MUTUALISM

By

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Chapter 1: Introduction

Through my artworks, I seek to express a mutualistic relationship between science and art. My photographic work is guided through science. Nature is the basis from which my creativity flows; scientific technology is the mechanism by which my art is shaped.

When I observe aesthetic structures of the natural world, I see a parallel between how they are constructed and how art is organized. To further investigate this relationship, I needed to find a way to look closer. I was able to do this using methods implemented by scientists in their study of specimen formation. Wishing to share these fascinating findings with others, I needed to devise a way to let them look closer. My venture would be to create work that would enable my audience to view the inherent beauty of science in a different way.

Using scanning electron and stereo microscopes, I tightly image organic specimens. Digitally manipulating and enhancing my subjects' space and color with vibrant hues, I meld minute matter into elements more alluring to the human eye, uncovering a world of fascinating form and transferring them into abstracted archival pigment and tri-color gum bichromate prints. Stalks of azure from a grass seed strike through a fiery orange picture plane; wispy hinges on a mosquito leg reveal a cerulean cloak of feathery scales; tangerine fibers twist from within a plant, spilling out towards the viewer. I merge actuality and abstraction, allowing unique anatomical attributes to surface. Scale and color no longer become the intrinsic property of the science, but a reflection of artistic subjectivity. By reconstructing scientific information into my own aesthetic forms, I hope to display a mutualism between science and art.

Chapter 2: Methods

The process of fabricating my compositions began with the employment of a scanning electron microscope (SEM). Unlike an optical microscope, which uses light, the SEM focuses beams of electrons upon the subject. Images are taken from an electrical signal and then sent to a computer. SEMs can vary greatly in quality and resolution. While the scope that I use at Radford University produces a very small, low resolution image, even this SEM offers a greater power of magnification and deeper depth of focus than could be achieved with a traditional optical microscope. I can obtain images of specimens that have a three-dimensional appearance versus the flat rendering of a traditional light microscope; however, most of my compositions are comprised of scans taken at power of only 50X-1500X.

It was essential to prepare the specimens prior to imaging them in the SEM. Once completely dried, the subjects were sputter coated in metal to make them more conductive, allowing them to hold up under the pressure of the SEM vacuum. This magical process gilded each item in fine layers of gold, one atom thick per coating, and finished with a purple puff of palladium. I then attached each specimen with copper tape to a small, metal stub that fit into the imaging apparatus of the SEM (Fig. 1).

Bold with texture and form (Fig. 2), I found my initial compositions to be fascinating, yet feedback concurred that they were not divergent from what had already been forged from science. I was tasked with the challenge to take what I already perceived as beautiful, but was not yet mine, and to mold it into my own fine art. Since there is no use of light with this microscope, my initial images were greyscale. The manipulation of color would be the channel through which I would manufacture art. *Fuzzy Wuzzy* was an experimentation with color manipulation.

Fig. 1 Langley Anderson Prepared specimen stub for scanning electron microscope, 2017.

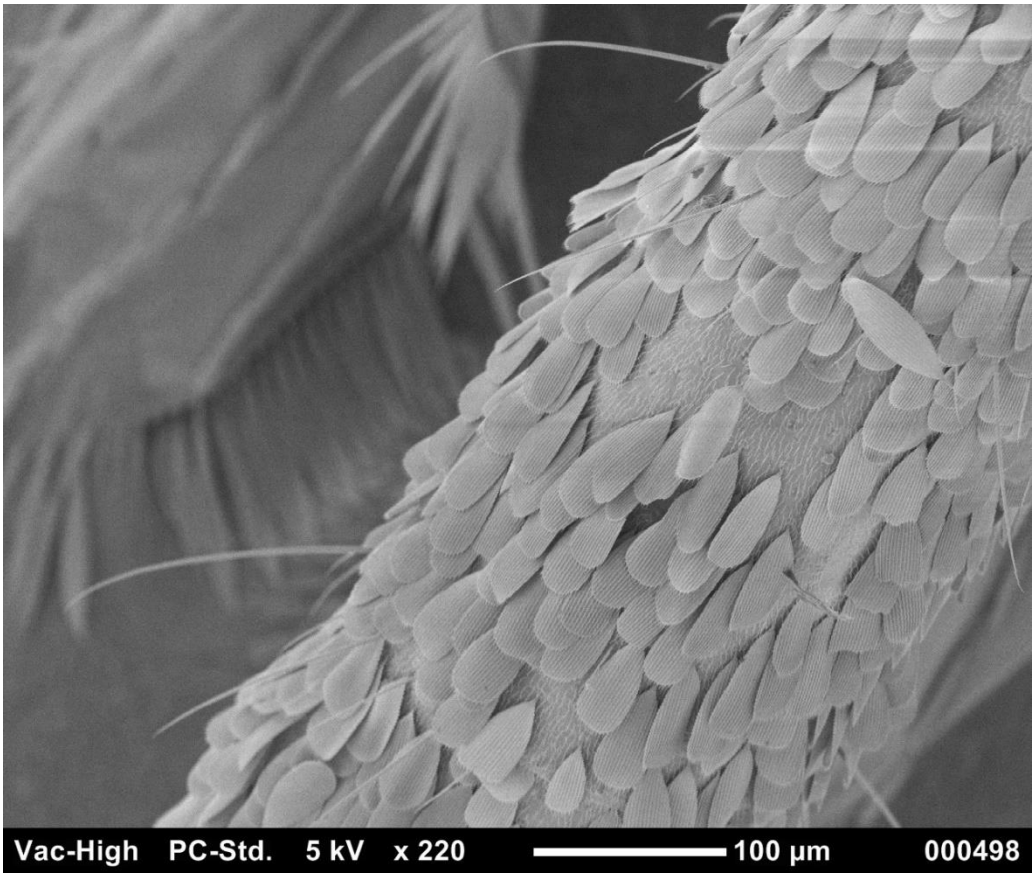

Fig. 2 Langley Anderson, scanning electron microscope scan of mosquito, 2016.

The mosquito's scales exhibited wondrous, velvety textures that mirrored soft, downy feathers. I wanted to accentuate these constructions by adding pairings of complementary hues. Mingled with cool blue, the hot orange popped from the confines of the flat paper (Fig. 3). I began each of my pieces by veiling the entire image with a translucent, digital layer of color in Adobe Photoshop. Using a subtractive feature of a digital paintbrush tool, I removed the entire color layer, only to switch the brush to an additive feature and painstakingly paint the tint back into only the areas where I desired that specific color. I was not trying to represent the true chroma of my subjects; rather I was creating my own imaginative concoctions. I wanted color groupings that were fun and playful. My curiosity picked the initial palette and I then sampled numerous combinations, tweaking them until I was satisfied. I experimented with the incorporation of more color layers, beginning with triads of hues, and later building up to ten coats of color. With *Seed,* I started with a complementary relationship of hues, aqua and tangerine, and I then balanced the blueness of the subject with details of analogous colors in green and blue-violet. The incorporation of bright colors can change the mood of the piece and hopefully the perception of the subject, turning a formidable creature, like a snake, into something to be taken not too seriously (Fig. 4).

On first inspection, I wondered if I had been overzealous with my use of color, that perhaps the schemes were too garish. Attempting to tone down my works, I toiled with hand-coloring in oil crayon and watercolor. I had unsatisfactory results with these techniques and was ultimately reassured that my work benefited from a strong punch of color.

A dilemma that I faced with the SEM that I had at my disposal was that it offered scans of very low resolution. This limited the size of print that I could make to about the dimensions of a post card. I could stretch this a bit in Photoshop, but I was still left with only a letter-sized print. I needed to find a way to generate larger images.

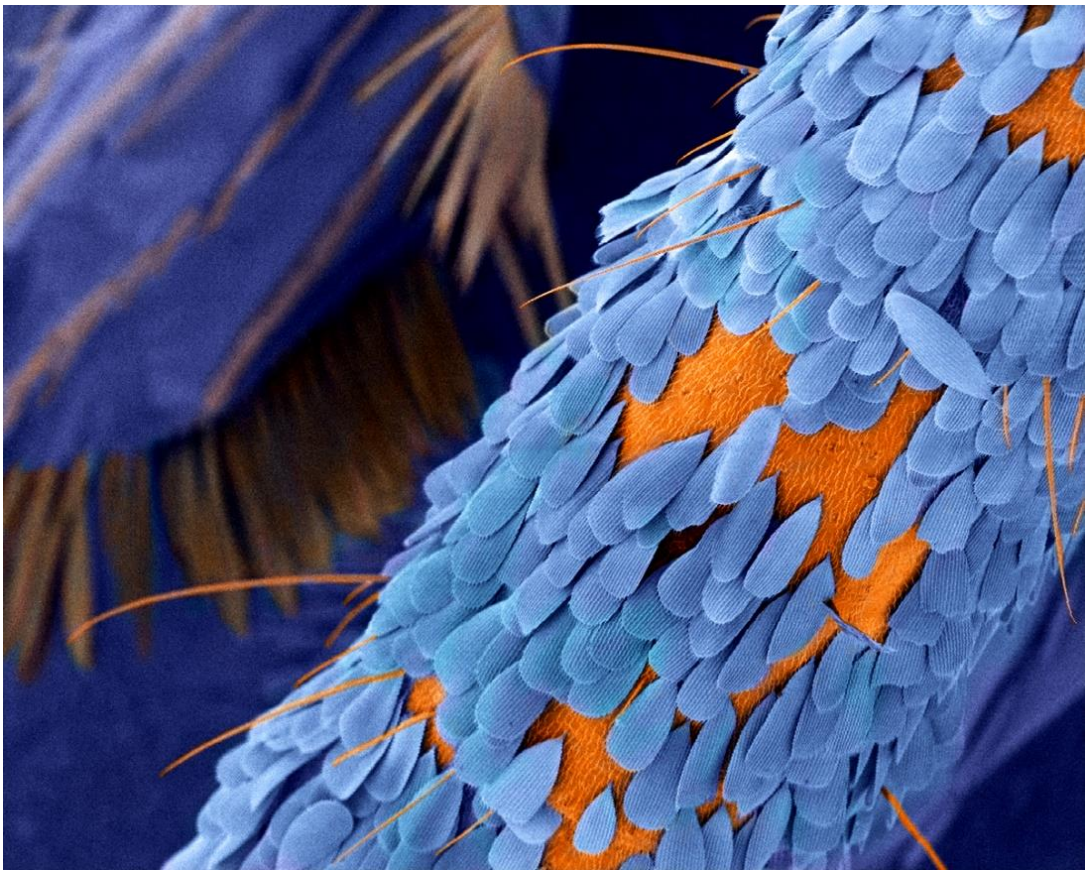

Fig. 3 Langley Anderson, *Fuzzy Wuzzy,* archival pigment print, 8”x10”, 2016.

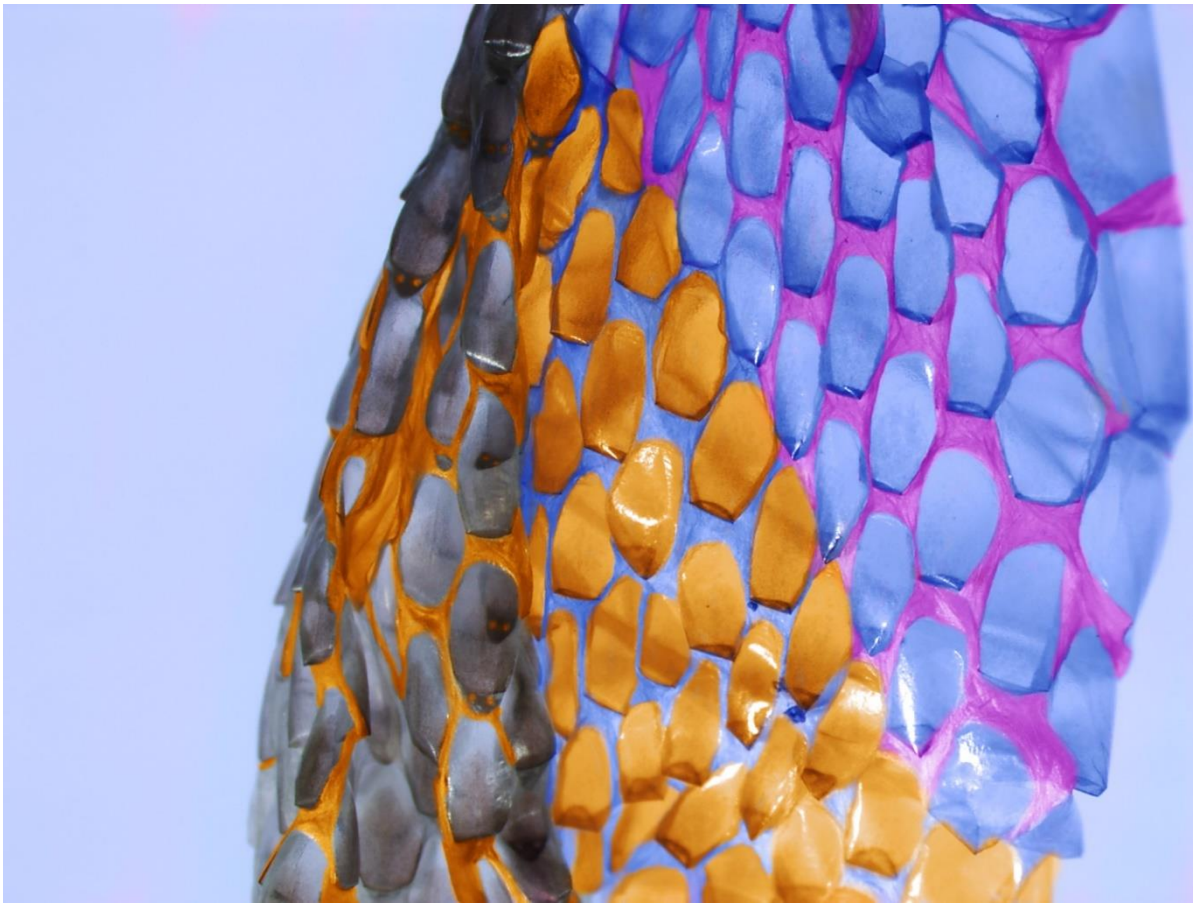

Fig. 4 Langley Anderson, *Candy*, archival pigment print, 10”x13”, 2017.

I was able to rectify this problem by taking multiple scans of a specimen rather than a standard, single image. This was a complicated process, as each time I steered the scope in a different direction, the focal point of the subject would change ever so slightly, altering the aspect ratio of the scan, and I frequently lost my place in the machine. The next step involved the collaging of the multiple images. With *Twist*, I made the artistic decision to keep the four images separated (Fig. 5). Later, I worked to blend the scans into single, seamless entities, retaining a more "natural" impression of wholeness. The process of digitally stitching these puzzle-piece-like images together was a tedious task due to the slight discrepancies in each image (Fig. 6). Precisely aligning the scans took quite a bit of patience and finesse. However, this method not only allowed for the fabrication of larger compositions, but it also let me capture more of the subject's surface area than I could with one scan. The original model for my piece, *Seed,* was smaller than a grain of rice, but my final print measures 20 inches x 16 inches (Fig. 7).

To approach my work from a different angle, I experimented with macro photography, using my SLR digital camera attached to a bellows. I photographed various intact insects as well as their wing structures. While I was able to obtain significant magnification, the focal range was very limited and obtaining a sharp picture was demanding. I discovered that I was able to operate a stereo dissecting microscope from the department of biology. This was an optical microscope hooked to a computer. To me, this machine was a combination of the SEM and macro as it provided decent amplification while allowing me to easily image specimens without significant prep work. It also enabled the application of lager specimens. I could place an unbroken shedding of a snake or the entire exoskeleton of a goliath bird-eating spider onto the viewing platform of this microscope. However, the dissecting scope did have its drawbacks.

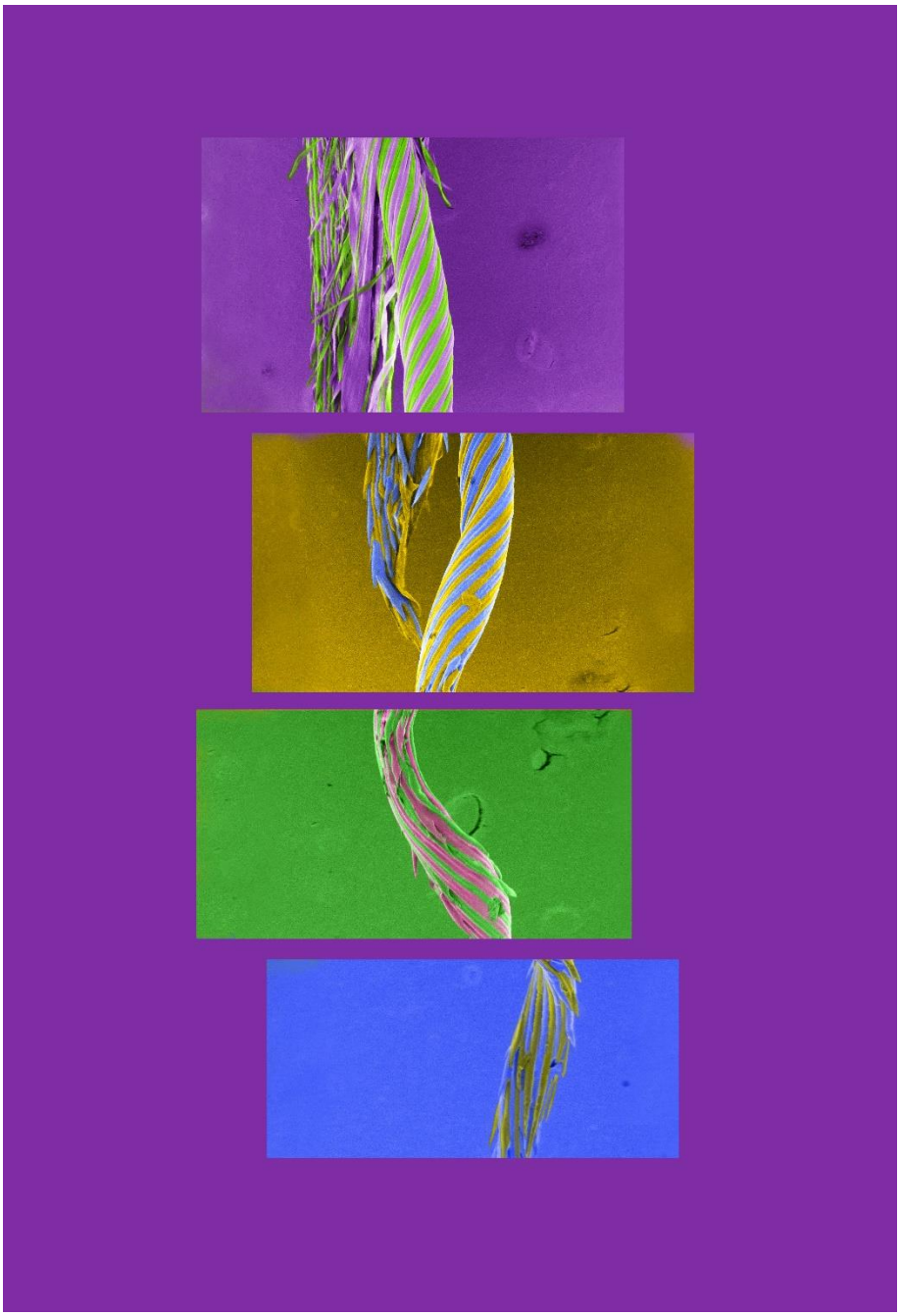

Fig. 5 Langley Anderson, *Twist*, archival pigment print, 13”x19”, 2016.

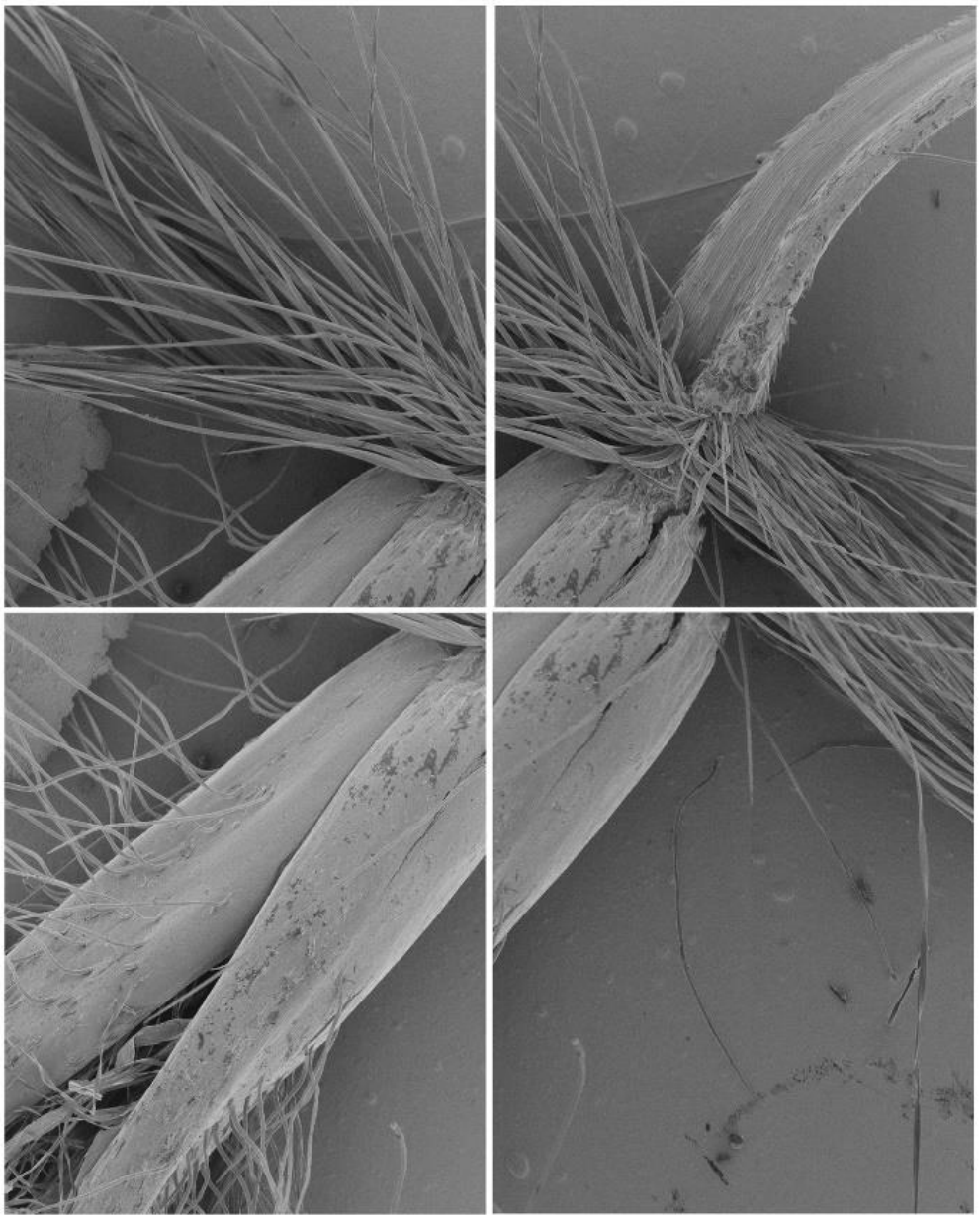

Fig. 6 Langley Anderson, scanning electron microscope scans of a grass seed, 2016.

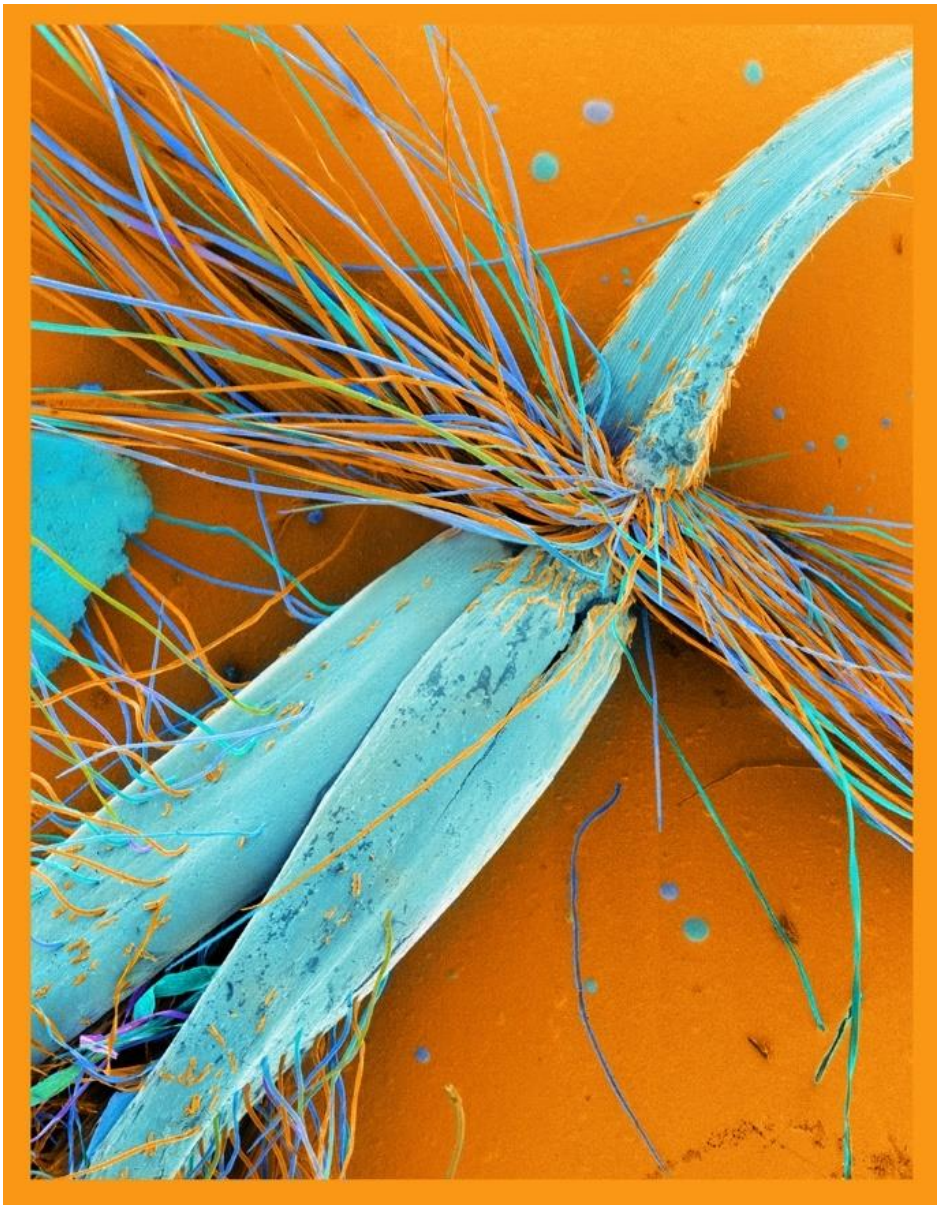

Fig. 7 Langley Anderson, *Seed*, Archival pigment print, 20”x24”, 2017.

The dissecting scope only offered magnification of up to 400x, so if I desired to peek into the ridges of a grain of lily pollen or the scales upon the leg of a mosquito, I preferred to use the SEM. The dissecting scope also had limited focal ranges, but I would create a process to remedy these shortcomings.

The task of aligning over twenty scans of a lily seed pod, of which *Blossom* is comprised, was tricky enough, but became even more daunting when I began the process of focus stacking. I stacked layers upon layers of scans from multiple areas of my model with varying focal ranges (Fig. 8). Using a subtractive brush tool, I removed sections of blurred focus to allow for parts with sharper focus to shine through. I was pleased with the end results of this 24 inches by 24 inches composition of a dried husk. Resembling a chrysalis-like orb, some viewers have remarked that it looks like a skeletal model of a human heart inside which bubble gum is stuck (Fig.9).

I discovered an old photographic process, gum bichromate, that denotes the cooperation between art and science by joining the world of chemistry and physics to the art of printmaking. The tri-color bichromate was able to offer the muted color for which I had earlier been searching, yielding a softer, yet robust palette of tinged tints and luminous textures. While this was a very time-consuming, and at times, frustrating operation, the hands-on procedure gave me a more visceral and rewarding experience than I received from sitting in front of an electronic screen. The first step in this production was to print transparency negatives of my digital compositions. This was done by separating color layers into cyan, yellow, and magenta within Photoshop and then printing them as greyscale negatives (Fig. 10). The second step was to prepare the printmaking paper. An emulsion of chemicals was mixed by combining gum Arabic, potassium dichromate, and pigment for an ultraviolet light sensitive developer. For the pigment, I used M. Graham watercolors. The emulsion was quickly brushed onto the paper and set to dry in a dark area.

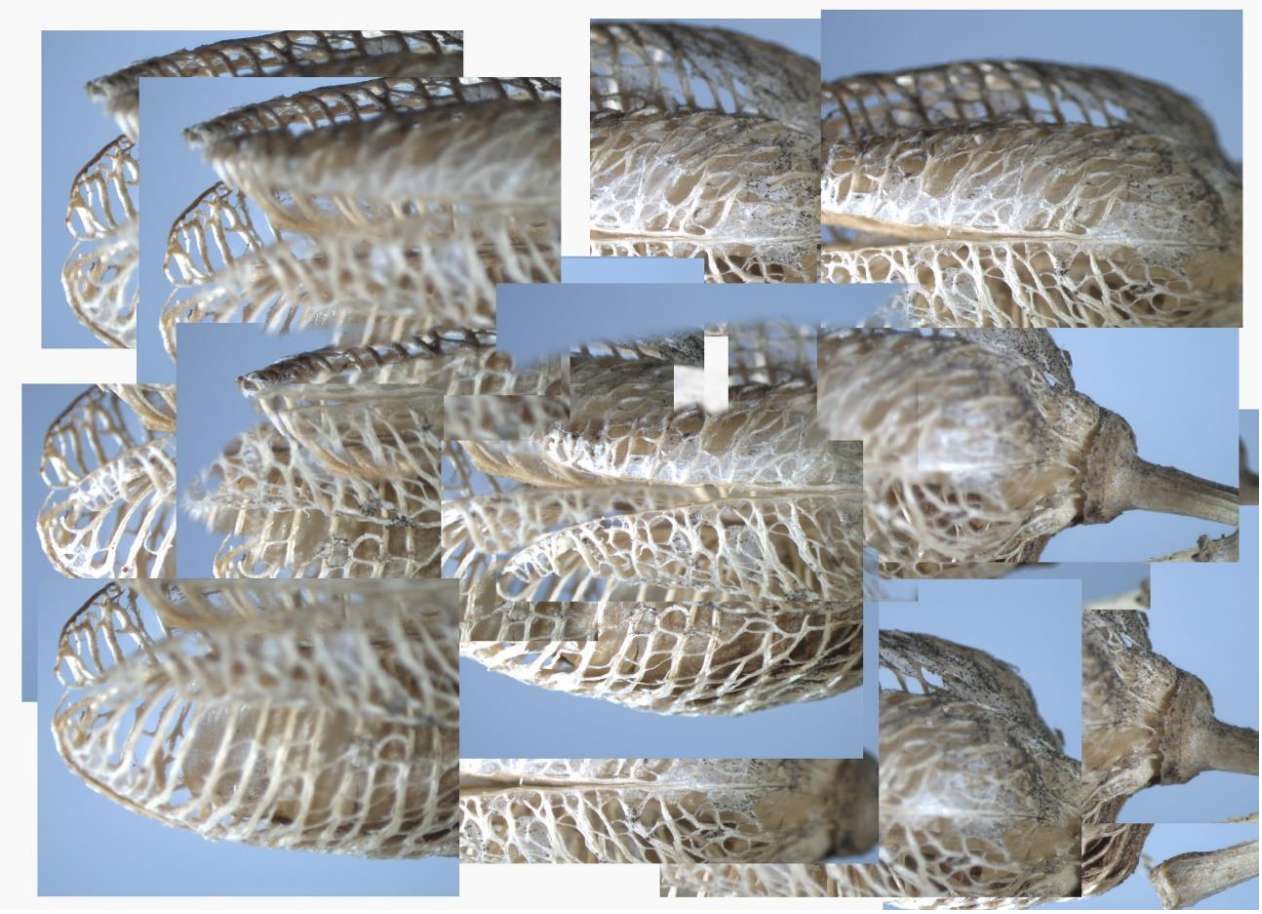

Fig. 8 Langley Anderson, *Blossom* draft, lily seed pod scans taken on a dissecting scope, 2017.

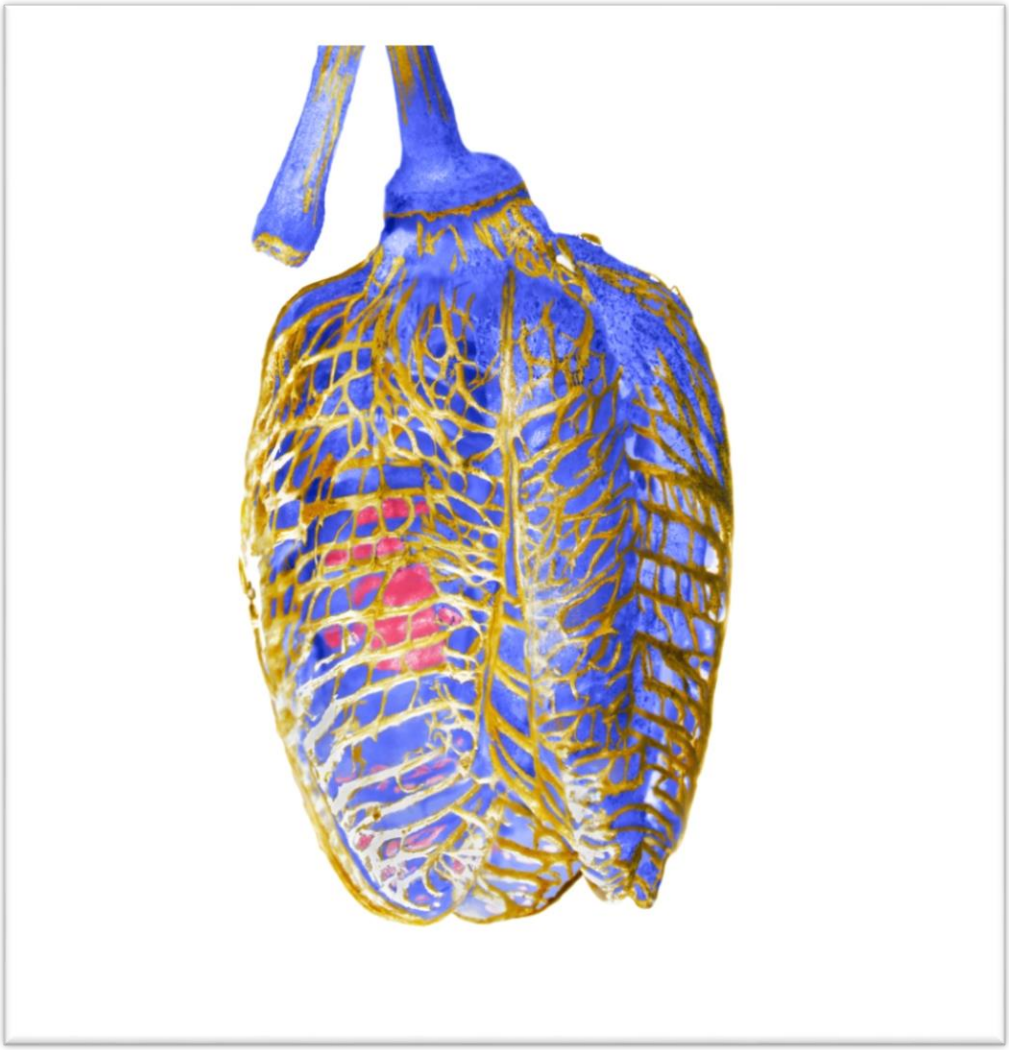

Fig. 9 Langley Anderson, *Blossom*, archival pigment print, 24”x24”, 2018.

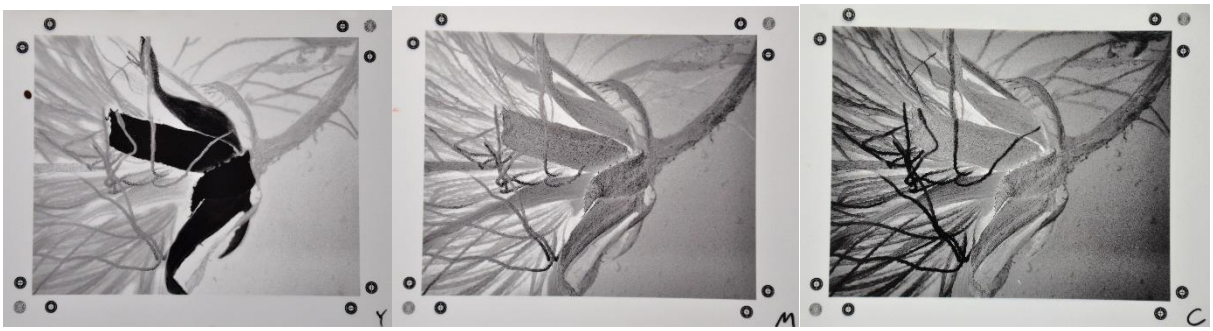

Fig. 10 Langley Anderson, negatives for tri-color gum bichromate printing, 2016.

Once dry, the first of the three negatives was sandwiched between the prepared paper and a piece of glass for exposure to UV light. The sun was my source of UV light. Since I was working with sun from wintry afternoons, the exposure times were long, between 15-20 minutes per negative. Development occurs when the print is bathed in water, which softens the gum in areas not exposed to the sun. The hardened, exposed areas hold on to the pigment and reside in the print. The paper must be dried before repeating this undertaking at least two additional times with the remaining color layers. The resulting prints discarded the hard-edged, bold intensity of my digital works and acquired a "painterly" effect of hazy hues and softer textures (Fig. 11).

While I planned to further explore this method of gum, I also proceeded with my digital work. My latest compositions would take a new turn. I separated the subject from its background, placing it upon pure white. This was a demanding process as I had to select and subtract all of the space around each and every fiber that my plant subjects exhibited. While this endeavor was exceedingly absorbing, I like to think that this test of patience and commitment was an integral part of the creative process and I do feel that the outcome was worth the effort. Sleek, stark space provided my fresh works an isolated site upon which to rest, similar in fashion to how a scientific specimen might be prepared for observation. The combination of this still and sterile backdrop with the whimsical aesthetic of colorful form, floating in its own world, presented another duality that further linked together science and art (Fig. 12).

Design and chroma coalesce in my compositions, asymmetrically balancing pattern with vivid hues. Through my work I wish to share the alluring structures of natural form. By creating my own art from science, I hope to illustrate the mutualistic cycle that spins around the two, weaving them together.

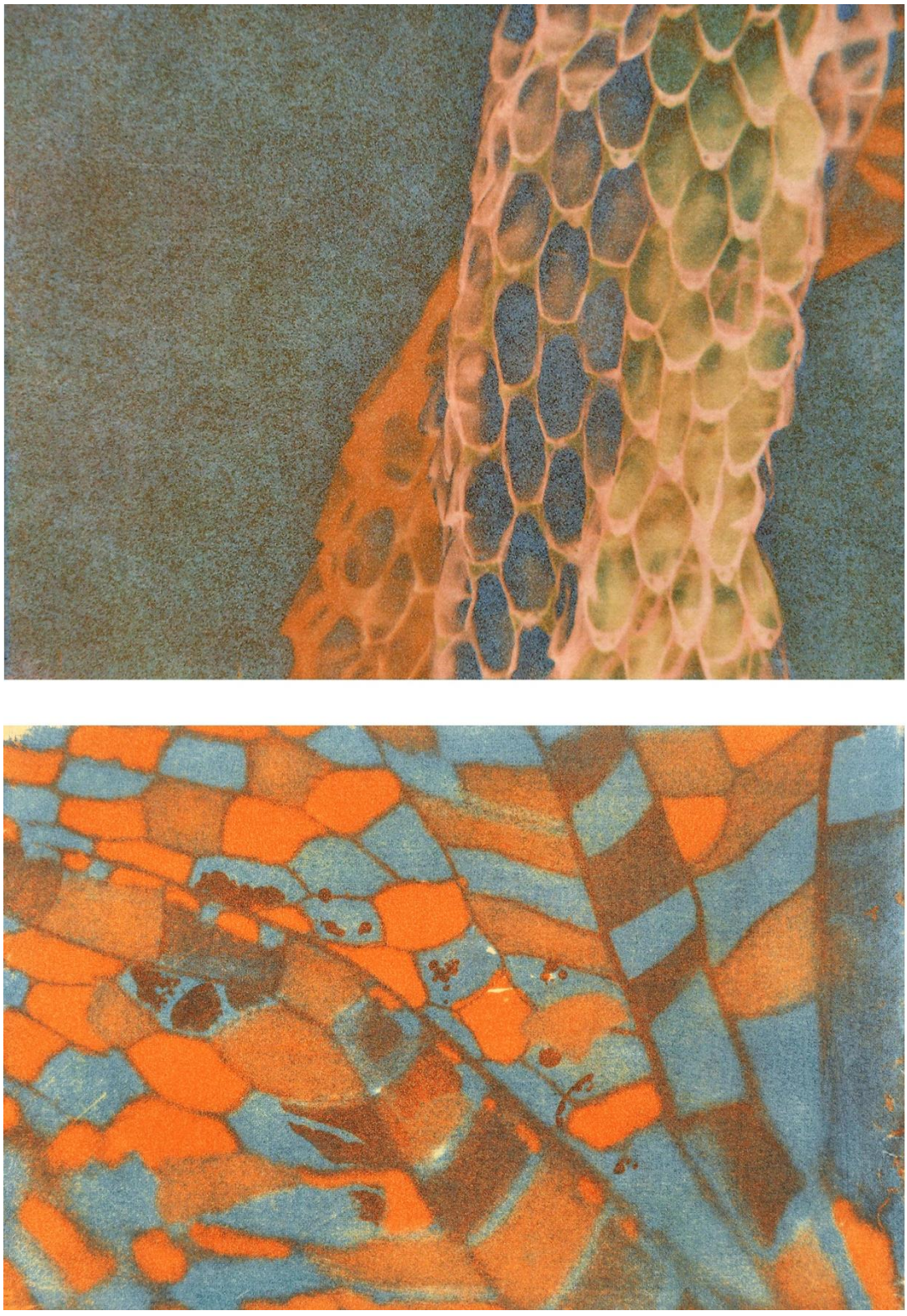

Fig.11 Langley Anderson, *Slither* (top) and *Dragon* (bottom), tri-color gum bichromate print, 2017.

Fig. 12 Langley Anderson, scans of hibiscus sepal with dissecting scope (top), *Rebloom* (bottom), 2017.

Chapter 3: Connections

My husband brought home an image of a mosquito that had been taken with a microscope by two undergraduate science students (Fig. 13). I was intrigued by the intricate arrangement of this greyscale puzzle. The picture resembled a print by M.C. Escher, yet it was only a duplicate of nature. It charged me to further delve into this aesthetically and intricately organized natural environment. The detailed creations of science seem to be designed in tandem with the Elements of Art and Principles of Design – billowy curves of lichen, delicate articulations of insects, undulating patterns of a hornet's nest. These were structures that I wished to explore in deeper detail, and I needed to employ a method to facilitate this endeavor.

Photography is a beautiful example of the mutualism between art and science. "Where science ends, art begins..." Nègre wrote, "…We are now convinced that it is less difficult to reproduce than it is to learn to see nature… Before, the challenge was to replicate nature; today it is to choose from within nature." Born out of chemistry and received by biology, photography was accepted as science before it was acknowledged as art. The first book to be illustrated with photographs was *Photographs of British Algae: Cyanotype Impressions* by Anna Atkins, a botanist who used the cyanotype process to preserve images of her collected specimens. Wilson "Snowflake" Bentley, a farmer from Vermont, helped scientific research when he devised a way to photograph the first snowflake with his camera and a microscope. Bentley's photography was not only visually stunning, but it also contributed to studies of atmospheric condition and established that every snowflake was unique. German photographer Karl Blossfeldt also used a microscope to photograph plant samples (Fig. 14).

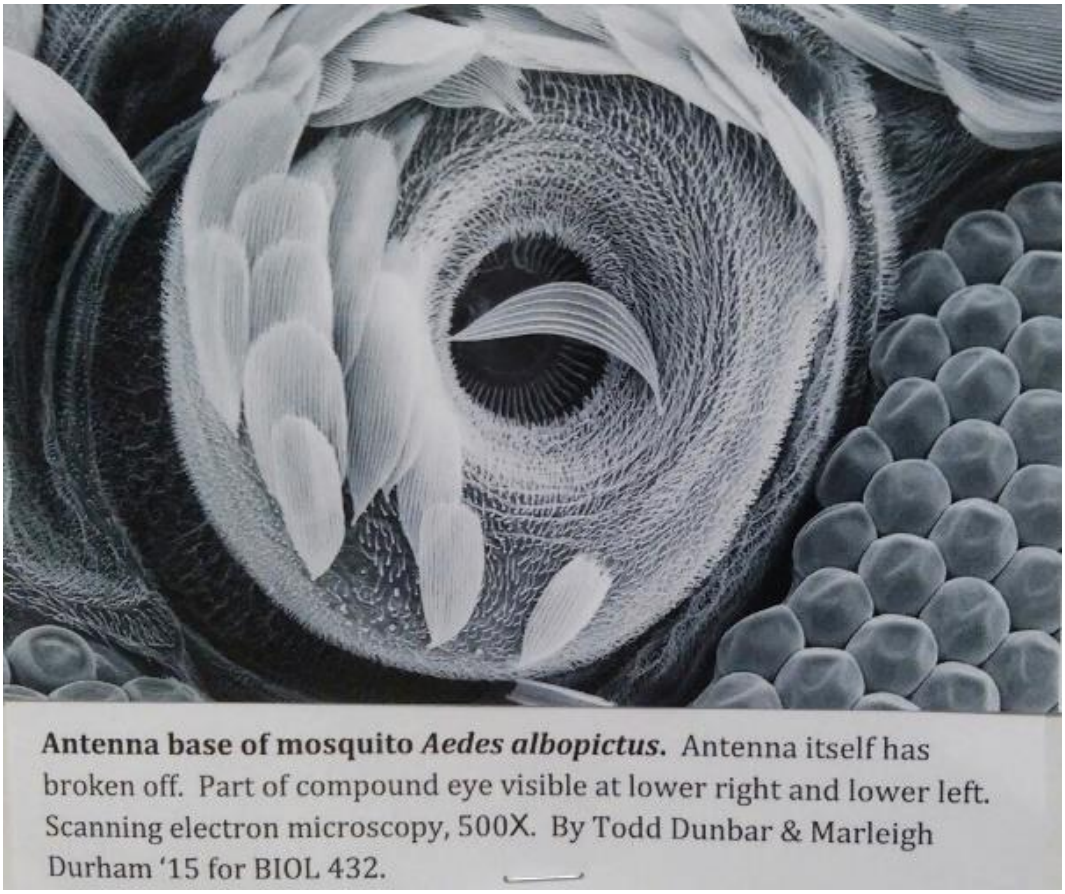

Fig. 13 Todd Dunbar and Marleigh Durham, *Antenna Base of Mosquito Aedes albopictus*, Digital Print, Radford University, Radford, VA, 2014.

Fig. 14 Karl Blossfeldt, photograveur, 1928.

Blossfeldt's images were to function as educational tools for students learning about the elements of design in nature, but they also provided an artistic view of science. What Blossfeldt said and displayed in his book, *Art Forms in Nature*, truly resonated with me as it expressed the feelings that I had regarding natural form and structure as art. These individuals used artforms to represent science and created something beautiful in the process.

I also became fascinated with the work of Daniel Kariko. His latest pieces are from a series of insects titled *Suburban Symbiosis: Insectum domesticus.* Kariko images insects with both an optical, stereoscopic microscope and a scanning electron microscope and sets up portrait lighting that is reminiscent of compositions by seventeenth century Dutch masters. Kariko takes six images of his subject with a microscope to obtain a focal stack and then he images the same specimen with the SEM. Using Adobe Photoshop for editing, he sandwiches one image from each microscope together to create one, spectacular composition (Fig. 15). Kariko titles his pieces in an amusing manner as he includes the location of where he found the insect (bath mat, recycle bin, kitchen sink, etc.) and the scientific nomenclature of the subject, but only a vague designation of a date without the scientific specificity of a year.

While I used both an optical, stereoscopic microscope and a scanning electron microscope, I did so independently from one another. I have yet to blend scans from the two machines. This is a process that I would like to practice in the future.

I hope that my art can behoove non-scientific viewers to become more receptive to the observation of the world of science while showing a non-artistic audience that the world of art might possess something curious for them to explore. My art thus far has seemed to successfully fill its niche as fine art that draws the attention of both an artistic and scientific following.

Fig. 15 Daniel Kariko. Front Porch, Doormat, August 14th *(Dryophthorine Weevil)* and Christmas Cactus Flowerpot, Kitchen Window, October 27th (Long Legged Fly).

Chapter 4: Exhibition

My thesis exhibition consisted of fourteen pieces, twelve archival pigment prints and two tri-color gum bichromate prints (Fig. 16). The works were made from natural specimens that were microscopically enlarged. My latest pieces were the largest in the collection and were comprised of four botanicals, each measuring 29 inches by 29 inches framed. They were presented with colored mats that coordinated with the hues of the composition and were framed in white. The works were balanced between smaller compositions of plants and insects framed in a similar way as well as pieces framed in black with white mats. I created an alternating pattern of dimension with a rhythmic play between the positive and negative relationships of black and white, insect and plant. The two tri-color gum bichromate prints were intentionally matted in a slightly different manner, gently suggesting that they were fabricated with a technique dissimilar to the archival pigment prints. I was eager to discover if fine artists would find more allure in the gum bichromate prints with individuals of scientific backgrounds being more enticed by the crisper precision of the bold pigment prints. I felt that this show contained a compatible combination of works that would appeal to a diverse audience.

I enjoy watching viewers engage in a game of guessing. “What is it?” people have asked in previous exhibitions of my work. “Is it a potato chip?” “Are those thorns?” “Is that a puddle?” I reveal to them that it is mosquito genitalia, a sliver of dragonfly wing, and the armor of a Question Mark cockroach. Some people are sorry they asked. Others requested that I create a list to accompany my oeuvres. For the thesis exhibition, I elected to offer visitors the occasion of having the identity of my subjects revealed. I presented the original specimen alongside my finished piece.

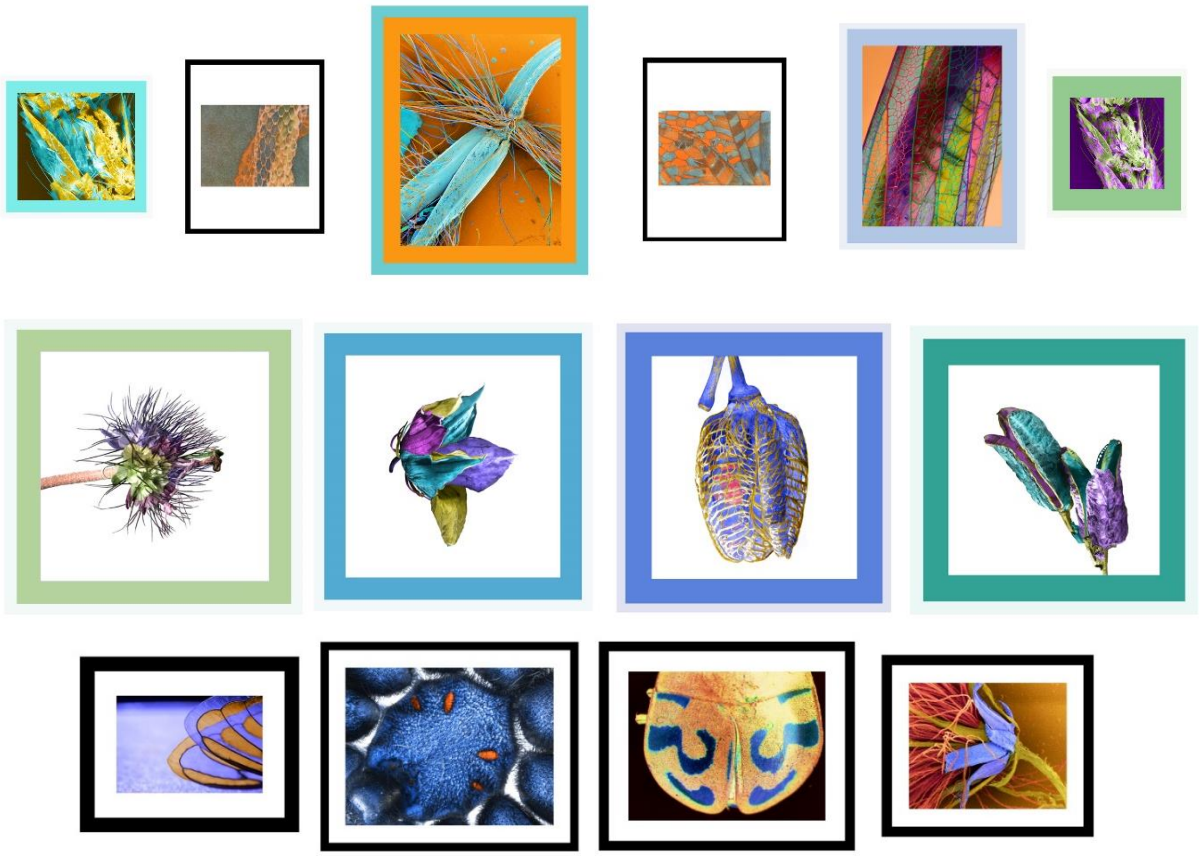

Fig. 16 Langley Anderson, *Mutualism*, MFA Graduate Exhibition, Radford University, 2018.

The specimens were housed in small, inconspicuous, acrylic boxes that did not detract from the artwork. Since the information was held within this tiny, clear space, the viewers had to scrutinize the material if they wished to decipher what it was. This brought the viewers closer to the artwork, inviting them to more intimately observe the detail of my compositions, while at the same time, having the possibility to ignore the small display if they preferred that the identity remained a mystery. I included the name of the subject in addition to an artistic title; however, only the scientific nomenclature appears, so for those without a basic background in Latin, it was not as if I were jumping out and shouting "spider." I feel that my work successfully stands alone as fine art without the admission of what I am photographing, but I see no harm in giving my audience this extra bit of data. While the plant photographs are more easily discernable, most viewers do not appreciate the scale of the original model. Many believe that they are looking at a large bloom of the flower rather than a miniscule component of that plant.

The installation conveys the significance of scale in my compositions, delivers context to my viewers, and strengthens the connection between science and art in my work.

Chapter 5: Reflection

My thesis exhibition was quite successful and I received a great deal of positive feedback. Viewers absolutely loved the specimen boxes. I was correct in my prediction that most of the attention for the tri-color gum bichromate pieces would be generated from my fine-artist and non-science audience; however, many viewers were drawn to my newest pieces. Overall, my work seemed to catch the attention of a varied audience. A few of my works sold and I even received compliments from the Dean of the College of Science and Technology, who thanked me for enhancing the natural beauty of life with my use of vivid colors and unique perspective, and for contributing to the understanding and appreciation of science.

I will make some modifications to how I display my work in future exhibitions. For the thesis show, I had originally planned to separate my work into groups, but the logistics of installing on one, long wall necessitated that I arrange them in a single cohesive, linear group. In a new space, I will arrange the pieces in groups. I will create more works in the style of my latest, large square botanical compositions, possibly incorporating insects. I might experiment with printing them larger at 40 inches by 40 inches versus 29 inches by 29 inches. Most of my buyers will not be interested in purchasing art this large, but I could have the chance of selling to a health center in San Antonio, Texas, which is looking for big! I have sufficient tri-color gum bichromate pieces for a small grouping that I will frame larger and more traditionally than I did for my thesis exhibition and I will include a short description of the process. I plan to continue the fabrication of insect compositions in the style that I presented at the thesis show, but I will display them in LED lightboxes. The technology of the lightboxes will further enhance the theme of science in my

art and will hopefully appeal to architectural, scientific, and medical venues in addition to galleries of fine art and photography.

I have an exhibition scheduled for this summer at a restaurant gallery in Radford, Virginia. I also have tentative plans to exhibit at Crowder College in Neosho, Missouri and a gallery in New Orleans, Louisiana. I intend to explore exhibition opportunities at the Nature Art Gallery in Raleigh, North Carolina.

I feel that I have reached my goal of employing science to construct art that allows viewers to see the allure of the natural world in a new way. By continuing to push my work further, I hope to continue to fabricate ways to exhibit the mutualistic relationship between science and art.

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