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PHYCOLOGICAL NEWSLETTER

Message from PSA President Susan Brawley

Greetings! The excellence of the scientific presentations across so many fields of science at the 2011 joint meeting of PSA/ISOP/NWAS continues to exhilarate me, and I, personally, benefited a great deal from a new element at our annual meetings: the technical workshops on genomics and sea vegetables. Look elsewhere in this Newsletter for more information on what happened in Seattle. It was particularly gratifying to have such a large turnout of the Society's membership in Seattle. The Program Committee, led by Dale Casamatta (dcasamat@unf.edu), has an equally exciting meeting "under construction" for June 27-30 in Charleston, S. C.; details about the program, plus abstract and registration due dates will be forthcoming soon at www.PSAalgae.org. Please mark your calendars and plan to attend, because we are strongest as a Society when we all network at the annual meeting.

Between Seattle and Charleston, the Society's Committees will be accomplishing a great deal on behalf of algal research, outreach, and education. One of the items in this Newsletter (p. 15) also requests members' immediate suggestions for the PSA presentation/booth at the 2nd National Science & Engineering Fair in Washington, D. C. (April 2012), including for those of you living near DC or willing to donate your travel expenses to come help, volunteers to staff the PSA booth. This is a great opportunity to reach literally hundreds of thousands of people about the importance of the algae.

As you know, I am a strong advocate of PSA engagement with the important issues of our time because I know we have many capable, expert members who can make a critical difference in achieving scientifically based solutions to some of the world's most severe problems. With this in mind, I ask that you consider the following: (continued, p. 2)

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(from p.1) **Be an advocate for scientific research:** There are few places in the world today that are not experiencing economic difficulties of one sort or another. Your appointed or elected leaders are likely to be under great pressure to cut spending on scientific research. As you have opportunities, or can make them, please consider inviting such leaders to your laboratories and talking to them about your research and why it is important. Those "personal stories" will go a long way in helping to maintain government support for scientific research that ultimately makes the Earth's people healthier and more prosperous. If you are shy, write a letter.

Share your scientific knowledge with the public: As algal scientists, we are acutely aware of the challenge that anthropogenic climate change poses to our biosphere. In the 1800s the great physical chemist Svante Arrhenius predicted anthropogenic global warming as a consequence of large-scale burning of fossil fuels during industrialization (S. Arrhenius. 1896. On the influence of carbonic acid in the air upon the temperature of the ground. Philosophical Magazine 41: 237-276). To me, this is like understanding that if you eat a certain number of calories, you will gain weight. However, Hans Paerl, in his excellent talk in the Human Impacts on Aquatic Ecosystems' symposium in Seattle, commented that the atmospheric effect of burning of fossil fuels (CO_2, CH_4, etc.) is still not understood as it should be in the US, in particular, and he offered a humorous example to supplement the "J curve" and ice core data—the decrease in mass of a certain item of women's clothing since the early 1800s —you had to be there! Phycologists understand the key role that the algae play in providing oxygen to Earth's organisms and in biogeochemical cycling of carbon. Please do not keep that knowledge under your hat—or even just in your classrooms—please communicate your knowledge respectfully to the public and to your appointed or elected officials.

Use service-learning to enhance education and recruit young algal scientists: For those of you who are professors or graduate teaching assistants, consider adding a "service-learning" component to your courses this fall or spring, and let's have a session of service learning papers in Charleston to report that student research. I backed into doing this, but there is a great deal of research that shows that students learn information better when they are doing service-learning projects that encapsulate the facts and concepts you wish them to learn. In 2010, my undergraduates helped a Maine company that sells sea vegetables determine that a competitor's product was not the species they claimed. This required the students to do DNA isolations, PCRs, edit and BLAST sequences, and microscopic studies of vegetative and reproductive anatomy that led to the triphasic life history of florideophytes being second nature to them. In 2011, another class did a month-long project to identify a nuisance green algal bloom in upper Penobscot Bay for Maine's Department of Environmental Protection. In both cases, the students put together Power Point presentations and went to the company/state agency to present their results. Gratifying to them? YES! My department paid for one student to come to Seattle to present the research as a paper at the PSA meetings; he had just finished his sophomore year in college. What better way to serve our local communities in the next year while building interest in algal careers?

I'll close by reminding you that we are having a large membership drive and also of the continuing fund-raising campaign. You will hear more of the 2012 Membership Campaign from Deborah Robertson (Membership Chair) soon, but in essence, we want to use 2012 to take our membership from its present level to at least 2,012. This only requires each member to recruit one new student, postdoc or professional colleague. Let's achieve this early in 2012! The campaign to raise funding to offset the currently low interest rates on the Endowment in order to maintain our superb level of funding for student grants, summer course tuition, and travel to the annual meeting is going well—the kelp (www.PSAalgae.org) is turning brown! —not least because the 2011 PSA Award of Excellence awardee Elisabeth Gantt immediately donated her $2,000 prize to the campaign. Please do your part, too. Have a great fall/spring, wherever you are!

Susan H Brawley

Awardees Honored at the 2011 PSA Annual Meeting

Beth Gantt received the PSA Award of Excellence in Seattle.

The PSA Award of Excellence (highest honor of the Society):

Elisabeth Gantt

(Professor Emerita and Distinguish University Professor,

University of Maryland)

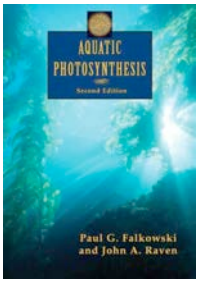
Dr. Gantt's numerous contributions to phycology span nearly 50 years and include the discovery of the distinctive localization of the phycobiliproteins in rhodophytan and cryptophytan chloroplasts, with studies leading to the isolation, purification, and characterization of *Porphyridium cruentum* and cyanobacterial phycobilisomes. More recently, she has contributed to the understanding of different aspects of the biosynthesis and roles of carotenoids. She continues to move into new fields, as exemplified by her current involvement in the *Porphyra umbilicalis* genome project. In 1994 she received the Gilbert Morgan Smith Medal from the U.S. National Academy of Sciences and was subsequently elected to the U.S. National Academy of Sciences in 1996.

Dr. Gantt has been an outstanding member of the PSA, serving as an Associate Editor of the *Journal of Phycology*, Vice-President (1977) and President of the PSA (1978), and editor of the PSA's classic *Handbook of Phycological Methods: Developmental and Cytological Techniques* (1980). She currently serves on the PSA Elections' Committee (2010-2012). In addition to her dedicated efforts for the PSA, she also has provided important service to the Botanical Society of America, the American Society of Plant Biologists (including as President), the National Academy of Sciences, the American Institute of Biological Sciences, and the National Research Council.

A complete list of past awardees can be found at the PSA web site.

The 2007-2008 Gerald Prescott Award

(best phycological monograph):



Paul Falkowski (Rutgers University)
and

John Raven (University of Dundee)

for

Aquatic Photosynthesis (2nd ed)

John A. Raven gave an acceptance speech for the 2007-2008 Prescott Award (photo by Michael Wynne).

The 2009-2010 Gerald Prescott Award

(best phycological monograph):

A tie between two books, given equal prizes:

Elizabeth Harris (Duke University) for

The *Chlamydomonas* Sourcebook (2nd ed.)

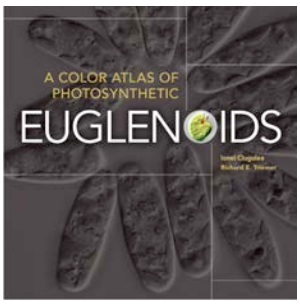
and

Ionel Ciugulea (Michigan State University) and **Richard E. Triemer** (Michigan State University)

for

A Color Atlas of Photosynthetic Euglenoids

Awardees for the 2009-10 Prescott Award, Richard Triemer (left) and Ionel Ciugulea (right). Elizabeth Harris, winner of the second award, is not pictured.



PSA Awardees, continued.

2010 Luigi Provasoli Award (Best Paper published in the Journal of Phycology):

Frederick W. Zechman, Heroen Verbruggen, Frederik Leliaert, Matt Ashworth, Mark A. Buchheim, Marvin W. Fawley, Heather Spalding, Curt M. Pueschel, Julie A. Buchheim, Bindhu Verghese, M. Dennis Hanisak (2010) An Unrecognized Ancient Lineage of Green Plants Persists in Deep Marine Waters. *Journal of Phycology* 46: 1288-1295.

On behalf of all of the authors, coauthors (left to right) Matt Ashworth, Curt Pueschel, Marvin Fawley, Dennis Hanisak, and Rick Zechman were presented the Luigi Provasoli Award in Seattle (photo by Michael Wynne).

Congratulations!

2011 Darbaker Award (Botanical Society of America prize for meritorious work on microscopic algae; a PSA Committee determined awardee at BSA's request):

Sallie (Penny) Chisholm (MIT)

PSA President Susan Brawley (left) honors Robert G. Sheath, Editor of the *Journal of Phycology*, with a small expression of our appreciation for his years of dedicated service. Bob began his term as journal editor in September of 2006 and will complete his term in December of 2011.

Thank you, Bob!

PSA Awardees, continued.

Harold Bold Award (Best student oral presentation at annual meeting):

In this 38th year of the **Harold C. Bold Award**, the PSA meeting in Seattle had one of the highest number of presenters, 24. The talks covered a wide range of topics from the molecular systematics of the diverse domains of algae to algal ecology, biomechanics and molecular cell biology. The five judges were unanimous in selecting two co-winners, **Philip Bucolo** from the Amsler lab at University of Alabama, Birmingham, for a talk entitled, "Effects of macroalgal chemical extracts on spore behavior of the Antarctic epiphyte *Elachista antarctica*" and **Elizabeth Tobin** from the Grunbaum and Cattolico labs at the University of Washington for a talk entitled, "Motility during pelagic-benthic life-stage transition for the harmful alga *Heterosigma akashiwo* and the implications for bloom dynamics". The judges were impressed with the thoughtful and well-executed experimental designs that enabled these young scientists to clearly test their hypotheses.

Philip Bucolo (left) was a co-winner of the Harold C. Bold Award for best student oral presentation at the 2011 PSA meeting. Bucolo is depicted with Bold Award Chair Paul Gabrielson (right) (photo by Michael Wynne).

Elizabeth D. Tobin was the other co-winner of the PSA 2011 Harold C. Bold Award (photo by Ryan Harris).

Ralph Lewin Award (Best student poster presentation at annual meeting):

The **Ralph A. Lewin Award** went to **Ken Hamel** (at left, next to Lewin Award Chair Paul Gabrielson) from the University of Hawai'i at Manoa. The poster was entitled, “Effects of nitrogen on rates of photoacclimation by invasive and native species of *Gracilaria* (Rhodophyta).”

Congratulations to all the participants, their mentors and the awardees!

Paul Gabrielson, Chair,
Bold and Lewin Awards Committee

Congratulations, Students!

Visit http://psaalgae.org/website/opportunities/grants.html for information about upcoming application deadlines.

In the last year PSA provided over $25,000 to students conducting research (GIAR), attending algae field courses (Croasdale Fellowship), and traveling to the annual conference to present their research (Hoshaw Travel Award). Below is a list of this year's awardees, reported by Eric Linton, Chair of the Student Grants and Fellowships Committee.

Grants-in-Aid of Research (GIAR)

Matt Ashworth
University of Texas at Austin / Section of Integrative Biology
Advisor: Edward Theriot
Project: Sequencing cladophoralean chloroplast genomes through next-generation high-throughput sequencing technology

Kylla Benes
Northeastern University / Marine Science Center
Advisor: Matthew Bracken
Project: Characterization and ecological consequences of the *Fucus* species complex on Northwestern Atlantic rocky shores

Niclas Engene
Scripps Institution of Oceanography, University of California, San Diego
Advisor: William Gerwick
Project: Taxonomy and biosynthetic evolution of tropical marine cyanobacteria of Panama

Heather Hunsperger
University of Washington
Advisor: Rose Ann Cattolico
Project: Maintenance and loss of genetic redundancy in the chlorophyll synthesis pathways of diverse algal lineages

Emily Johnston
Ohio University / Department of Environmental and Plant Biology
Advisor: Morgan Vis
Project: Revision of the genus *Thorea* using molecular and morphological data

Sophie McCoy
University of Chicago / Department of Ecology and Evolution
Advisor: Catherine Pfister
Project: The Influence of ocean acidification on crustose coralline red algae (Rhodophyta, Corallinaceae) physiology and species interactions

Sutinee Sinutok
University of Technology, Sydney / Department of Environmental Sciences
Advisor: Peter Ralph
Project: Biomechanical consequence of ocean acidification, ocean warming and increasing storm severity of the reef-building alga *Halimeda* sp.

Croasdale Fellowship

Lauren Fuelling
Ohio University / Department of Environmental and Plant Biology
Advisor: Morgan Vis
Field Station: Iowa Lakeside Laboratory; University of Iowa
Course: Ecology and Systematics of Diatoms, 00L 217

Emily Nodine
Florida International University / Department of Biological Sciences and Southeast Environmental Research Center
Advisor: Evelyn Gaiser
Field Station: Iowa Lakeside Laboratory; University of Iowa
Course: Ecology and Systematics of Diatoms, 00L 217

Joseph Richards
University of Louisiana at Lafayette / Department of Biology
Advisor: Suzanne Fredericq
Field Station: Friday Harbor Laboratories; University of Washington
Course: Marine Algae, Biology 539

Carrie White
University of British Columbia Okanagan / Biology, and Earth & Environmental Sciences
Advisor: Ian Walker
Field Station: Iowa Lakeside Laboratory; University of Iowa
Course: Ecology and Systematics of Diatoms, 00L 217

Hoshaw Travel Award

Katie Anderson
Western Washington University
Advisor: Kathryn Van Alstyne

Stephanie Brunelle
Medical University of South Carolina
Advisor: Frances Van Dolah

Philip Bucolo
University of Alabama at Birmingham
Advisor: Charles Amsler

Sophie Charvet
Université Laval
Advisor: Connie Lovejoy

Karolina Fučíková
University of Connecticut
Advisor: Louise Lewis

Michele Guidone
University of Rhode Island
Advisor: Carol Thornber

Talina Konotchick
Scripps Institution of Oceanography, UCSD
Advisor: Paul Dayton

Schonna Manning
The University of Texas at Austin
Advisor: John La Claire

Ruth McDowell
The University of Alabama at Birmingham
Advisor: Charles Amsler

Kevin Miklasz
Stanford University
Advisor: Mark Denny

Ian Misner
University of Rhode Island
Advisor: Chris Lane

Amanda Savoie
University of New Brunswick
Advisor: Gary Saunders

Kate Schoenrock
University of Alabama at Birmingham
Advisor: Charles Amsler

Pia Tahvanainen
University of Helsinki
Advisor: Anke Kremp

Krystle Wiegert
Michigan State University
Advisor: Richard Triemer

Cooking with Sea Vegetables

Prannie Rhatigan in the kitchen.

It is a rare occurrence that my two pleasures in life, science and food, are combined together in a single event. I was pleasantly surprised to find just the workshop to whet my appetite at the 2011 PSA meeting: a "Sea Vegetable Cooking Demonstration," led by Dr. Prannie Rhatigan, G. P., accomplished chef and author of **The Irish Seaweed Kitchen**. Without a second thought, I signed up for what was a fantastic exploration of ways to use seaweeds in the kitchen.

I have long been an advocate of sampling seaweeds in the field and fully believe in experiencing seaweeds with all of your senses, including taste. When I take students in the field, I always have them eat some *Porphyra*, or tell them about all of the different ways the food industry utilizes algae. But saying that algal-derived agar is a food additive in ice cream is completely different from eating a dish that highlights the flavor profile and texture of the algae itself. This perspective and taste experience was exactly what Prannie gave us in her 90 minute demonstration- the realization that seaweeds can be the highlight of a dish, rather than a hidden behind-the-scenes player.

The workshop was held in the fully-equipped demonstration kitchen at Seattle Pacific University. The workshop started with shots of a seaweed smoothie, a delicious breakfast made to jumpstart your day. We sipped our fluorescent green smoothies made with *Alaria esculenta*, the wing kelp, while Prannie told us about the nutritional value packed inside this brown alga. Next we moved on to my new favorite snackfood, dulse (*Palmaria palmata*). This seaweed is simply amazing; when dried it has a texture like fruit leather and a totally unique and savory taste. Prannie lightly fried this seaweed to make dulse chips, the perfect snack food. Then it was our turn to cook. Prannie walked us through her dulse-cheese scone recipe, which tasted absolutely delicious. We made way more scones than we could possibly eat, so we brought some of the freshly baked algae scones back to the catered refreshment table at the conference. I watched in amazement as people picked up and ate the scones, without realizing that algae were a main ingredient in the scones or that they were made just an hour before by fellow scientists.

The ending of the workshop was perhaps the most fantastic part. While our scones were baking, Prannie made a wing kelp, fruit and bean salad, explaining how the molecules from the kelp complemented both the flavor and texture of the dish by softening the harsh skins of the beans. I was surprised to learn that seaweeds were not a particularly new fashion of Prannie's but were a long part of her family's Irish heritage. Collecting algae during low tide for later consumption is common in Northern Ireland and a component of many traditional dishes. Thus in appropriate traditional Irish fashion, we ended the workshop by sipping some Irish breakfast tea (kindly brought over the pond by Prannie) with our scones and salad, as Prannie entertained us with an Irish step dance.

The workshop was without a doubt a highlight of the conference for me. Not only was it a highly informative exploration of seaweeds in the kitchen, but more importantly it was an extremely delicious one.

Kevin Miklasz

Hopkins Marine Biology Station

Cannellini Bean Salad with Marinated *Alaria*

(Reprinted with permission from Prannie Rhatigan's **The Irish Seaweed Kitchen** [www.prannie.com]; this recipe was demonstrated and eaten at the Sea Vegetable Cooking Workshop during the Seattle PSA meeting).

Seaweed used: *Alaria*

(a kelp; see below for instructions on using dried *Alaria*, which is available from various suppliers in many grocery stores, including Maine Coast Sea Vegetables' product at Whole Foods or by direct order www.seaveg.com; MCSV donated product for the workshop and the PSA's Sustainable Seafood Dinner at the University of Washington Faculty Club).

Serves 4

25 g (1 oz) raisins

Juice of 2 lemons

100 ml (3 ½ fluid oz) olive oil

½ onion

2 garlic cloves, chopped finely

½ red chilli, seeds removed, sliced finely

¼ teaspoon black onion seeds

450 g (1 lb) cooked cannellini beans or 2 tins

2 bananas

½ a mango, fresh, cubed or chopped roughly

Marinated *Alaria*

Large fistful coriander leaves, chopped

Coriander leaves to decorate

To prepare marinated *Alaria*

Alaria needs to be simmered for around 40 minutes because the midrib is quite tough*. Marinated *Alaria* can be used to stir through other salads, or as a side dish with grains.

2 x 15 cm (6 inch) pieces of fresh *Alaria* cut into 1-2.5 cm (1/2-1 inch) pieces or same length (about 3 g) or dried *Alaria*, snipped as above.

1 tablespoon tamari or soy sauce

3 garlic cloves, crushed

2 teaspoons honey

1 tablespoon tamari or soy sauce

3 garlic cloves, crushed

2 teaspoons honey

1 tablespoon olive oil

1 teaspoon grated ginger

A dash of toasted sesame oil

*Note from Prannie: the *Alaria* from Maine Coast Sea Vegetables was really tender and needed a very short simmer to soften the midrib.

Soak the *Alaria* in just enough tepid water to cover it for 20 minutes

In a small saucepan, combine the rest of the ingredients except for the sesame oil and boil for 1 minute over moderate heat.

Add the *Alaria* and a little of the soaking water to the saucepan and bring back to the boil, uncovered. Simmer for 40 minutes or until the midrib is very tender.

Add a little more of the soaking water, if needed , and continue to boil until the midrib is very soft.

Remove from the heat, add a dash of toasted sesame oil and taste for sweetness, adding more honey if needed.

To prepare the cannellini bean salad

Soak the raisins in lemon juice to allow them to plump up

Heat the oil in a large frying pan and sauté onion until transparent. Add the garlic, chilli and onion seeds and sauté for 2-3 minutes. Set aside to cool.

Rinse the cannellini beans under cold running water, drain well and place in a large bowl.

Add the lemon juice and raisins stirring to coat the beans. Toss in the cooled onion and chilli. Slice the bananas and toss in immediately to prevent blackening. Add the mango, marinated *Alaria* and coriander. Mix gently and decorate with the coriander leaves.

Celebrating Bob Guillard's 90th

Robert R.L. Guillard celebrated his 90th birthday on February 5, 2011. Even at this age, Bob is an active Emeritus Senior Research Scientist at the Bigelow Laboratory for Ocean Sciences in West Boothbay Harbor, Maine. Guillard is famous for his f/2 medium that is used for growing marine algae, and f/2 medium played a major role in the domestication of marine phytoplankton for use in aquaculture hatcheries (Wikfors and Ohno 2001). Guillard also developed several other growth media in his "alphabet series" and the best-known are h/2, K and L1.

Bob was born Robert Louis Russell on February 5, 1921, in New York City. His mother was of Portuguese descent and his father was of Scots-Irish descent. Bob's parents were divorced when he was an infant, but his mother married François Guillard, a New York City jeweler. François was of French Swiss Huguenot descent. While working for the US Navy, Bob's two middle names became switched on an official document, and he has been "Robert R.L." ever since. Guillard has been married the past 48 years to Ruth (née Fredericks). The Guillard home in Boothbay, Maine, is a 19th century farmhouse surrounded by 50 acres of mature forest.

Guillard completed grammar school in seven years, graduated from the prestigious Townsend Harris High School in three years, and entered City College New York (CCNY) at the age of 16. Bob received his Bachelor's of Science degree in 1941 at age 20 and he was immediately hired by the U.S. Navy to install and maintain anti-magnetic mine equipment. After World War II, he returned to academia where he was hired as an Instructor at New York University and as a Tutor at CCNY. Bob began graduate studies at Yale University in 1949, receiving a Master's Degree in 1951 and a Ph.D. in 1954. His dissertation was titled "A mutant of *Chlamydomonas moewusii* lacking contractile vacuoles." Bob mentions the works of Grassé (1952) and Konrad and Kufferath (1954) as influential in his career choice of marine phytoplankton (he initially began graduate studies on plant/fungal relationships). After receiving his Ph.D., Guillard was hired as a research associate (= research assistant professor) at the University of

Bob Guillard, August 2008
(photo by Ruth Guillard).

Hawaii. In late 1955, he was hired as an Aquatic Microbiologist by the Oyster Institute of North America, and he worked at the U.S. Fish and Wildlife Service Marine Laboratory, Milford, Connecticut. In 1958, Bob was recruited and hired by Woods Hole Oceanographic Institution. Guillard made his final relocation in 1982 when he moved to Bigelow Laboratory for Ocean Sciences, which is located in West Boothbay Harbor, Maine. Much of Guillard's career involved culturing algae, and his isolate of *Thalassiosira pseudonana*, strain 3H or CCMP1335, was the first eukaryotic alga to have its genome sequenced (Armbrust et al. 2004).

(continued, p. 11)

Bob played a significant role in the algal physiology era (ca. 1950s to 1970s), including the autecology of marine phytoplankters and the role of trace metals in oceanic primary productivity. Guillard published 114 peer-reviewed publications, including six publications in *Nature* and one in *Science*. A full list of Guillard's publications can be found in an on-line supplement to the November 2011 issue of *Limnology and Oceanography Bulletin* (V. 20, Issue 3) at http://www.aslo.org/bulletin/11_v20_i3a.pdf.

Bob was instrumental in establishing what is now the world's largest collection of marine phytoplankton, which is named in his honor (Provasoli-Guillard National Center for Culture of Marine Phytoplankton). In 1992, Public Law 102-587 (Oceans Act of 1992) designated the Provasoli-Guillard CCMP as a National Center and Facility. Among many awards, Bob received the Darbaker Award in 1969 (with James Craigie), an honorary Life Membership in the National Shellfisheries Association in 1995 (see Wikfors 1996) and an honorary Life Membership in the World Aquaculture Society in 1998 (see Anonymous 1998). His students and colleagues further honored Bob in two issues of Biological Oceanography [1988/1989: Vol. 6 (3/4): 241-511]. Several taxa have been named in his honor: the cryptophyte genus *Guillardia*, and three phytoplanktonic species (*Mastogloia guillardii*, *Pycnococcus guillardii*, *Thallasiosira guillardii*). Bob was also a prolific taxonomist, naming the family Pycnococcaceae and genus *Pycnococcus* (*P. provasolii*). With others, he named *Bellerochia polymorpha*, *Bellerochia spinifera*, *Chlorella capsulata*, *Chlorosarcinopsis halophila*, *Cyclotella cryptica*, *Fragilaria rotundissima*, *Halochlorococcum saccatum*, *Oocystis minuta*, *Skeletonema menzelii*, *Synedra fragilarioides*, and *Thalassiosira stellaris*.

Guillard supervised five Ph.D. students (Larry E. Brand, Kenneth C. Haines, Dorothy G. Swift, William G. Sunda, and Alan W. White). Bob was also an advisor or committee member for 13 other students (M.A. Anderson, R.J. Buchanan, Catherine T. Enright, M.A. Farmer, R.A. Fisher, J.A. Geiselman, Diane McKnight, Maureen D. Keller, R.C. Schenck, J.R. Sears, D.R. Stoll, Mark L. Wells, Gary A. Wikfors.) Bob taught or lectured in a broad range of academic courses, e.g., Phytoplankton Ecology (Friday Harbor Laboratories), Experimental Marine Botany (MBL, Woods Hole), Marine Mariculture (MBL, Woods Hole), and Phytoplankton Culturing Techniques (Bigelow Laboratory).

The stories involving Bob Guillard are legendary, and these emphasize his wit, frugal nature, propensity for collecting "stuff", seasickness, road-killed animals, shooting and gun collecting, and arts/culture to mention but a few. His collegiate fencing (he was team captain) and his decadal musical activities with lutes and guitars seem irreconcilable with his avid rifle and pistol shooting or his frequent inquiries about freshly killed animals along the road. But these are only a few of the many complexities and contradictions that flavor the life and personality of Bob Guillard. Despite his being frugal and his being a collector of the most amazing assembly of worthless matter, Bob is an exceptionally generous person. For decades, he has given substantially to worthy causes, and from the scientific prospective, Bob has always given very freely his time, knowledge, brilliance and humor. Because Bob always has time for everyone, even a stranger, his life is filled with friends. Our best wishes to Bob as he passes through age 90 on the way to ... to what? Well, something extraordinary, I am sure!

Literature Cited

Anonymous 1998. Honorary Life Memberships Awarded. *World Aquaculture* June 1998: 11-12.

Armbrust, E. V. et al. 2004. The genome of the diatom *Thalassiosira pseudonana*: Ecology, evolution and Metabolism. *Science* 306 (5693): 79-86.

(continued, p. 12)

Guillard, continued.

Conrad, W. and Kufferath, H. 1954. Recherches sur les eaux saumâtres des environs de Lilloo. II. Partie descriptive. Algues et protistes. Considérations écologiques. *Méms Inst. r. Sci. natur. Belg.* 127: 1-346 (14 plates, 27 tables).

Grassé, P.P. 1952. *Traité de Zoologie. Anatomie, systématique, biologie.* Tome I, Fasc. 1. Protozoaires: généralités. Flagellés. Masson, Paris. 1071 pp.

Guillard, R.R.L. 1988. The Center for Culture of Marine Phytoplankton: History, Structure, Function and Future. *J. Protozool.* 35: 255-256.

Guillard, R.R.L. and J.H. Ryther. 1962. Studies of marine planktonic diatoms. I. *Cyclotella nana* Hustedt and *Detonula confervacea* (Cleve) Gran. *Can. J. Microbiol.* 8: 229-239.

Wikfors, G.H. 1996. Robert R.L. Guillard, Honored Life Member, National Shellfisheries Association. *J. Shellfish Res.* 15: 533-534.

Wikfors, G.H. and Ohno, M. 2001. Impact of algal research in aquaculture. *J. Phycol.* 37: 968-974.

Robert A. Andersen

Upcoming Conferences, Courses, Workshops

2011 Southeastern Phycological Colloquy (SEPC) Soon!

Registration is open for the 33rd Annual Southeastern Phycological Colloquy hosted by the Marine Macroalgae Research Laboratory of Florida International University **Friday, October 14-Saturday, October 15, 2011**. Please complete the online registration form located at www.marinemacroalgae.com with your intent to attend and/or submit an oral or poster presentation by 5 pm on **September 15**. All registration fees (detailed on the website) should be postmarked by **October 1st**.

We look forward to seeing you in Miami for some phycological fun!

Questions? Visit our website at www.marinemacroalgae.com for detailed information on colloquy schedule, registration fees and event location or contact organizers: Ligia Collado-Vides (colladol@fiu.edu) or Elizabeth Lacey (elacey@fiu.edu).

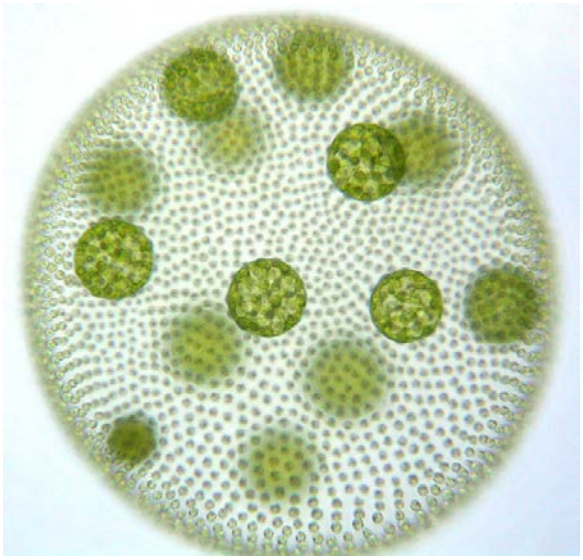
PSA GRANTS-IN-AID OF RESEARCH

Grants-in-Aid of Research awards are made in amounts of up to $1,500 by the Phycological Society of America in support of graduate student research in any area of phycology. Awards are intended to enable the student to accomplish work not otherwise possible. Awards are made directly to the student. No part of the award may be used to pay indirect costs to the applicant's institution, or to pay stipends. Selection of recipients will be based primarily on the applicant's research proposal and two supporting letters. Additional criteria will include evidence of past research achievements and the perceived future of the applicant as a researcher. In the course of a student's graduate education, no more than two grants in aid of research will be awarded. Travel to scientific meetings should be requested from other PSA programs. Tuition and expenses for taking critical techniques courses not available at the home institution will be considered. Applicants must submit one electronic copy of a brief research proposal, a proposed budget and two letters of recommendation to Eric Linton (email) by the deadline, **November 1, 2011.**

Upcoming Conferences, continued.

1st International *Volvox* Conference

Please join us for the 1st International *Volvox* Conference (focused on the green alga *Volvox* and its close relatives) to be held **December 1-4, 2011** at the Biosphere 2, in Arizona, USA (http://www.b2science.org/). This is the first of what we hope to be a long series of *Volvox* meetings to be held every other year, alternating with the *Chlamydomonas* meetings. The idea of a meeting on everything about *Volvox* and its relatives (aka Volvocales or volvocine algae; see http://www.unbf.ca/vip/index.htm) reflects both an increase in the size of the *Volvox* community and the realization that many researchers from fields traditionally not associated with *Volvox* research (e.g., physics, theoretical biology) are interested in various aspects of the system. Volvocine algae have become an important model system for the evolution of multicellularity, development and cellular differentiation, and lately have yielded important results in fields as diverse as genomics, hydrodynamics, and social evolution. We hope that such a meeting will foster exchange of ideas and expertise, and will initiate new collaborations. With these meeting we also wish to attract new people and to build a stronger *Volvox* community. In addition to sessions (contributed papers and posters) on various aspects of the biology, taxonomy, ecology, development and evolution of *Volvox* and its relatives, we are organizing a workshop on *Volvox* genetics and genomics that will provide a forum to discuss emerging tools and methods (or ways of adapting those that have been developed in other systems) to enhance our understanding of genetically-controlled processes in this group of algae. For additional information and updates (including preliminary program, registration and abstract submission deadlines) please visit the Conference page at http://www.unbf.ca/vip/IVC/index.htm).



Volvox carteri (photo by A. Nedelcu)

PSA 2012

We are pleased to announce that the 2012 annual PSA meeting shall be held in historic Charleston, SC from June 27-30, 2012. We have several excellent workshops tentatively scheduled, including microscopy techniques, genomics tools and one employing the statistical package Primer. The planning committee is finalizing the symposia, and shall have the topics and speakers posted in the near future on the PSA web site (www.psaalgae.org). If you have any questions/ comments/ suggestions please do not hesitate to contact either the Program Director Dale Casamatta (dcasamat@unf.edu) or Local Organizer Jack DiTullio (DitullioJ@cofc.edu).

APCAB 2012: Algae for the Future

Join us for the 8th Asia-Pacific Conference on Algal Biotechnology, 9 – 12 July 2012, at the Adelaide Convention Centre.

More details can be found at: www.sapmea.asn.au/apcab2012

Obituary: Dr. Franklyn D. Ott (1935-2011)

Franklyn Ott, on Martha's Vineyard, summer of 1965 (photo courtesy of Hollings T. Andrews).

It is with regret that we inform you of the death of Dr. Franklyn D. Ott at the age of 75. Franklyn was a loyal member of the Society for many years. He was born August 29, 1935, in Front Royal, Virginia, and passed away on July 30, 2011, in Topeka, Kansas. He earned a joint Bachelors Degree in Biology and Chemistry from Lynchburg College in 1964 and went on to earn his PhD degree from the University of Kansas in 1970 under the supervision of Dr. Rufus H. Thompson, thus an “academic grandson" of Gilbert Morgan Smith. It was while a grad student that he met and married Aleta Jo Petrik, who earned her own PhD in pteridology. They were always a devoted couple and supported one another’s research efforts. I recall running into them (more than once) during Christmas holidays in the library of the Missouri Botanical Garden, using the great resources available there. Over his career he was employed at several places, including the Virginia Institute of Marine Science; the Marine Biological Laboratory in Woods Hole, Massachusetts; Memphis State University; and Texas A & M University. He had an “eagle eye” for rare algae, finding the rare *Porphyridium sordidum* Geitler in several greenhouses in North America (1987, Arch. Protistenk. 134: 35-41) and making the first report of Geitler’s *Rhodosorus marinus* in the western hemisphere (1967, J. Phycol. 3: 158-159). He got credit for the description of the new genus, new species, *Flintiella sanguinea* from Barton Springs, Austin, Texas (1970, Bourrelly, Les algues d'eau douce, Tome III). He published on *Porphyridium* (1972, Nova Hedw. 23: 237-289). He demonstrated his scholarship with his analyses of two of Eugen Esper’s treatises (1989, Taxon 38: 204-215; 1995, Ann. Naturhist. Mus. Wien 97B: 1-36). His greatest passion was always the freshwater red algae, and in 2009 he published a massive “Handbook of the taxonomic names associated with the non-marine Rhodophycota” (969 pp., J. Cramer, Berlin & Stuttgart). Going back to his time in Lawrence, Kansas, and at Woods Hole, he always had a keen interest in culturing algae. Even in his retirement he continued to maintain his many cultures of algae, using his wife’s pressure cooker in the kitchen to sterilize glassware. He collaborated with Nozaki & Coleman in describing two new species of *Pleodorina* (2006, J. Phycol. 42: 1072-1080) and with Scott, Baca and West in describing a new genus of red algae, *Erythrolobus*, dependent on Franklyn’s maintaining two cultures (from Texas and Washington) since the 1970s (2006, Algae 21: 407-416). Following Aleta Jo’s death in August, 2009, Franklyn’s own health declined, and he really never recovered from that loss. He designated that memorial contributions could be made to the Phycological Society of America Endowment. His algal cultures had been transferred to the Bigelow Laboratory for Ocean Sciences in West Boothbay Harbor, Maine, and to The Culture Collection of Algae at the University of Texas, Austin.

M. J. Wynne
University of Michigan Herbarium

PSA Outreach

Algae will take the stage, or at least fill a booth, at the *Second USA Science and Engineering Festival* in Washington, DC, on April 27-29, 2012. The Executive Committee of PSA decided that our Society should be part of what should be one of the premier public science events of the year. The Festival is a free event first held in 2010, when over 500,000 people attended a weekend celebrating science education and research. The first Festival had public lectures, performances, exhibits, and school events filling the mall and convention center with robots, flight simulators, Einstein impersonators, exhibits on biodiversity, and countless other immersive events. The Festival mission, stated on the web site (http://www.usasciencefestival.org/about/mission) is "to re-invigorate the interest of our nation's youth in science, technology, engineering and math (STEM) by producing and presenting the most compelling, exciting, educational and entertaining science gatherings in the United States." And in 2012, PSA will be there.

The 2012 Festival should be even bigger than the first, with even more exhibits, including a book fair. The PSA is an official partner for the Festival, joining dozens of other scientific societies, government agencies, universities, industry, and K-12 schools in support of science in the USA.

PSA has rented a 10 x 10 foot booth, with a table, chairs, and electricity. Beyond that, the booth will be limited only by our creativity in putting algae and algal science on public view. With many good (biofuels and food) and bad (harmful blooms in lakes and oceans) images of algae in the news, PSA hopes to present the diversity and value of algae for science, education, and society to the huge crowds expected at the Festival. PSA members from several PSA committees are organizing the event and need additional volunteers and your ideas on what the PSA's display should be. Chairs Walter Adey (AdeyW@si.edu) and Charlie Yarish (charles.yarish@uconn.edu)welcome your suggestions for activities and exhibits that will excite visitors. So far we expect to have live algal specimens, microscopes, banners, and hands-on activities on micro-algae and seaweeds. So think outside the box and inside the booth to make the display an exciting promotion for our science and our society.

A Preview for Congressional Representatives and local schools will take place on Friday, April 27th, and the public is invited on Saturday and Sunday. That means about 24 hours of booth-time needs to be supplied to talk to visitors. **Volunteers are needed to help host the booth for 1-2 hour shifts, so if you're interested in helping bring phycology to probably the largest public audience in history, contact Charlie Yarish and Walter Adey.**

Check for more information on the PSA website www.psaalgae.org in the coming months. For more information on the USA Science and Engineering Festival visit the web site at http://www.usasciencefestival.org/. (To see PSA's logo, look under the drop down menu for "About" and click on "2012 Partners.")

--Rick McCourt (Committee Member)

Phycological Trailblazer No. 35: Francis Wolle

The Rev. Francis Wolle (1817-1893) (Fig. 1) was an early American phycologist and microscopist who deserves our attention because of his numerous contributions and detailed observations that were made under modest circumstances. He was responsible for literally hundreds of first reports of algal taxa belonging to all categories of the freshwater flora of North America. He also described numerous new species and varieties and a pair of new genera.

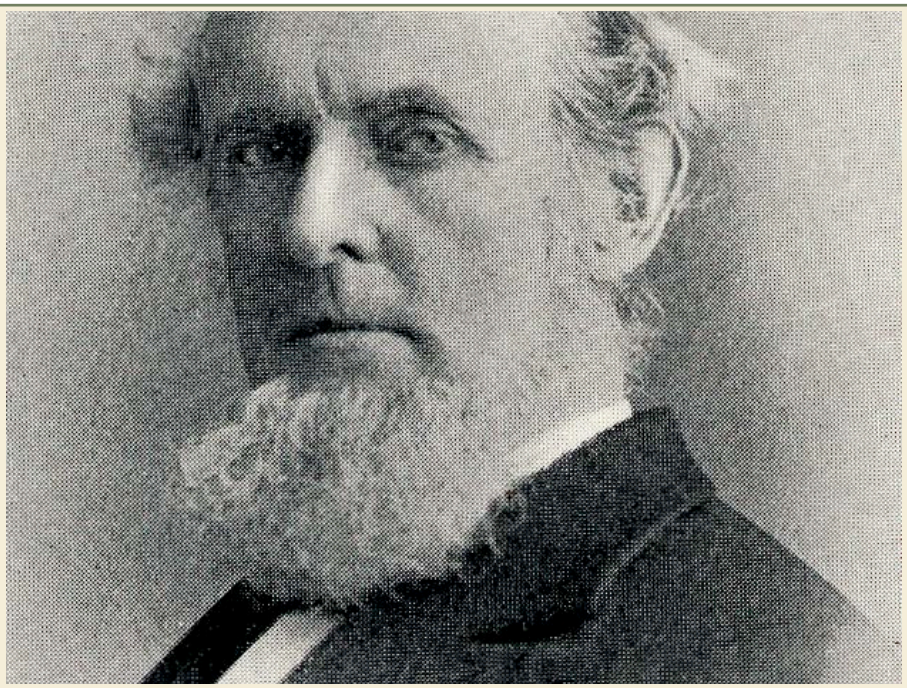


Fig. 1. Rev. Francis Wolle.
(from Harshberger, 1899, photograph by E. A. Rau.)

Francis Wolle was born on 17 December, 1817, in Jacobsburg, Northampton County in eastern Pennsylvania, and for his entire life he was closely associated with the Moravian Church. His first job was as a clerk in his father's store. Later, in 1839, he became a teacher, first at Nazareth Hall, a Moravian preparatory school, and subsequently in Bethlehem, Pennsylvania. In 1857, Wolle became a vice-principal of the Moravian Seminary for Young Ladies. By 1861, he was elevated to principal and was also ordained as deacon in the Moravian church. With an innate ability and a fierce determination, Wolle saw the school make it through the years of the Civil War followed by the difficult post-War circumstances of high inflation and related problems. He continued with the Moravian seminary until 1881, when the infirmities of age had taken their toll and caused him to retire to a less demanding schedule.

Fig. 2. Rev. Francis Wolle at his monocular microscope.

Wolle had a restless, inquisitive nature,

and both his younger years and his later years were occupied with his love for things botanical. In and around the countryside of Bethlehem, he had ample access to the beauties of nature. He had a passion both for botany and entomology. Northampton County is located in the Lehigh Valley, extending from the Pocono Mountains as its northern border to the Delaware River, which separates Pennsylvania from New Jersey. It was an ideal region to pursue natural history on weekends. He gradually immersed himself in bringing home his collections of botanical specimens, including plankton samples, and in using a monocular microscope (Fig. 2) to make observations, eventually compiling hundreds of sketches of his observations. A steady stream of Notes began appearing in the Bulletin of the Torrey Botanical Club starting in 1876. Eventually, ten such notes were published up through 1884.

The background of research on freshwater algae of the U.S. was then very limited. Dr. Jacob Bailey of West Point [Phycological Trailblazer No. 18 (Wynne, 2003)] had published a couple of papers on desmids. Another important milestone in North American freshwater phycology had been the publication by Horatio C. Wood (1872), who was profiled as Phycological Trailblazer No. 15 (Wynne, 2001). Wood brought together previous records and observations that had been made up to that time for the entire country, which included 160 species of desmids, many depicted in his colored plates.

In Wolle's (1876) first "Notes", he described many new species of the desmid genera *Cosmarium*, *Micrasterias*, and *Staurastrum*, all within a 20-mile "circuit" around Bethlehem, Pennsylvania, thus, not far from home. Wolle (1877a) presented a lengthy list of those species that were thought to be entirely new discoveries for the United States. He followed the nomenclature of Dr. G. L. Rabenhorst and "others of the German school", while accepting the then-current names of Thuret & Bornet (1875) for members of the "Nostochinées".

Wolle's (1877b) Notes III listed 150 "forms" new to the United States, a list that included 24 entirely new species and a pair of new genera. The new genus *Kalodictyon* (based on *K. margaritatum* sp. nov. and assigned to the "Chlorophyllophyeae") was found on *Potamegeton* in slow river waters in Bethlehem, Pennsylvania. Wolle's *Kalodictyon* is not to be confused with two other algal names. *Calidictyon* of Greville (in Lindley, 1836) or *Callidictyon* of Norris and Abbott (in Norris et al., 1955).

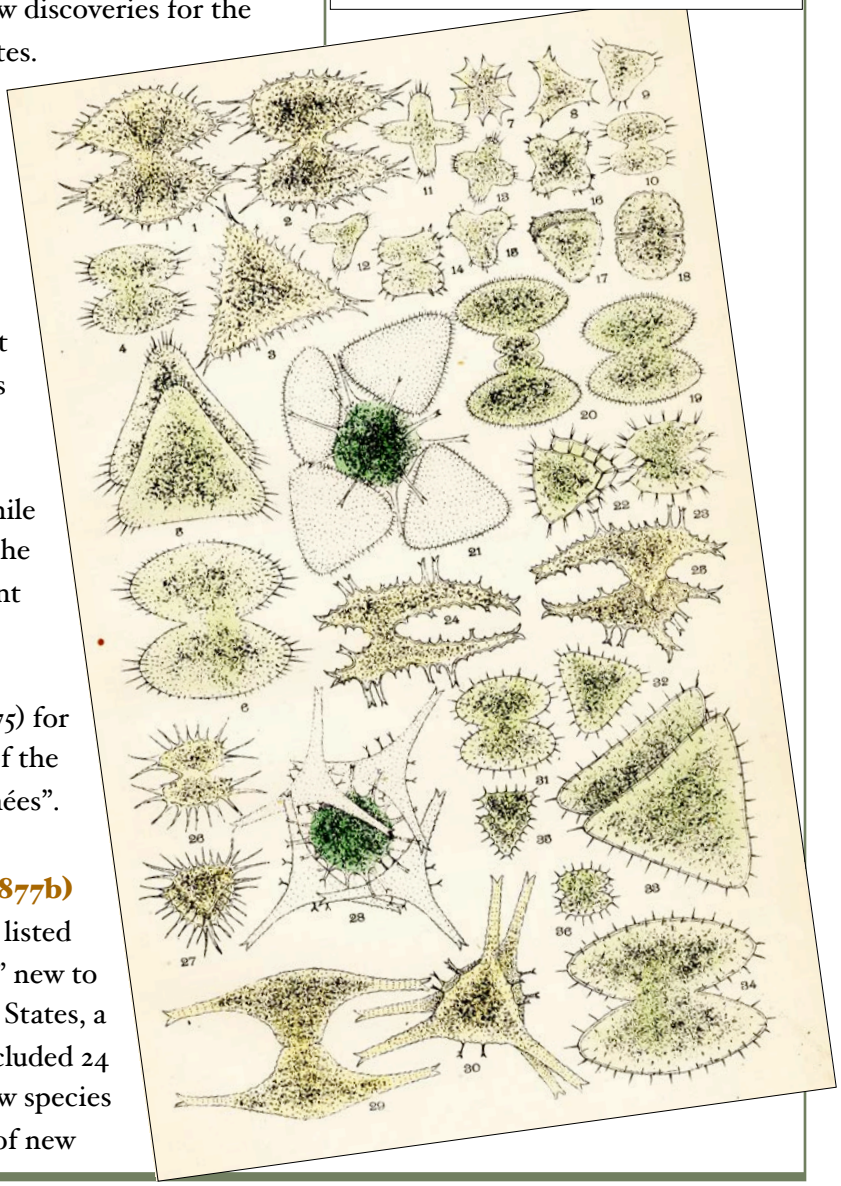


Fig. 3. Various species of *Staurastum* (pl. 45, Wolle, 1884).

A second new genus, *Poterophora* (based on *P. donnellii* sp. nov. and assigned to the "Zygnemaceae"), was collected from the bark of trees in Florida by Capt. J. Donnell Smith of Baltimore, Maryland. But Austin (1879) later discounted Wolle's *Poterophora*, saying that it was merely "the prothallus of some dioecious fern or filicoid." Wolle was greatly helped by Capt. Smith, who made extensive collections of freshwater algae in Florida in the 1870s, sending his gatherings to Wolle. Mr. C.F. Austin of Closter, New Jersey, was also a great help in making collections. Wolle had an eye for freshwater Rhodophyceae, describing *Entothrix grande* Wolle (1877b) [later *Tuomeya grandis* (Wolle) Wolle (1887a) and more recently *Paralemanea grandis* (Wolle) Kumano (2002)] from shallow rivers near Bethlehem. He described *Chantransia beardsleei* from Painsesville, Ohio (Wolle, 1879), which was later transferred to *Audouinella* by Ott (2009). He also observed reproduction in *Chantransia violacea* [= *Audouinella hermannii* (Roth) Duby] (Wolle, 1880c).Wolle (1885b) described a freshwater species of *Ectocarpus*, *E. rivularis*, from a few inland sites in northeastern Florida. He had made his own collection of it from an inland site near Green Cove Springs (Clay County), whereas Rev. H.D. Kitchel had collected it from Blue Springs on the St. John's River (Orange County), and Capt. Smith had collected it a few years earlier from an unstated site. This species has not been re-collected.

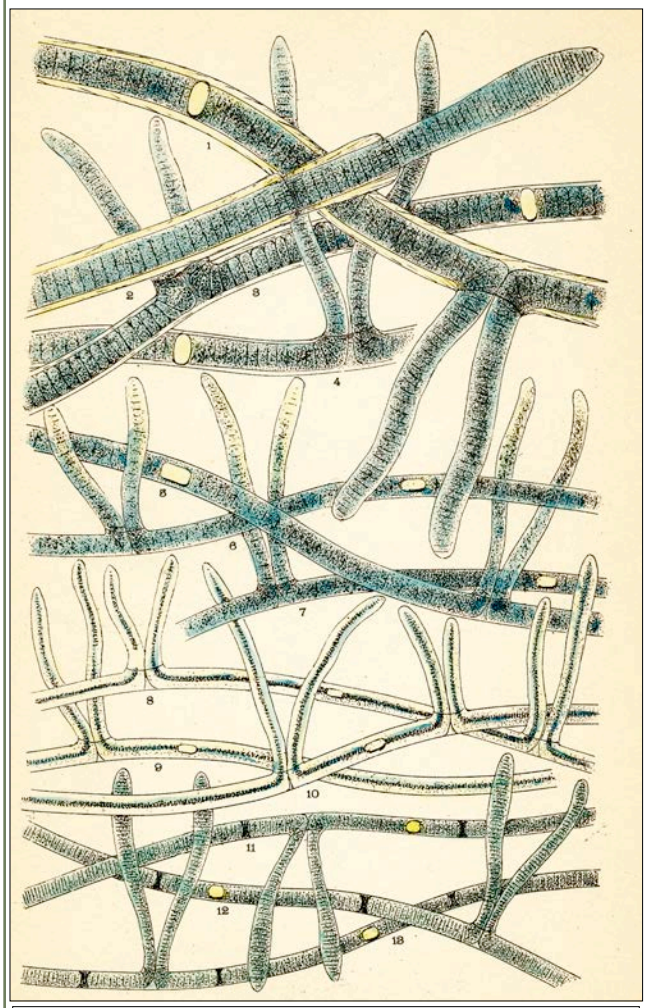


Fig. 4. Various species of *Scytonema* (pl. 183, Wolle, 1887).

Because there was essentially no one at that time in America to offer Wolle encouragement in his field of study, he turned to European experts to receive the necessary advice. In the Preface of his impressive "Desmids of the United States" (Wolle, 1884b), he acknowledged that help from several foreign workers. That volume contained 53 lithographed color plates (Fig. 3). Many new species of *Cosmarium*, *Docidium*, *Euastrum*, *Micrasterias*, *Staurastrum*, and *Xanthidium* were described. He dedicated the desmid volume to Dr. Otto Nordstedt of the University of Lund, saying that Nordstedt kindly determined the identities of certain of his American desmid species found by Wolle with those already known in Europe and pointing out those taxa that then appeared to be restricted to the United States. Wolle also acknowledged the help of Dr. L. Rabenhorst of Meissen, Germany. He had sent to Rabenhorst many sets of his mounted specimens, which Rabenhorst then included in the distribution of his *Algae* exsiccatae. Wolle also contributed to Wittrock & Nordstedt's *Algae aquae dulcis* (Stafleu & Cowan, 1988). Wolle received many valuable communications from Alexander Braun of Berlin. A "new and enlarged edition" of this work on desmids appeared in 1892. According to Stafleu & Cowan (1988), Wolle's herbarium and types were deposited in PH (the Academy of Natural Sciences, Philadelphia), with residual collections also in several other herbaria. Sayre (1975), however, claimed that the bulk of his herbarium is now in F (the Field Museum of Natural History in Chicago) and that various herbaria have material that he distributed with the printed title "FRESH WATER ALGAE OF THE UNITED STATES".

"Wolle's (1890) "Diatomaceae of North America" was a remarkable synthesis..."

A second volume on "Fresh-Water Algae" by Wolle (1887a) complemented the earlier volume on the desmids but excluded the diatoms. This "Volume II" contained 157 colored plates, with 2,300 figures, and depicted Cyanobacteria (Fig. 4), green algae (other than desmids), and freshwater red algae. A remarkable number of the figures depicted reproductive stages as in *Coleochaete*, *Oedogonium*, *Bulbochaete*, *Spirogyra*, *Volvox*, and others. Drouet (1939) published an account of Wolle's filamentous Myxophyceae, offering some clarifications and transfers. Bornet & Flahault (1888) remembered Wolle with the honorific name *Wollea* of the Nostocaceae.

Wolle's (1890) "*Diatomaceae of North America*" was a remarkable synthesis in that it compiled 2,300 of "the author's drawings", presented on 112 plates (fig. 5). From the scattered and often difficult to obtain literature, Wolle "collected the cream of what has already been written on the subject, as well as the figures of all known North American species". Most of the figures were redrawn, and the original sources of the figures were duly cited. Wolle admitted that he was following the example of Dr. Adolph Schmidt (1874-1890), in letting the figures suffice for the descriptions of the species. He followed the most current classification scheme of the day, namely, the "conspectus of the families and genera of the Diatomaceae" of Dr. H.L. Smith of Hobart College, Geneva, New York (Smith, 1872). Wolle dedicated his treatise on North American diatoms to Dr. Smith. Wolle's work included 125 genera of pennate and centric diatoms (Fig. 5).

It is worth noting that another of Wolle's accomplishments, thanks to his inventive nature, was designing various mechanical devices. An example of one of his inventions was the machinery for making paper bags. The goal was simply to allow customers to hold items more easily. Wolle's patent, taken out by him in 1852, seems to have been the first such granted in the U.S. and possibly in the entire world. His patent was later taken out in England and in France. With his brother Sylvester Wolle and other investors, he cofounded the Union Paper Bag Machine Company in 1881. In 1936 this company opened a $4 million plant, employing 500 workers, in Savannah, Georgia. The plant still is in operation today, although now owned by the International Paper Company (from on-line data).

Anonymous. 1894. Rev. Francis Wolle [Necrology]. Proc. Amer. Microscop. Soc. 15(4): 245-246.

Austin, C. F. 1879. Notes on Hepaticology. Bull. Torrey Bot. Club 6: 301-306.

Bornet, É., & C. Flahault. 1888. Revision des Nostocacées hétérocystacées contenues principaux dans les herbiers de France. Ann. Sc. Nat., Bot., sér. 7, 7: 177-262.

Drouet, F. 1939. Francis Wolle's filamentous Myxophyceae. Botanical Series, Field Museum of Natural History, 20(2): 17-64.

Kumano, S. 2002. Freshwater Red Algae of the World. Biopress, Bristol, U.K. xi + 375 pp.

Lindley, J. 1836. A natural system of botany.... Second edit. Xxvi + 526 pp. Longman, Rees, Orme, Brown, Green & Longman, London.

Norris, J. N., I. A. Abbott & C. R. Agegian. 1995. *Callidictyon* abyssorum, gen. et sp. nov. (Rhodophyta), a new deep-water net-forming alga from Hawai'i. Pacific Science 49: 192-201.

Ott, F. D. 2009. Handbook of the taxonomic names associated with the non-marine Rhodophycophyta. Gebr. Borntraeger, Stuttgart. xxiv + 969 –[971] pp.

Sayre, G. 1975. Cryptogamae Exsiccatae--an annotated bibliography of exsiccatae of Algae, Lichenes, Hepaticae, and Musci. V. Unpublished Exsiccata. I. Collectors. Mem. N. Y. Bot. Gard. 19: 277-423.

Schmidt, A. 1874-1890. Atlas der Diatomaceen-Kunde. Ascherleben, Leipzig.

Smith, H. L. 1872. Conspectus of the families and genera of the Diatomaeae. Lens 1: 1-19, 72-93, 154-157.

Stafleu, F. A. & R. S. Cowan. 1988. Taxonomic literature, II. Volume VII: W-Z. Bohn, Scheltema & Holkema, Utrecht, Antwerp.

Thuret, G., & É. Bornet 1875. Essai de classification des Nostochinées. Ann. Sci. Nat., Bot., sér. 6, 1: 372-382.

Wolle, F. 1876. Fresh water algae.—Collected during the past three years, mostly within a circuit of about twenty miles around Bethlehem, Penn. Bull Torrey Bot. Club 6: 121-123.

_____. 1877a. Fresh water algae. II. Bull. Torrey Bot. Club 6: 137-141.

_____. 1877b. Fresh water algae. III. Bull. Torrey Bot. Club 6: 181-189.

_____. 1878. A *Nostoc* the matrix of *Scytonema*. Bull. Torrey Bot. Club 6: 217-218.

_____. 1879. Fresh water algae. Synopsis of discoveries and researches in 1878. Bull. Torrey Bot. Club 6: 281-288.

_____. 1880a. Fresh-water algae. IV. Bull. Torrey Bot. Club 7: 43-48.

_____. 1880b. New American desmids. Bull. Torrey Bot. Club 7: 91, pl. V.

_____. 1880c. Cell-multiplication in *Chantransia violacea* Kg. Am. Mo. Mic. J. 1: 43-45.

_____. 1881a. American fresh-water algae. Bull. Torrey Bot. Club 8: 1-4, pl. VI.

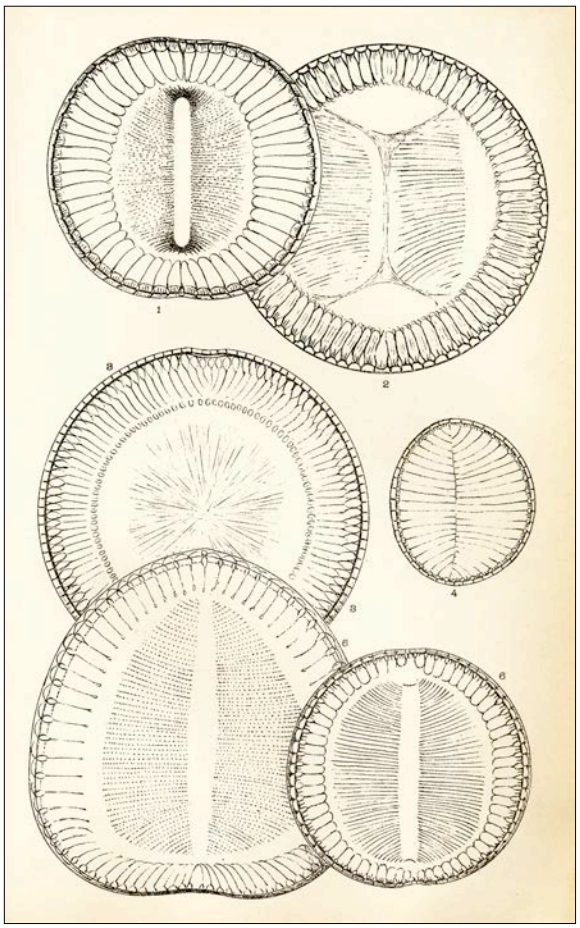


Fig. 5. Various species of *Campylodiscus* (pl. 72, Wolle, 1890).

_____. 1881b. Fresh-water algae. V. Bull. Torrey Bot. Club 8: 37-40.

_____. 1882. Fresh-water algae. VI. Bull. Torrey Bot. Club 9: 25-30, pl. XIII.

_____. 1883. Fresh-water algae. VII. Bull. Torrey Bot. Club 10: 13-21, pl. XXVII.

_____. 1884a. Fresh-water algae. VIII. Bull. Torrey Bot. Club 11: 13-17, pl. LXIV.

_____. 1884b. Desmids of the United States and list of American Pediastrums with eleven hundred illustrations on fifty-three colored plates. Moravian Publications Office, Bethlehem, Pennsylvania. xiv + 182 pp., 64 pls.

_____. 1885a. Fresh-water algae. IX. Bull. Torrey Bot. Club 12: 1-6, pl. XLVII.

_____. 1885b. Fresh-water algae. X. Bull. Torrey Bot. Club 12: 125-129, pl. LI.

_____. 1886. Turner's "New Desmids of the United States." Bull. Torrey Bot. Club 13: 56-60.

_____. 1887a. Fresh-water Algae of the United States; (exclusive of the Diatomaceae) complemental to Desmids of the United States ... One hundred and fifty-one plates ... including nine additional plates of desmids. The Comenius Press, Bethlehem, Pennsylvania. [i] – xix – [21] – 364 pp.

_____. 1887b. Desmids of the Pacific coast. Bull. Calif. Acad. Sci. 2: 432-437.

_____. 1888. Desmids of the Pacific coast. Proc. Calif. Acad. Sci., ser. II, 1: 79, 80.

_____. 1890. Diatomaceae of North America, illustrated with twenty-three hundred figures from the Author's drawings on one hundred and twelve plates. The Comenius Press; Bethlehem, Pennsylvania, U.S.A. 112 pl.

_____. 1892. Desmids of the United States and list of American Pediastrums with eleven hundred illustrations on fifty-three colored plates. "New and enlarged edition." Moravian Publications Office, Bethlehem, Pennsylvania. i-xiv + 15-182 pp., 64 pls.

Wood, H. C. 1872. A Contribution to the History of the Fresh-water Algae of North America. Smithsonian Contributions to Knowledge 19(3): i-viii, 1-262, with 19 colored and 2 uncolored plates from 360 original microscopic drawings.

Wynne, M. J. 2001. Phycological Traiblazer No. 15. Horatio C. Wood. Phycological Newsletter 37(2) 4-5

_____. 2003. Phycological Trailblazer No. 18. Jacob W. Bailey. Phycological Newsletter 39(1): 23-5.

Michael J Wynne
University of Michigan Herbarium,
Ann Arbor

A Brief History of the PSA Endowment

Modest Beginnings

In 1974, Gerry W. Prescott handed **a $100 check** to the treasurer of PSA, with the idea of starting an "endowment fund" for the Phycological Society of America. As of July 1, 2011, the PSA Endowment had a net value of $1,150,286.31. The history of the endowment - the vision for the fund and the people who facilitated its startling growth - is quite a story. It is a history remarkable for the foresight and hard work of the first members of the Board of Trustees and the enthusiastic support of the relatively small scientific society that the Endowment serves.

The precursor of Endowment actually started in 1967 when Bruce Parker and Malcolm Brown started gathering funds from Harold Bold's students for an award to be named in his honor, the first named award given by PSA. At the first Bold Award competition in Tempe, Arizona, in 1974, Prescott gave the $100 check to Bruce Parker and told Bruce that PSA needed an Endowment. But the official birth of the Endowment occurred in late 1979, when Article XIII of the PSA Bylaws was approved by the membership and the first Board of Trustees was formed. Robert W. Hoshaw was elected Chair by the membership. The Executive Committee appointed Norma J. Lang, Michael D. McCracken, Bruce C. Parker, Milton R. Sommerfeld, and Janet R. Stein to the first Board. They hit the ground running.

Growth Phase

Charged by the Executive Committee with increasing monies in the Endowment, in July 1980 this **gang of six launched a fundraising campaign** at the Annual Meeting of PSA, during Botany 80, at the University of British Columbia, in Vancouver. The first of 14 newsletters published by the Board (edited by the indefatigable Bob Hoshaw, with the assistance of his wife, Ruth) appeared in October 1980 and defined the Endowment as "an active resource to provide monies continuously for programs of education, communication, and interaction among PSA members and others." From the beginning this overarching vision guided a variety of efforts that expanded communication in Phycology beyond the two society publications that already existed in 1979—the Journal of Phycology, and Phycological Newsletter. In fact, the The PSA Endowment itself was the first and most obvious expression of this enhanced communication. A four-page folio, on canary paper and printed in brown ink, was mailed to every member of the society, as were the 13 succeeding issues. Much of the history summarized here comes from those newsletters, almost all of which were edited by Hoshaw.

At its inception the Endowment comprised five funds: Publication, Education, Lecture, Bold Award, and General. Anticipating and encouraging changes that would come in the next 30 years, the newsletter states "Additional funds may be established by any individual or group who wishes to contribute by gift or bequest."

The Board answered a series of questions in that first PSA Endowment, such as how to give to the Endowment (usually checks, sent to Norma Lang), how members would benefit (the Endowment would provide seed money for handbooks, manuals, audiovisual materials, special lectures and short courses), when benefits would begin (as soon as $20,000 was raised), what funds would be spent (interest only), and how the funds were managed (by the Board of Trustees).

The first formal project to raise money was an ambitious though not entirely successful printing of certificates with the signatures of 11 of the charter members of the PSA who were still alive in 1980. Nine of the signatures on the limited run of 100 certificates were handwritten by the signers. Two of the charter members who had agreed to sign, passed away in 1980 before the project was completed; their signatures were added as reproductions from existing documents. For gifts of over $200, donors received a hand-signed edition. For $25-$200, a facsimile of the certificate was provided. Unfortunately, the certificates didn't produce the collectors' mania hoped for by the Board, and I remember seeing a pile of them at Hoshaw's house in the late 1980s. A few copies grace donors' walls, and a few more remain available for future donors.

(continued, p. 22)

History of the Endowment, continued

And yet this effort, which might have been labeled a failure, didn't discourage the Board, and it didn't define the nature of its future efforts, almost all of which were successful. Begun at the same time as the certificate effort, the **first t-shirts** were sold at Botany 80—a yellow shirt with a sea palm, *Postelsia palmaeformis*, on the front. Succeeding t-shirts have been a perennial best seller every year since.

The fundraising campaign had a target of raising $20,000 in the year following its announcement at the 1980 Annual Meeting. The Endowment began August 4, 1980 with a check from the PSA treasury of $4,868.15. Several additional such transfers, along with the money in the Bold Award account, allowed the purchase of a federally-insured money market certificate in the amount of $14,000, with a yield a little higher than 12% annually. (This rate may take your breath away if you've purchased money market certificates recently, but of course, mortgage interest rates then were also breathtaking.) By year's end, with a little over $2,000 in donations from 198 members (13% of membership) the amount had grown to $16,929.64. By August 1981, the $20,000 target was reached. One could say the Endowment never looked back. With individual contributions, conservative, sound investments in robust 1980s and 1990s financial markets, and royalties from PSA publications, the Endowment grew steadily.

The Endowment motto was that no contribution was too small.

Traditions

Later efforts of the Board included traditions that have become familiar to members attending Annual Meetings. A headquarters room was established in 1981, at the meeting at Indiana University, where the t-shirts and other **phyco-paraphernalia** were sold. A sequel to the first ***Selected Papers in Phycology*** (provocatively titled *Selected Papers in Phycology II*) was planned and became a big seller over the course of several years. This weighty volume, with an original cover illustration of the giant kelp, *Macrocystis pyrifera*, by noted printmaker Henry Evans more than recouped the investment in it. It came with a cost, though, with major investments in time by the editors, Jim Rosowski and Bruce Parker, and untiring promotion by the Board in the *PSA Endowment* and at annual meetings. After a few years, more than 1,000 were sold.

More successes followed. The **National Lecturers** series began in 1981. In this program four distinguished phycologists (starting with Jeremy Pickett-Heaps, Beth Gantt, Ralph A. Lewin, and Michael Neushul, Jr.), volunteered to give as many seminars as they could manage in their busy schedules, and donate the honoraria to the Endowment. Plastic seaweed coasters, seaweeds embedded in acrylic to make drink coasters, also raised money and these nearly indestructible coasters can still be found in many phycologists' offices and homes.

The most visible and possibly most enjoyable money-making idea began in 1984 at the Colorado Annual Meeting, when Russ Chapman served as the first and arguably best emcee of the PSA **Auction**. A call for "new or used books, reprints, slides, photos, translations, pressed or preserved specimens, algal artifacts, teaching aids, ornaments or T-shirts with a phycological motif, novelty items, etc." went out in the *PSA Endowment*. Every year since **the auction has been one of the social high points of Annual Meetings**, as well as a regular source of funds for the Endowment.

Still Growing, and Growing . . .

The Endowment continued to increase. Royalties of the ***Phycological Methods Handbooks*** series, National Lecturer donations, auctions, t-shirts, and more yielded a balance of $48,000 in 1983; $58,000 in 1984; and more than $77,000 by the time of the last *PSA Endowment* published in 1985. By that time, the Board of Trustees recognized that the initial growth period of the Endowment had ended, and the focus shifted to activities that the Endowment supported—Bold Awards, Provasoli and Prescott Awards for books and *Journal* articles, respectively, Croasdale Awards for students to take summer phycology courses at field stations, Grants-in-Aid for student research, and most recently, the Lewin Award for the best poster at the Annual Meeting.

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History of the Endowment, continued

The growth phase moved to the background after 1985, but growth didn't stop, and now, 30 years later, the Endowment stands at more than $1,000,000. Each year disbursements of interest support dozens of students, bring symposia speakers to Annual Meetings, and help the society recognize excellence in Phycology worldwide. The healthy nature of the Endowment is the reason that Executive Committees can sleep relatively easily at night and plan for a productive, bright future of PSA.

The message of the first *PSA Endowment* was clear: **An Endowment was being established, and it would require the donations and support of all members.**

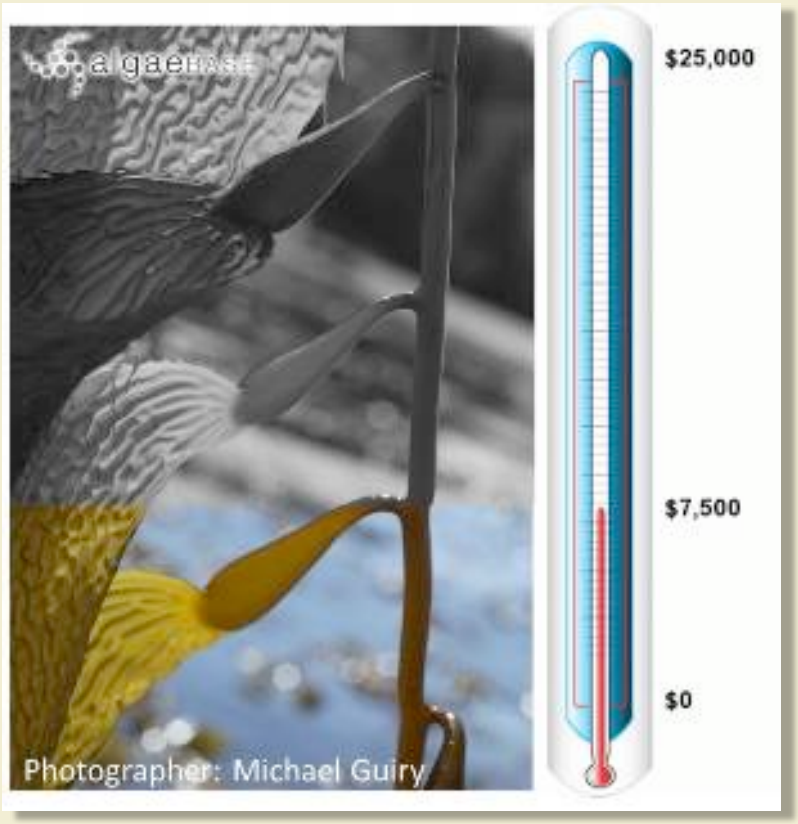
The Endowment motto was that no contribution was too small. In fact, the Endowment has never received a major gift. This was so unusual that Allen Press invited Bob Hoshaw to give a talk at their offices on how such a successful Endowment could be built by small contributions by the membership. Hoshaw took t-shirts, mugs, coasters, and other items sold in the Headquarters room to show the assembled group. Ruth Hoshaw was there and tells me that the other societies Allen Press handled counted mostly on large contributions by wealthy individuals. She wrote to me in an email for this article, "Allen Press people were impressed that from so little one can accumulate so much."

A footer on the bottom of the pages reads "An Every Member Participation Program . . . Giving Time and Money to Support One's Profession Doesn't Cost . . . It Pays . . . Achievement of Its Goals Rest Largely Upon the Support and Generosity of Its Members." The first *PSA Endowment* ends with a statement that's hard to argue with, that the "ENDOWMENT WILL BECOME A MAJOR RESOURCE." After 30 years, these words ring true, along with the obvious conclusion that the Endowment is an Every Member Benefit as well.

Rick McCourt

Chair of the Board of Trustees

Thanks to Bruce Parker and Ruth Hoshaw (who were there), John Hall, and Tim Nelson for comments on this article.



The 2011 Student Fund Raising Campaign is growing!! Help a stipe by sending contributions and watch the kelp turn golden.

It's an exciting time to be a phycologist. From biofuels to genomics and environmental research, research and education on algae is at an all-time high. Towards this end the PSA supports many programs for its student members each year through its Endowment Funds, administered by the Board of Trustees. These funds have supported student travel to the Annual Meeting, Grants-in-Aid for research, and financial aid to attend courses in phycology at field stations.

We want to grow the student membership by making membership and participation in PSA activities more accessible and attractive to young members, and YOU CAN HELP!

Visit www.psaalgae.org/ to make a donation.

Minutes of the PSA Annual Business Meeting, 2011

McMahon Hall Pompeii Room, University of Washington, Seattle, WA

July 15, 2010

The meeting was called to order at 5:31 pm by President Susan Brawley.

Approval of the 2010 PSA Annual Business Meeting minutes was requested. The motion for approval was made by Michelle Wood, seconded by Chuck Amsler and unanimously approved.

Membership Director's Report – given by Louise Lewis for Deb Robertson. Louise reported on the activities of the Membership Committee. They have been working with Wiley to make the Wiley-PSA webpages more professional and easier to use, and changes are still in progress. The Committee will determine if there is adequate space on the Wiley site to store meeting minutes and other important documents for Executive Committee (EC) access on a secure site. She also informed the membership that the EC recommended keeping the price of individual PSA memberships the same next year. Current membership is at 1,021 members (up from 780 this time last year), representing 47 countries, and they will be pushing for an even bigger increase in 2012. They are asking members to each encourage one person to join. PSA will be advertising at other conferences, especially to students. PSA is now on Facebook and Twitter.

Communications Committee Report – Louise Lewis. Tim Nelson reports that the PSA listserv is functioning well. He requests that email address changes be done directly on the Wiley membership site since he gets the email list from them. A PSA photo contest will be held this fall with the photos to be used for education and outreach. The Committee is initiating changes to the PSA website and they have many ideas for improvements. They will solicit more ideas from the membership, and will be using a professional service to update the site. The next PSA Newsletter submission deadline is August 15. Louise is looking for a new Newsletter co-editor since Juan Lopez-Bautista will be PSA President next year. Tim Nelson moved that PSA membership dues be kept at the same levels for 2012, which was seconded by Russ Chapman and unanimously approved. The Communications Committee Report was unanimously accepted.

Program Director's Report – Dale Casamatta. This year's meeting has 375 registrants in total, of which 275 are associated with PSA. The 2012 meeting will be held in Charleston, SC from 26-29* June and the Program Committee is in the process of soliciting ideas for workshops and symposia. The 2013 PSA meeting will be held from 4-10 August in Orlando, FL in conjunction with the International Phycological Congress with Dennis Hanisak as the local organizer. In 2014 PSA will be meeting with several societies in Portland, OR from 18-23 May. The Program Committee will increase advertising for upcoming meetings on the website. Question – Is the increase in PSA registrants this year because people are members of more than one society? Reply – Uncertain due to issues with the registration and abstracting service (SG), but most likely from an overall increase in registration. The report was unanimously accepted.

Student Representative's Report – Craig Aumack. The student social at this year's meeting drew 68 students, which was a great attendance. The NSF Town Hall and Career Workshop were also very well attended, and are highly recommended for future meetings. More international expertise will be included at these events in the future. Craig reported that a PSA advertisement / presentation at the Benthic Ecology meeting this year resulted in several attendees to PSA this summer who would not normally have participated. The report was unanimously accepted.

Committee Reports:

Elections Committee Report – Wayne Litaker. PSA held a very successful election this spring, with 6-32 nominees for every position and a total of 207 people voting. Those voted into positions include Linda Graham as the new Vice-President / President-Elect, Mike Guiry as the PSA's first International Vice-President, Alison Sherwood for a second term as PSA Secretary, Matt Bennett as the new Student Representative, and four new members of the Editorial Board of the Journal of Phycology (Juliet Brodie, Geoff McFadden, Karen Steidinger and Karina Nielsen). Three bylaw changes were also approved. Primarily electronic voting seemed to work well, but Wayne would appreciate feedback from anyone who has comments on the system. The report was unanimously accepted.

Education Committee Report – Jesse Muhlin. The Committee composition is relatively new, and members are very enthusiastic. The Committee arranged for two workshops at the current meeting – Robin Kodner organized the Genomics Workshop, and the Career Workshop was hosted by several professional PSA members. Currently the Committee is developing curricula that will be available online and intended for use by PSA members for teaching purposes. The Committee is also looking at better ways to educate the public through local zoos and aquaria. The report was unanimously accepted.

Nutrition Committee Report – Susan Brawley. This committee is composed of eight biochemists tasked with reading the literature and publishing a review article with a rubric of what to do to establish acceptable standards on algal nutrition. The overall goal of the Committee is to promote research on algal nutrition and use of algae for human consumption. (continued, p. 25)

*Note: Dates changed to June 27-30 after the minutes were submitted.

Archives Committee Report – Bruce Parker. The PSA archive is stored in the Virginia Tech Special Collections, and is also available on the PSA website. This year the Committee decided to showcase the 11 PSA recipients of the Gilbert Morgan Smith Medal (awarded by the National Academy of Sciences) on a poster that was displayed at the meeting. They are in the process of generating new ideas for next year. The report was unanimously accepted.

Grants and Fellowships Committee Report – given by Amy Carlile for Eric Linton. The Committee awarded >$20K last year to student members of PSA. Seven awards were made for the Grants-in-Aid of Research (with 29 applications), 16 Hoshaw awards were made (out of 44 applications) and four Croasdale awards (with six applications). Amy reminded the membership that competition for these awards is high, and for students to have their advisors and other lab members read their applications prior to submission. The application deadlines are listed on the PSA website. The Committee is looking for new reviewers; please contact Eric Linton if you are interested in serving. The report was unanimously accepted.

Publications Committee Report – Linda Graham. The Publications Committee evaluates proposals for publications that might generate money for PSA. The Committee had a request to re-print the Algal Culturing book, but decided to wait until techniques for mass culture become available in order to make the new edition highly desirable. The Committee has also come up with a process to demonstrate how to develop content for the Phycopedia. They have commissioned material on biofuels as a pilot of this process and are waiting for results. The Committee will then post this process and make Phycopedia available for content development. Question – Is the content on Phycopedia to be reviewed? Response - Peer-review is part of the proposed process. Linda mentioned that Phycopedia content development would be an excellent example of Broader Impacts for phycologists. The report was unanimously accepted.

Science and Engineering Fair Report – Dail Laughinghouse and Rick McCourt reported that an inter-committee working group is arranging for PSA to have a booth next 27-29 April in Washington, DC at the Science and Engineering Fair. They are soliciting ideas for the booth, emphasizing that >1 million people are expected to visit the Fair. Rick McCourt described his work with the BioBus, and reported that PSA will be interacting with the BioBus at the Fair. Volunteers from PSA in the DC area are also needed to man the booth. The Science and Engineering Fair will be associated with a weeklong set of activities that include public lectures, and the working group may recommend PSA members for this.

PSA President's Report – Susan Brawley. Susan reported that she is pleased with how active the committees are (almost 150 people involved). She has been representing PSA at the Council for Scientific Societies' Presidents (CSSP) meeting which has helped us understand the degree to which we can advise the public in the science policy arena as a 501c non-profit, has provided leadership training, etc. Representation at the CSSP meeting also helped us set up the 2014 meeting with several other societies who are members of CSSP (ALSO, SFS, SWS). At the EC meeting this week the confusion of the terms "phycologist" and "psychologist" were discussed, and an ad hoc committee was established to consider a change in name of the journal and the society, with substantial input from the membership to be acquired by the Committee. Any changes proposed will be put to the membership by ballot for approval. Susan then gave the Past President's Report for Paul Hayes. This year he formed a small search committee to consider the upcoming turnover in Editorship of the Journal of Phycology, and they have recommended that the job is now too large for one person. The new model is to have four co-editors, and two of these have been identified (Mike Graham and Arthur Grossman). The Editorial Office (and Editorial Assistant) will be affiliated with Mike Graham's institution. The committee is still recruiting other two editors. The four co-editors will operate by consensus with the Managing Editor taking a smaller content role to supervise the Editorial Assistant. Arthur Grossman added that under this new model they would like to speed up the editorial process (generate a system for faster turnaround), and deal with the issue of variable quality in the journal. The Associate Editors will likely also have new tasks, for example, soliciting review articles. They are also looking at new features for the journal. There have been many recent big issues involving algae, but the Journal has not been all that visible on these issues. It was asked whether the team was looking for certain disciplines for the remaining two editors, and the response was yes, they need spread in expertise, although there could be some overlap. They may also want to change and broaden some of the Associate Editor positions to ensure discipline coverage. Ideas from the membership are welcome. Susan finished her report by thanking the membership for response to the membership survey. The report was unanimously accepted.

Journal of Phycology Editor's Report – Bob Sheath. Bob gave an overall report of the journal over the last five years since this was his last report as Journal editor. During his tenure 1,407 manuscripts were processed, the publication rate of submitted manuscripts was approximately 50%, and almost 6,700 journal pages were published. The production and format of the journal were modified substantially during his term, for example, they have added 12 more color plates to the recent Journal contract, and PDF reprints are now free to authors. Submissions to the Journal have fluctuated although they have gradually increased over the years.

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More recently the Journal is seeing many submissions from Europe and Asia compared to North America. The categories of submissions were presented. In comparison to similar journals the Journal of Phycology is very large, and requires a full time Editorial Assistant/assistant editor. The turnaround time of submissions should be reduced in the future; it has increased recently in part because more reviewers need to be asked to get two adequate reviews for a manuscript. Bob reported that he would like to see an increase in the impact factor of the Journal, which has decreased the last couple of years (which was partly due to publishing the backlog of manuscripts from several years ago). The Journal is fortunate to have a large Editorial Board and number of Associate Editors, and Bob thanked them, plus all the reviewers, for their time and contributions. Susan Brawley thanked Bob for his excellent service to the society in serving as Editor for the past five years, and this was echoed by the membership. The report was unanimously accepted.

Board of Trustees (BOT) Chair's Report – Rick McCourt. Rick explained that the role of the BOT is to serve as an advisory capacity to the EC, to invest the PSA's endowment, attempt to increase the endowment and establish guidelines for programs. The membership of the BOT was noted, with mention that international representation is being increased. BOT activities for 2011 included giving student and society awards from the endowment, assessing the long-term health of PSA, and running the PSA auction and the headquarters room at the annual meeting. Rick reported that the prize amount for the Prescott Award will increase. The student fundraising campaign raised approximately $3,500 (the amount can be monitored on the colorized kelp thermometer on the PSA website), and will increase through funds from the current year's auction as well as more fundraising activities for this year. Endowment updates will be provided to the membership through electronic means this year. Index cards were handed out to the membership to solicit information and ideas on fundraising priorities and any suggestions for the Science and Engineering Fair. One suggestion offered from the membership was to assess whether we have a large enough endowment to give out small faculty research grants. The report was unanimously accepted.

Fund Manager's Report – Tim Nelson. Tim explained the setup of the funds that he manages as being in three separate accounts: the Treasury Reserve, the Life Members Fund, and the PSA Endowment. The total value of these funds was $1,319,617.21 as of 01 January 2011. The endowment funds multiple awards for PSA. Endowment principle is doing well since the balance increased this year from transfers from the Treasury. However, interest rates continue to decline which affects the amount available to spend from each line (overall 20% drop in income generated over the last few years). We have not been spending from the Treasury Reserve or Life Members funds. The general issue is that we have not been able to maintain funding levels. Tim reported that the Publications line now has sufficient money to use income, and he recommends assigning this to other lines such as student awards. The EC also approved transferring $1,200 from the Treasury to maintain status quo for student awards. This year the PSA also transferred $150K to the Endowment from the Treasury, which will be left in a general line so that it can be used as needed. Tim explained that it is important to bring these lines up now since interest generated in 2012 will not be available to use until 2013. The report was unanimously accepted.

Treasurer's Report – given by Alison Sherwood for Chuck Delwiche. Alison reported that PSA income from the Wiley profit share decreased for the first time in 2010, which should be noted but interpreted with caution given that this has been the first year that it has happened. She also reported that the layout of the budget is changing from previous years to accommodate more detailed reporting requirements by the IRS and to allow greater ease of use. The EC supported the transfer of $150K from the treasury to the endowment at their spring midyear meeting, which helped to build up the endowment while keeping the PSA's accounts below the FDIC-insured limit. The proposed 2012 budget was presented to the membership for discussion, which included some requests from officers and committees to carry out specific projects and costs associated with the turnover of the Editorial Office for the Journal of Phycology. It was noted that the future transfers of funds from the Treasury to the Endowment should be removed from the budget since they seem to be an accidental carryover from 2011. The report and proposed budget were unanimously approved.

New Business – Concern was raised over the fate of AlgaeBase, which is at risk of being shut down due to a lack of funding. Susan reported that the EC came up with some recommendations this week and will be involved in trying to maintain AlgaeBase. It was also asked whether we provide an algae expertise database on PSA website. Susan replied that the Public Policy committee has been charged with this, and checkboxes will be provided on future renewal forms to try to capture these data.

The motion to adjourn was made at 6:49 pm by Tim Nelson, seconded by Russ Chapman and was unanimously approved.

Respectfully submitted by

PSA Secretary Alison Sherwood

More from PSA 2011

At right: An example of the glass and sandstone "Cornerstones" by artist Stacy Levy, installed in sidewalks in the Eastlake neighborhood of Seattle, that were objects of the Facebook/Twitter Scavenger hunt during the PSA meeting.

Deadline for Contributions to the Next Phycological Newsletter

January 15th, 2012

Please contact Louise Lewis

louise.lewis@uconn.edu

or

Naomi Phillips

phillipsn@arcadia.edu

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