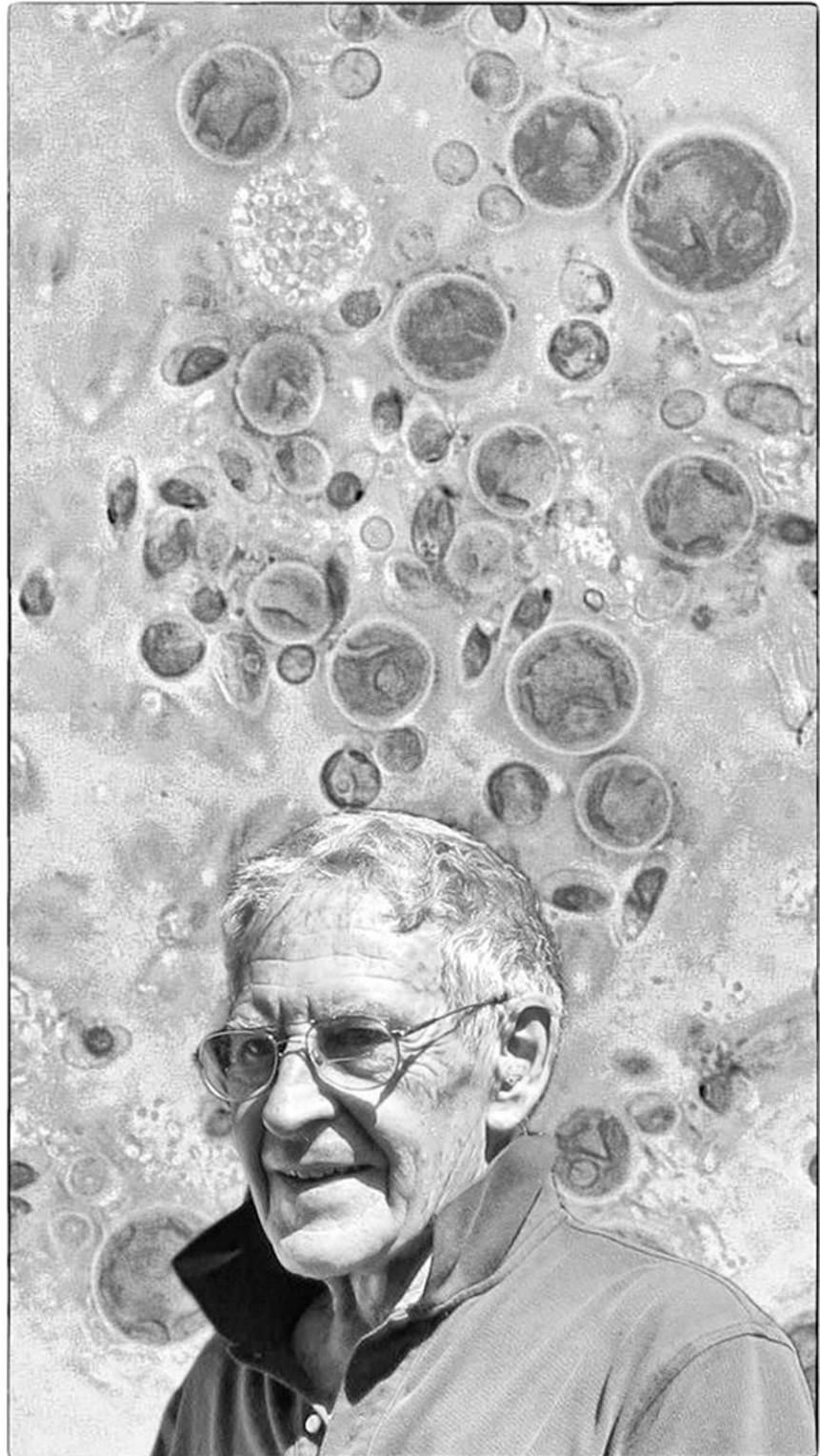


IN MEMORIAM
Robert R. L. Guillard
February 5, 1921–September 25, 2016

Robert “Bob” Guillard was an icon in all senses of the word. Many tributes to him have been and will be written (see Wikfors 1996, Anderson 2011, Sunda 2017). This is but a brief overview of a life very well-lived and shared, with contributions from colleagues and friends.

Born in New York City on February 5, 1921, Bob’s love for the natural environment was firmly established during his time with his grandparents in Stonington, Connecticut. An early scholar, Bob completed grammar school in 7 years, graduated from Townsend Harris High School in New York City in 3 years, and earned a B.S. in physics (City College New York) at the age of 20. Bob was hired by the U.S. Navy to install and maintain antimagnetic mine equipment. He continued to pursue course work in the evenings and taught at New York University and CCNY. During this time, he was smitten by a botany professor and decided that he wanted to become a “naturalist.” He went to Yale in 1949 and received a Master’s degree (1951) en route to his Ph.D. (1954) under the tutelage of G. Evelyn Hutchinson. Soon after, he was awarded a summer fellowship to the Woods Hole Oceanographic Institute—he changed fields from botany to oceanography. After a short period in Hawaii, Bob was hired by the U.S. Bureau of Commercial Fisheries Marine Laboratory in Milford, CT, where he was challenged by Victor Loosanoff with the task of “figuring out how to grow oysters.” As Bob recounted it, his first thought was that the little oysters would need to be fed and he reasoned that they were partial to what was in the water column. That was when he began isolating phytoplankton and developing the techniques to culture them in volume. His first publication was in the *Proceedings of the National Shellfisheries Association*, and it launched shellfish aquaculture as we know it today—the path to f/2 was being laid. The first paper demonstrated that individual phytoplankton isolates differed in their nutritional value to oysters, thereby establishing the foundation for “the Milford Method” of feeding hatchery seed of shellfish selected strains of microalgae



DOI: 10.2983/35.036.0201

which was further developed by Ravenna Ukeles and others. Without Bob's pioneering work in phytoplankton culture and nutritional value, the rearing of shellfish in captivity would not be possible.

In 1958, John Ryther recruited Bob to Woods Hole where he was a senior scientist and, in 1981, he moved to the recently established Bigelow Laboratory for Ocean Sciences and instituted the collection of algae and other microscopic marine organisms that was designated by Congress as the Provasoli-Guillard National Center for Culture of Marine Phytoplankton to honor two men whose research and mentoring had provided the world with a first-class source of algae for research and aquaculture. Anybody in the field of algal culture knows "f/2" but few realize that this was but a sideline for Bob. He was a global leader in the physiological ecology of phytoplankton. Bob reduced the curiosity that drove his science to this question: "Why do they live where they do?" Considering that phytoplankton cannot control their position, the question becomes almost metaphysical and leads one into the "n-dimensional hyperspace (Bob's phrase)" of physics, chemistry, and biology combined. Bob excelled at creating an environment in which ephemeral microbes could thrive and be sustained and, in 1962, he published a paper with John Ryther that became one of the most cited papers in marine science (over 3,400 citations at last note) as it described in detail the most successful algal-culture medium ever developed.

Bob was anything but a one-dimensional scientist. He had a wide array of interests and talents outside the laboratory, including fencing (he was an instructor), Morris dancing (one of the best in the country), target shooting (his keenness for guns was legendary), and Transcendental Meditation™ (TM), a practice he shared with his wife, Ruth, a TM teacher. His penchant for collecting all manner of what most would deem junk was well known, and those same doubters always knew where to go when they needed some esoteric item. Bob was recycling long before it was a word!

Bob's publication record was impressive by any standard, and his advice was in constant demand. Ever the teacher, one frequently got far more than bargained for when they asked what they initially deemed a "simple question." Out-of-the-blue phone calls that began with the words, "I've been thinking..." could lead to a lifetime's worth of questions needing answers. There are countless "Bob stories" and, whereas some are not entirely suitable for publication, these will be saved for later celebrations. He was generous with his time and expertise and never lost his curiosity and questioning mind. In 1995, Bob was named an Honored Life Member of the National Shellfisheries Association and, in 1998, he was presented with the Honorary Life Member Award from the World Aquaculture Society.

Bob passed away in his sleep on September 25, 2016 in Boothbay Harbor, Maine, leaving behind his wife of 53 years, Ruth, three stepsons and their families, and a barn full of decades of accumulated treasures—"just in case I need them someday" (including, one presumes, all those boxes of little blue paper circles that separate Millipore filters).

Bob would scoff at all the attention being paid to his accomplishments. His curiosity was at the core of his existence, his keen intellect and sharp wit were evident even after the shortest discussion with him. Scholar, old Yankee, friend—it was an honor, privilege, and most entertaining to have known him.

SANDRA E. SHUMWAY
Groton, Connecticut

GARY H. WIKFORS
Milford, Connecticut

Anderson, R. A. 2011. Robert Guillard celebrates 90th birthday. *The Limnology and Oceanography Bulletin* 20:54–58.

Guillard, R. R. L. 1957. Some factors in the use of nanoplankton cultures as food for larval and juvenile bivalves. *Proc. Natl. Shellfish. Assoc.* 48:134–142.

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

Sunda, W. G. 2017. In memoriam Robert R. L. Guillard. *Phycologica* 56:354–358.

Wikfors, G. 1996. Robert R. L. Guillard honored life member National Shellfisheries Association. *J. Shellfish Res.* 15:533–534.

REMINISCENCES

Larry Brand, University of Miami

I consider Bob Guillard to be my academic father. Just as with my biological father, I have discovered decades later that I have become more like him than I would have ever imagined. I also learned a lot more from him than I realized at the time. Bob was a subtle teacher. I now realize much of what I learned from him came from simply observing how he approached science. He had a creative mind, always coming up with new ideas. It probably helped that he started out in physics and thus had a somewhat different perspective in asking questions about biology. He gave me complete freedom to pursue what scientific topics I was interested in. Yet I ended up working on research topics similar to his not because he directed me to, but because of the various ideas I picked up from him over time. He was also a wealth of knowledge on all the subtle things about phytoplankton that never got published. I would have never gotten this from a formal course in phytoplankton ecology. During my time in his laboratory, I observed quite a few phytoplankton ecologists visiting him, and I am sure they benefited from his insights as much as I did. His impact on the field of phytoplankton ecology is surely more than just his long list of publications.

Edward J. Carpenter, San Francisco State University

I still remember the first words that Bob said to me as I nervously entered his laboratory and started my postdoctoral fellowship with him in September 1969. He said “Do you have any bugs?” I thought he was asking if I had fleas or bedbugs, but he was really asking if I had brought any phytoplankton cultures with me. I learned so much from Bob in that two year experience, and it seems that I use something that he taught me every working day. I learned how to isolate single phytoplankton cells, culture them, and carry out experiments on nutrient uptake as well as a myriad of other valuable techniques.

Bob ran a very “Green” laboratory and was way ahead of his time. We were taught to hang up paper towels to dry for later reuse. Coverslips and microscope slides were also washed and dried after their use. Any other laboratory would have tossed these items.

Bob loved to target practice with a rifle, and the two of us would head out to the shooting range on Cape Cod on the weekends. When airplane hijackings started occurring in the early 70s, Bob said that the solution was to hand everyone a loaded gun when they boarded the plane and there would be no more hijackings!

Once, Bob and I went to St. Croix in the Caribbean to try to get *Trichodesmium* into culture. We were taken offshore in a small (~20 feet) boat, and both of us immediately became seasick and puked over the side. So much for the seagoing abilities of two guys from Woods Hole Oceanographic Institution (WHOI)! We did manage to culture the *Trichodesmium* for a few months, but eventually it died. We stayed in an old stone sugar cane plantation, and Bob said he was going to take a shower and practice transcendental meditation. After his shower, Bob sat in a chair in his room in the nude and closed his eyes and began to meditate, and I sat outside on the porch. Meanwhile, a cleaning woman went into Bob’s room and began straightening things up. After about five minutes, I heard her scream and run out of the room, presumably because she discovered this naked guy sitting still in the chair. Bob just continued meditating.

Bob was extremely generous with ideas and with giving his time to teach techniques to young investigators. In the years he was at WHOI, he mailed out hundreds if not thousands of cultures to scientists all over the world for free. His only request was that the mailers be returned to his laboratory. He had a major influence on the field of phytoplankton research in so many ways!

Barrie Dale, University of Oslo, Norway

There was a wonderfully inclusive scientific and cultural fellowship enjoyed by a diverse group of scientists at the Woods Hole Oceanographic Institution when I arrived in 1964. Specialists from all the main scientific disciplines applied and pooled their research efforts in what now seems like early days of oceanography and I do not think there were integrated courses of oceanography at that time. Many WHOI scientists were also strong-minded individualists, and Bob stood out from the crowd. Nobody could have written the script for my own interactions with Bob over the next ten years—a barefoot-immigrant (Charlie Yentch’s words) paleontologist from England, not only learning how to culture “living-fossil dinoflagellate cysts” from Bob, but also learning to Morris dance from him outside office hours. “Eccentric” became a favorite word for us, for example, as the Guillard Morris team of six men dressed in traditional costume danced their annual spring progression through Harvard Yard with Ruth playing pipe and tabor, and Bob calling out to the women student spectators “close your windows—these are fertility dances!” From the Scandinavian perspective that I now enjoy, I feel that Bob the strong-minded individualist deserves an epic poem.

AN EPIC POEM FOR BOB'S "RETIREMENT" CELEBRATION AT WOODS HOLE

Barrie Dale with Apologies to Pam Ayres

Once I was a phytoplankton living in the sea.
 Now I'm Guillard's Culture #69,523.
 I used to like my other life, please don't misunderstand.
 I was never one for cloning, or lounging on the sand.

I've always despised sinkers, been a swimmer all my life,
 turned on by flagellation – in the oceans it's quite rife.
 I've always liked to mix it, the war-zone suits me fine –
 for ever dodging zoos amid the foaming brine.

But the fateful day that changed my life I never will forget –
 Helen Stanley sucked me up and took me for a pet.
 No I never will forget it – I almost changed my form –
 In a tube fresh from the autoclave, so clean but Oh so warm!

While they discuss at great extent life-cycles so complex,
 I'm longing for that clone next door – and good old algal sex.
 But there's security in culture – no zoos on your rear.
 NSF pays all the bills – no need for Blue Cross here.

The problem is the pressure on how to stay alive.
 How to keep their interest up – in order to survive.
 Wiz-kids down from MIT with elbows sharp as files
 coming here to pick our brains – with such beguiling smiles.

What do they really want from us – these academic freaks
 searching for new angles – and national funding peaks?
 I'm trying to make some toxins – otherwise they'll throw me out.
 It's all those *Alexandriums* that seem to have the clout!

I've shown them all my symbionts, made things that look like cysts,
 faked a few new pigments – but I'm running out of twists.
 We long for better days again – all of us inside.
 Just like the good old days, when science had more pride.

We miss the old taxonomists who looked and gave us names –
 without waving their flagellate and playing funding games.
 Now I've been studying alga-freaks for five and twenty years,
 and my observations just confirm my worst-of-all-case fears.

They are losing touch with algae – what chance have I to make a case
 when I cannot leave the culture room for the global database.
 The satellites can't see me here – Bob has to realize that.
 There is no hope for clones like me unfunded by SCANSAT.

But please don't worry about us clones – for now we've moved to Maine
 where we hope to lose the Wiz-kids, and find scientists more sane.
 And if Bob takes his pension leave (I'm sure he never will)
 They'll find another keeper with the Guillard/Stanley skill.

Don't worry for the plankton or the clones around you see.
 Worry more about the scientists – for they are far from free!
 When you look outside the culture flasks, amid the moans and groans
 About NSF and funding – is it you or they who're clones?

They also have their keepers – they know famine more than boon,
 For he who pays the piper also calls the tune.
 Like us their keepers feed them if they need them, and push them to the brink,
 And when it suits administration – they flush them down the sink!

Paul Hargraves, Harbor Branch Oceanographic Institute and Smithsonian Marine Station

In 1968, I came to GSO-URI to organize and curate a phytoplankton culture collection for EPA via a contract to Ted Smayda. One of my first tasks was a 90-min trip to WHOI to consult with Bob on the many aspects of microalgal cultivation of which I was a novice. He was welcoming, open, and full of advice, both solicited and unsolicited. During the succeeding 40 years, we maintained fairly close contact; he moved to Maine, I advanced through the academic ranks until I retired as full professor in 2006. Though we never had a formal mentoring connection, as many other budding phycologists did, I always considered Bob as a primary mentor. I always impressed on my students the need for open sharing of any knowledge that might bring unforeseen future benefits to them.

Our formal collaboration was somewhat limited, but one of my cited papers was a short one coauthored with him, and it had much more to do with one of Bob's "f/2" iterations, "L-1," than with the work I did (*Phycologia* 32:234–236). We had a couple of additional collaborations like "cooking" but sadly, they never reached fruition. Such a wellspring of ideas one seldom sees. During my retirement career at Harbor Branch Oceanographic Institute, I lost touch with Bob until 2014 when he called out of the blue to say he was sending me some old files. When they arrived, I was surprised to see that many of them were detailed responses to my academic Dean concerning promotions on the academic ladder. It is not amiss to say that my career was successful in part because of Bob's support.

Kay Kilpatrick, University of Miami, Michelle Wood, University of Oregon, and Clarice Yentsch, The Waypoint Foundation

Robert Guillard, a renowned phytoplankton physiologist, became an icon in shellfish research initially because of a quest for oyster baby food, but most importantly because he understood at the most fundamental level that "you are what you eat," be you human, clam, or algae, diet matters! Recently, the three of us met for lunch at the Fish House in Key Largo, FL, for a good time instigated by Kay's dealings with a local sailboat dealer. Good friends, good food, and great conversation dominated by discussion of Bob Guillard who impacted all three of us professionally and personally. We each met Bob while he was at WHOI: Kay when she was part of the Boston University Marine Program (BUMP) in 1978, Michelle while taking Marine Botany at the Marine Biological Laboratory (MBL) in 1974, and Clarice in the same MBL course in 1964 and 1967. Bob at WHOI was remembered as enlightened and inspirational. He could make rapid mental moves describing microalgae in time and space often with links to form and function. He would punctuate his logic with random thoughts that sometimes bemused and sometimes befuddled. Our heads might spin after an encounter with Bob. No wonder that his WHOI nickname was "Spinhead."

We really got to know and love Bob after he moved to Bigelow Laboratory for Ocean Sciences in Maine and established the Provasoli-Guillard Culture Collection (now part of The National Center for Marine Algae and Microbiota). Each of us worked in direct collaboration with Bob and, as we knew him better, he was less befuddling, but still bemusing. Usually this was because of his non sequiturs that peppered conversations about science with observations relating to his other great loves: music, Morris dancing, guns, and meditation. Bob was widely recognized as a creative, although idiosyncratic thinker, and he could be relied upon for allusions to obscure, but important, scientific papers. He was effervescent and always interested in our ideas and initiatives whether they were novel or not—a supreme educator. Bob exuded a happy quality akin to what one thinks of with a high-level yogi. Many people suggest that he also gave ladies more attention than men, but we note that he cultivated a wide collection of friends and collaborators. It was a delight to be in his presence and to participate in his stream of consciousness.

Steve Morton, NOAA/NOS Charleston, South Carolina

I had the pleasure of working with Bob when I was appointed Curator of the Provasoli-Guillard National Culture Collection of Marine Phytoplankton (CCMP). During this time Bob had been "retired" for over seven years, yet he was always a presence at the collection. I will always remember how generous Bob was with his time and ideas. He welcomed me into his laboratory in a "temporary trailer" at Bigelow to develop axenic cultures for the collection. I was always amazed at the wealth of knowledge that Bob had on phytoplankton culture most of which has never been published. One of the projects I worked on with Bob was the culture of *Dinophysis*. We managed to culture this dinoflagellate for a few weeks to a few months, but were ultimately unsuccessful in producing a stable culture. Ultimately, a group from Japan was successful in the culture of *Dinophysis* using a three-step feeding protocol in which a cryptophyte was fed to *Mesodinium* which was then fed to *Dinophysis*. A similar three-step process was hypothesized by Bob to be the key. Like most of his career, his insight turned out to be correct.

During my two years at the Collection, it felt like I received another doctorate degree thanks in part to all the knowledge I absorbed from Bob, not only what he taught me outright, but also from observing the man work. After I left the Collection, I had the honor to write the Culture Techniques chapter for the Manual of Harmful Algae with Bob. I will always remember the countless phone conversations to make sure every line of the chapter was perfect. The early drafts of the chapter had many "Bobisms" which could make up a book by themselves. He definitely was one of a kind! I thank my lucky stars that I had the opportunity to work with Bob during my career; he made me a better researcher and a better person.

Sandra Shumway, University of Connecticut

I had the good fortune to share a "temporary" office space (trailer) with Bob for the best part of six years. That meant regular stories, discussions, and outright entertainment. Bob was very generous with his time and his ideas and shared both freely with graduate students and senior colleagues alike. Several colleagues have also pointed out that Bob was one of the last of a dying breed: of the gentleman scientist. He was a man of impeccable integrity, who, if he wanted to get into a new area of research and he knew another colleague was working in that area would ask them if that was okay. And if they said no, then he would respect their wishes. Not only did he not enter into

professional jealousy, he seemed not even to understand the concept. He shunned recognition, rarely attended conferences, and did not even visit the NSF until very late in his career by then only out of curiosity. At one “retirement” party, we presented him with a gold-painted bottle of f/2 (as sold by Sigma Chemical) mounted on a plaque, and he quipped that it was the most he had ever received for the product!

I was in the early days of demonstrating particle selection in bivalve molluscs and working toward identifying the underlying mechanisms. Having Bob available for advice and criticism and consolation was invaluable. He was nothing short of a one-man library, a font of knowledge, and able to put failures into their proper perspective. We often talked about the peculiarities of biology and he was as perplexed as I when I told him which algal species the shellfish were selecting. He noted clearly that they were most certainly not making the best choices, but buffered that thought with a warning not to anthropomorphize my thinking.

We shared a common geographical heritage and an old Yankee penchant for saving and reusing the most unlikely items, admiration for common sense, and intolerance for unnecessary and time-wasting bureaucracy. We also shared a genuine excitement when we noted an animal or an alga doing something that had not been observed previously, and we had great fun discussing the interactions of the two.

Bob introduced me to the wonders of phytoplankton and became a good friend and colleague. I miss our discussions and his humor and his common-sense approach to life, but I think of him often and treasure his contributions.

Diane Stoecker, University of Maryland

I was lucky to have been Bob’s last post doc at a Woods Hole Oceanographic Institution before he moved to the Bigelow Laboratory for Ocean Science. Although I was a zoologist by training, he welcomed me to his laboratory and taught me microscopy as well as how to isolate and grow phytoplankton. He freely shared his ideas, time, knowledge, cultures, and equipment with students and colleagues. His focus was on what would advance the science not just his laboratory or career. His degree of openness and sharing was unusual.

Bob loved talking about his “bugs” (phytoplankton cultures). His concern extended from cultures to the environment. He was careful never to cut wood on his farm during nesting season. I remember driving with him and stopping to untangle an angry cormorant from a fence. Although he did not use the term, he ran a “green” laboratory before this was a concern to most scientists.

My first oceanographic cruise was on the *R/V Oceanus* to Georges Bank with Bob as chief scientist. He got seasick almost immediately and disappeared until we returned to the dock. He commented afterward that he liked a Captain with a good bedside manner. It is ironic that although he rarely went to sea, he knew phytoplankton more intimately than sea-going oceanographers because he knew how to make them grow.

I always enjoyed visiting Bob and Ruth and their dogs after they moved to Maine, and catching up with Bob about his newest ideas and observations. He was an inspiring mentor and friend.

Mark Wells, University of Maine

My first contact with Bob Guillard was in 1984 when I wrote to ask about the possibility of doing graduate work with him. Whereas he could not take on students himself at Bigelow, he led me to Larry Mayer at the University of Maine Darling Marine Center, on the other side of the Damariscotta River estuary from Bigelow. I arrived later that year, and Bob joined my thesis committee. I remember the day after I arrived we sat on the banks of the Damariscotta and just talked about plankton. Of all the scientists I know, he was probably the easiest to talk to as a student.

I think that my strongest memories of Bob revolve around the kindness that he showed in taking me under his wing. He would spend endless hours with me when I traveled to Bigelow, showing me the techniques, tricks, and insights into rearing phytoplankton and running culture experiments. It amazed me how much of the current “knowledge” stemmed from his happenstance and his “green thumb” intuition. It never occurred to me as a young graduate student how important “tinkering” was to the development of what I saw as established methods. Bob was always engaged in some small little test or experiment whenever I visited Bigelow, most which would never be published but only added to his encyclopedic understanding of phytoplankton. To me he was the “plankton whisperer” because he always seemed to know how to improve the growth of my cultures.

The first time I visited him at Bigelow, I was astonished how many cultures and so much activity there was to maintain the collection, all being done in such a tiny space. Bob impressed me from the start with how frugal he was, whether it was with space or materials. He was particularly proud to show me the “incubators” for the entire culture collection; refurbished grocery store coolers that a local store had been throwing out because they were obsolete. I had been “raised” in a laboratory that washed pipette tips for reuse, but he was a recycling guru by comparison.

Another important lesson Bob taught me was about replication. I did all of my early culture work over at Bigelow Laboratories in space that Bob found for me. Bob wandered in one day whereas I was measuring the growth response of an extensive experiment, all treatments in triplicate. In his normal way of clearing his throat before he spoke, he asked me why I had so many cultures? Thinking it strange, I said that I wanted to be able to calculate a SD for my growth rates. His response was that I certainly would be able to calculate the precision of a possible mistake, but that if I wanted to know the real answer I should run single cultures per treatment and repeat the experiment three times. I did my thesis work that way and remember this insight every time I read a paper based on single, well-replicated experiments.

My other strongest recollections will be the way that he helped me learn how to write. I would spend hours struggling to find the structure, words, and phrases for drafts of my thesis chapters before getting into my car and driving to Bigelow to see Bob. He would sit down with me at a table, side by side, pull out his pencil and work, sentence by sentence, through the entire draft. In his kindness, he would say after (almost) each sentence “this is good but... what if we were to say it this way...” With what seemed like no effort he would transform my text from blatherings to focused insight. Now trying to carry on this support for my students, I know the patient endurance it required of him. When he was having particular difficulty interpreting my mangled prose he would ask “What are you trying to say?” Thinking that writing needed to be structured in a “scientific” format, it never entered my mind that I could just say what I thought. It is perhaps his most lasting impact on me. I often find myself echoing the same phrase, and it never fails to improve my writing.

PUBLICATIONS OF ROBERT R. L. GUILLARD

- Guillard, R. R. L. 1957. Some factors in the use of nanoplankton cultures as food for larval and juvenile bivalves. *Proc. Natl. Shellfish. Assoc.* 48:134–142.
- Guillard, R. R. L. & P. L. Wangersky. 1958. The production of extracellular carbohydrates by some marine flagellates. *Limnol. Oceanogr.* 3:449–454.
- Davis, H. C. & R. R. L. Guillard 1958. Relative value of some genera of microorganisms as foods for oyster and clam larvae. *USFWS Fish. Bull.* 136:293–304.
- Guillard, R. R. L. 1959. Further evidence of the destruction of bivalve larvae by bacteria. *Biol. Bull.* 117:258–266.
- Ryther, J. H. & R. R. L. Guillard. 1959. Enrichment experiments as a means of studying nutrients limiting to phytoplankton production. *Deep-Sea Res.* 6:65–69.
- Wangersky, P. J. & R. R. L. Guillard. 1960. Low molecular weight organic base from the dinoflagellate *Amphidinium carteri*. *Nature* 185: 689–690.
- Guillard, R. R. L. 1960. A mutant of *Chlamydomonas moewusii* lacking contractile vacuoles. *J. Protozool.* 7:262–268.
- Hulburt, E. M., J. H. Ryther & R. R. L. Guillard. 1960. The phytoplankton of the Sargasso Sea off Bermuda. *J. Cons. Cons. Int. Explor. Mer* 25:115–128.
- Guillard, R. R. L. 1962. Salt and osmotic balance. In: Lewin, R. A., editor. *Physiology and biochemistry of algae*. London: Academic Press. pp. 529–540.
- Guillard, R. R. L. & J. H. Ryther. 1962. Studies of marine planktonic diatoms. I. *Cyclotella nana* Hustedt and *Detonula confervacea* (Cleve). *Gran. Can. J. Microbiol.* 8:229–239.
- Ryther, J. H. & R. R. L. Guillard. 1962. Studies of marine planktonic diatoms. II. Use of *Cyclotella nana* Hustedt for assays of vitamin B₁₂ in sea water. *Can. J. Microbiol.* 8:437–445.
- Ryther, J. H. & R. R. L. Guillard. 1962. Studies of marine planktonic diatoms. III. Some effects of temperature on respiration of five species. *Can. J. Microbiol.* 8:447–453.
- Guillard, R. R. L. & S. W. Watson. 1962. A new marine bacterium. *Oceanus* 8:22–23.
- Guillard, R. R. L. 1963. Organic sources of nitrogen for marine centric diatoms. In: Oppenheimer, editor. *Symposium on Marine Microbiology*. Springfield, IL: Charles C. Thomas Publisher House. pp. 93–104.
- Guillard, R. R. L. & V. Cassie. 1963. Minimum cyanocobalamin requirements of some marine centric diatoms. *Limnol. Oceanogr.* 8:161–165.
- Kuenzler, E. J., R. R. L. Guillard & N. Corwin. 1963. Phosphate-free sea water for reagent blanks in chemical analysis. *Deep-Sea Res.* 10:749–755.
- Reimann, B. E., J. C. Lewin & R. R. L. Guillard. 1963. *Cyclotella cryptica*, a new brackish-water diatom species. *Phycologia* 3:75–84.
- Lewin, J. C. & R. R. L. Guillard. 1963. Diatoms. *Annu. Rev. Microbiol.* 17:373–414.
- Mendiola, L., C. A. Price & R. R. L. Guillard. 1966. Isolation of nuclei from a marine dinoflagellate. *Science* 153:1661–1663.
- Wall, D., R. R. L. Guillard & B. Dale. 1967. Marine dinoflagellate cultures from resting spores. *Phycologia* 6:83–86.
- Hellebust, J. A. & R. R. L. Guillard. 1967. Uptake specificity for organic substrates by the marine diatom *Melosira nummuloides*. *J. Phycol.* 3:132–136.
- Degens, E. T., R. R. L. Guillard, W. M. Sackett & J. A. Hellebust. 1968. Metabolic fractionation of carbon isotopes in marine plankton - I: temperature and respiration experiments. *Deep-Sea Res.* 15:1–9.
- Guillard, R. R. L. 1968. B₁₂ specificity of marine centric diatoms. *J. Phycol.* 4:59–64.
- Deuser, W. C., E. T. Degans & R. R. L. Guillard. 1968. Carbon isotope relationships between plankton and sea water. *Geochim. Cosmochim. Acta* 32:657–660.
- Hulburt, E. M. & R. R. L. Guillard. 1968. The relationship of the distribution of the diatom *Skeletonema tropicum* to temperature. *Ecology* 49:337–339.
- Yentsch, C. S. & R. R. L. Guillard. 1969. The absorption of chlorophyll-*b* in vivo. *Photochem. Photobiol.* 9:385–388.
- Guillard, R. R. L. & S. Mykelstad. 1970. Osmotic and ionic requirements of the marine centric diatom *Cyclotella nana*. *Helgolander wiss. Meeresunters.* 20:104–110.
- Wall, D., R. R. L. Guillard, B. Dale, E. Swift & N. Watabe. 1970. Calcitic resting cysts in *Peridinium trochoideum* (Stein) Lemmermann, an autotrophic marine dinoflagellate. *Phycologia* 9:151–156.
- Blumer, M., M. M. Mullin & R. R. L. Guillard. 1970. A polyunsaturated hydrocarbon (3,6,9,12,15,18-heneicosahexaene) in the marine food web. *Mar. Biol.* 6:226–235.
- Blumer, M., R. R. L. Guillard & T. Chase. 1971. Hydrocarbons of marine phytoplankton. *Mar. Biol.* 8:183–189.
- Carpenter, W. J. & R. R. L. Guillard. 1971. Intraspecific differences in nitrate half-saturation constants for three species of marine phytoplankton. *Ecology* 52:183–185.
- Siegelman, H. W. & R. R. L. Guillard. 1971. Large-scale culture of algae. *Methods Enzymol.* 23:110–115.
- Guillard, R. R. L. & J. A. Hellebust. 1971. Growth and production of extracellular substances by two strains of *Phaeocystis pouchetii*. *J. Phycol.* 7:330–338.
- Guillard, R. R. L. & C. J. Lorenzen. 1972. Yellow-green algae with chlorophyllide-*c*. *J. Phycol.* 8:10–14.
- Guillard, R. R. L. 1973. Methods for microflagellates and nanoplankton. In: Stein, J., editor. *Handbook of phycological methods. Culture methods and growth measurements*. Cambridge, United Kingdom: Cambridge University Press. pp. 69–85.
- Guillard, R. R. L. 1973. Division rates. In: Stein, J., editor. *Handbook of phycological methods. Culture methods and growth measurements*. Cambridge, United Kingdom: Cambridge University Press. pp. 289–311.
- Guillard, R. R. L., P. Kilham & T. A. Jackson. 1973. Kinetics of silicon-limited growth in the marine diatom *Thalassiosira pseudonana* Hasle and Heimdal (= *Cyclotella nana* Hustedt). *J. Phycol.* 9:233–237.
- Norgard, S., W. A. Svec, S. Liaaen-Jensen, A. Jensen, & R. R. L. Guillard 1974. Chloroplast pigments and algal systematics. *Biochem. Syst. Ecol.* 2:3–6.
- Norgard, S., W. A. Svec, S. Liaaen-Jensen & R. R. L. Guillard. 1974. Algal carotenoids and chemotaxonomy. *Biochem. Syst. Ecol.* 2:7–9.
- Price, C. A., L. R. Mendiola-Morgenthaler, M. Goldstein, E. N. Breden & R. R. L. Guillard. 1974. Harvest of planktonic marine algae by centrifugation into gradients of silica in the CF-6 continuous flow zonal rotor. *Biol. Bull.* 147:136–145.

- Guillard, R. R. L., E. J. Carpenter & B. E. F. Reimann. 1974. *Skeletonema menzeli*, a new diatom from the western Atlantic Ocean. *Phycologia* 13:131–138.
- Hargraves, P. E. & R. R. L. Guillard. 1974. Structural and physiological observations on some small marine diatoms. *Phycologia* 13:163–172.
- Haines, K. C. & R. R. L. Guillard. 1974. Growth of vitamin B₁₂-requiring marine diatoms in mixed laboratory cultures with vitamin B₁₂-producing marine bacteria. *J. Phycol.* 10:245–252.
- Guillard, R. R. L. 1975. Culture of phytoplankton for feeding marine invertebrates. In: Smith, W. L. & M. H. Chanley, editors. Culture of marine invertebrate animals. New York, NY: Plenum Press. pp. 29–60.
- Guillard, R. R. L., H. C. Bold & F. J. MacEntee. 1975. Four new unicellular chlorophycean algae from mixohaline habitats. *Phycologia* 14:13–24.
- Klaveness, D. & R. R. L. Guillard. 1975. The requirement for silicon in *Synura petersenii* Korschikoff. *J. Phycol.* 11:349–355.
- Murphy, L. S. & R. R. L. Guillard. 1976. Biochemical taxonomy of marine phytoplankton by electrophoresis of enzymes. I. The centric diatoms *Thalassiosira pseudonana* and *T. fluviatilis*. *J. Phycol.* 12:9–13.
- Nelson, D. M., J. J. Goering, R. R. L. Guillard & S. S. Killham. 1976. Kinetics of silicic acid uptake and rates of silica dissolution in the marine diatom *Thalassiosira pseudonana*. *J. Phycol.* 12:246–252.
- Fisher, N. S., R. R. L. Guillard & F. Wurster. 1976. Effects of a chlorinated hydrocarbon pollutant on the growth kinetics of a marine diatom. In: Canale, R. P., editor. Modeling of biochemical processes in aquatic ecosystems. Ann Arbor, MI: Ann Arbor Science Publisher, Inc. pp. 305–317.
- Sunda, W. & R. R. L. Guillard. 1976. The relationship between cupric ion activity and the toxicity of copper to phytoplankton. *J. Mar. Res.* 34:511–529.
- Berger, R. & S. Liaaen-Jensen. 1977. Carotenoids of Prymnesiophyceae (Haptophyceae). *Biochem. Syst. Ecol.* 5:71–75.
- Swift, D. G. & R. R. L. Guillard. 1977. Diatoms as tools for assay of total B₁₂ activity and cyanocobalamin activity in seawater. *J. Mar. Res.* 35:309–319.
- Guillard, R. R. L. & P. Kilham. 1977. The ecology of marine planktonic diatoms. In: Werner, D., editor. The biology of diatoms. Oxford, United Kingdom: Blackwell Science Publisher. pp. 372–469.
- Price, C. A., E. M. Reardon & R. R. L. Guillard. 1978. Collection of dinoflagellates and other marine microalgae by centrifugation in density gradients of a modified silica sol. *Limnol. Oceanogr.* 23:548–553.
- Fuhrman, J. A., S. W. Chisholm & R. R. L. Guillard. 1978. Marine alga *Platymonas* sp. accumulates silicon without apparent requirement. *Nature* 272:244–246.
- Swift, D. G. & R. R. L. Guillard. 1978. Unexpected response to vitamin B₁₂ of dominant centric diatoms from the spring bloom in the Gulf of Maine. *J. Phycol.* 14:377–386.
- Anderson, M., F. M. M. Morel & R. R. L. Guillard. 1978. Growth limitation of a coastal diatom by low zinc ion activity. *Nature* 276:70–71.
- Guillard, R. R. L. 1978. Counting slides. In: Sournia, A., editor. The phytoplankton manual. Paris, France: UNESCO. pp. 182–189.
- Guillard, R. R. L. 1978. Separating phytoplankton components. In: Sournia, A., editor. The phytoplankton manual. Paris, France: UNESCO. pp. 129–131.
- Waterbury, J. B., S. W. Watson, R. R. L. Guillard & L. E. Brand. 1979. Widespread occurrence of a unicellular, marine, planktonic cyanobacterium. *Nature* 277:293–294.
- D'Elia, C. F., R. R. L. Guillard & D. M. Nelson. 1979. Growth and competition of the marine diatoms *Phaeodactylum tricorutum* and *Thalassiosira pseudonana*. I. Nutrient effects. *Mar. Biol.* 50:305–312.
- Nelson, D. M., C. F. D'Elia & R. R. L. Guillard. 1979. Growth and competition of the marine diatoms *Phaeodactylum tricorutum* and *Thalassiosira pseudonana*. II. Light limitation. *Mar. Biol.* 50:313–318.
- Morel, F. M. M., J. G. Reuter, D. M. Anderson & R. R. L. Guillard. 1979. Aquil: a chemically defined medium for culturing marine phytoplankton. *J. Phycol.* 15:135–141.
- Blackwelder, P. L., L. E. Brand & R. R. L. Guillard. 1979. Coccolith morphology and paleoclimatology II. Cell ultrastructure and formation of coccoliths in *Cyclococcolithina leptopora* (Murray and Blackman) Wilcoxon and *Gephyrocapsa oceanica* Kamptner. In: Scanning electron microscopy II, AMF O'Hare, IL. pp. 417–420.
- Reardon, R. M., C. A. Price & R. R. L. Guillard. 1979. Harvest of marine microalgae by centrifugation in density gradients of "Percoll", a modified silica sol. In: Reed, E., editor. Methodological surveys in biochemistry (8). New York: John Wiley & Sons. pp. 171–175.
- Bankston, D. C., N. S. Fishere, R. R. L. Guillard & V. T. Bowen. 1979. Studies of element incorporation by marine phytoplankton with special reference to barium. In: Proceeding New England Conference Current Development. Spectrochemical Excitation and Analysis, US DOE Quarterly Report, July 1979. pp. 509–531.
- Dudley, W. C., J. C. Duplessy, P. L. Blackwelder, L. E. Brand & R. R. L. Guillard. 1980. Oxygen isotope analyses of coccoliths grown in culture: species dominant in Pleistocene-Holocene nannofossil assemblages. *Nature* 285:222–223.
- Miller, C. B., D. M. Nelson, R. R. L. Guillard & B. L. Woodward. 1980. Effects of media with low silicic acid concentrations on tooth formation in *Acartia tonsa* Dana (Copepoda, Calanoida). *Biol. Bull.* 159:349–363.
- Brand, L. E. & R. R. L. Guillard. 1981. The effects of continuous light and of light intensity on the reproduction rates of twenty-two species of marine phytoplankton. *J. Exp. Mar. Biol. Ecol.* 50:119–132.
- Brand, L. E., L. S. Murphy, R. R. L. Guillard & H.-t. Lee. 1981. Genetic variability and differentiation in the temperature niche component of the diatom *Thalassiosira pseudonana*. *Mar. Biol.* 62:103–110.
- Gavis, J., R. R. L. Guillard & B. L. Woodward. 1981. Cupric ion activity and the growth of phytoplankton isolated from different marine environments. *J. Mar. Res.* 39:315–333.
- Brand, L. E., R. R. L. Guillard & L. S. Murphy. 1981. A method for the rapid and precise determination of acclimated phytoplankton reproduction rates. *J. Plankton Res.* 3:193–201.
- Stoecker, D. K., R. R. L. Guillard & R. Kavee. 1981. Selective predation of *Favella ehrenbergii* (Tintinnia) on and among dinoflagellates. *Biol. Bull.* 160:136–145.
- Murphy, L. S., R. R. L. Guillard & J. Gavis. 1982. Evolution of resistant phytoplankton strains through exposure to marine pollutants. In: Mayer, G., editor. Ecological stress and the New York bight: science and management. Columbia, SC: University of South Carolina Press. pp. 401–412.
- Tangen, K., L. E. Brand, P. L. Blackwelder & R. R. L. Guillard. 1982. *Thoracosphaera heimii* (Lohmann) Kamptner is a dinophyte: observations on its morphology and life cycle. *Mar. Micropaleontol.* 7:193–212.

- Stoecker, D. & R. R. L. Guillard. 1982. Effects of temperature and light on the feeding rate of *Favella* sp. (ciliated protozoa, suborder Tintinnina). *Ann. Inst. Oceanogr. Paris (Nouv. Ser.)* 58(Suppl):309–318.
- Holick, M. F., S. A. Holick & R. R. L. Guillard. 1982. On the origin and metabolism of vitamin D in the sea. In: Oguro, C. & P.K.T. Pank, editors. Comparative endocrinology of calcium regulation. Proceedings Satellite Symposium IX International Symposium. Comparative Endocrinol. Tokyo, Japan: Japan Science Society Press. pp. 85–91.
- Greenbaum, E., R. R. L. Guillard & W. G. Sunda. 1982. Hydrogen and oxygen photoproduction by marine algae. *Photochem. Photobiol.* 37:649–655.
- Brand, L. E., W. G. Sunda & R. R. L. Guillard. 1983. Limitation of phytoplankton reproductive rates by zinc, manganese and iron. *Limnol. Oceanogr.* 28:1182–1198.
- Murphy, L. S., R. R. L. Guillard & J. F. Brown. 1983. The effects of Fe and Mn on Cu sensitivity in diatoms: differences in the responses of closely related neritic and oceanic species. *Biol. Oceanogr.* 3:187–202.
- Fiksdahl, A., N. Withers, R. R. L. Guillard & S. Liaaen-Jensen. 1984. Carotenoids of the Raphidophyceae—a chemosystematic contribution. *Comp. Biochem. Physiol.* 78B:265–271.
- Guillard, R. R. L. & M. D. Keller. 1984. Culturing dinoflagellates, Chapter 13. In: Spector, D. M., editor. *Dinoflagellates*. New York, NY: Academic Press. pp. 391–442.
- Foss, P., R. R. L. Guillard & S. Liaaen-Jensen. 1984. Prasinolanthin—a chemosystematic marker for algae. *Phytochemistry* 23:1629–1633.
- Alberte, R. S., A. M. Wood, T. A. Kursar & R. R. L. Guillard. 1984. Novel phycoerythrins in marine *Synechococcus* spp.: characterization, and evolutionary and ecological implications. *Plant Physiol.* 75:732–739.
- Guillard, R. R. L. 1984. Culture of phytoplankton for feeding marine invertebrates. In: Berg, C. J., Jr., editor. *Culture of marine invertebrates, selected readings*. Stroudsburg, PA: Hutchinson Ross Publisher. pp. 108–132.
- Guillard, R. R. L., L. S. Murphy, P. Foss & S. Liaaen-Jensen. 1985. *Synechococcus* spp. as likely zeaxanthin-dominant ultraphytoplankton in the North Atlantic. *Limnol. Oceanogr.* 30:412–414.
- Cucci, T. L., S. E. Shumway, R. C. Newell, R. Selvin, R. R. L. Guillard & C. M. Yentsch. 1985. Flow cytometry: a new method for characterization of differential ingestion, digestion and egestion by suspension feeders. *Mar. Ecol. Prog. Ser.* 24:201–204.
- Foss, P., R. R. L. Guillard & S. Liaaen-Jensen. 1986. Carotenoids from eucaryotic ultraplankton clones (Prasinophyceae). *Phytochemistry* 25:119–124.
- Glover, H. E., M. D. Keller & R. R. L. Guillard. 1986. Light quality and oceanic ultraphytoplankters. *Nature* 319:142–143.
- Brand, L. E., W. G. Sunda & R. R. L. Guillard. 1986. Reduction of marine phytoplankton reproduction rates by copper and cadmium. *J. Exp. Mar. Biol. Ecol.* 96:225–250.
- Shapiro, L. P. & R. R. L. Guillard. 1986. Physiology and ecology of the marine eukaryotic ultraplankton. In: Platt, T. & W. K. W. Li, editors. *Photosynthetic picoplankton*. Reprinted from Canadian Bulletin Fisheries Aquatic Sciences. 214:371–389.
- Keller, M. D., R. C. Selvin, W. Claus & R. R. L. Guillard. 1987. Media for the culture of oceanic ultraphytoplankton. *J. Phycol.* 23:633–638.
- Bomber, J. W., R. R. L. Guillard & W. G. Nelson. 1988. Roles of temperature, salinity, and light in seasonality, growth, and toxicity of ciguatera-causing *Gambierdiscus toxicus* Adachi et Fukuyo (Dinophyceae). *J. Exp. Mar. Biol. Ecol.* 115:53–65.
- Keller, M. D., W. K. Bellows & R. R. L. Guillard. 1988. Microwave treatment for sterilization of phytoplankton culture media. *J. Exp. Mar. Biol. Ecol.* 117:279–283.
- Guillard, R. R. L. 1988. The center for culture of marine phytoplankton: history, structure, function, and future. *J. Protozool.* 35:255–256.
- Bjornland, T., R. R. L. Guillard & S. Liaaen-Jensen. 1988. *Phaeocystis* sp. clone 677-3—a tropical marine planktonic prymnesiophyte with fucoxanthin and 19'-acyloxyfucoxanthins as chemosystematic carotenoid markers. *Biochem. Syst. Ecol.* 16:445–452.
- Pennington, F., R. R. L. Guillard & S. Liaaen-Jensen. 1988. Carotenoid distribution patterns in Bacillariophyceae (diatoms). *Biochem. Syst. Ecol.* 16:589–592.
- Hooks, C. E., R. R. Bidigare, M. D. Keller & R. R. Guillard. 1988. Coccoid eukaryotic marine ultraplankters with four different HPLC pigment signatures. *J. Phycol.* 24:571–580.
- Keller, M. D., W. K. Bellows & R. R. L. Guillard. 1989. Dimethyl sulfide production in marine phytoplankton. In: Saltzman, E. S. & W. J. Cooper, editors. *Biogenic Sulfur in the Environment*. *Amer. Chem. Soc. Symp.* 393:167–182.
- Shapiro, L. P., E. M. Haugen, M. D. Keller, R. R. Bidigare, L. Campbell & R. R. L. Guillard. 1989. Taxonomic affinities of marine coccoid ultraplankton: a comparison of immunochemical surface antigen cross-reactions and HPLC chloroplast pigment signature. *J. Phycol.* 25:794–797.
- Cierszko, L. S. & R. R. L. Guillard. 1989. The influence of some cembranoides from gorgonian corals on motility of marine flagellates. *J. Exp. Mar. Biol. Ecol.* 127:205–210.
- Keller, M. D., W. K. Bellows & R. R. L. Guillard. 1989. Dimethyl sulfide production and marine phytoplankton: an additional impact of unusual blooms. In: Cospér, E. M., V. M. Bricelej & E. J. Carpenter, editors. *Novel phytoplankton blooms*. Coastal and estuarine studies no. 35, Berlin, Germany: Springer-Verlag. pp. 101–115.
- Bidigare, R. R., M. C. Kennicutt, II, M. E. Ondrusek, M. D. Keller & R. R. L. Guillard. 1990. Novel chlorophyll-related compounds in marine phytoplankton: distributions and geochemical implications. *Energy Fuels* 4:653–657.
- Wells, M. L., L. M. Meyer & R. R. L. Guillard. 1991. Evaluation of iron as a triggering factor for red tide blooms. *Mar. Ecol. Prog. Ser.* 69:93–102.
- Wells, M. L., L. M. Mayer & R. R. L. Guillard. 1991. A chemical method for estimating the availability of iron to phytoplankton in seawater. *Mar. Chem.* 33:23–40.
- Fisher, N. S., R. R. L. Guillard & D. C. Bankston. 1991. The accumulation of barium by marine phytoplankton grown in culture. *J. Mar. Res.* 40:339–354.
- Guillard, R. R. L., M. D. Keller, C. J. O'Kelly & G. L. Floyd. 1991. *Pycnococcus provasolii* gen. et sp. nov., a coccoid prasinolanthin-containing phytoplankton from the western North Atlantic and Gulf of Mexico. *J. Phycol.* 27:39–47.
- Aakennann, T., R. R. L. Guillard & S. Liaaen-Jensen. 1993. Algal carotenoids 55. Structure elucidation of (3S, 5R, 6R, 3'S, 5'R, 6'S)-13'-cis7', 8' dihydroneoxanthin-20'-al 3'-β-D-lactoside (P457). Part 1. Reisolation, derivatization and synthesis of model compounds. *Acta Chern. Scandinavica* 47:1207–1213.
- Guillard, R. R. L. & P. E. Hargraves. 1993. *Stichochrysis immobilis* is a diatom, not a chrysophyte. *Phycologia* 32:234–236.

- Guillard, R. R. L. 1995. Culture methods. In: Hallegraeff, G. M., D. M. Anderson & A. D. Cembella, editors. Manual on harmful marine algae, IOC manuals and guides, 33. Paris, France: UNESCO. pp. 45–62.
- Egeland, E. S., R. R. L. Guillard & S. Liaaen-Jensen. 1997. Additional carotenoid prototype representatives and a general chemosystematic evaluation of carotenoids in Prasinophyceae (Chlorophyta). *Phytochemistry* 44:1087–1097.
- Guillard, R. R. L. & S. L. Morton. 2003. Culture methods. In: Hallegraeff, G. M., D. M. Anderson & A. D. Cembella, editors. Manual on harmful marine microalgae, IOC monographs on oceanographic methodology, 11. Paris, France: UNESCO. pp. 77–97.
- Vaillancourt, R. D., C. W. Brown, R. R. L. Guillard & W. M. Balch. 2004. Light backscattering properties of marine phytoplankton: relationships to cell size, chemical composition and taxonomy. *J. Plankton Res.* 26:191–212.
- Guillard, R. R. L. 2005. Purification methods for microalgae. In: Andersen, R. A., editor. Algal culturing techniques. Amsterdam, The Netherlands: Elsevier Academic Press. pp. 117–132.
- Guillard, R. R. L. & M. S. Sieracki. 2005. Counting cells in cultures with the light microscope. In: Andersen, R. A., editor. Algal culturing techniques. Amsterdam, The Netherlands: Elsevier Academic Press. pp. 239–252.