50 Years of Women in Cell Biology: Where have we been? Where are we going?

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ABSTRACT **It's been 50 years since Women in Cell Biology (WICB) was founded by junior women cell biologists who found themselves neither represented at the American Society for Cell Biology (ASCB) presentations nor receiving the information, mentoring, and sponsorship they needed to advance their careers. Since then, gender parity at ASCB has made significant strides: WICB has become a standing ASCB committee, women are regularly elected president of the ASCB, and half the symposia speakers are women. Many of WICB's pioneering initiatives for professional development, including career panels, workshops, awards for accomplishments in science and mentoring, and career mentoring roundtables, have been incorporated and adapted into broader "professional development" that benefits all members of ASCB. The time has passed when we can assume that all women benefit equally from progress. By strategically, thoughtfully, and honestly recognizing the challenges to women of the past and today, we may anticipate those new challenges that will arise in the *next* 50 years. WICB, in collaboration with the ASCB, can lead in data collection and access and can promote diversity, equity, and inclusion. This work will be a fitting homage to the women who, half a century ago, posted bathroom stall invitations to the first Women in Cell Biology meetup.**

Monitoring Editor
Matthew Welch
University of California, Berkeley

Received: May 21, 2021
Revised: Oct 7, 2021
Accepted: Oct 8, 2021

THE FIRST 50 YEARS: 1971–PRESENT

Let's start with a little time travel to the USA, 1971.

You are a newly minted PhD cell biologist with great skills, passion for your research, and a paper about to be published in the *Journal of Cell Biology*. You are heading to the American Society for Cell Biology (ASCB) annual meeting as a full member of a meritorious community. However, you have been turned down for several postdoctoral positions for unspecified reasons, and you have heard that this is not unusual for accomplished young woman scientists.

At the ASCB annual meeting, you wonder, "Why are there so few women speakers?" As you exchange stories with other women, you learn that, although there are many academic jobs, they are advertised mostly by word of mouth. The women scientists at the meeting describe examples of sexual harassment, including one in which a researcher had to lock herself in the darkroom to keep her mentor at bay. Another reports on comments she received following a seminar featuring exciting data, which were not about the speaker's data, but about her looks and clothes. And a third reports a particularly egregious example of getting an interview for a postdoc position in a great lab at a New York institution only to be dismissed by the white male division head who says, "Since you are a married woman, you are likely to have a child and therefore take time out. It would be wasting a place at the lab's bench."

Outside the walls of science, you find that you cannot get a credit card in your own name; instead, your credit card reads "Mrs. Husband's Name."

Although this sounds like a dystopian novel, it describes the time and the environment in which a group of women founded Women in Cell Biology (WICB). These women were cell biologists—mostly graduate students, research associates, and postdocs from Yale—and included Virginia Walbot, PhD; Mary Clutter, PhD; and

DOI:10.1091/mbc.E21-04-0186

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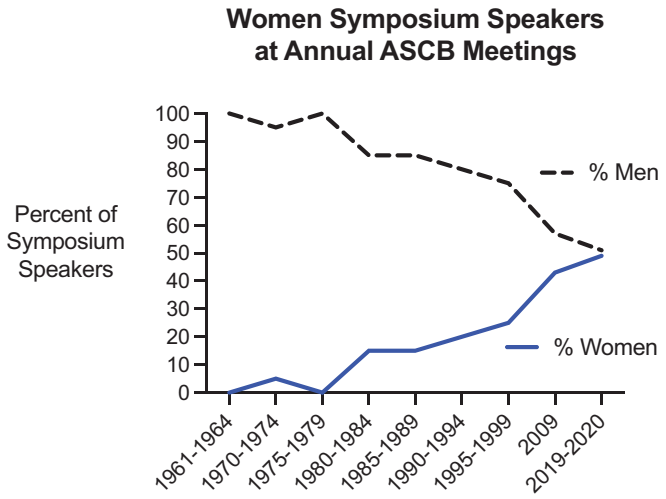

FIGURE 1: The percentage of women speakers at ASCB symposia from 1961 to 2020. (Years where data are unavailable are omitted.) Women were essentially absent prior to the early 1980s and currently constitute 50% of the speakers.

Mary Lake Polan, MD, PhD. They had hoped to find in the ASCB a meritocratic, egalitarian, scientific society in, and through which, they would have a voice. But they did not. Hence, WICB's formation.

In 1971, the inaugural session of WICB was announced with fliers in the women's bathroom stalls at the ASCB annual meeting, which attracted about 30 people to a hotel bar (Williams, 1996).[1] The founders reasoned that if women were not fully included in the biomedical community, 50% of the mind power that could contribute to scientific output was excluded. They were surprised to be told, even by colleagues who considered themselves sympathetic, that speaking up for gender equity meant that they would be labeled as "feminists."

At that time, second-wave feminism, associated with the likes of Betty Friedan, Gloria Steinem, and Florynce Kennedy, was catalyzing the recognition of gender discrimination in numerous contexts. Unfortunately, in many quarters, including the ASCB, the term feminist was a condemnation, as feminists were viewed as antagonistic, humorless, and sexless, implications that regrettably persist in some cultures today. On the national front, shortly after WICB's first meeting, Title IX (Education Amendments Act of 1972, 2020) was established. It stated that "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." In the same time frame, the Department of Labor ordered a compliance review of hiring policies for women at universities. Other entities were awakening to recruit women and scientists of diverse backgrounds onto review panels and Advisory Boards. But despite WICB's existence and these other activities, there were few, if any, women speakers at the ASCB annual meeting well into the early 1980s (Figure 1).

To develop their burgeoning vision, WICB's members initially worked in parallel with, but separately from, the ASCB. This separation had advantages. WICB members brought an "outsider" perspective that allowed them to see what was missing from their ostensibly data-driven scientific society. In principle, the ASCB's purpose was to support and promote interest in, and publication of, scientific results pertaining to the cell as the fundamental unit of all life. In actuality, the limited embrace and representation of women as speakers, authors, awardees, and general participants in the life of the Society was an indication that the ASCB fell short of its mission. To serve this need, WICB members continued to organize gatherings at the annual meetings so that women could present their science.

Another urgent issue guided WICB founders: how do women find out about job openings? It became clear that news of positions was conveyed by informal networks dominated by men, almost all of whom were white. To increase opportunity and transparency, WICB members published a newsletter that listed jobs that members had learned of through their own networks.

Also lacking were opportunities for women to gather information vital to their professional development, such as how to obtain effective mentors to advise you and sponsors to advocate for you, how to overcome gender inequity in job placement, and how to juggle the demands of your career with those of your personal life. Most graduate programs provided no regular counseling on how to find open jobs and how to apply for them, how to give a recruitment talk, how to negotiate and deal with conflict, or (more recently) how to write an educational philosophy statement. To meet those needs, WICB sponsored an annual career advice panel and group discussion. (https://www.ascb.org/careers/the-history-of-wicb-the-later-years/). That panel and discussion became very popular, drawing a record turnout of 900 in 1991. Finally, WICB members applied their strategic thinking to generate resources by publishing booklets such as *How to Get a Job* and *How to Keep a Job* and multiple editions of *Career Advice for Life Scientists.* (Tactical advice is now provided year-round in the WICB's Career Navigator Columns in the *ASCB Newsletter.*)

1993: WICB BECOMES AN ASCB STANDING COMMITTEE

In 1993, more than 20 years after its founding, WICB chose to become a standing committee of the ASCB. WICB's leadership reasoned that it could more effectively pursue its original goals with a formal seat at the table and would have a greater influence from *within* the leadership than was possible from the outside.

Building on its earlier momentum at the ASCB annual meetings, WICB sponsored career issue-related workshops. An example was the unique WICB Mentoring Theater, which provided humor to help unravel complex and sensitive dynamics faced by cell biologists. WICB also created *Career Discussion and Mentoring Roundtables*, where senior and junior scientists connect around a table in groups of 10 in an informal setting for targeted career advice. These Roundtables covered career options (biotech, pharm and industry, patent law, scientific writing, obtaining a postdoc), career preparation (interviewing and negotiation skills, setting up your first lab, developing research teams, collaborations), and career and life (work/life satisfaction, LGBTQ+ in science, two career moves). An indication of their utility is that, in recent decades, many men also have availed themselves of these WICB resources (attending WICB career sessions, joining the WICB network, writing and reading WICB career articles).

Because WICB has been acutely sensitive to the challenges for parents of young children to avail themselves of the richness of the annual meeting, it obtained funding to provide childcare awards. This financial support enables parents to care for their children on

[1]Importantly, it would be several more decades before strict binary definitions of gender were recognized as incongruous. But at the time, standard definitions of being a woman were sufficient cause for disregard or exclusion by the male scientific community. We use the term "woman" here to encompass any individual, regardless of gender, who identifies as a woman.

their own terms (e.g., pay for an at-home or an on-site sitter) so that they can attend the meeting and present their science.

WICB's strong emphasis on mentorship served as a valuable pilot project from which the ASCB developed the current Professional Development track at the annual meeting. In addition to career-related workshops, the ASCB's Scientific Roundtables has adopted the scientific topics, format, and mentoring goals of the *WICB Career Discussion and Mentoring Roundtables*. Now, small groups of all ASCB members can learn from a scientific expert in an informal discussion. A previous *MBoC* article (Masur, 2013) summarizes WICB-sponsored activities as they evolved in alignment with the Committee's original goals.

Since WICB's founding and recognition as a formal ASCB committee, the percentage of women's voices at the ASCB annual meeting has increased substantially. WICB's regular input into the annual meeting program has been fundamental to achieving this trajectory. In the annual ASCB meetings from 1961 and 1977, we could identify only one woman Symposium speaker. By the period 1990–1999, 21% of Symposia speakers were women. In the years 2019 and 2020, 49% of symposium speakers were women, and women and men were equivalently recognized in receiving major ASCB awards. (Figure 1). Consistent with data collected recently from other professional societies, our ASCB experience demonstrates a "significant positive correlation between the proportion of women on [scientific meeting] planning committees and representation of female speakers" (Ford *et al.*, 2018; Arora *et al*, 2020). Despite these gains in ASCB by WICB, it must be remembered that today, at scientific conferences across a range of fields and specialties in STEMM, there remains a lower proportion of women speakers and a corresponding overrepresentation of males on panels ("manels") (Jones *et al.*, 2014; Nittrouer *et al.*, 2018; Stewart and Valian, 2018; Ruzycki *et al.*, 2019; Arora *et al.*, 2020), even when there is a 1:1 gender ratio at the meeting (Minello, 2020). To assist the scientific community to move beyond manels and to serve as a resource for STEMM meeting organizers generally, WICB has generated Speaker Referral lists that are comprised of datasets of women candidates for seminars and review panels in all cell biology fields. This model has been replicated by other scientific groups, including ASCB's own Minorities Affairs Committee and LGBTQ+ Committee (https://www.ascb.org/career-development/speaker-referral-lists/).

Awards and recognitions conferred by professional societies provide important scientific exposure and recognition of impactful work. By 1982, the ASCB had established two awards to honor "eminent cell biologists" for their "far-reaching contributions to cell biology over a lifetime in science." WICB members both approved of these awards and also suggested that there were other forms of excellence that merited celebration in that the scientific contributions of junior and women scientists were often not recognized. As a corrective measure, WICB established two additional awards in 1986. The first was the WICB *Junior* Award, which recognizes excellence in research by an early-career woman who is making exceptional scientific contributions to cell biology, developing a strong independent research program, and exhibiting the potential for continued research excellence and leadership. Again, based on this pilot by WICB, ASCB has since established additional junior scientist awards. The second was the WICB *Senior* Award (now called the Sandra K. Masur Senior Leadership Award), which is unique in that it celebrates active leadership in mentoring of both men and women *and* outstanding scientific contributions. On the heels of this, ASCB now has the "Mentoring Keynote," which recognizes the impact of mentorship on the training of scientists and scholars from underrepresented groups in cell biology. The agility and resourcefulness

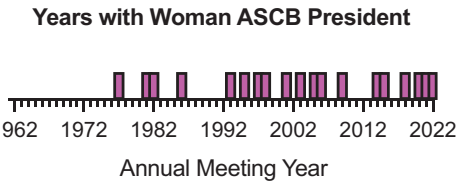

FIGURE 2: Years in which ASCB presidents are women. In 1977 Elizabeth Hay was the first woman elected president and since 1993, approximately 50% of ASCB presidents are women.

of WICB were particularly evident in 1999, when the group decided to give an award to Nancy Hopkins, PhD, for her fundamental role in the groundbreaking MIT report (MIT Faculty Newsletter, 1999) documenting gender inequity of STEM women faculty in their School of Science. Since the WICB award winners had already been chosen for that year, the members of the Committee pulled out their personal checkbooks to cover the expenses of bringing Dr. Hopkins to the meeting.

In 2013, WICB established the unique *Mid-Career* Award, which targets mid-career scientists who demonstrate both exceptional research that translates cell biology across disciplines and leadership. This award recognizes scientists at that critical, mid-career phase which, especially for women, is often at the intersection of a tenure decision and heightened family responsibilities. WICB's innovation in acknowledging the importance of this stage is now replicated in three newly established ASCB honors that, beginning in 2021, will recognize people in mid-career for "*Innovation in Research*," "*Innovation in Education*," and "*Excellence in Inclusivity*."

Of note is that, from its beginning, WICB members intentionally avoided the hierarchical committee meeting style often encountered in academia and its associated organizations. Rather, they adopted a collaborative approach governed by consensus and included diverse voices of varying race, ethnicity, institutional type, and academic status and, more recently, input from those in industry. Given the importance of WICB in the ASCB, men have joined WICB, including ASCB presidents, council members, and a Nobelist. In WICB's early years, some women were concerned that association with a "women's" committee would sideline them in the larger ASCB community or workplace. Instead, leadership has flowed in both directions: WICB chairs have been elected ASCB presidents and vice versa, including Mina Bissell, Susan Gerbi, Ursula Goodenough, and Zena Werb. In the 28 years since 1993, 50% of ASCB presidents have been women, compared with only 15% in the previous 31 years (in fact, the first woman president, Elizabeth Hay, was elected in 1977 as the 15th president after the founding of ASCB) (Figure 2).

In summary, in its 50 years, WICB has been a force for increasing the number of women featured on ASCB's platform, enlarging the categories of people who are celebrated by awards; fostering the success of historically minoritized, marginalized, and excluded scientists by implementing many forms of active mentoring and support; and providing templates that are now central to the programs and character of the ASCB.

THE NEXT 50 YEARS: 2021 AND BEYOND

During these 50 years of WICB, the situation for women in science has improved. Since 1994, women have constituted 58% of non-MD graduate students in biological, clinical, and health science doctoral programs (Lautenberger and Dandar, 2020), the overall proportion of STEMM full-time women faculty has risen steadily from 36% in 2009 to 41% in 2018, and these increases have been similar at each

faculty rank (Lautenberger and Dandar, 2020). Disappointingly, women still do not constitute half of the faculty at any rank except instructor, where they make up a majority of faculty (Lautenberger and Dandar, 2020). Why is this the case? Several factors are at play. The path for women remains riddled with barriers such as "implicit and explicit bias; sexual harassment; unequal access to funding and resources; pay inequity; higher teaching and advising loads; and fewer speaking invitations, among others" (from Sardelis and Drew, 2016; National Academies of Sciences, Engineering, and Medicine, 2020). Still relevant is the training WICB has provided in workshops on how to negotiate past bias, deal with sexual harassment, and negotiate for funding resources and pay. In addition, despite societal advances, professional women still bear an excess burden of housework and childcare (Minello, 2020) and are more affected by unique disruptors like the COVID-19 pandemic (Daminger, 2019; Minello, 2020; Lautenberger and Dandar, 2020; Bernard and Lauer, 2021; Langin, 2021; National Academies of Sciences, Engineering, and Medicine, 2021). All of these conspire to render career advancement for women more precarious than for men (Hamli, 2021), and require that WICB remains active at the forefront for cell biologists specifically, and for women scientists generally. Continuing the WICB Childcare awards is essential, and WICB needs to support national initiatives for childcare, which is conspicuously lacking in the US. Perhaps this will be best done in collaboration with ASCB's Public Policy committee. Thus, after many years of advocating for the advancement of women, *much* work remains to be done.

Equally importantly, when we conceptualize 'gender equity', we must expand our thinking from equity *between* genders to equity *within* a gender. The new critical questions are: Who is still missing? Which metaphorical 'seats' are still empty? What systemic, institutional, and cultural barriers and biases account for these empty seats – both at the ASCB and in the biomedical workforce at large? These questions must be investigated and answered with the same scientific rigor that we apply to our cell-based research. Little research has investigated how multiple, intersecting identities impact sub-communities of women in science. Such intersectionality[2] is significant for members of minoritized, marginalized, historically excluded, and underrepresented groups (National Academies of Sciences, Engineering, and Medicine, 2018; Lautenberger and Dandar, 2020; Fry *et al.*, 2021). In a 2020 publication, the AAMC reported that "among *full-time women faculty*, the proportion of women from an underrepresented-in-medicine race or ethnicity (URiM) group was 12% in 2009 and 13% in 2018, with the greatest proportions of URiM women faculty at the assistant professor rank." Many other studies confirm that not all women benefit equally from the progress of some women (Ginther *et al.*, 2011; National Academies of Sciences, Engineering, and Medicine, 2018/2021, Association of American Medical Colleges, 2018-19; American Medical Association, 2020; H.R. 2695, Combating Sexual Harassment in Science Act, 2021; O'Grady, 2021; Tilghman *et al.*, 2021, National Science Foundation: National Center for Science and Engineering Statistics, 2021). History reinforces this point. The decades-long women's suffrage movement resulted in the 19th amendment to the Constitution, which granted "voting rights to women." However, this right was intended for white women. Women of color would wait nearly five more decades for that same right.

In the *next* 50 years, WICB must seek to bolster *inclusive* gender equity to maximize diversity, equity and inclusion ("DEI;" see[3]) in STEMM. This initiative must be carried out in a data-driven manner (National Academies of Sciences, Engineering, and Medicine, 2020). As noted candidly in the AAMC's report (2018–2019), "knowing the data is the first step toward creating a more equitable and inclusive environment, [and] understanding the state of women in academic medicine is key to acknowledging and evaluating the existing systems and structures that may be limiting or supporting them." The WICB and the ASCB together should take the lead among professional scientific societies to collect and make fully accessible disaggregated data on women to include age, race, ethnicity, and other critical features, so that goals for DEI can be identified and reached.

The WICB's programs can be readily adapted to promoting DEI within the ASCB. Already, WICB is using the Career Navigator column to focus on increasing the diversity of scientists by mentoring scientists (Sept), cluster hires (April), and increasing access for people with disabilities (August). ASCB has included LGBTQIA+ issues[4] in the Mentoring Roundtables, and issues faced by other underrepresented groups can be readily targeted by choice of topics and table leaders. The spotlight and humor of the Mentoring Theater could be used deal with intersectionality and promotion of diversity and inclusion. Moreover, as noted above, WICB has intentionally avoided a hierarchical meeting style and instead adopted a collaborative approach of consensus and inclusiveness. As such, WICB has fostered diverse voices of varying race, ethnicity, institutional type, academic status and, more recently, industry. Such inclusiveness recognizes the benefits of capturing the broadest range of talents and insights, can serve as a measure of systemic institutional reform, creates a climate where members of all groups can flourish, and displaces exclusive practices and behaviors such as systemic and structural racism, implicit bias, microaggressions, and overt discrimination (Barber *et al.*, 2020; Ali *et al.*, 2021). WICB has expanded this model to intersect with other committees like the Minorities Affairs Committee (MAC) and the Committee of Postdocs and Students (COMPASS). The resulting diversity of perspectives is likely to help us find creative solutions to the challenges ahead.

Importantly, recognition of inequities does not equate with *progress toward equity*. To ensure both, we must measure and monitor the lag between written strategies and reform to represent and advance women from *all* groups. Specifically, WICB and its progeny must embrace inclusiveness that extends beyond gender, race, and ethnicity to individuals from other traditionally underrepresented groups, including those with disabilities and members of the LGBTQIA+ community, including nonbinary scientists.

As we have seen from the journey back in time through WICB's history, scientific societies—as hubs of community and intellectual exchange—can initiate and sustain impactful and expanding inclusion of members from all communities. This is the most fitting homage possible to the women who, half a century ago, pasted fliers in bathroom stalls announcing the birth of Women in Cell Biology.

[2]Rooted in Black feminist scholarship, intersectionality is the perspective that various "social categories (e.g. race, gender, sexual orientation) are not independent and unidimensional" but rather intersect "at the micro level of individual experience to reflect interlocking systems of privilege and oppression (i.e., racism, sexism, heterosexism, classism) at the macro social structural level." (Crenshaw, 1994; Bowleg, 2012).

[3]Referred to commonly as "DEI," the phrase "diversity, equity, and inclusion" can be interpreted quite widely depending on the field, sector, and context in which it is used. For the purpose of this article, we define diversity as the representation of a variety of identities and differences (e.g., socioeconomic status, gender, sexual orientation), we define equity as the process of ensuring that fair and equal opportunity and treatment is given to all, and we define inclusion as the act of creating an environment or culture that invites the participation of all people.

[4]The abbreviation "LGBTQIA+" refers to the Lesbian, Gay, Bisexual, Transgender, Queer (sometimes Q denotes "Questioning"), Intersex, and Asexual (sometimes the "A" denotes "Ally") community. The "+" is a denotation used to capture individuals on the gender and sexuality spectrum which the aforementioned letters (LGBTQIA) inadequately describe.

ACKNOWLEDGMENTS

We thank our colleagues Virginia Valian, Mary Munson, Emily Mace, Ora Weisz, JoAnn Trejo, Mina Bissell, Susan Gerbi, Victor Faundez, Titilayo Omotade, and Victor Schuster for their thoughtful reading and suggestions and Lindsey Loeper, the librarian of the University of Maryland Baltimore Campus, for data on the early ASCB.

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