

Cyanotypes in Many Colors

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1. Details of the Project Character and scope including explicit statement of research hypothesis/question or creative problem.

Cyanotype printing of photographs dates back to the 19th century when it was an important method of making prints of plant materials and photographic negatives, though it ultimately lost out to silver halide photography. Famous examples in science include the use of directly-printed, dried seaweeds by Anna Atkins in her masterful book



Fig. 1 A cyanotype of a British seaweed, by Anna Atkins.
https://upload.wikimedia.org/wikipedia/commons/c/c4/Anna_Atkins_algae_cyanotype.jpg

Cyanotypes, as their name indicates, produce blue images, but we have preliminary data that shows substitution of the iron ions used in traditional blue cyanotypes for other metal cations can provide different colors such as red and green (see Fig. 4).



Fig. 2 A cyanotype by Susanna Crum, which combines reduction woodcut printing with the traditional cyanotype process, using a hand-drawn film. 13" x 19"



Fig. 3 A cyanotype in a sculptural book form by Susanna Crum, created using photographic films, 30" x 42" x 42".

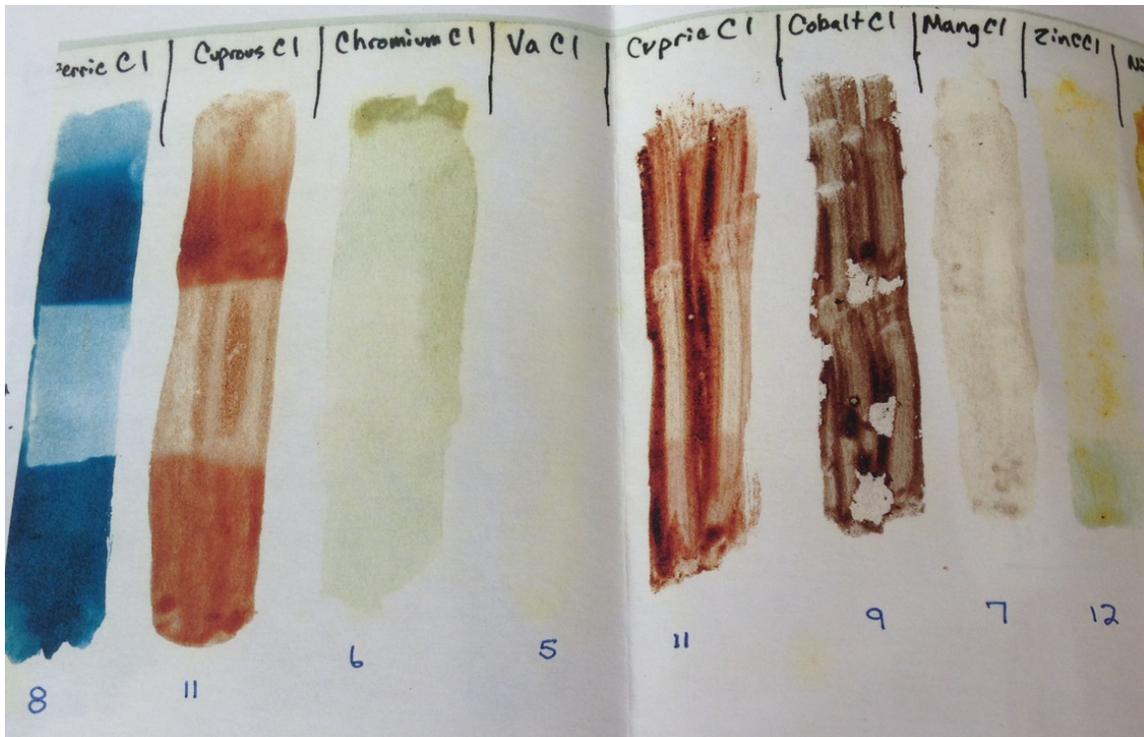


Fig. 4 Cyanotypes of a different color, preliminary data. The indicated metals chlorides (XCl where X=metal) were used to substitute out iron in the traditional cyanotype recipe. Then the entire image was exposed to UV light with an opaque strip across the center and washed. Colors which worked well (red from Cuprous Cl and green from Zinc Cl) show up as colored blocks above and below a lighter colored bar in the center where UV exposure/"cyanotype" formation did not occur.

This proposal requests support for doing several experiments to develop this idea: 1) to test various metals chlorides (including retest of those in Fig. 3) to see what colors can be obtained; 2) to test the light-fastness of those colors; 3) to test the stability of the chemical mixtures using various metal chlorides; 4) to test the use of blue, green, and red cyanotype layers to create full-color images. 1-3 will be subjects of this grant and 4 may be, depending on time and how long supplies last.

Methodology

For each metal chloride, a cyanotype solution will be prepared (Darnowski) using the other standard ingredients, including ammonium chloride and ferricyanide.

-A sample of each variation on cyanotype chemistry will be divided, with one part used right away (next bullet point) and one part stored for 6 months and then used, to test the chemical stability of the solutions over time.

-Each variant will be applied to hot-pressed watercolor paper which is Prof. Crum's standard choice and exposed using the point-source found in the Printmaking Program at

IUS using the same standard negative. One print of each type will then be placed in a window for 6 months to test the light-fastness after prints are made.

-Various metal chlorides will be used to see what range of colors can be obtained.
-Eventually, a multi-layer print will be tried using blue, red, and green layers and color separation negatives to obtain a full-color print similar to that obtained by traditional silver halide photography.

Presumable scholarly significance

Neither applicant is aware of any such use of metals other than iron in cyanotype photographic printing, and this includes a literature search back into the 19th century. The only color modifications available involve “toning” which creates darker and muddier shades such as purple-brown, not colors such as red or green. The red and green colors in the test results (Fig. 3 above) are revolutionary.

Cyanotype is a process that has gained a substantial amount of critical and creative attention in the field of contemporary art within the last 10 years, with major contemporary artists such Christian Marclay and Christina Nguyen using the technique in works that are represented in the collections of galleries and museums. Academic institutions, particularly fine arts programs, are increasingly bringing “alternative photography” processes like Cyanotype, Van Dyke, and Collodion printing into fine art printmaking programs for studio arts students pursuing undergraduate and graduate studies. Some schools like California State University, Fresno have incorporated analog photographic practices into their Printmaking concentrations. Others, like Bowling Green State University, emphasize the use of photographic techniques within their printmaking curricula both as a bridge to more in-depth dialogues with contemporary practices in digital imaging, and to provide students broader possibilities to address the ubiquity and impact of the printed image in commercial and artistic media. Cyanotype is a commonly-used technique within these programs, and capabilities to print with more than one color with the cyanotype process would create a variety of new teaching and learning opportunities for students and artists alike.

Application or relation of possible results from these investigations to more general problems in the field.

This could lead to a technology giving full-color prints with different chemical and light stability than existing photographic processes.

When commenced, progress to date, and expectation as to completion and publication.

Work will begin as soon as the grant is received and will take 6-8 months, including the stability and light-fastness tests.

Assessment of the likelihood that this project will lead, directly or indirectly, to external funding.

Unknown, but the potential for patenting suggests the potential for obtaining outside funds after the basic methodology above is followed and shows light-fast, stable

results.

2. Qualifications of the Applicant:

Applicant's special competence for this project (background, training, preparation).

Prof. Crum has used the cyanotype process in the creation of original artwork as a significant part of her creative research since 2011. In 2016, her cyanotype triptych, "Breaking the Loop [The Loop]" was one of 14 works selected from 639 entries for exhibition in the international juried show, *Memory Palace*, at the Manifest Research Gallery and Drawing Center, Cincinnati, OH. Prof. Crum has taught the process of cyanotype to college students, including a Cyanotype Workshop in January 2017 with IU Southeast students in Printmaking and Digital Art and Interactive Media. This workshop combined the use of hand-drawn films with photographic negatives that students produced, and culminated in an exhibition in the Knobview Hall lobby, titled *The Color of Horizons*, which remains on display until April 2017. In summer 2017, Crum will teach a class of IU Southeast students the process, and resulting artwork will be displayed in a group exhibition at Yew Dell Botanical Gardens, Crestwood, KY.

Prof. Darnowski has used cyanotypes for artistic purposes and in Biology course lab exercises for over 17 years and performed the initial experiments to substitute various metal ions for the iron ions in the standard cyanotype recipe.

Papers published or presented by the applicant bearing upon this subject.

Crum

Crum's cyanotypes have been featured in the following solo exhibitions:

1078 Gallery, *A Collecting Place*, Chico, CA, 2016

Louisville Photo Biennial: Revelry Gallery, *Fight or Flight*, Louisville, KY, 2013

Art Building West Gallery, *The Heart of the Park*, University of Iowa, Iowa City, IA, 2012

Printmaking Gallery, *Guardians: Care-taking & Place-making on St. James Court*, Iowa City, IA, 2011

Crum's cyanotypes have been featured in the following national and international juried and invitational exhibitions:

Museu do Douro, *3rd Global Print 2017*, curated by Nuno Canelas, Douro, Portugal (forthcoming), 2017

New Harmony Gallery of Contemporary Art, *The Disseminator of Useful Knowledge Print Invitational Exhibition*, curated by Brett Anderson, New Harmony, IN, 2017

Brick Street Gallery, *A Bridge Between*, in conjunction with the Mid-America Print Council conference, curated by Susan Harrison, New Albany, IN, 2016

Chicago Printmakers Collaborative, *Cuts: An Exhibition of Relief Prints*, Chicago, IL
City Gallery at Downtown Art Center, *Beveled Edges – Printmaking in Kentucky*, Lexington, KY, 2016

Manifest Creative Research Gallery and Drawing Center, *Memory Palace*, Cincinnati, OH, 2016
Carnegie Center for Art and History, *Held from Beneath: An Exploration of Cultural Sustainability*, New Albany, IN, Curator: Karen Gillenwater, 2015
SHYRABBIT Contemporary Arts Gallery, *SHYRABBIT Print International 3: International Juried Online Exhibition*, Juror: Juergen Strunck, Professor of Art, University of Dallas, Irving, TX, 2011
Benedictine University, *Mid America Print Council Fall 2011 Members' Juried Exhibition*, Lisle, IL, 2011. Juror: Andrew DeCaen, Assistant Professor of Art, Printmaking, University of North Texas
Springfield Art Museum, *Prints U.S.A. 2011*, Springfield, MO. Juror: Elizabeth Wyckoff, Curator of Prints, Drawings and Photographs, St. Louis Art Museum, St. Louis, MO, 2011

Darnowski

-Exhibit at the IUS Library Gallery, 07/13: Nature Prints: Another Kind of Ukiyo-e (included cyanotypes)
 -Darnowski, DW (2006) Nature printing in the college biology classroom, *Nature Printing Society Newsletter* 24: 4-5.

Other publications by the applicant. (on the topic of carnivorous plants)

Crum

"Brick by Brick: Creative Entrepreneurship After Graduation," *Mid America Print Council Journal*, Vol. 23. Feb 15, 2015.

"Beyond the Studio: WPA Printmakers and Networks for Innovation in Print Media," *Arts Louisville*, June 8, 2015.

Darnowski

-Darnowski DW (2002) *Triggerplants*, Rosenberg Publishers, Pty. Ltd., Dural, New South Wales, Australia. (book)
 [DWD add more papers from cv]
 -Darnowski, DW (2016) The Search for All of the Victims and All of the Killers. *J Intl Carn Pl Soc* 45: pages to be determined.
 -Darnowski, DW (2016) Further Evidence of Carnivory in Triggerplants (*Stylidium*; Stylidiaceae). *J Intl Carn Pl Soc* 45: pages to be determined.
 -Darnowski DW, Carroll DM, Plachno B, Klebanoff E, Cinnamon E (2006) Protocarnivory in Triggerplants Is Timed to Flowering. *Plant Biology* 8: 805-812.
 -Darnowski, DW (2016) "Attraction of Preferred Prey by Carnivorous Plants" in *BioCommunications*, published October, 2016.
 -Santiago, Yana and Douglas W. Darnowski (2012) Mycorrhizal formation by various carnivorous plants. *J Intl Carn Pl Soc* 41(1):4-7
 -Darnowski, Douglas W. and Sarah Fritz (2010) Prey preference in Genlisea small crustaceans, not protozoa. *J Intl Carn Pl Soc* 39(4):114-116 (PDF)

- %Koerber A, Moberly S, Darnowski DW (2007) Prey preference in two aquatic bladderworts. *J Intl Carn Pl Soc* 36: 57-61.
- Darnowski DW, Celano MA, %Moberly S, %Lalor CD (2005) Vegetative reproduction during development in Australian pygmy and tuberous sundews. *Acta Botanica Gallica* 152: 147-157
- Saha S, Darnowski DW (2005) Effects of Cu and Fe on the growth of *Utricularia gibba* and *U. macrorhiza*. *J Intl Carn Pl Soc* 34: 41-46.
- Darnowski DW (2004) How to grow a ridiculously large number of sundews. *J Intl Carn Pl Soc* 33:90-94.
- Darnowski DW (2003) Triggerplants (*Stylidium* spp.; Stylidiaceae) a new floral and horticultural crop with preliminary analysis of hardiness. *Acta Horticulturae* 624: 93-101
- McDermott M, Darnowski DW (2002) Ecology of bladderworts in a unique site on the Eastern Shore of Maryland. *J Intl Carn Pl Soc* 31: 67-74.
- Chadwick ZD, Darnowski DW (2002) Observations on the associations of crustaceans and protists with actively growing *Aldrovanda vesiculosa*. Proceedings of the 4th International Carnivorous Plant Conference, Laboratory of Plant Chromosome and Gene Stock, Hiroshima University, Hiroshima, Japan.

References (give name, title, and address).

Letters will be sent by

-Dean Elaine Haub of the School of Natural Sciences, IUS

-Prof. Pamela Connerly, Associate Professor and Head, Biology, IUS

3. Previous Research Funding:

Crum Grants:

Indiana University Southeast Summer Faculty Fellowship, \$8000, 12/2015

Indiana University Southeast Teaching Improvement Grant, \$1000, 12/2015

Indiana University Southeast Research Support Grant, \$2835, 1/2016

These grants allowed Professor Crum to work as a visiting artist at the renowned Edinburgh Printmakers Studio in Edinburgh, Scotland, in summer 2016. There, she created a series of original prints which, along with cyanotypes, were featured in a solo exhibition at 1078 Gallery, Chico, CA.

Crum has also received funding support from a variety of external nonprofit organizations for recent architectural video projections, such as the Art and Heritage Initiative, Chicago, IL (2016); the Central Indiana Community Foundation (2016); the Efroymsen Family Fund (2016); and the Louisville Fund for the Arts (2016). She was the inaugural recipient of the Mary Alice Hadley Prize, a \$5,000.00 competitive grant awarded to Louisville area artists, in 2013.

Darnowski Grants:

-Indiana University Southeast Grant-In-Aid of Research for Hungry Ocean II, \$1000, 04/2016

- Indiana University Southeast Quick Response Mini-Grant for Nature Printing Supplies, \$75, 04/2015
- Indiana University Southeast Grant-In-Aid of Research for Hungry Ocean, \$1000, 04/2015
- Indiana University Southeast Grant-In-Aid of Research for dryland pitcherplants, \$1000, 04/2014
- Indiana University Southeast Student Assistant Grant, \$1000, 04/2008
- Indiana University Southeast Grant-In-Aid of Research for a Sunbow Lamp, \$770, 04/2008
- Ohaus Case Study Winner, \$2200 four-place digital balance, 02/2008
- Indiana University Southeast Large Grant Program for short term metabolomics exchange, \$5000, 12/2006
- Indiana University Southeast Large Grant Program for short term metabolomics exchange, \$5000, 04/2006
- Indiana University Southeast Large Grant Program (with David Taylor and John Doyle) for purchase of a transmission electron microscope, \$5000, 04/2006
- Indiana University Overseas Conference Fund, \$700 for travel to IBC2005 in Vienna, Austria, 2005
- Indiana University Southeast Office of International Programs, \$200 for research on triggerplants with Dr. Laurent Legendre, 2005
- Indiana University Institute for Advanced Study Fellowship for Dr. Laurent Legendre to come to IU Southeast for collaboration 07+08/05, \$7500, 2004
- Indiana University Research Support Fund, \$12,000, 2004
- Indiana University Intercampus Research Fund (with Maxine Watson of Indiana University Bloomington), \$6800, 2004
- Indiana University Southeast Summer Faculty Fellowship, \$8000, 2005
- Indiana University Southeast Office of International Programs, \$500 for research on triggerplants, 2004
- Indiana University Southeast Office of International Programs, \$100 for the 2006 ICPS meeting, 2004
- Indiana University, Center for the Study of Global Change Travel Grant, \$440, 2004
- Indiana University, Intercampus Travel Grant, \$200, 2004
- Indiana University Southeast, School of Natural Sciences, McCullough Grants, 2003-2004, 2004-2005 \$675, \$1500
- Indiana University Southeast, Student Assistant Grants, 2003-04, \$1685 and \$750; 2006 \$956.25; 2006 \$1000

These grants have led to the papers, listed above and marked “%” with IUS student coauthors, as well as several IUS Student Conference Presentations (and 2016 International Carnivorous Plant Society meeting in London, England) and several talks by myself at national (Botany 2011, 2012) and international (Vienna 2005, Lyon 2004, Frostburg 2006) conferences.

Other sources and amounts of support for research you have received in the last five years.

All of my funding in the last 5 years has been internal, from IUS and from small remaining balances from previous grants IU grants which I continued to use for my various projects.

Budget

4. Other Relevant Information, If Any

Please note that, of the total requested below, any fraction could usefully promote this work.

5. Total Amount Required

Amount requested. (this should be the same as the amount on the cover page)

\$1000

Amount(s) anticipated/confirmed from other sources including other IU Southeast and IU sources: None.

Itemized budget.

Light bulb for point source device for cyanotype exposure **\$250**

Purchase of ferricyanide and other non-metal chlorides for cyanotype tests **\$200**

from an alternative photography supplier such as Bostich and Sullivan

Purchase of watercolor paper as the medium for cyanotype chemicals **\$100**

Purchase of metal chlorides **\$450** (as an example, basic grade cobalt chloride from sigma.com is \$26.70 for 25 grams; some are much more per gram, others are less; the amount requested will allow testing of 10-20 metal chlorides)