpion first sheds its shell, the newly revealed body will not fluoresce until the new cuticle of the exoskeleton fully hardens. This could indicate that the substance causing fluorescence could be a byproduct of the hardening process itself, or that it might be secreted not long after the creature molts.

Various magnified photos of Black Scorpion comparing visible to UV reflectance

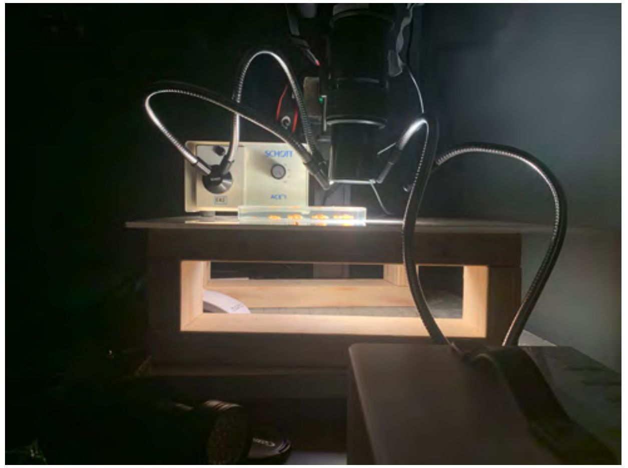


Various magnified photos of Golden scorpion comparing visible to UV reflectance



Ultraviolet Light

Photographic Setup



Equipment Used:

Canon 5D Mark III

SD Card

StackShot for Canon Kit

100 mm Canon Macro Lens

65 mm 1-5x Canon Macro Lens

CopyStand

Fiber Optic Lights (2)

LED mini light

Ultraviolet Flashlight

Single Black Scorpion Specimen

“Life Cycle” 5-piece Scorpion Specimen

Article Resources:

https://www.kidsdiscover.com/quick-reads/makes-scorpions-glow-ultraviolet-light/
https://a-z-animals.com/animals/scorpion/
https://www.nationalgeographic.com/animals/invertebrates/group/scorpions/

About the Creator

Jameson Wright is a current Photographic Sciences senior at Rochester Institute of Technology. He has completed a co-op internship at Flaum Eye Institute as a diagnostic ophthalmic imaging technician and plans to continue working in that field after graduating. Some of his other interests include forensic photography as well as criminal justice.

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This Article was created as a final project for Photomacrography, taught by Ted Kinsman at Rochester Institute of Technology Fall 2022. All images taken and owned by Jameson Wright.