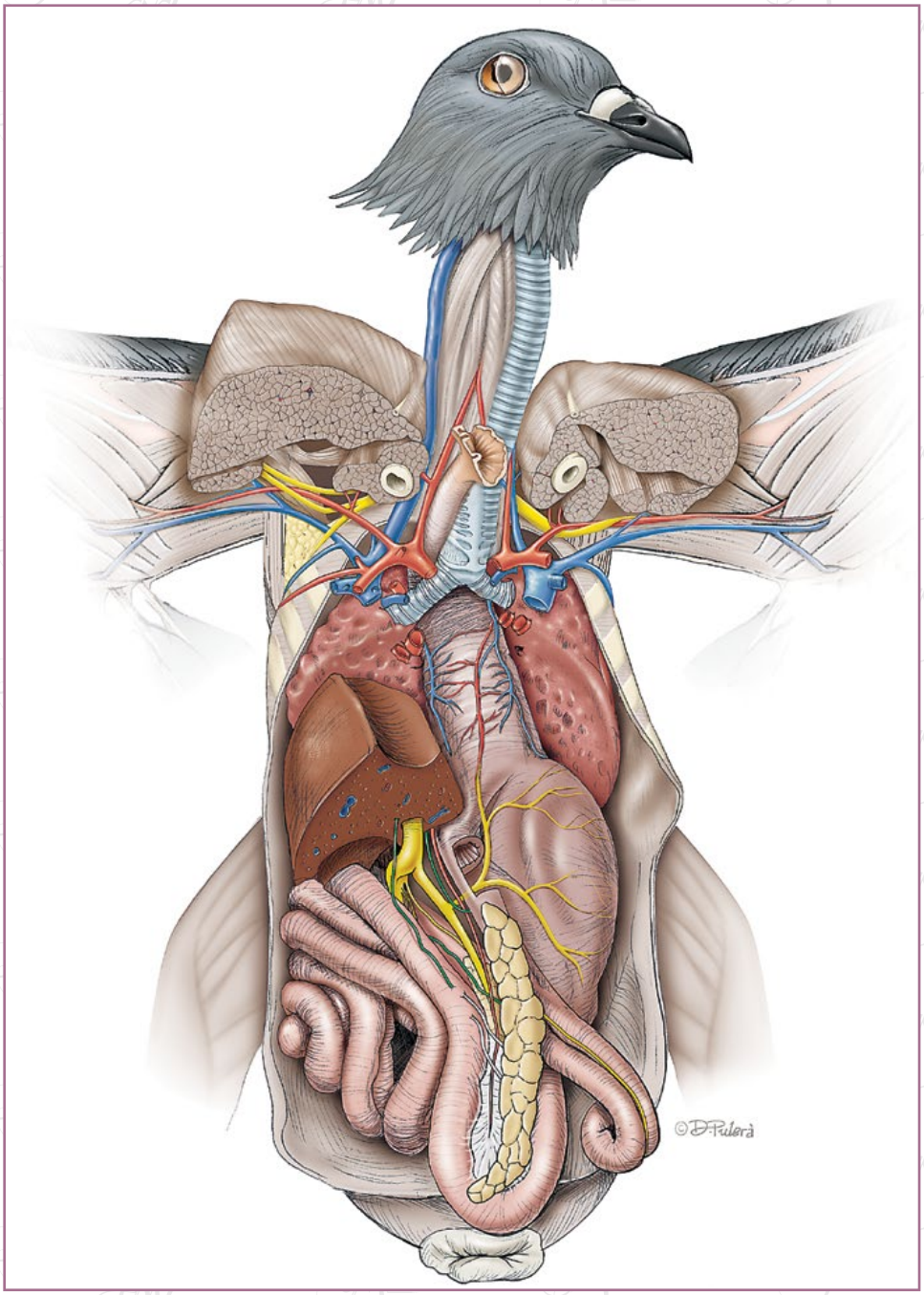
Journal of Natural Science Illustration

GUILD OF NATURAL SCIENCE ILLUSTRATORS



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A Note From...

Gail Guth, GNSI Journal Co-Editor-In-Chief

Diversity is the current buzzword. Clara and I were talking about the State of the Journal, as we regularly do, and were remarking to each other about the amazing diversity of articles we have published over the past few years; and of course, that diversity is a direct reflection of the composition of our membership. The GNSI is most definitely an umbrella organization: we are not all botanical illustrators, or all medical illustrators. We in fact embrace a dizzying array of interests and skills. But underlying all of that diversity of interest and skill is our fundamental fascination with nature, with its beauty and form, function and wonder, and our desire to share our visual insights with the world.

If you've been fortunate enough to have gone on a field trip at an annual conference, you already know the scenario: your fellow trippers could be two botanists, a paleontologist, a cartographer, three freelancers, and the rest specialists in illustrating bees, fish, birds, mammals or all of the above — and perhaps a sculptor for good measure. But let someone spot a rare and/or unusual flower or insect and the entire group converges, and out come the sketchbooks and cameras. Everyone is interested, everyone records the sighting in one way or another, because at minimum it adds to their enjoyment of the world to see such a lovely and unique thing. This is the GNSI at its best… shared interest, shared goals, and shared enthusiasm for our profession.

We hope you enjoy the continuing diversity of topics in this issue of the Journal! And please, as always, consider adding your insight and enthusiasm to our pages. It's a great way to get published, which is good for the group, good for the soul and may be good for your resumé as well!

— Gail Guth
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Rock Dove *(Columba livia)* viscera in ventral view (pencil sketch and colour rendering in Photoshop®). © Dino Pulerà. Illustration published in De Iuliis, G and Pulerà, D. 2011. *The Dissection of Vertebrates: A Laboratory Manual, Second Edition* Amsterdam: Elsevier / Academic Press.

GUILD OF NATURAL SCIENCE ILLUSTRATORS

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BEAUTIFUL LUMINOUS *Gray*

From Chemistry to Harmony

—Patricia Savage

Figure 1: Paint label

Color mixing can really stress you out. First you have to find the right paints that will match the subject. Then you have to make sure that they all mix together correctly. On top of that, you also have to find the colors that will work well with one another. And, they have to work throughout the piece. Finding the right colors to form relationships that create color magic need not be so stressful! And the process is not magic. Muted, neutral hues, tend to leave the novice artist staring off in space totally flummoxed trying to figure out how to mix them. These neutral hues generally make up the majority of real estate in a painting. Learning how to make them work is one less stress point in your creative process.

Hopefully, this article will help you learn how to combine paints to create neutral hues that harmonize within a painting, rather than a jarring mixture of hues that compete and argue. We are seeking what Betty Edwards in *Color, A Course in Mastering the Art of Mixing Color*, calls "that most elusive goal, harmony of color."

INSIDE THE TUBE

To work with paint, to really understand what's going on with your pigments and how they might mix out, means you will need to explore the nature of what you're using. You cannot just depend on the name on the label of the tube. (Fig. 1)

Let's start with a watercolor paint label — they can actually carry a lot of useful information in all those obscure words. The paint's name is generally the first thing we look for. Traditionally, manufacturers have named pigments to make them memorable. They honor the pigment's inventor (Scheel's Green),

Above, left: *Water Droplets.* Pastel. *11" x 20".* © *2017* P. Savage

famous painters (Van Dyke's Brown), place of origin (Naples Yellow), chemical component (Cadmium Red), plant dye (Rose Madder), chemical process (Burnt Sienna), source mineral (Cobalt Blue), trade name (Winsor Blue), or simply nostalgia (Dragon's Blood) and whimsy (Lunar Earth).

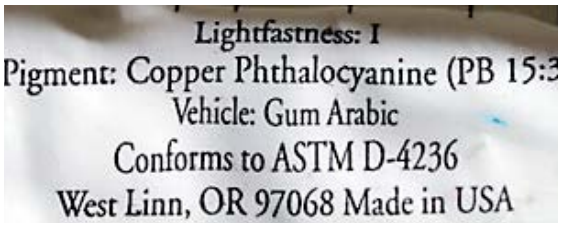
However — and this is important, folks — when "Hue" is added to the end of the name of the paint, the manufacturer has substituted that pigment with another pigment that looks similar. For example, in Cadmium Yellow Hue the manufacturer has replaced zinc with a different pigment. It's an industry norm to list the actual ingredients just below the color name, but many do not. Worse yet, some manufacturers do not add "Hue" either. Then you need to check the ingredients list to find out what pigments are actually in the tube (which is a total pain in the ahem). If it's not listed, or the ingredients are different than the color name, don't buy the tube.

Since this substituted color is a totally different pigment, it may not mix with the other paints in the same way. Say you have been using Cadmium Yellow to make green. You run out to the art store and Wow! Check out the much lower price of Cadmium Yellow Hue! Then you mix this new color with Cobalt Blue, and voilá, it's not the same green. Eeeek! Stress. This is not to say that the pigments in that paint are bad colors, they just don't match the relationships that you have been building in your painting.

Figure 3 *(below)*: Raw pigment, Burnt Sienna. (Extraordinary gift from our Scott Rawlins who bought it while traveling in Sienna, Italy.)

Figure 4 *(below right)*: Mineral, Lapis Lazuli

However, there are some instances when you *should* use the "Hue" labeled paint. Many paints that have the word "Lake" added to the common name are a dye (original Rose Madder Lake). In this instance, you want to use Rose Madder Lake Hue. In this context, "Hue" means that they used a synthetic pigment instead.



But, you have to make sure that the synthetic they used is lightfast too! New Gamboge is another one to watch. The original pigment is very fugitive. New Gamboge is a synthetic that is permanent.

Please note, that many manufacturers sometimes leave off "Hue" and "New" since they have been using the synthetic for many years and it is assumed to be lightfast, Ultramarine Blue being one example.

Another word in the name's label to pay close attention to is "Genuine". Genuine Alizarin Crimson should raise red flags because the original paint was originally made from the madder plant and was fugitive. Later, it was made from a coal tar extract aniline, also not lightfast. The more lightfast synthetic versions are created from quinacridone pigments. Genuine Vermillion contains mercuric sulfide which is poisonous. The modern synthetic version is made from Cadmium Red and is cancerous if eaten in very large quantities.

Paints containing multiple pigments —mixed paints — can be the manufacturer's trade name, something they made up, or the name of a discontinued pigment. Some tubes will be named for the predominant pigment contained in the tube.

Somewhere on the tube it should list all the pigments included. If it does not, go to their website and look for a pigment list. This is important. In watercolor paints, mixed paints generally become less lightfast when several pigments are mixed together because they respond differently when exposed to light. Manufacturers will claim the tube to be lightfast even though only one of the pigments in that tube is lightfast and the others are fugitive.

Do NOT buy a brand that does not list the ingredients on the tube or website. You really need this information to make an educated decision about how these paints will mix out with one another.

Next up on paint tube exploration: let's look at how the "Ingredients" section

is organized. On the tube, right after the word "Ingredients," you should find a code that will always consist of two letters and then two or three digits. All manufacturers worldwide recognize this letter-number system for specific pigments, called the Color Index Name, and it identifies the color and pigment.

The standard abbreviations for the different pigments are:

PB — Pigment Blue

PBk — Pigment Black

PBr — Pigment Brown

PG — Pigment Green

PO — Pigment Orange

PV — Pigment Violet

PW — Pigment White

PY — Pigment Yellow

NP – Natural Pigment

For variants of Pigment Yellow, the "P" stands for pigment, the "Y" stands for yellow, and the assigned number 35 is specifically for Cadmium Yellow made primarily of cadmium zinc sulfphide. PY 37 is Cadmium Yellow but made of cadmium sulphide, and is cooler. On any CIN chart you'll notice lots of variation in manufacturers' names for these; they're guaranteed to be cadmium but have unique mixtures of medium or additives. Think of the number as the species name. PY 35 is always Cadmium Yellow, PB 29 is always Ultramarine Blue, but you know that species have local varieties. Knowing these numbers will at least help you when you order new paints and want to make sure you buy the correct pigment. This number may identify the color but keep in mind that each manufacturer makes their paints differently. A Winsor & Newton Cadmium Yellow is a distinctive blend, a subspecies, and will mix, look, and brush out differently from a Graham Cadmium Yellow.

There are still quite a few paints that are made directly from plant or mineral sources. Paints made from plants (Sap Green, originally made from lilies) are notoriously impermanent. Their CIN should start with NP, but some manufacturers will use PG instead. Minerals too should be NP because they are ground from natural rocks, but again, are sometimes listed as PG. Use care when buying any pigment whose Color Index Name begins with NP. Always check the lightfastness and stability rating on the tube and do not buy from a manufacturer who does not provide this information on the tube or their website.

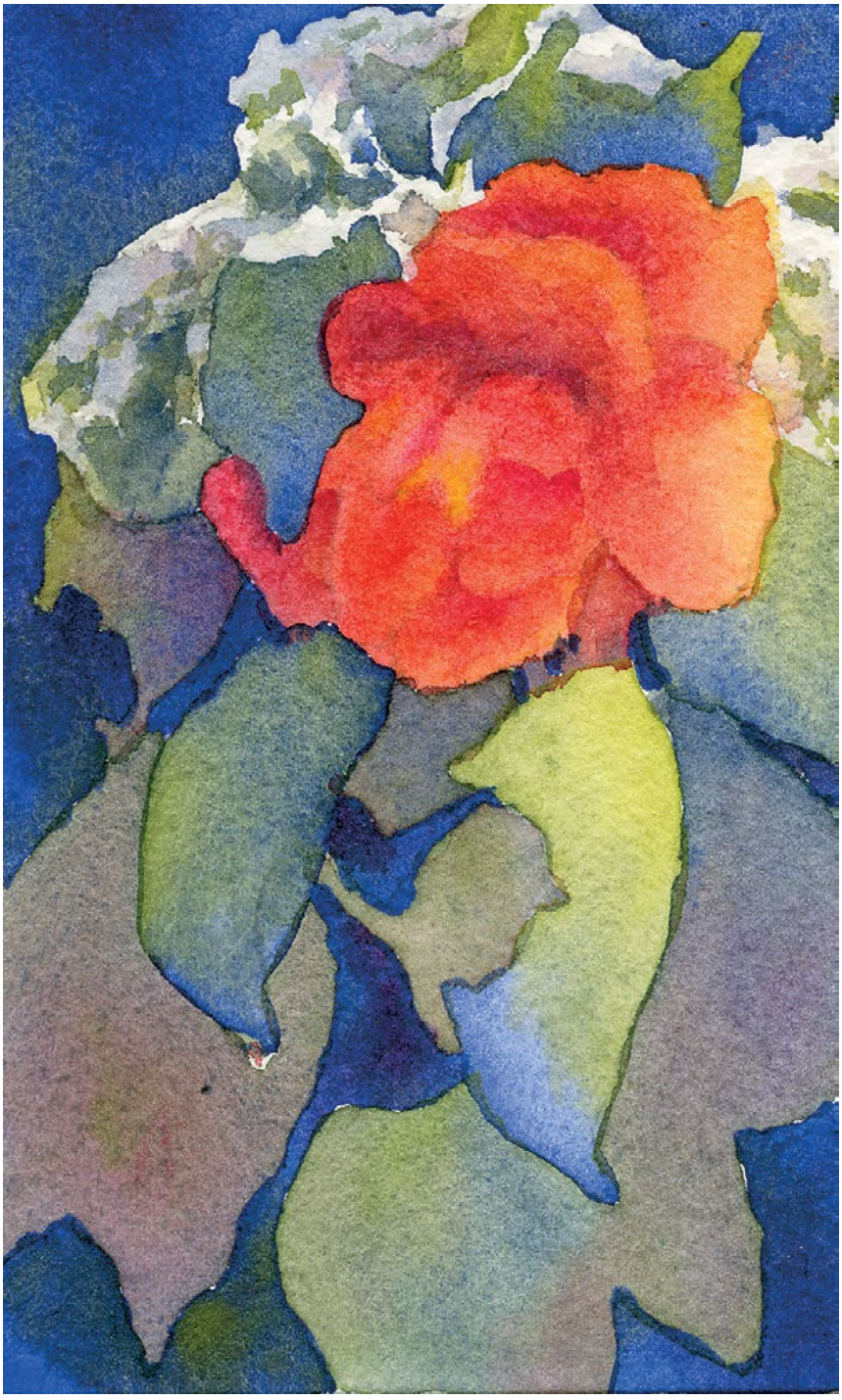


Figure 5: *Water Droplet, Study # 5*, close-up, Watercolor. © P. Savage

TRANSPARENT AND OPAQUE PAINTS

Each of your paints will have different levels of transparency; this can really affect how light penetrates the pigment. Transparent hues allow light to pass through them; opaque colors are "thicker" looking and do not allow as much light to pass through. When applied too heavily, no light can pass through and the paint will look lifeless. It is best to apply opaque paint in thin layers and to mix it with a transparent paint. Stay away from mixing two opaque colors together. You can go to the manufacturer's

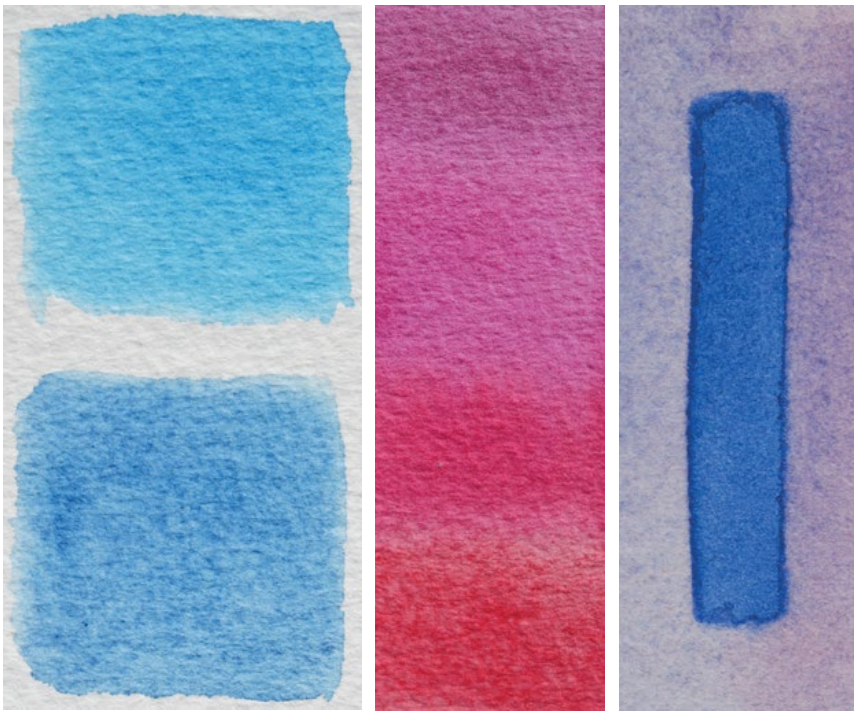


Figure 6 *(left)*: Warm/cool bias, primary colors, Phthalocyanine Blue, green shade (top), Phthalocyanine Blue, red shade (bottom).

Figure 7 *(middle)*: Range of quinacridones

Figure 8 *(right)*: Warm/Cool. Ultramarine + quinachridone red. Note the reddish tint on right (warm) versus the bluer tint on left (cool).

website to find out which individual paints are transparent, semi-transparent, and opaque.

Right about now, you might be wondering what on earth all this stuff about pigments and paint labels have to do with painting beautiful neutral hues. Primarily, what I hope you learn is that, before you even start your painting, check out what's in and on your tube. Mixed paints, mis-named hues, inadvertant introduction of new hues can all play havoc in a painting. It's important to try to work with…

SINGLE PIGMENT PRIMARY PAINTS

In a painting, most of the hues will be muted hues with saturated colors being reserved for spots of interest and to help guide the eye around the composition. On the one hand, you have to try to match the color of your subject, but on the other, you also need to make the colors work together throughout the entire piece. This is a dry telling of what we artists really want in a painting, which is for our colors to make music together, to dance and sing in four-part harmony, to weave themselves together in a beautiful tapestry of color, to form life-long attachments with one another — in short, we want them to look really good.

To make colors begin to form an attachment with one another, they need to hold hands and then — gasp — mate with one another, on their very first date. Other times you might want them to be not quite so intimately joined. (Fig. 5, previous page) Leaving unmixed paint on the brush and on the palette, allows bits of the two primaries to be visible alongside the secondary. Adding a third, fourth, or fifth single pigment or mixed hue can be, well, dangerous. The harmonious couple that has been developing is all of a sudden thrown off balance by the addition of a third party. Now this might still be workable, but you would need to begin to work that color into relationships across the whole painting. One hue should not hog up a small section of the painting. Otherwise, it's a bad affair and becomes a screaming accidental focal point. Working the color to form companionable relationships throughout the piece lets everyone join in the ménage à trois.

Attachments can only form when you limit the number of interactions that can occur. Just like people, smaller groups can get to know one another faster and more intimately than a large one. Intimacy between hues occurs when there are fewer around to compete with. The best place to start is with the primary colors and single pigment paints.

The three primary colors are red, blue, and yellow. They are pure pigment and the purest, most saturated hue. A primary color means you cannot mix two colors together to make it. If you mix two similar primary colors you still have a primary color [Ultramarine Blue + Cerulean Blue = blue. Cadmium Yellow + Aurelian Yellow = yellow]. These cannot be "broken" until you mix two different primary hues together to create a secondary, at which point it can never return to a pure, unbroken primary state. The three secondary colors are violet, green, and orange and are created by mixing two primary colors together. Blue + yellow = green. Blue + red = violet. Yellow + red = orange. Visually, they are halfway between the primaries on a color wheel. Not biased either red or yellow. All the other colors in your painting start with at least one of these colors. From these three primaries, you can literally mix thousands of hues.

There are also many "secondary" colors that are single pigment paints as well; for example, Viridian and Phthalocyanine Green. These single pigment hues, when mixed with primary colors, help keep the colors clean.

Each of the primary hues can have a warm and cool bias (Fig. 6). Cool-biased colors are more blue and green in appearance, whereas warm colors are more yellow/yellow-orange. Quinachridone red hues, for example, are considered a cool red, but there are several versions of it (Fig. 7). The color can range from coolish Permanent Magenta (which has a bluish bias) to Quinacridone Red (which has an orange bias). Ultramarine Blue is considered a warm blue because it is redder (more violet) than any of the other blues. It also comes in a red (warm) and green (cool) shade. (Fig. 8)

Practically speaking, what this means is that you can use the warm and cool shades to help make your subjects look more three-dimensional by using warm colors to "pull" the front part of the subjects into the foreground and the cool colors to "push" the back parts into the background. It also means that you can mix a warm Ultramarine with a cool Phthalocyanine Blue Green Shade and play with the warm/cool interactions between those two as well (Fig. 9).

Single pigment paints give that creative, intuitive part of your brain a place to let your colors express themselves, to harmonize, and to vibrate from excitement. Because you are mixing your own secondary and muted colors, you can control the bias of the end result. You can shift the color warm or cool, more muted or more saturated, or lighter or darker. Your paints don't have to lose themselves in each other's arms either. Parts of each of their individual personalities can peek through. In other words, you don't have to have the color totally mixed out on your palette or brush. You can leave some of the blue and yellow somewhat unmixed on your brush to create an enormous amount of visual excitement to a green. Think of it this way: if you are standing in front of a painting of a leaf, which is going to be more interesting to look at? A flat pre-mixed green or a green that has hints of both yellow and blue and perhaps a touch of red?

So, using single pigment paints (this includes greens like Viridian) is a HUGE advantage. Single pigment paints act more like a primary because they are not already muted mixtures, like you get with pre-mixed paints. It is easier to attain the color harmony that pleases you. Pure primary paints create beautiful colors that glow because you have not mixed so many different chemical colors together. The muds you do create intentionally will glow and be rich in color.

If you don't have to match the colors of the subject and wish to explore color relationships, you can start to play with your own intuition and how you emotionally experience the color and how it feels when placed next to other colors. Over time, you will find hues that just plain feel wonderful to work with and you will find yourself repeatedly going back to them.

Paints that contain a single pigment also allow you to layer multiple times, because they are not a mixture. They are purer in hue than a mixed pigment. They keep your colors fresh and vibrant.

On the practical side, besides making control of color easier, you don't have to buy all kinds of paints.

COMPLEMENTARY COLOR

Complementary pairs (Fig. 11) form the visual interest and spark in your paintings. They make it happen, man! The complement of primary blue is orange (primary red and primary yellow). It's not just any orange; it's the orange you make from your primaries. The complement of red is green (blue and yellow). The complement of yellow is violet (red and blue) (Figs. 12-14). Putting the primary together with its complement is called the complementary pair.

Figure 10: *Water Droplet Study* #4, Watercolor, © P. Savage

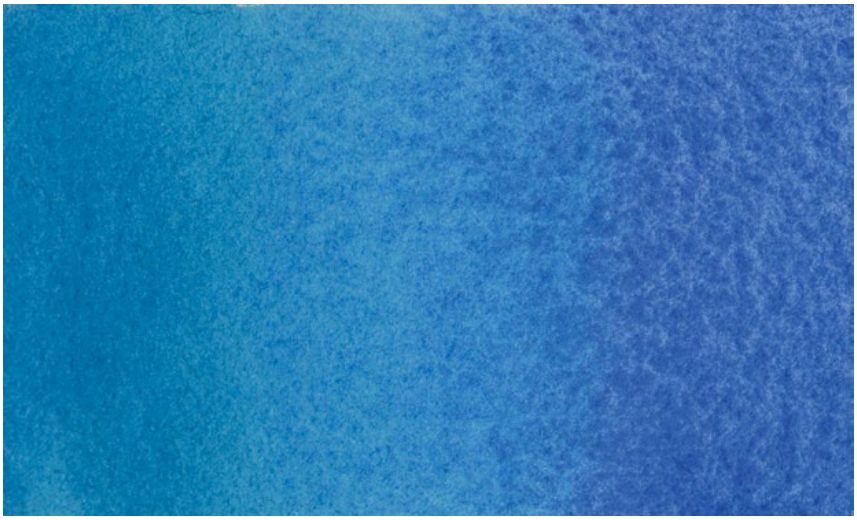


Figure 9: On the right is warm Ultramarine blending in with cool Phthalocyanine Blue Green Shade on the left. When paired side by side, notice how the Ultramarine appears to have a more reddish cast.

Figure 11: Complementary pairs: Sometimes you really need to use a secondary single primary paint, but the nifty thing about using three primaries to create the complement is how you can use these three colors, instead of just two, to push your hues in many different directions. You can choose to play with the chroma and/or easily shift the temperature.

And my, oh my, what a lovely pair they make. They are the couple you always envy when they walk by you! When paired together, these two vibrant beings do a tango together which blend into a lovely muted color that shares the vibrancy of both.

The secondary colors can also be paired with their tertiary complements (Figs. 15-17, next page). The complement of yellow-orange is blue-violet, red-orange is blue-green, and red-violet is yellow-green. These can also be used for quite lovely visual effects.

The muted hue formed from blending a complementary pair produces a kind of gray — which means you should never have to buy a gray. Why, you ask? What do think will happen if you all of a sudden introduce a manufactured gray that contains absolutely zero, zip, nada of the colors you are using? Essentially, you just added in a hue that has not been a part of the conversation going on between the colors in your painting (that's a seriously dangerous ménage à trois!). Unless you know exactly which pigments the manufacturer used, adding gray with totally different pigments could throw your relationships completely off and give you a bad and frustrating case of the not-so-pretty muds. (Do you ever get an uneasy feeling of something being off or hating what is happening with your colors but not sure why? Well, this might be a reason.) Divorce ensues (as in painting thrown away). However, when the primary moves in next door to the lovely complementary color, it can get interesting! There will be visual excitement, creating (ahem) overt tension with one another.

Manufactured grays also tend to be neutral. You do not want this. Remember the leaf? You want grays that can move slightly towards red, blue, or yellow. When you make your own gray from complements, you can shift the gray a bit to one of the primaries or make it purely neutral, and your budding relationships continue to bond with and strengthen one another. Grays that modulate in hue help to enhance the push/pull and warm/cool interactions in a piece too.

Which brings us back to those pre-mixed colors you own. (They are call convenience paints.) Pre-mixed paints lack color vibrancy precisely because they are already mixed. If the tube is called a green, double check the ingredients. It could be a single primary paint but the manufacturer may have used a couple of different yellows and a blue or two, black, gray, and maybe red or even orange or both.

One manufacturer's Olive Green contains Phthalocyanine Green, Quinacridone Deep Gold, Phthlacyanine Blue, and Nickel Azo Yellow. Another manufacturer's Naples Yellow lists Zinc White, Titanium White, Nickel Titanate Yellow, Perinone Orange, and Isoiandoline Scarlet. These are all perfectly legitimate pigments all by themselves, but do you need to spend the money to buy the paint when you can mix your own and get much more interesting color mixtures?

Since you also may not always know what pigments went into making a mixed paint, you cannot predict how that paint will mix with the other colors on your palette. If you start with a muted color of your own creation and mix it with totally different muted colors from your pre-mixed paint, you mixed a muted color with another muted color and all you will get is a visual mess. This can be disastrous if this happens in the later stages of a painting.

You really need to double check that the pigments in the tube are the same pigments you have mixed together for your painting. And, really, why buy

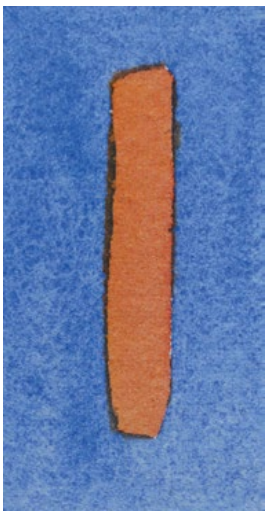


Figure 12: Ultramarine Blue (background). Cadmium Red + Cadmium Yellow = orange.

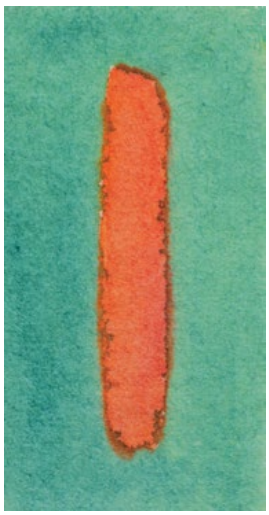


Figure 13: Cadmium Yellow Light + Lemon + Phthalocyanine Blue (green shade) = green (background). Scarlet Red + Permanent Red (Winsor Newton) (Perylene Red) = red.

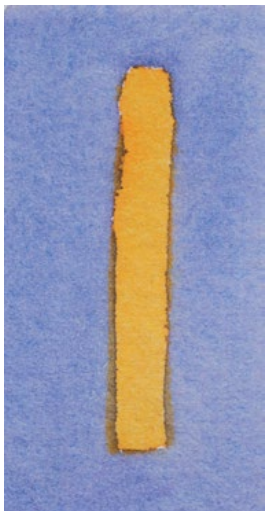


Figure 14: Quinachridone Red + Ultramarine Blue = violet (background). Cadmium Yellow

Figure 15 *(top)*: Ultramarine Blue + Phthalocyanine Blue Red Shade + Cadmium Red = **blue violet**. Cadmium Yellow + Cadmium Red = **yellow orange**

Figure 16 *(middle)*: Phthalocyanine Blue + Cadmium Yellow Light = **blue green** Quinachridone Red + Cadmium Yellow Light = **red orange**

Figure 17 *(bottom)*: Permanenet Magenta = **red violet** Phthalocyanine Blue + Cadmium Lemon = **yellow green**

a mixed green when you can mix your own with your own three primary paints? Save yourself some money!

It is also worth the time to make color charts. By experimenting with your different colors, you quickly learn the personality of the individual color and how they mix with the other colors in your palette. Many artists make small portable charts that show a wide range of color values, different mixtures of saturated and muted colors, and the different chroma possibilities. Having the charts on hand helps you find a color quickly, especially if you are painting outside.

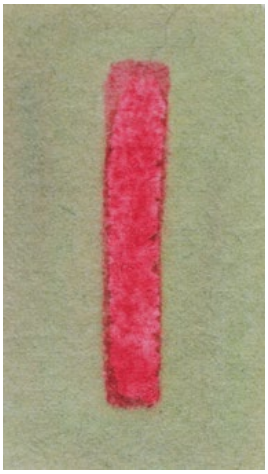


Figure 18: Phthalocyanine Blue (red shade) + Quinachridone Red + Cadmium Yellow Light = muted grey-green (background). Quinachridone Red.

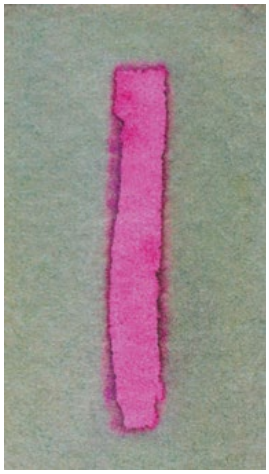


Figure 19: Phthalocyanine Blue (red shade) + Permanent Magenta + Cadmium Yellow Light = muted blue-green-grey (background). Permanent Magenta.

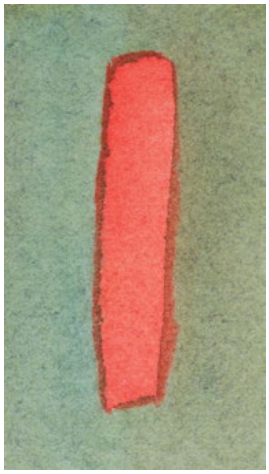


Figure 20: Phthalocyanine Blue (red shade) + Cadmium Red + Cadmium Yellow Light = muted blue-green-grey (background). Cadmium Red.

Color Theory books that help with principles and rules:

Phillip Ball, *Bright Earth: The Invention of Colour*, 2008

Betty Edwards: *Color by Betty Edwards: A Course in the Mastering the Art of Mixing Colors*, 2005

Bernard Guineau and Francois Delamare, *Colors: The Story of Dyes and Pigments Paperback,* 2000

Margaret Kessler, *Color Harmony in Your Paintings*, 2012

Hillary Page, *Hillary Page's Guide to Watercolor Paints*, 1997

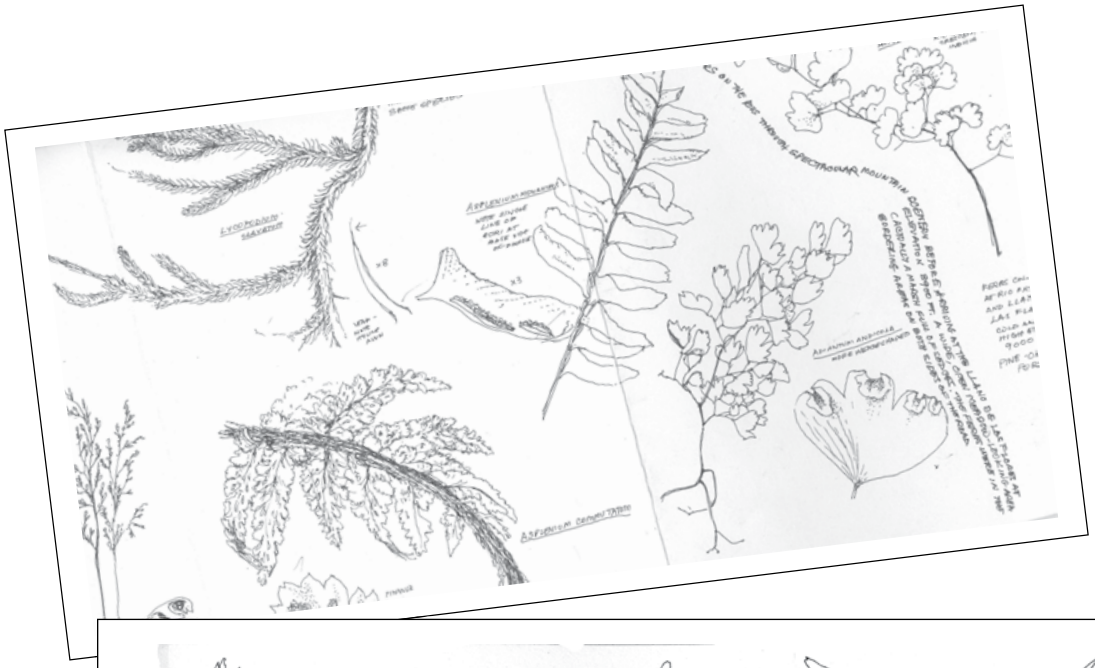
Josef Albers, *Interaction of Color*, Revised Ed. 1975

Jeanne Dobie, *Making Color Sing*, 2011

Michael Wilcox, *The Wilcox Guide to the Best Watercolor Paints*, 2000

To learn more about Color Index Numbers, go to: www.artiscreation.com

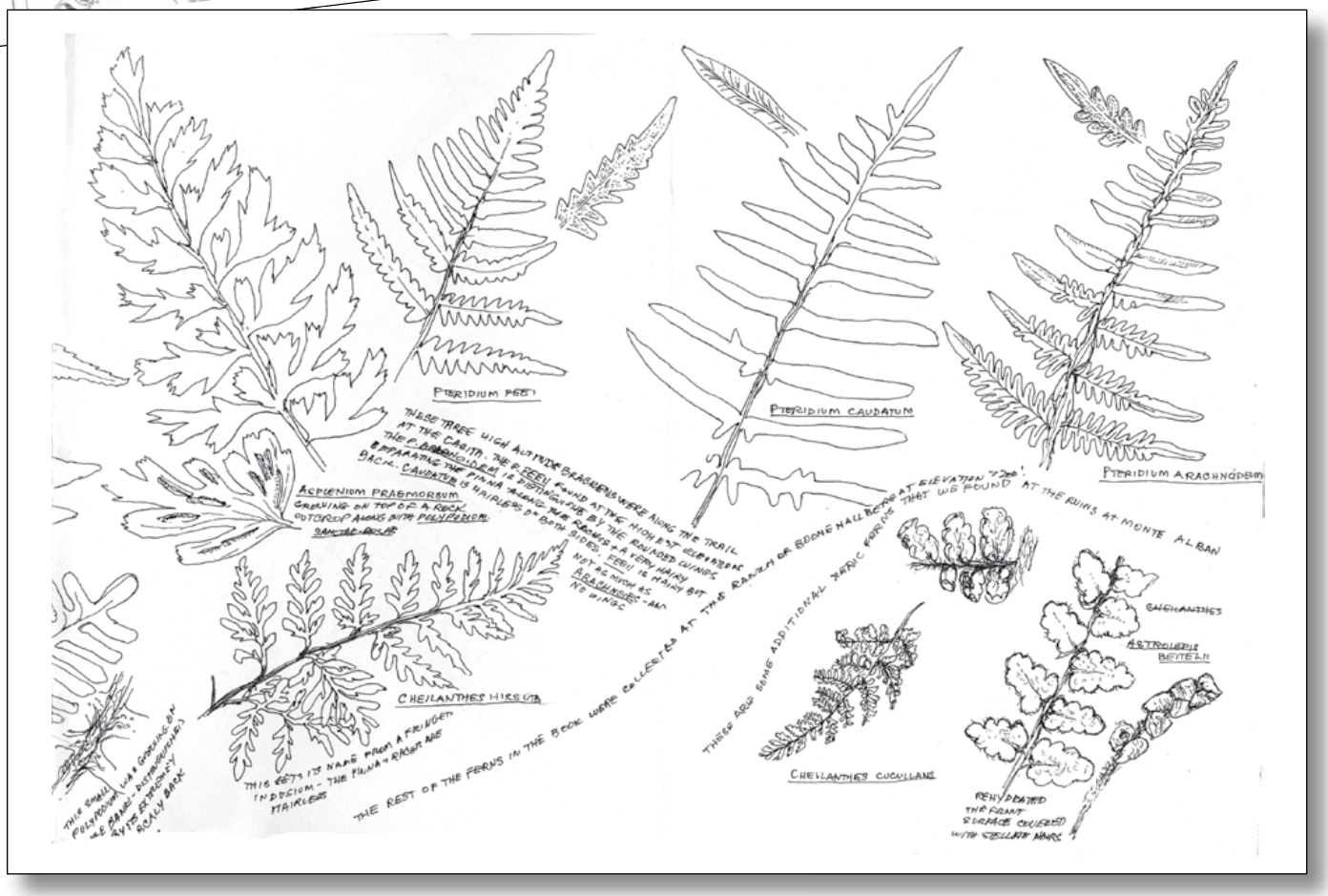
Pages From My Sketchbook



— *by Dick Rauh*

"These are sections of an accordion sketchbook that I drew on a Fern Foray with the New York Fern Society in Oaxaca, Mexico. The area is very rich in a variety of habitats for fern, from desert to rain forest and we would go out each day collecting and sketching. Most of these sketches were done back at the hotel; I tried to show the reproductive units whenever possible and had a running commentary describing locations and other details. They were done with a variety of Micron pens."

Art © Richard Rauh



Where it all began...

Welcome to Washington D.C. and Our 50th Anniversary Celebration Conference

July 15 – 21, 2018

GNSI's Greater Washington D.C. Chapter is thrilled to host the 50th Anniversary Celebration of the Guild of Natural Science Illustrators with our annual conference in the organization's birthplace. Situated in the coastal plain between the Appalachian Mountains' Piedmont formation and the Chesapeake Bay, Washington D.C., best known as the nation's capital, is also a dynamic city of history and art expressed in its monuments, architecture, and world class museums.

Our main conference venue this year is American University, distinguished for graduating quality political "wonks" and home of WAMU, the National Public Radio affiliate that produced the Diane Rehm Show and other nationally syndicated public radio programs.

The 50th Anniversary Special Exhibition will show our members' best selected works at the American Association for the Advancement of Science Gallery, with an opening evening reception on the first full day of the conference.

Later in the week, GNSI members will continue to observe its semicentennial by ***spending a day at the actual place we had our genesis in 1968, the Smithsonian National Museum of Natural History.*** This fun day will include plenary keynote talks, the techniques showcase, and behind-the-scenes tours of various museum departments.

Then, our ***awards banquet*** at American University's Law School, will feature a talk about GNSI's creative history.

In addition to a ***full schedule of speakers***, with an emphasis on state-of-the-art science communication and visualization, a host of ***hands-on workshops*** are offered to expand traditional art and digital skills. We will also be offering ***exciting field trips*** to local museums, gardens, and natural areas.

You won't want to miss this conference!

Registration begins April 6th at noon PDT on our 2018 Conference Website. A complete list of speakers, workshops, presenters' biographies, and field trip options will be detailed.

For more information and the latest updates on the 2018 Conference, visit our website at *2018.conf.gnsi.org*

Photo © Charles Chen

GNSI's 50th Anniversary Special Exhibition

If you are reading this before March 31st, 2018, there is still time to submit your work for what will be one of GNSI's most memorable members' exhibits.

The exhibition will be on display for 3 months in the beautiful gallery of the American Association for the Advancement of Science (AAAS), a well-regarded venue in downtown Washington, D.C..

The opening reception will be held on the evening of Monday, July 16th. It is being well publicized and the public and local scientific community is invited. Since this exhibit will have a more public face at this world center for science communication, the exhibition organizers have gone to great lengths to make this presentation more than a members' show, having additional sections on the history of scientific illustration, interactive displays, and videotaped testimonials by GNSI members.

This year there are 4 category options to submit work to: 1) Our Diverse World; 2) Seeing the Unseen; 3) Simplifying Complex Science; and 4) Innovation for Today and Tomorrow. We are accepting traditional, digital, 3-dimensional works, and video animation.

For more details on the exhibit rules and specifications, please see the 2018 Conference Website's link for the Call for Entries and Entry Form at: *2018.conf.gnsi.org/exhibit*

AAAS

Speakers

Highlights of our planned speakers and presentations... more to come!

Monday and Tuesday, July 16th and 17th, our first two days will have morning plenary and shorter afternoon concurrent talks held in Constitution Hall at American University, conveniently located in the same building as the residence hall where most of our participants will be staying. The third day, July 18th, will be our Day at the Museum at the Smithsonian Natural History Museum. Attendees will be bussed from American University in the morning for a group picture in the museum's rotunda beneath the giant African elephant specimen. The museum is where the primordial soup of like-minded natural science illustrators came together in the mid-1960s for the brown bag lunch meetings that spawned our organization.

A plenary session is being held in the museum's Baird Auditorium beginning with ***Kirk Johnson, the Director of the National Museum of Natural History,*** giving a welcome address to GNSI members.

Dr. Kirk Johnson oversees the museum, and is a paleontologist who has led expeditions in 19 states and 11 countries that resulted in the discovery of more than 1,400 fossil sites. He is known for his scientific articles, popular books, museum exhibitions, documentaries, presentations, and collaborations with artists to reconstruct ancient ecosystems.

SELECTED PLENARY AND CONCURRENT TALKS

Science of Story — Liz Neeley, Executive Director of The Story Collider

The field of science communication is striving to become more scientific; Liz will start at the interface of art and science, wrestle with tensions between theory and practice, and explore ideas about the power of narratives that manifest across storytelling formats and modes.

Science Visualization at National Geographic — Fernando Baptista, Senior Graphics Editor, National Geographic Magazine

Fernando will share his process, challenges, and successes in creating science visualization graphics. Fernando will talk about how he balances traditional and digital art techniques, and will be sharing his approach of innovating his art through stop-motion animation, paper modeling, and interactive online graphics. He will also give us insights as to how he creates award-winning graphics that combine science, journalism and art.

Visualizing Science Journalism in the YouTube Era — Nancy Shute, Editor in Chief at Science News

High-quality visuals can power people's engagement with science, and that's especially true in journalism, where science is all too often treated as a niche beat and editors don't always get the picture. Nancy will discuss how to make the case for visual storytelling and how to get it funded.

Scientific Illustration: A New Approach to Story-telling: Nature Mandalas — Tim Phelps, Professor and Medical Illustrator, Johns Hopkins University Department of Art and Applied Medicine

For the past 5 years, Tim has been exploring the significance of mandalas and mindfulness culminating in his current two-volume *Wonders*; a set of nature mandala coloring books followed. Using the graphic and symbolic patterns of "circular" mandalas his images cast an artistic eye on the real and imagined architecture of plants and animals.

Science Education Media for the Classroom and Broadcast — Fabian de Kok-Mercado, Howard Hughes Medical Institute, Chevy Chase, Maryland

Fabian de Kok-Mercado will present a series of recent projects produced by Howard Hughes Medical Institute's BioInteractive and Tangled Bank Studios. He will primarily focus on the animation production process but will also touch on methods for designing educational media that can be adapted for a range of audiences.

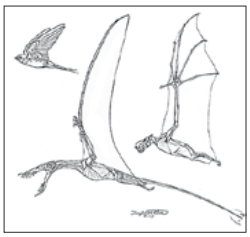
Erased Drawings: Reaching Audiences in Support of Conservation — Kim Heise is an emerging artist, activist and educator working in Florida on new approaches to public involvement in conservation through or inspired by the arts.

Erased Drawings is a collaboration first performed at the Box Gallery in West Palm Beach, consisting of 50 drawings of native Florida wildlife, which were erased during the performance by guests, leaving watercolor silhouettes. The intent: to illicit real experiences of loss for biodiversity and to create discussions and understandings about habitat loss and destruction.

Accessibility, Simplicity, and Humor: Creating Educational Work for a Young Audience
— Sara Lynn Cramb, Children's Book Illustrator

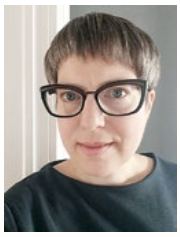
This presentation will be of special interest to those curious about illustrating for children's books, who want to know how to approach creating work for a young (sometimes very young) audience in a way that will appeal to them and expand their minds.

EDITOR'S NOTE: With apologies to the speakers and our readers, we repeat the following two plenary talks from the Conference Bulletin, as their text was inadvertently partially masked by the images.



Wings, Tails, and Real Flying Monsters: Illustrating Flying Vertebrates
— Terryl Whitlatch, Internationally respected creature designer for Lucasfilm Ltd., Pixar, Walt Disney, and various zoos and natural history museums and Dr. Michael Habib, Paleontologist at the University of Southern California, who explores the relationships between animal structure and motion.

How does one get a large flying carnivorous four-legged mammal out of one's imagination and into the air? Join paleontologist Dr. Michael Habib and animation creature designer Terryl Whitlatch as they apply the latest cutting edge discoveries in pterodactyl flight dynamics to get a hippogriff, and other monsters, off the ground.



Visualizing Science: Illustration and Beyond
— Jen Christiansen, Senior Graphic Editor, Scientific American

Where does illustrator end and infographer begin? How does data visualization fit in? And what does science have to say about the design decisions we make? With the goal of strengthening connections between communities, Jen hopes to get folks thinking about what they can learn from—and teach to—different visual sub-disciplines within the broader orb of science communication.

"...As always, it was a blast: lively, inspiring, and a creative kick in the pants. It's great to be with such a wonderful group of people who love what they do and are incredibly generous with their expertise and experience."
— Erica Beade, commenting on the Bar Harbor Conference, 2013

Behind-the-Scenes Tours at the Smithsonian's National Museum of Natural History

During Wednesday afternoon's Day at the Museum (July 18th), a series of behind-the-scenes tours will be offered and guided by curators and staff of various collections. The size of the groups is limited and most will have two tours for each department at different times. Each conference attendee may sign up for one tour only. Tours include:

- Department of Invertebrate Zoology Collection
- Department of Entomology Collection
- Department of Botany Collection
- Division of Birds Collection
- Division of Mammals Collection
- Division of Fish Collection
- Department of Mineralogy Collection
- Cullman Library Collection
- Scanning Electron Microscopy Lab
- Skin and Bones Exhibit App and Tour

For details of each tour, visit the conference website: 2018.conf.gnsi.org

FIELD TRIPS

United States Botanic Garden Tour *(Half day)*

The Bureau of Engraving and Printing *(Half day)*

NASA's Goddard Flight Space Center, Greenbelt, Maryland *(Full day)*

United States National Arboretum National Bonsai Penjing Museum
(Three-fourths day)

Giant Panda at the National Zoo; Photo © Smithsonian National Zoo

National Museum of Health and Medicine, Silver Spring, Maryland *(Three-fourths day)*

Smithsonian's National Zoo *(Three-fourths day)*

Exploring the Miocene Ocean Floor and Field Sketching at Scientists Cliffs, Chesapeake Bay *(Full day)*

Day Hike: Great Falls and the C&O Canal *(Full day)*

For more information and the latest updates on the 2018 Conference, visit our website: 2018.conf.gnsi.org

Workshops

Sculpting Beetles in Polymer and Wire — *Karen Johnson, Scientific Illustrator and Insect Jewelry Maker (Full day)*

Using the Eyed Click Beetle as our example, we'll learn how to translate 2D drawings into a realistic sculpture or wearable art.

Information Graphic Design in Adobe Illustrator — *Christie Newman, Illustration Editor for Annual Reviews, and Bricelyn Strauch, Certified Medical Illustrator and Animator (Full day)*

Learn the principles of graphic design and visual communication needed to make highly effective and stunning information graphics. Please have basic familiarity with Adobe Illustrator; extensive knowledge or experience is not required.

Decorated Letters — *Karen Ackoff, Artist and Educator (Full day)*

Explore how to create contemporary decorated letters using animal and plant imagery. We'll focus on basic design and composition, and how to create natural textures in order to represent fur, feathers, flowers, etc. using watercolor and/or gouache.

3D Principles with Cinema 4D — *Valerie Altounian, Senior Scientific Illustrator for the journal, Science (Half Day)*

Learn the fundamental principles behind working in 3D, regardless of which program you decide to use beyond this class.

Let's Learn Botany — *Mervi Hjelmroos-Koski, Manager of School of Botanical Art and Illustration at the Denver Botanic Gardens, (Half day)*

Take a closer look at plant anatomy and learn to recognize botanical details that will make your drawings more accurate and realistic.

Digital Watercolor: The Workshop — *Sarah Dahlinger, Owner of Sarah Dahlinger Art (Half day)*

Participants will learn about the unique properties of Photoshop's watercolor brushes, how to make a quick mask for a subject, and quickly render an image.

Horns, Hooves, and Hair: Modeling Ungulates in ZBrush — *Quinn Burrell, Artist at University of Chicago Medicine (Full day)*

Choose a hooved mammal to model in ZBrush and walk away with a full 3D model and portfolio-ready images. Follow along with exercise files or branch out with new skills; beginner to intermediate ZBrush users are welcome!

SPONSORSHIP

This year the conference team is making a big push to get businesses and organizations to contribute to funding certain aspects of our conference activities, specifically the special exhibit at AAAS. Take a look on the website *(2018.conf.gnsi.org/exhibit/sponsorship)* to see the sponsorship levels. If you know of any potential sponsors who might be interested in making a donation, please forward them the information, or contact our Sponsorship Coordinator, Rachel Cornell, at rcornell20878@gmail.com

PORTFOLIO SHARING

If you arrive by Sunday evening, be sure to bring your portfolio (digital or hard copy), or any work you wish to share, to the Katzen Art Center Rotunda, where an informal reception will give you a chance to meet new and old GNSI friends.

GNSI ANNUAL AUCTION

The auction this year is looking for your cast-off studio items, art books and supplies, journals, and original art, or anything else you think GNSI members would purchase to benefit our organization. The auction is an important part of GNSI fundraising, with proceeds split evenly between the GNSI General Fund and Education Fund. Your donations help to keep the organization afloat and support educational initiatives for natural science illustrators. Along with the silent auction, you can expect a spirited live auction with witty and disguised auctioneers soliciting your bids. Please bring donations to the registration desk at the conference, or mail items ahead of time whether you are planning to attend or not, to our local coordinator:

Leslie Becker
3 Vallingby Circle
Rockville, MD 20850-2762

DRUM CIRCLE

Photo © Britt Griswold

Thursday evening of the conference will bring back the Drum Circle, a popular event at our Asheville, NC conference. Relaxing and at the same time energizing, please come get in sync with your inner circadian self at the American University Amphitheater. You can get rhythm if you don't have it, or show your chops with multiple drum choices and other percussion instruments made available to help all get into a groove as only artist nerds can do. Refreshments provided.

For more information and the latest updates on the 2018 Conference, visit our website: 2018.conf.gnsi.org

A Closer Look: Cornelia Hesse-Honegger's 'Disturbed' Insects

— *Genevieve Hitchings*

If you have not encountered Cornelia Hesse-Honegger's 'disturbed' insects you are in for a treat. Her brilliant, graphic and anatomically correct watercolor paintings of true bugs (Heteroptera[1]) quietly call attention to disturbing deformities. At first glance these deformities are not particularly obvious but if you look at her beautiful creatures long enough, strange asymmetries in color or in body parts start to become noticeable.

Perhaps most well known for her meticulous paintings of mutated insects that dramatically explore the damaging aftermath of Chernobyl's nuclear meltdown, Hesse-Honegger has spent her long career bridging science and art in an effort to call attention to unacknowledged dangers of nuclear energy.

She began her career in the 1960s as a scientific illustrator at the Zoological Institute of the University of Zurich. Hesse-Honegger spent years drawing poisoned, mutated flies for zoologists who were researching the effects of the chemical EMS. To draw the flies accurately she studied them intensely. Their complexity and deformed faces intrigued her. During this time, her ability to see and to recognize abnormalities in these creatures became second nature.

In 1969 fascinated by the abstract patterns and powerful colors of true bugs she found next to her home at the edge of the forest, she felt compelled to paint them in her free time. True bugs continued to be the subject of her research. Depending on the species, they live on host plants. As they do not fly far stretches, it is possible to observe generation after generation. This proved valuable as it allowed her to study them over long periods of time.

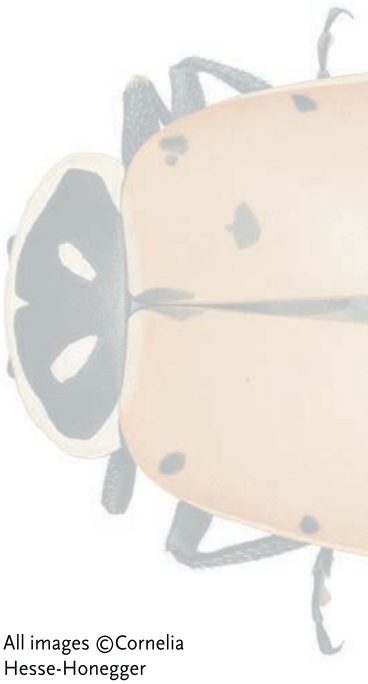
By the 1980s, the rich diversity of bugs she had been collecting seemed harder and harder to find. Worried that true bugs were disappearing, she mentioned her observation to the director of the Zoological Museum in Zurich. He dismissed her concerns, claiming such fluctuations in nature are normal and, also difficult to determine.

For some time, Hesse-Honegger had been feeling frustrated with the geneticists she worked for in the lab. Her confidence in their ability to understand and to document nature had started to wane. "People who do not draw and paint, perhaps they don't see anything. I think with scientists, they don't see the deformations we produce with mutations. They only know that there is a mutation of this or that gene, but they do not see the phenotype they produce or what they do to nature."

On several occasions, she had been asked to retouch photographs of flies. The biologists considered photography to be less subjective and more 'accurate' than painted illustrations. This seemed disingenuous to Hesse-Honegger. She found herself questioning their general competency. Natural scientists were fixated on genes; they were not observing what effects pollution was having on nature. "…[F]or a long time this was no topic at all." The lab seemed out of touch and uninterested with what was happening in nature.

Atomic energy was rapidly emerging in the 80s not only as a means for weapons of mass destruction but also as a viable alternative energy source. Since the early 20th century artificial radioactivity had been studied for military purposes, but mostly in secrecy.[2] In 1959 International Atomic Energy Agency (IAEA) was founded and made responsible for all data and research on health problems related to artificial radioactivity. Universities and governments relied on information provided by IAEA. The effect of this artificial radioactivity on nature was not a topic, and therefor not a concern.

In 1985, Hesse-Honegger came across mutated houseflies *(Musca domestica)* at the University of Zürich. She started to paint houseflies with legs growing out of antennae or part of wings out of eyes. The flies had been irradiated with X-rays and



All images ©Cornelia Hesse-Honegger

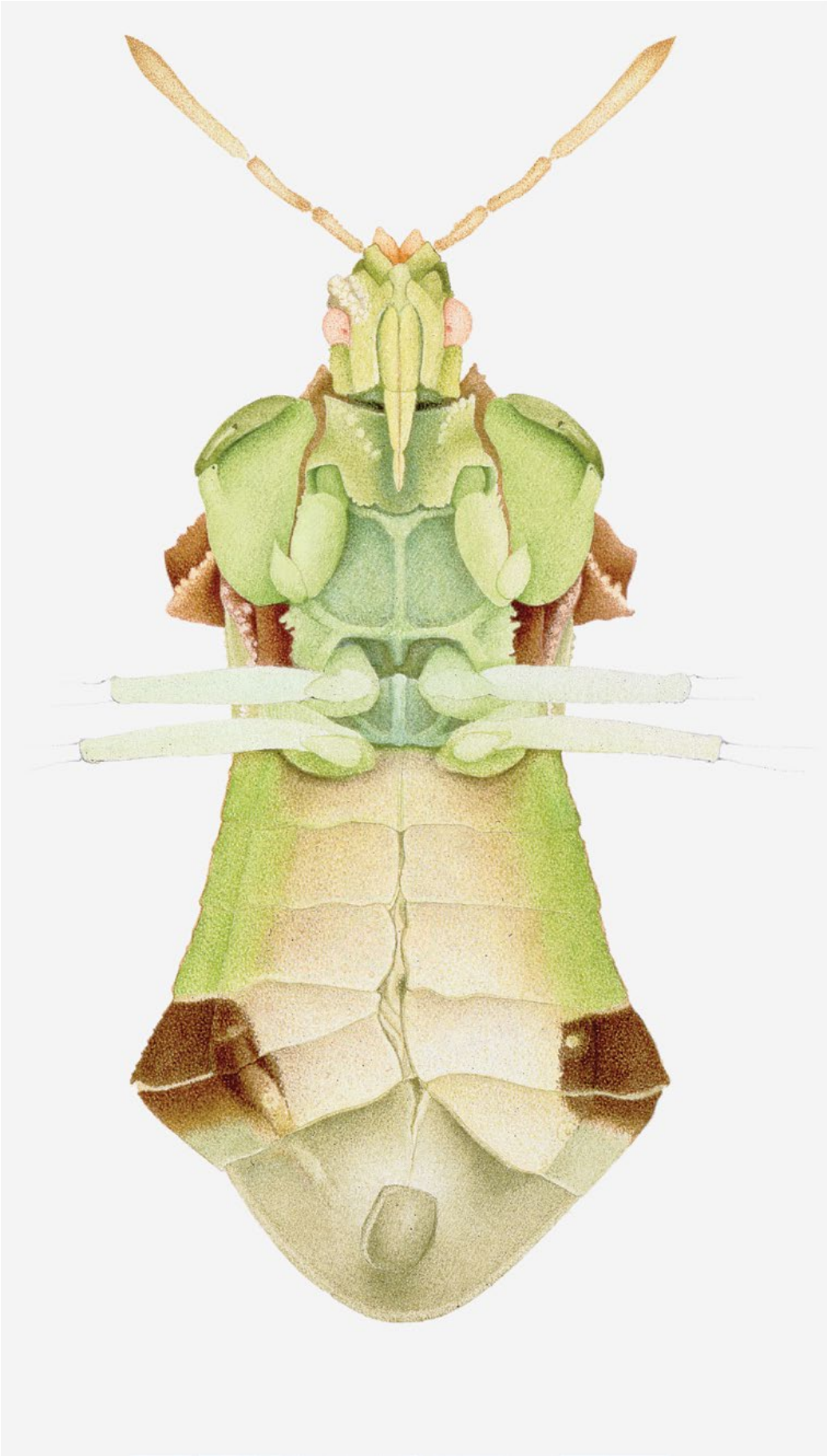
ABOUT THE AUTHOR:

M. Genevieve Hitchings is an Associate Professor in the Communication Design department at New York City College of Technology. As principal designer of ARTORIUM, a design studio in New York City, Genevieve is responsible for project management, art direction, design and illustration in the development of a wide range of multi-media projects. She also works as a contract artist for scientists at several research organizations.

www.artorium.com

1 The Hemiptera is an order of insects comprising some 35,000 species, including the suborders of aphids (Sternorrhyncha), leafhoppers, (Auchenorrhyncha) and true bugs (Heteroptera). One main characteristic is their modified piercing and sucking mouthparts.

2 Advisory Committee on Human Radiation Experiments. "Final Report." USA 1995



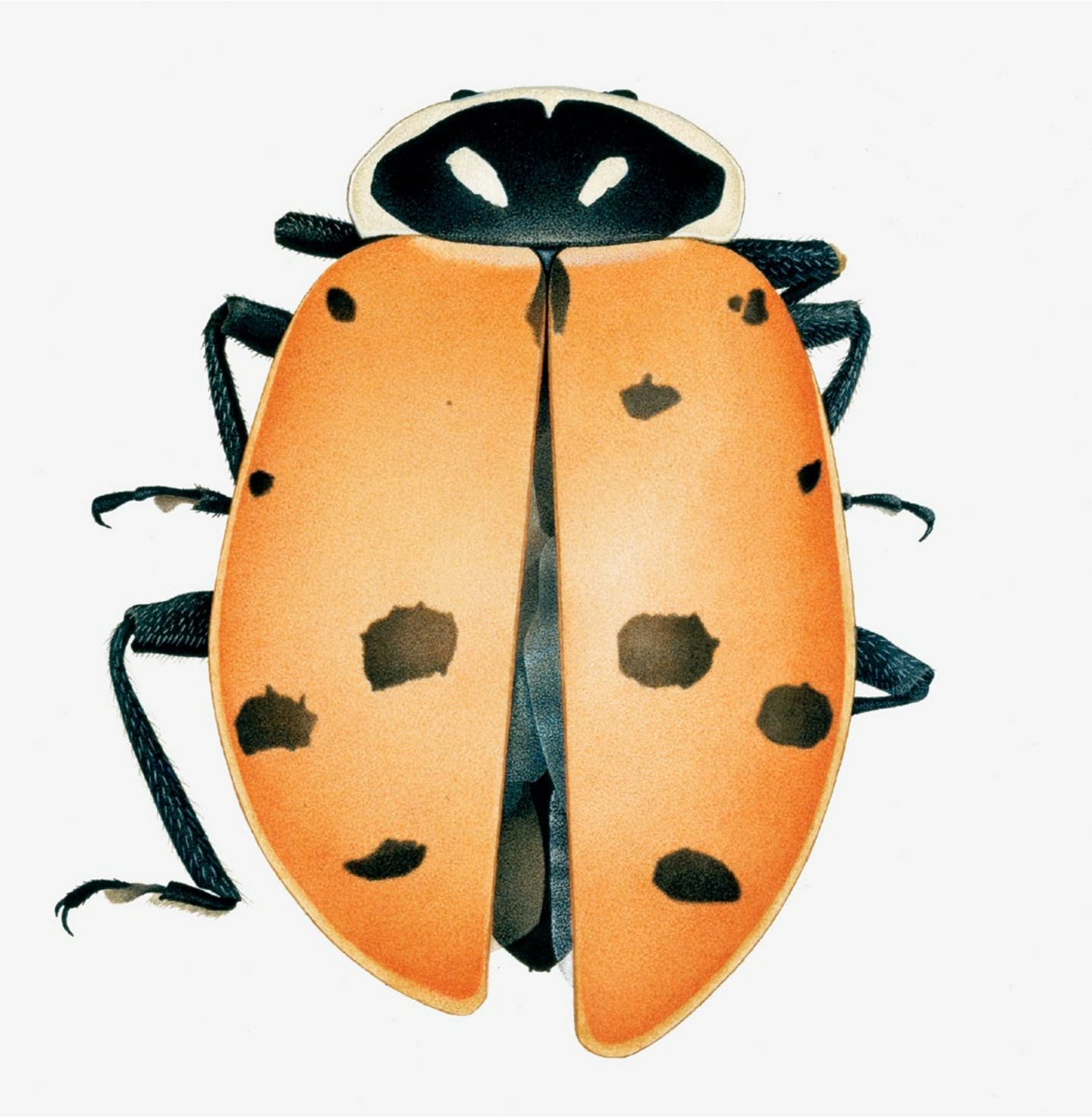
had by far the most appalling mutations she had ever witnessed. The ability to manipulate nature into such cruel and unnatural forms horrified her. "I thought scientists had made these prototypes to forewarn what a man-made nature might look like if we continue to pollute the world as we are doing."

Shortly thereafter, in April 1986, Chernobyl happened. Known as the Chernobyl accident, it was one of the most catastrophic explosions of a nuclear power plant in history (the other being the Fukushima Daiichi nuclear disaster in Japan in 2011). Located in a small town in northern Ukraine, the Chernobyl accident resulted in a steam explosion and fires that released nearly all the radioactive reactor core into the atmosphere. In the following days most of this radioactive material went on to precipitate across the western USSR and Europe, and eventually the rest of the world.

Government officials and scientists across Europe reassured the public that levels of radiation from the fallout of Chernobyl would be too low to affect the surrounding natural world. Hesse-Honegger was dumfounded by their response. How could they be sure? They were not out in the field, studying nature.

Dismayed by the deformities she had witnessed in fruit flies poisoned in the controlled environment of the lab, she worried about what kind of deformities she might now find in nature. She knew the controlled environment of the lab (with X-rays and external radiation) was completely different from the complexities of nature (with fallout of artificial radiation

Ambush Bug (Phymatidae) from near the nuclear power plant Peach Bottom Plant, Pennsylvania USA © 1992; watercolor. Ventral view; the right side of the abdomen is disturbed and asymmetrically distorted.



in a complex mixture and half-life). Scientists were fixated on implications for humans (men in particular), not on other life forms; no one was asking what impact artificial radiation might have on different biological communities. Hesse-Honegger feared the natural world was irreversibly being altered by the dramatic increase in nuclear energy and mankind was not taking note.

Disheartened by the scientific community's unresponsive and blasé reaction, she set out on her own to investigate the effects of the nuclear disaster. She packed her art supplies and headed to Sweden, the first country to register the fallout of the Chernobyl explosion. As she had suspected, she found abundant Heteroptera with severe disturbances — asymmetrical bodies, deformed wings, antennas, and legs. Upon her return to Switzerland she went straight to the zoologists she had worked with to show them her findings, but her efforts were met with rejection.

Lady Bird Beetle (Coccinellidae) from the Hanford area of Richland, Washington, USA © 1998. The left wing is shorter and there are dark patches on the right wing.

Steadfast, she pressed on. Switzerland had also suffered fallout from the explosion. Hesse-Honegger proceeded to investigate areas that had been hardest hit. Her findings were similar to what she had encountered in Sweden.

Concerned by the high levels of damaged bugs, she decided to collect three pairs of *Drosophila melanogaster* (fruit flies) found in these contaminated areas and breed them in her kitchen. In 1988, she published her findings in a Swiss magazine.[3] The public response to the article went viral. The magazine featured her paintings of mutated bugs both inside and on the cover. In the article, she was critical of the zoologists she spoke with, citing that they had all dismissed the possibility that any changes in hereditary material were a result of Chernobyl. Across Europe the article sparked a revived conversation about the yet unknown dangers of radiation contamination. In public, scientists remained notably silent in response to her article. In private, she was treated as an outcast and given a cold shoulder.

Invigorated by the uproar she had prompted, Hesse-Honegger felt reassured that her efforts were worthwhile. She never set out to be an artist. Her parents were well-known graphic designers and artists (Warja Lavater and Gottfried Honegger). She grew up surrounded by important artists. And while she had great respect and appreciation for their pursuits, she never intended to become one herself.

Having worked successfully for twenty-some years as a scientific illustrator, she suddenly found herself in this strange predicament of outlier. The science world condemned her paintings as having no scientific relevance: recreating existing forms visually is not the job of a scientist. And the art world rejected her work claiming, "merely imitating nature" is not considered art. And yet despite all the criticism Hesse-Honegger was confident in her pursuits. "As a science artist inventing a new profession, I had chosen to be true to factual observation, to be true to nature, and I didn't intend to deviate from this path."[4] Her work had become political and she had every intention to use her platform, her talent, and her knowledge to educate, enlighten, and inform people.

"Yes I felt insecure with all the criticism, but I had expanded my studies; I had more knowledge about how I could make a proper study; and I was well versed in how heavily disturbed the insects were from certain areas. My main supporter was nature itself. I saw what I saw. I knew what was there. Until Fukushima nobody had ever gone to that point and looked, collected insects, and cared. Nature gave me all the support (and evidence) that I needed."[5]

One of the biggest criticisms she received early on from scientists, was that she did not include a 'reference biotope.' This means that when collecting

Cicada, *Cicadella viridis,* from Shinobu Spa, near the City of Fukushima, Japan © 2017; watercolor. This animal is pale without its natural colors.

3 Cornelia Hesse-Honegger. "Wenn Fliegen und Wanzen anders aussehen als sie sollten." *Tages-Anzeiger Magazin* 1988

4 Cornelia Hesse-Honegger. "Heteroptera The Beautiful and the Other or Images of a Mutating World." Scalo Zürich, ISBN 3 – 908247 – 31 4

5 Atsuki Hiyama, Joji Otaki u.a. "The biological impacts of the Fukushima nuclear accident on the pale grass blue butterfly." *Scientific Reports* 2, 9. August 2012

Shin-Ichi Akimoto. "Morphological abnormalities in gall-forming aphids in a radiation- contaminated area near Fukushima Daiichi: selective impact of fallout." *Ecology and Evolution*, Vol. 4, Nr. 4, Februar 2014

Cornelia Hesse-Honegger and Peter Wallimann. "Malformation on True Bug (Heteroptera): a Phenotype Field Study on the Possible Influence of Artificial Low-Level Radioactivity, 'Chemistry & Biodiversity." *Verlag Helvetica Chimica ACTA*, in English and German (499 – 539)

Cornelia Hesse-Honegger. "Field Study on True Bug, Heteroptera and Cicada, Auchenorrhyncha in the Environs of the Nuclear Power Plant, Fukushima-Daiichi Prefecture Fukushima, Japan." October 2016, personal publication.

insects from a contaminated area, an accurate field study should contain a collection of insects from a non-contaminated area. Hesse-Honegger finds this problematic because she believes there are very few, if any, uncontaminated areas in the world. "One would have to investigate soil and plants for radionuclides, and this is difficult to do (and expensive)." Ever since the first nuclear bombs were tested in 1945 by the USA, the world has been exposed to 'low' doses of radiation, which scientists do not consider harmful. So, to make her studies credible she has since always included a reference biotype. Many of them turned out to be irradiated.

Hesse-Honegger proceeded to travel the world examining the morphological appearance of various types of true bugs affected by radiation. Having discovered such notable damage in bugs receiving very low doses of artificial radiation, in 1988 she began to study true bugs in areas close to nuclear power plants. In addition to noted disaster zones such as Chernobyl, Three Mile Island in Pennsylvania and Sellafield in Cumbria, she visited over 25 nuclear sites all around the world. She has collected over 18,000 insects. As it happens, Switzerland is a country heavily reliant on nuclear power and has been an ongoing source of her research. "With regards to the use of the nuclear power worldwide, you can do everything with impunity. There is no law that forbids harming people with man-made radioactivity and we do not take the health of future generations into consideration."

She has learned that true bugs, in proximity to nuclear power plants, have a very high chance of deformities if they are located directly in the path of where the wind blows. The deformities, even miniscule, seem to consistently affect the symmetry of these bugs. "I think that these doses of radioactivity are so small, we currently do not have the ability to measure all of them. But nature is a measuring apparatus. We have to go back and learn what nature is telling us. Nature told me again and again and again. This gave me the strength. I was also angry. We kill a lot of people like this and nobody cares."

Over the years, Hesse-Honegger has accumulated an impressive collection of accomplishments. She has been an unrelenting voice for a nuclear free world, and her efforts have not gone unnoticed. In 2015 she was the chosen Laureate for the Nuclear Free Future (NFF) Award. She has published six books about her paintings and her research. There is an extensive list of articles that have been written about her and she is frequently invited to speak about her work around the world. While initially being dismissed by the art world, her paintings have since accumulated an impressive collection of galleries and museums that have exhibited them.

Her original intention was to pressure scientists to take a more holistic approach to their research by observing the real world. "We are confronted with a science that is immensely detached from nature." A recent article published in the New York Times cites "[t]here is alarming new evidence that insect populations worldwide are in rapid decline…More research is also needed to better understand why, where and what insects are disappearing and how they can be saved."[6]

Hesse-Honegger is currently looking for a 'home' to house the valuable collection of true bugs and plants (Herbarium) she has compiled over the past 30 years. The ultimate irony may just be that future scientists will have a very different take on her work. Thanks to her perseverance in following her intuition, she has not only produced stunning paintings but through her meticulous field studies she has assembled a uniquely comprehensive and focused collection of historical evidence. She is also in the process of writing a paper in collaboration with a statistician. Together they are able to prove that even the lowest amounts of man-made radioactivity from normal working nuclear power plants cause deformations. They hope to publish the paper in spring or early summer.

6 The Editorial Board. "Insect Armageddon." *The New York Times,* 29 Oct. 2017: A18. Print.

Harlequin Bug, *Murgantia histronica* (Pentatomadae), from near Three Mile Island, Governor's Stable. ©1991; color sketch. Collected near the nuclear power plant; the shield is bent and the yellow form is asymmetrical.

Cornelia Hesse-Honegger's Creative Process

Hesse-Honegger believes that people learn to see when they draw and paint. Here are a few details she has shared relating to her own creative process:

"I don't have a studio. I was a single mother of two sons, and would work from home. I do not need much: a table, a chair and a window, a painting box and brushes.

I only work in watercolor. I prefer Lukas watercolors. And I prefer brushes that are the numbers 2, they are retouch brushes, to retouch photos. Their hair is shorter than in normal watercolor brushes.

When I sketch, I like to sketch quickly, without measuring with the scale mounted in one ocular of my microscope. For instance, when I sketch a true bug larva, its color and form changes very quickly within half an hour or so. Sometimes I sketch without pencil but with very thin watercolor. As I continue I become more secure and can mix the watercolor in stronger shades.

I have two cold lights and a binocular microscope. I can enlarge the insects with my binocular microscope up to 80 times.

When I start a painting, I first outline what I see through the microscope. In my right ocular I have a scale of centimeters and I measure every, every little detail with a ruler. I measure everything. The drawing is like an architectural drawing with centimeters and lines. It's a very accurate drawing and it sometimes takes me days to do it. I calculate all the little distances from one point to the next. And then I draw it to scale, sometimes 20 times, sometimes 60 times, sometimes even 100 times larger.

From this drawing I make a line drawing on tracing paper. And from this tracing paper I copy it onto the watercolor paper with graphite paper. Then I start to paint. I paint it in very, very thin layers, and it takes me a lot of time. Sometimes it can take months.

For paintings that are on colored paper, I work from dark to light. I start with the darkest color and then I work to the lighter color. I work layer upon layer. I very rarely start over. What I feel is that I am never happy with the results.

I feel that I can never really grab what is in front of me, but at one point I have to tell myself, ok I have to leave it like this. Later often I see that the image is right, and at the end the image stays.

One thing that makes a difference in my work is that I do not use light and shadow. I use what is called the 'color perspective.' I use the colors in such a way that they create space.

For example if I had a disturbance of the color on one of the wings, let's say on the left wing and it would be darker than the right wing and I had the light source from the left. This would mean that both sides would end up having the same coloring and shade even though the right side has the shadow and the left side the light. I use what is called the 'local colors.' I paint the way the colors are with lightness and darkness, I make space like in modern 'no object' or nonfigurative art. This adds a timeless quality to the images.

When I am on the go on research trips, I have my painting materials with me. I have a microscope that I can take along. I also need insect needles, labels, freezing boxes, Styrofoam. This way I can keep the insects well protected when I am traveling. I have a little laboratory for on the go. Sometimes I draw in the hotel room where I am staying, or sometimes I take them back home and draw them there. I always keep the insects I collect.

Drawing is very important. One should not draw from photographs. One should draw from the real insect. When you have it below your magnifying glass you can turn it around. Photographs give you a very false security. Sometimes I see tiny, tiny details, like abnormalities in the abdomen through the transparent part of a wing. Because the animals are three-dimensional, not flat, I need to view them at several different levels and angles.

I think it is very important that scientific illustrators make drawings, not the scientists themselves. There would be less mistakes in visualization, and also less lying. I think it is important that we illustrators teach young people to really draw and illustrate well."

Member Spotlight: Dino Pulerà

All art © Dino Pulerà

NOTE: Images with labels have been modified by the editors for better visibility in this publication.

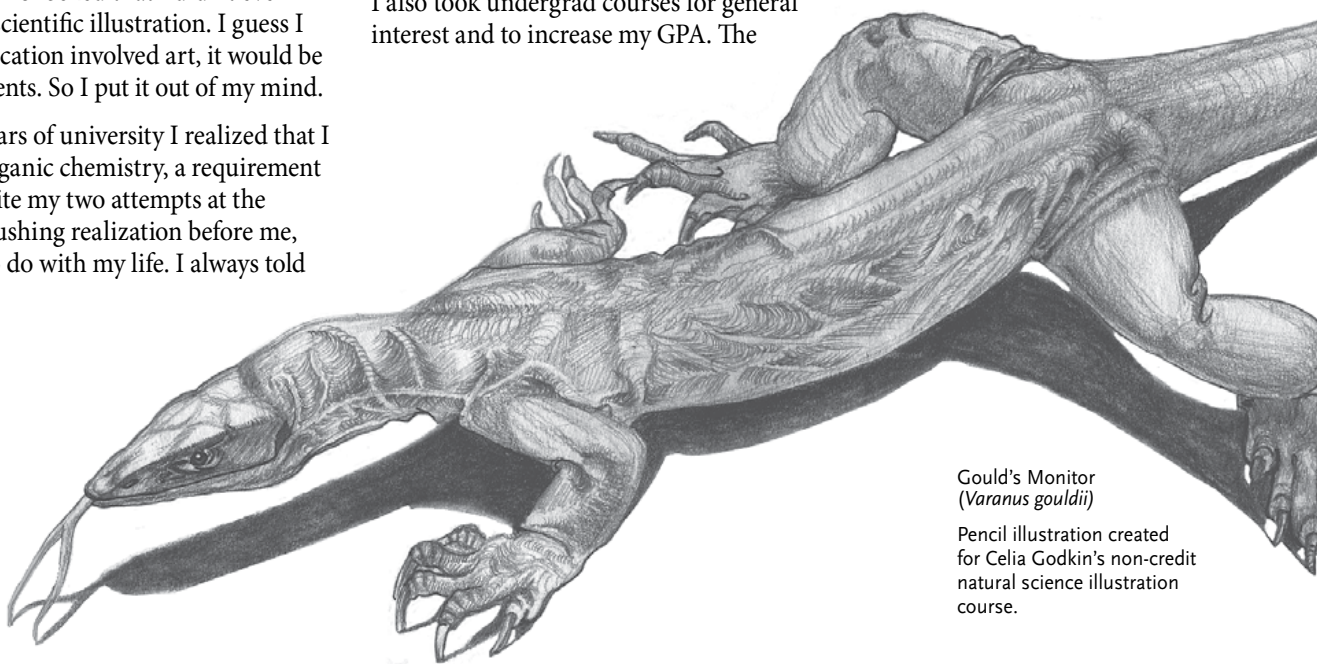
I've always been inquisitive and fascinated by nature. I would spend many hours drawing as a child but, despite my interest in nature, I never thought to draw it. Instead I spent my time reading and drawing Marvel Comics super heroes. Being the son of immigrant parents, I was encouraged to pursue a career that was stable and with a steady income; they didn't want their son to become a struggling artist. So I set my sights on science with the hopes of going to medical school.

In my senior year in high school my biology teacher noticed that I used drawings to record my observations in labs and mentioned that some people made a living from illustrating scientific concepts. Looking back now I'm shocked that I didn't even consider a career in scientific illustration. I guess I thought since this vocation involved art, it would be a hard sell to my parents. So I put it out of my mind.

After my first two years of university I realized that I didn't understand organic chemistry, a requirement for med school, despite my two attempts at the subject. With this crushing realization before me, I had no idea what to do with my life. I always told myself, if worse comes to worse, I can always teach — but that would be a very last resort.

Throughout my undergrad time at the University of Toronto I noticed little posters in the medical sciences building about an open house for the Department of Art as Applied to Medicine, now called Biomedical Communications (BMC). These little posters always had amazing illustrations which captivated me. For fun I went to a couple of these open houses: I was blown away with what I saw. I couldn't believe the caliber of work depicted in a variety of media and such diverse topics ranging from food webs to human surgery to drug interactions to gross anatomy. I was quite envious of these students and wished I had their talent. But even then, I still never considered a career in scientific illustration because I only drew for fun, which wasn't much anymore because I never could seem to find the time or a reason.

When I completed my undergraduate degree in zoology I still had no idea of what I wanted to do. I decided I would take some time off and figure out some options. I decided to prepare for a career in teaching. For the next two years I volunteered my time at an elementary school to gain experience. I also took undergrad courses for general interest and to increase my GPA. The

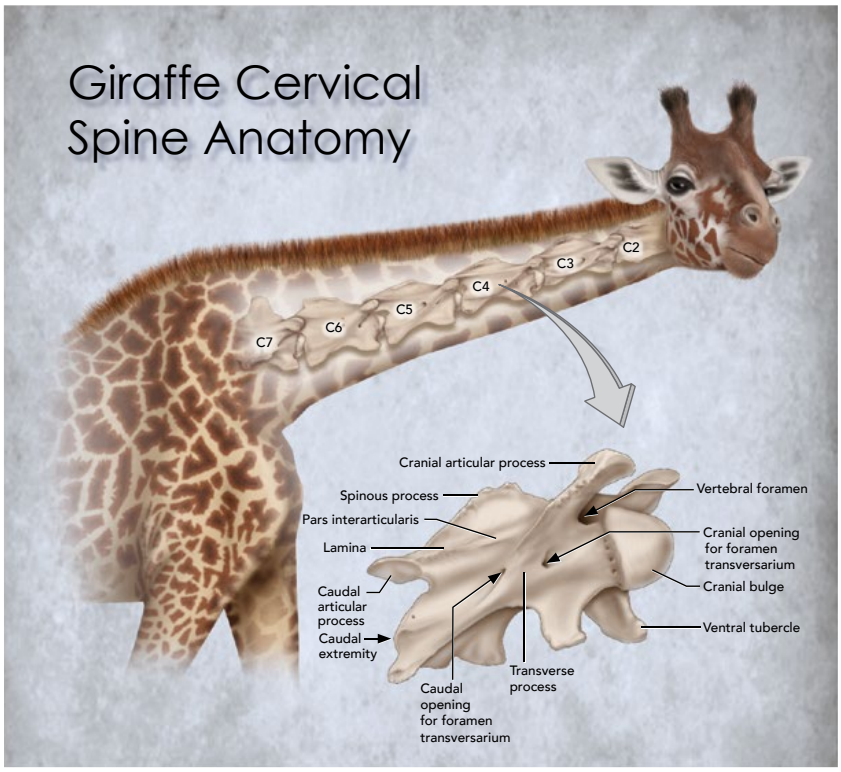


Gould's Monitor
(*Varanus gouldii*)

Pencil illustration created for Celia Godkin's non-credit natural science illustration course.

courses I took included in vertebrate paleontology, comparative vertebrate anatomy (CVA) and intro to paleontology, because I was also entertaining the idea of possible graduate studies in paleontology. I volunteered and later worked for the Royal Ontario Museum (ROM) in the vertebrate paleontology lab preparing and repairing fossils, moulding and casting, and also helping to mount a *Triceratops* skeleton. During this time, I thought it would be fun to draw again and coincidently discovered some non-credit scientific illustration courses. These courses were taught by GNSI member Celia Godkin, an instructor at the BMC program. I absolutely loved these courses! After completing the third and final course, I asked Celia if she taught any more courses. She disappointingly told me that she didn't, but encouraged me to apply to the BMC program. I was utterly shocked by her suggestion: I tried to explain that I had no formal art training and quite frankly didn't think I was qualified. She disagreed and encouraged me to apply and also offered to write a letter of reference. I couldn't contain my excitement and hope. At this time I had already applied to teacher's college. Now I was in a mad scramble to put together a portfolio, which I had never done before, and complete my application to meet the fast-approaching deadline. I barely passed my pre-interview, but was granted permission to formally apply to the BMC program.

Adjudication was a nerve-racking experience. A table was assigned to each candidate to display their work.



Giraffe cervical spinal anatomy, Photoshop®.

Then about a half dozen faculty members, including the late Steve Gilbert*, conducted the interviews and portfolio reviews. I felt completely out of my league and somewhat embarrassed about my work. When adjudication was over, I remember walking towards the subway and thinking to myself, "I guess being a teacher won't be so bad and I'll have summers off too" because I had just received admittance into the faculty of education the week before. Shortly after I arrived home I received a call from the BMC director congratulating me on my admittance into the program. I couldn't believe my ears! I was overjoyed with this news. I contacted the faculty of education to decline my acceptance. I was told they would defer my acceptance for a year; I thought that was ideal because if I didn't like scientific illustration, at least I had a secure backup. I have never looked back.

I'm so glad I entered the BMC program when I did because, upon entering, I received extensive training in traditional media (e.g. carbon dust, pen and ink, water color, scratch board, continuous tone, stipple, photography and coloured pencil) and cutting-edge digital media (e.g. 3D modeling and animation, web design, interactive media and post-production techniques for video and animation, raster and vector art and desktop publishing). When I entered the BMC program, it granted a 3-year bachelor of science degree. The program transitioned after my second year and I formally entered the graduate BMC program in my third year.

During my time at BMC, I felt privileged to participate in human dissections, watch surgeries inside the OR, attend an autopsy, watch the birth of triplets and learn many other aspects about the human body. But I quickly realized my true passion was with non-human natural science illustration. This was solidified when I was first introduced to the *The Guild Handbook of Scientific Illustration* and knew I had to have this book. As a student with limited funds, over the next few years I managed to scrimp and save until I had enough money to buy my own copy. It is still one of my most treasured books.

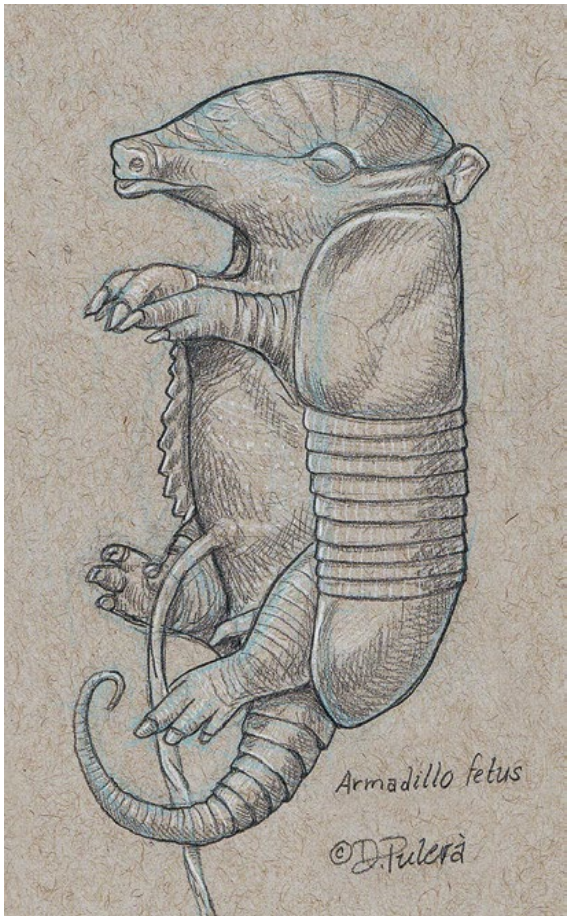
In my first year in the BMC program we had a self-directed independent project of our choice. I chose to illustrate and compare the skulls of three similar Tyrannosaur species. Unlike most dinophiles, I didn't get bitten by the dinosaur bug until my early twenties. While working at the ROM on my Tyrannosaur skulls I met a graduate student by the name of Thomas Carr. We immediately hit it off because he was looking for an illustrator to depict his Tyrannosaur research and I was interested in producing paleo art. Thomas is now one of the world's leading experts on Tyrannosaurs, and we have been working together ever since that fortunate day. We originally produced traditional

carbon dust illustrations and are currently using digital media. Thomas recently described a new species of Tyrannosaur, *Daspletosaurus horneri* in which I created a life restoration *(Journal of Natural Science Illustration*. 2017. 49(2):3-6) and later this year he also will be publishing a field guide about the fossils of the Hell Creek Formation of Montana where I created a couple dozen illustrations of reconstructed organisms.

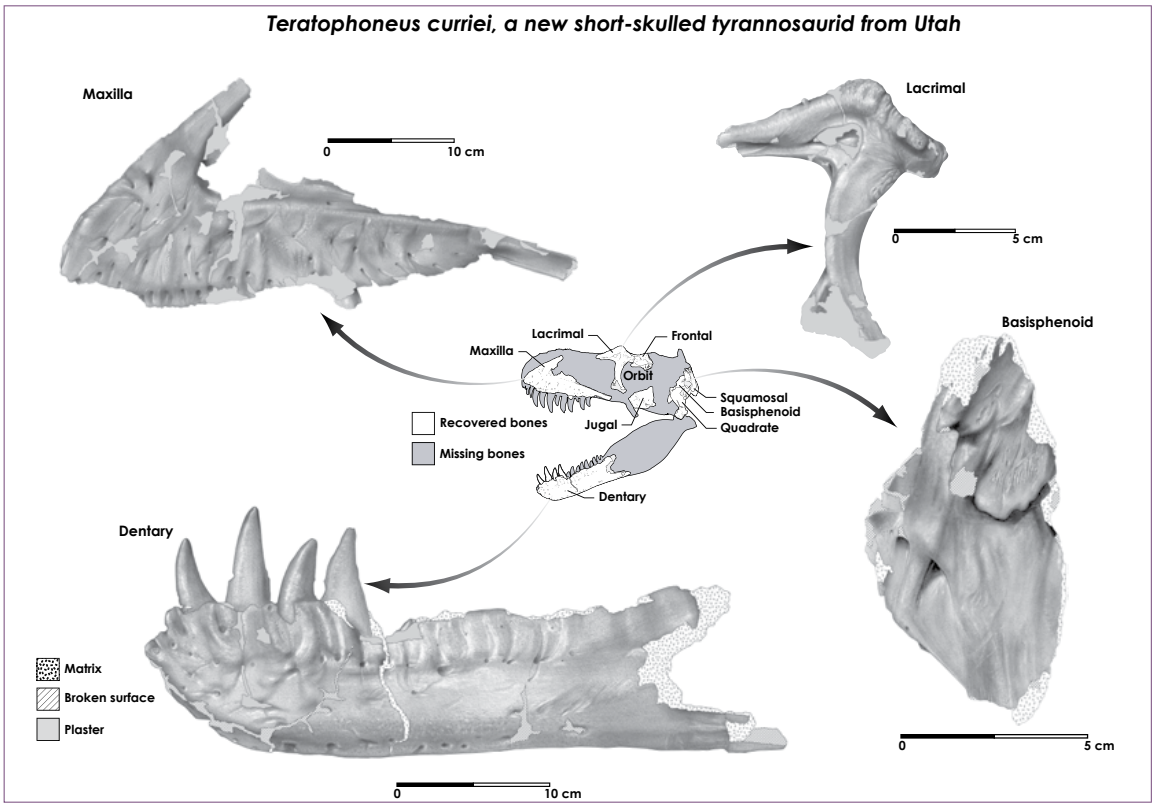
After undergrad and before starting BMC, I enrolled in a CVA (comparative vertebrate anatomy) course. That's when I met Gerardo "Gerry" De Iuliis, who, at the time, was one of the lab teaching assistants. We became instant friends because we had many things in common. For instance, we are first generation Canadians of Italian immigrant parents, we both loved hockey (not surprising from a couple of Canadians, eh!) and we both had a deep interest in paleontology and animal anatomy. During our CVA labs, Gerry noticed that I liked to sketch my dissections. He asked if I'd be interested in volunteering some of my time in illustrating fossils of giant ground sloths for his PhD research.

I gladly accepted the challenge. Several years later while working in his office on some fossil sloth illustrations, Gerry lamented that he was frustrated with the available CVA books on the market. These books all tried to be a textbook and lab manual at the same time and this was confusing students as to what they were responsible for in the lab. So he nonchalantly asked me if I'd be interested in teaming up with him to create a new CVA manual. I jumped at the opportunity because it was a professional dream and goal to illustrate a book and earn co-authorship just like my mentor Steve Gilbert*.

Shortly thereafter, Gerry wrote a proposal and I created some sample illustrations and we started sending our proposal package to various publishers. After more than a year of pitching our book idea, we found an interested publisher and they gave us 18 months to complete the book. We naively thought we could meet this deadline. But after six long and arduous years and two publishers later, we finally completed the book which

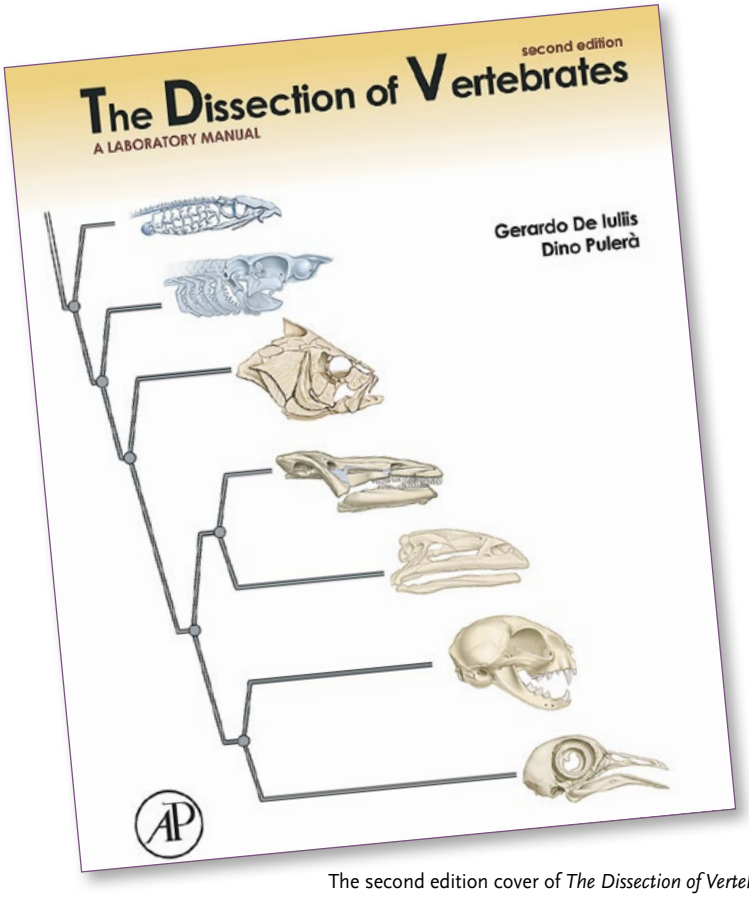


Armadillo fetus study: graphite pencil on toned paper with coloured white pencil highlights.



Traditional carbon dust illustration created on illustration board and conté pencils commissioned by Thomas Carr.

Carr, T.D., T. E. Williamson, B. B. Britt and K. Stadtman, 2011, *Evidence for high taxonomic and morphologic tyrannosauroid diversity in the Late Cretaceous (Late Campanian) of the American Southwest and a new short-skulled tyrannosaurid from the Kaiparowits formation of Utah*. Naturwissenschaften: 98:241–246.



The second edition cover of *The Dissection of Vertebrates: A Laboratory Manual*. 2011 De Iuliis, G and Pulerà, D. *The Dissection of Vertebrates: A Laboratory Manual, Second Edition*. Amsterdam: Elsevier / Academic Press.

was published in 2007. Our book celebrated its tenth anniversary last summer. Since its publication it has received modest success and won several awards, to warrant the publisher's request for new editions. We are currently working on the third edition with the hopes of a late 2018 or early 2019 publication date.

Upon graduating from BMC, I was very fortunate to have been hired by a studio that created textbook illustrations and animations. During this time I contributed to over 70 titles on topics as diverse as genetics, chemistry, geology, human anatomy, physiology and herpetology. It was a great place for a newbie to learn and grow. I learned to use many types of software from vector to raster to 3D modeling to 2D and 3D animation to desktop publishing. But after seven years I felt that I became stagnant and was getting bored and felt it was time to move on. Once again I was fortunate to have joined another excellent studio specializing in medical legal visuals. I was hired for an art director position but before I could assume that role I had to learn the ins and outs about the studio and the medical legal illustration field. I spent the next two years illustrating and rendering trauma, surgery, pathology and other medical concepts. I currently hold a full-time position at Artery Studios as the associate art director. My freelance work predominately deals with natural science illustration, with a specialization in depicting animal anatomy and vertebrate paleontology.

*The late and great Steve Gilbert was very influential in my career. You can read more about that in an article I wrote in the 2006 *Journal of Natural Science Illustration* 38(8):17-22.

If you're interested in knowing more about my career path, here are some online interviews:

www.sciencemag.org/careers/2005/04/sketching-out-career-science-illustration

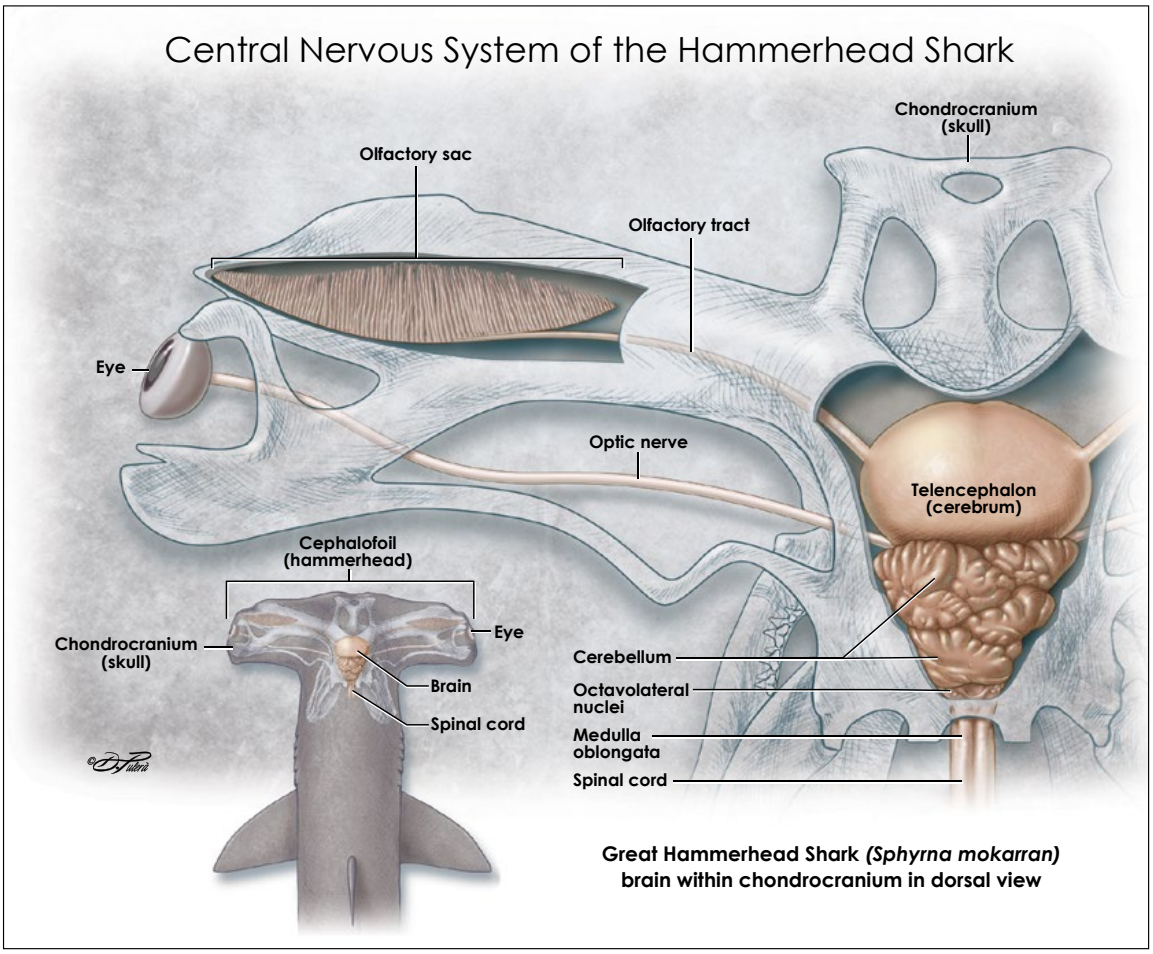
explorecuriocity.org/Explore/ArticleId/69

sonsi.ca/2010/07/20/sonsi-interview-dino-pulera/

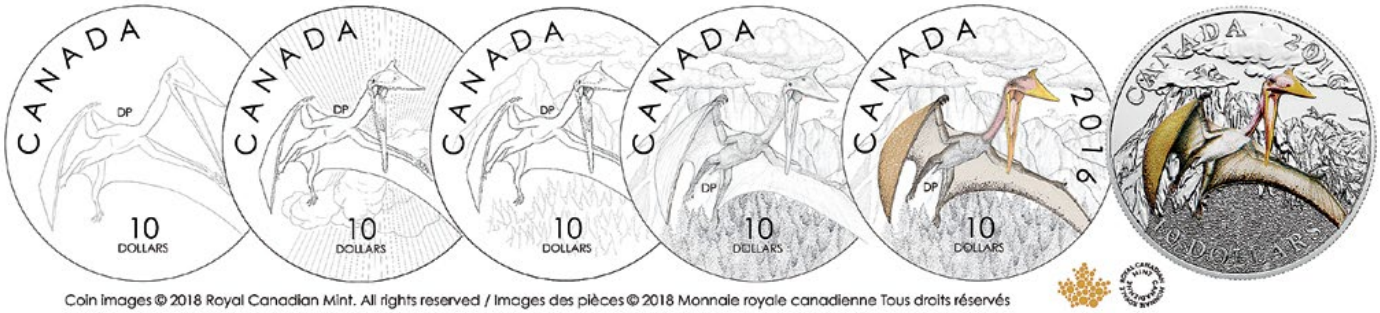
Traditional carbon dust illustration of *Albertosaurus libratus* colourized in Photoshop; created for Thomas Carr and published in Carr, T. D. 1999. *Craniofacial ontogeny in the Tyrannosauridae (COELUROSAURIA, DINOSAURIA)*. Journal of Vertebrate Paleontology 19 (3):497-520.

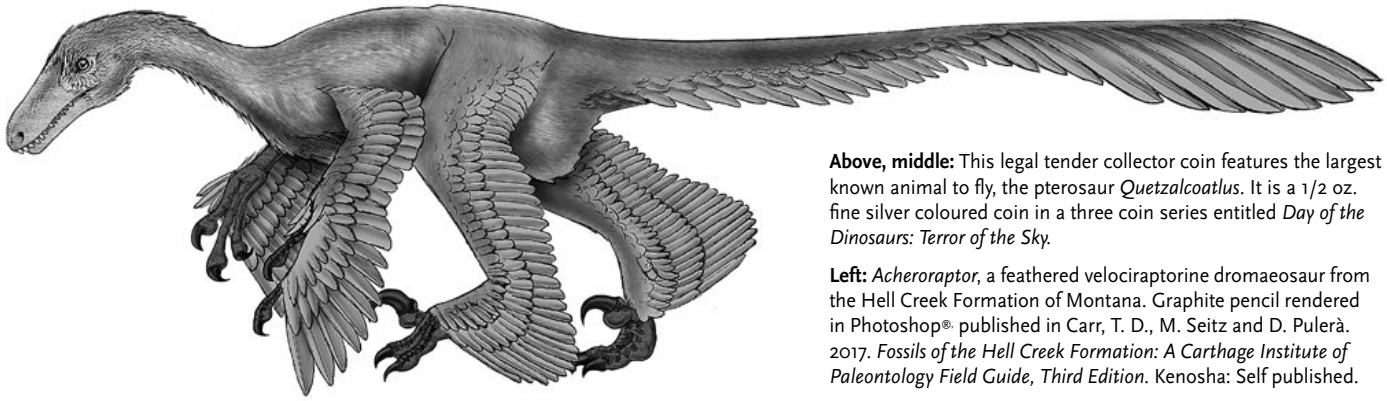
American crow
Corvus brachyrhynchos

Pencil illustration created for Celia Godkin's non-credit natural science illustration course.



Left: Central nervous system of the Great Hammerhead Shark *(Sphyrna mokorran)* created as a personal research project.





Above, middle: This legal tender collector coin features the largest known animal to fly, the pterosaur *Quetzalcoatlus*. It is a 1/2 oz. fine silver coloured coin in a three coin series entitled *Day of the Dinosaurs: Terror of the Sky.*

Left: *Acheroraptor*, a feathered velociraptorine dromaeosaur from the Hell Creek Formation of Montana. Graphite pencil rendered in Photoshop®, published in Carr, T. D., M. Seitz and D. Pulerà. 2017. *Fossils of the Hell Creek Formation: A Carthage Institute of Paleontology Field Guide, Third Edition.* Kenosha: Self published.

Chapter Happenings: A LOOK AT GNSI CHAPTER ACTIVITY PART I

Our local Chapters are the heart of the GNSI!

While many members are unable to attend our annual conferences, their membership in local chapters gives them similar opportunities to connect with other science artists, exhibit their work, explore new techniques and discover valuable assets right in their own locales.

Here is a taste of what a few of our dynamic Chapters and Groups have been doing (we'll have more from other Chapters in future issues):

FINGER LAKES

GNSI Finger Lakes serves members from the Finger Lakes area of Upstate NY, as well as northern Pennsylvania. We have member shows, workshops with the Cornell Botanic Gardens and local artists, art supply swaps and other fun meeting events. Our current show, Elusives: The Natural World We Seldom See, at the Cumming Nature Center in Naples, NY, is open until May 13 and then other venues TBA.

Finger Lakes Chapter members try out Qor watercolors after a field trip and factory tour to Golden Artist Colors in New Berlin, NY, in October 2017.

www.rmsc.org/cumming-nature-center/exhibits/item/512-elusives-the-natural-world-we-seldom-see

Finger Lakes contacts:
gnsi.fingerlakes@gmail.com
gnsifingerlakes.wixsite.com/gnsi-fingerlakes

NEW ENGLAND

Under the direction of a new chapter president, the New England Chapter is reenergizing itself with plans for field trips, workshops, and a themed exhibit on migration set to open in November. This exhibit will be open to New England based GNSI members, and more information will be provided in the coming months including a call for exhibitors, group critique sessions, and even informational talks on migratory species for those who can't decide what species they want to focus on.

New England Contacts:
gnsi-ne.org

www.facebook.com/GNSI.NE/

NORTHWEST CHAPTER

GNSI-Northwest Chapter is nearing its 40th year of existence. Based in Seattle, Washington, most of our members reside in the greater Puget Sound area. Our meetings and events are currently not on a regular schedule but are posted to our sites and blasted to our members via MailChimp.

Submissions have just opened for our upcoming juried exhibition, *Natural Musings,* at the Washington State Convention Center in Seattle, Washington. The exhibition will be on view from

Would you like to join a chapter or start a new one?

The GNSI currently recognizes 11 Chapters and 3 Groups:

- California
- Carolinas
- Finger Lakes
- Great Lakes
- Great Plains
- Greater New York
- Greater Washington DC
- Illinois Prairie
- Maine Group
- New England
- Northwest
- Oregon Group
- Portugal
- Texas Group

You do not have to be a GNSI member to join a Group or Chapter, but of course we encourage you to join us. If you wish to attend a Chapter/Group meeting or event, contact an officer or member for specific dates, times and locations. Links to Chapter/Group contacts are available on the GNSI website: *gnsi.org/groups*

For information on Groups and chapters and how to set up or join, contact GNSI Membership Secretary Daisy Chung.

June 30 – September 27, 2018. Our chapter has been involved in a lot of outreach the last few years, from manning drawing tables for aspiring young illustrators at the Burke Museum of Natural History of the University of Washington during their "Family Days", talking with high schoolers at Ocean Career Day at the Seattle Aquarium, and providing instruction and demonstrations at local schools and organizations. We are regularly contacted to assist with science illustration projects at local schools and several of our members have been able to fit these into their busy schedules.

TEXAS GROUP

The GNSI Texas Group meets once a month for a sketch session at a different location in the greater Dallas/Fort Worth area; past field trips have included the Perot Museum of Nature and Science, the Dallas Zoo, and the Fort Worth Botanic Garden, as well as making protest signs for the 2017 March for Science. This year, we are also planning sketch trips to locations in Austin (the Lady Bird Johnson Wildflower Center) and Houston (the Houston Museum of Natural Science), and we hope that Guild members from throughout Texas will join us!

Texas Contacts:

Email: gnsitexas@gmail.com

www.facebook.com/GNSITexas

GREATER WASHINGTON DC CHAPTER

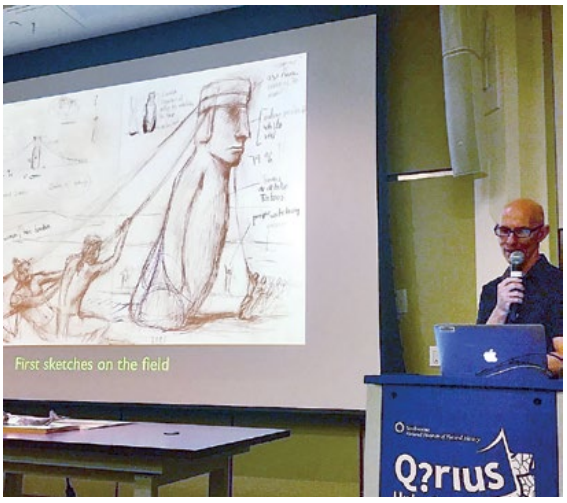
The GNSI's founding Chapter is always busy, this year even more so as they prepare to welcome us all to the nation's capital city for the GNSI's Annual Conference and 50th Anniversary Celebration.

The D.C. Chapter meets monthly at the Smithsonian. They are fortunate to have a wealth of resources from which to draw speakers and presenters, both from the many GNSI members in the chapter and from the larger science community concentrated in the area. Chapter activities also include workshops and portfolio sharing events.

Leftt: GNSI Northwest Chapter's Burke Museum Bug Blast event

Left: Linda Feltner introduces the D.C. Chapter to Diablo during her workshop "The Nature of Drawing Birds" last April.

Below, left: Fernando Baptista, National Geographic Artist, gave a presentation in October on Science Visualization at National Geographic.



We will feature more GNSI Chapter and Group activities in upcoming Journal issues... Stay Tuned!!

GUILD OF
NATURAL
SCIENCE
ILLUSTRATORS

P.O. Box 42410
Washington, DC
20015

SAVE THE DATE!

2018.conf.gnsi.org

Logo: Trudy Nicholson/Design: John Norton • Graphic Design: Amanda Zimmerman

Katzen Arts Center, American University Photo: Shannon Russell

2018 GNSI Annual Conference

July 15 - 21, 2018
American University, Washington, DC

Invertebrate Zoology, Smithsonian National Museum of Natural History Photo: Taina Litwak