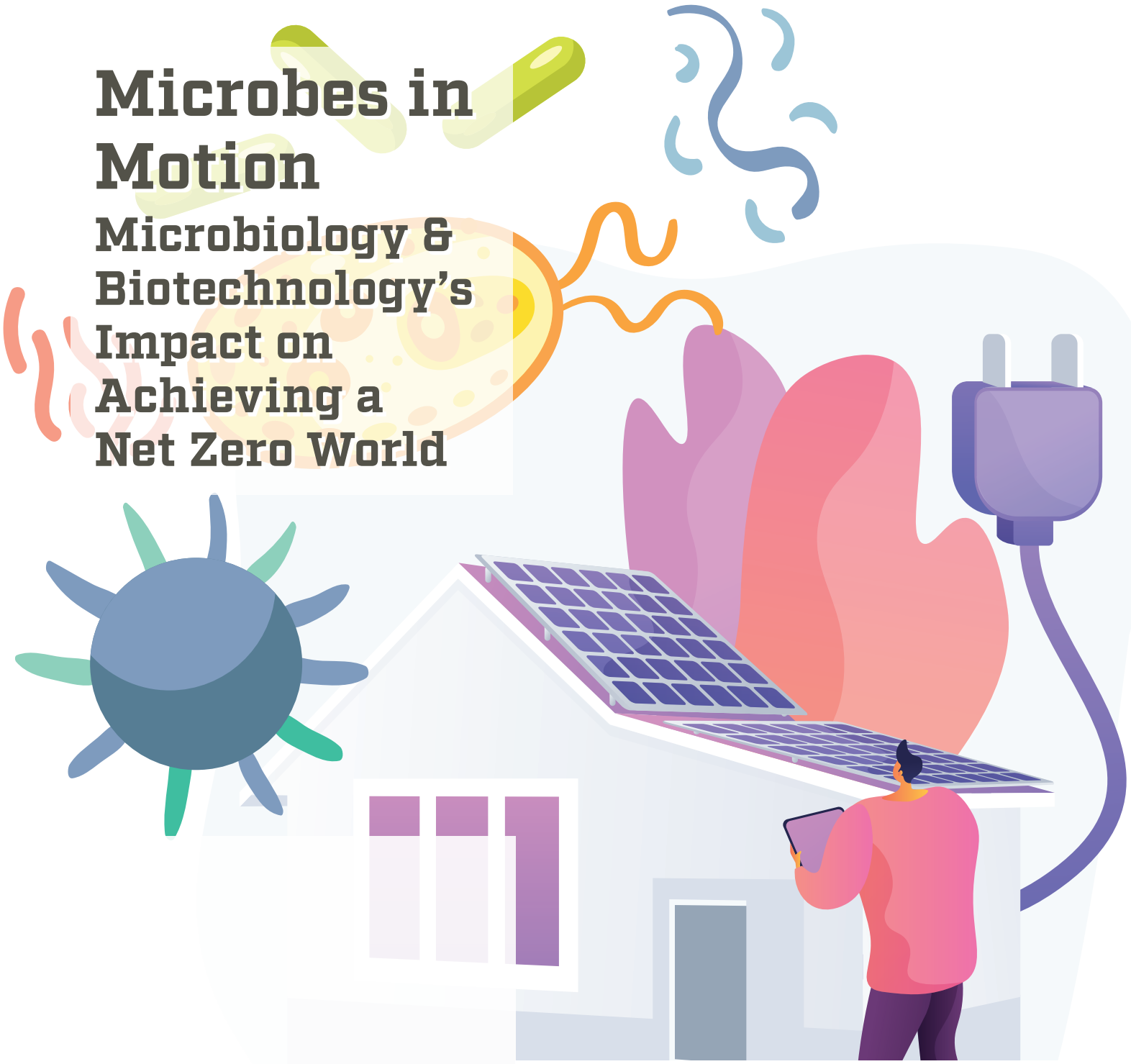
SIMB News

News Magazine of the Society for Industrial Microbiology and Biotechnology
July/August/September 2024 v.74 n.3 • *www.simbhq.org*

Microbes in Motion

Microbiology & Biotechnology's Impact on Achieving a Net Zero World



July/August/September 2024 v.74 n.3

SIMB | Society for Industrial Microbiology and Biotechnology

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Journal of **Industrial Microbiology and Biotechnology**

Editor-in-Chief: Yi Tang

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The *Journal of Industrial Microbiology and Biotechnology* (*JIMB*) is the official journal of the Society for Industrial Microbiology and Biotechnology (SIMB) that publishes papers in all aspects of industrial microbiology and biotechnology including the following:

- Applied Genomics & Systems Biotechnology
- Biocatalysis
- Bioenergy, Biofuels & Biochemicals
- Biotechnology Methods & Techniques
- Environmental Microbiology
- Fermentation, Cell Culture & Bioengineering
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- Metabolic Engineering & Synthetic Biology
- Natural Products

A journal for the industrial microbiology and biotechnology communities

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contents

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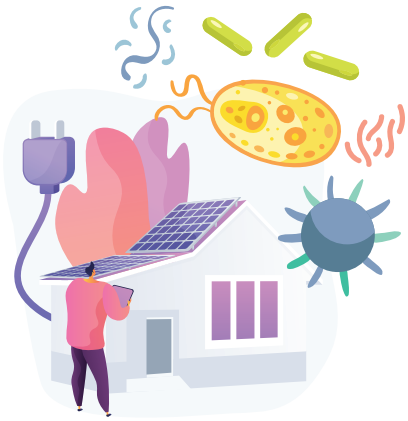

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Introduction to Kris Rath, the new Editor-in-Chief for *SIMB News*

Kris Rath is an experienced AI/Gen AI (Healthcare) consultant, specializing in integrating emerging technologies into healthcare and biomanufacturing. He has developed AI and Gen AI solutions to address manufacturing and supply chain disruptions in pharma and medical devices, improving both product yield and quality. Kris has authored over 30 research articles, contributed to 10+ book chapters, and holds several patents. He has also edited books in biotechnology and bioengineering, published by Elsevier, Springer, Wiley, the American Society for Microbiology, and the American Chemical Society. Kris has introduced new sessions as a convener and served as Biocatalysis Chair at the SIMB Annual Meetings and has conducted interview articles with a few past SIMB presidents.

2024–2027 SIMB Strategic Plan

1 Scientific Excellence and Leadership

SIMB will identify the technical needs of our community to advance the industry and facilitate solutions

- Continue to foster collaboration and knowledge sharing between academic, industrial, and government stakeholders
- Offer educational opportunities and programs that focus on current and future trends with input and support from industry partners
- Elevate the Journal of Industrial Microbiology and Biotechnology to be a key information source for the SIMB community
- Recognize and promote the current leaders, future leaders, and scientific excellence of our community

2 Communication and Outreach

SIMB will connect and advocate for our community to internal and external stakeholders

- Increase capacity and opportunities for the SIMB community to advocate for industrial microbiology and biotechnology, the Society and the field's impact
- Partner with organizations to introduce SIMB to new audiences
- Provide tools to help the community develop and promote the industrial microbiology and biotechnology workforce
- Conduct, support, and/or amplify information gathering activities relevant to the SIMB community

3 Inclusion and Responsibility

SIMB will promote and maintain a responsible community that is welcoming to all

- Provide activities and communication that ensure a sense of belonging amongst members and the community
- Enable our community to work toward relevant sustainable development goals for a positive global impact
- Maintain an inclusive community supported by an enforceable Code of Conduct
- Foster a governance structure that embodies transparency and accountability

4 Value and Function

SIMB will enhance membership value and maintain its financial and operational viability

- Provide products and services to meet the needs of the SIMB individual membership
- Understand and answer the needs of SIMB corporate members
- Maintain product and service costs at sustainable levels while expanding or enhancing services to membership
- Strengthen stable, long-term revenue streams that work to support the Society's mission and vision

Newsworthy

NSF Encourages Research Proposals at the Intersection of Biology and AI/ML

The National Science Foundation (NSF) Directorate for Biological Sciences (BIO) has released a Dear Colleague Letter (DCL) encouraging proposals that leverage Artificial Intelligence (AI) and Machine Learning (ML) to advance biological research.

The DCL, titled "Advancing Research at the Intersection of Biology and Artificial Intelligence (AI)/Machine Learning (ML)," emphasizes AI/ML's potential to address complex biological questions, develop predictive models, and spur bio-inspired innovations. It also highlights how increased understanding of biological systems can inform AI/ML developments.

Proposals should be submitted to existing BIO programs and must integrate or develop AI/ML methods to advance one or more goals represented by NSF biological sciences programs. Collaborative projects between biologists and AI/ML experts are encouraged, particularly those advancing both biological discovery and novel AI/ML research. However, proposals solely aimed at data generation are discouraged.

Researchers can access computing resources through the National Artificial Intelligence Research Resource (NAIRR) Pilot for AI-related projects. Principal Investigators are advised to contact relevant NSF program directors before submitting proposals. Inquiries may be directed to bio-ai@nsf.gov.

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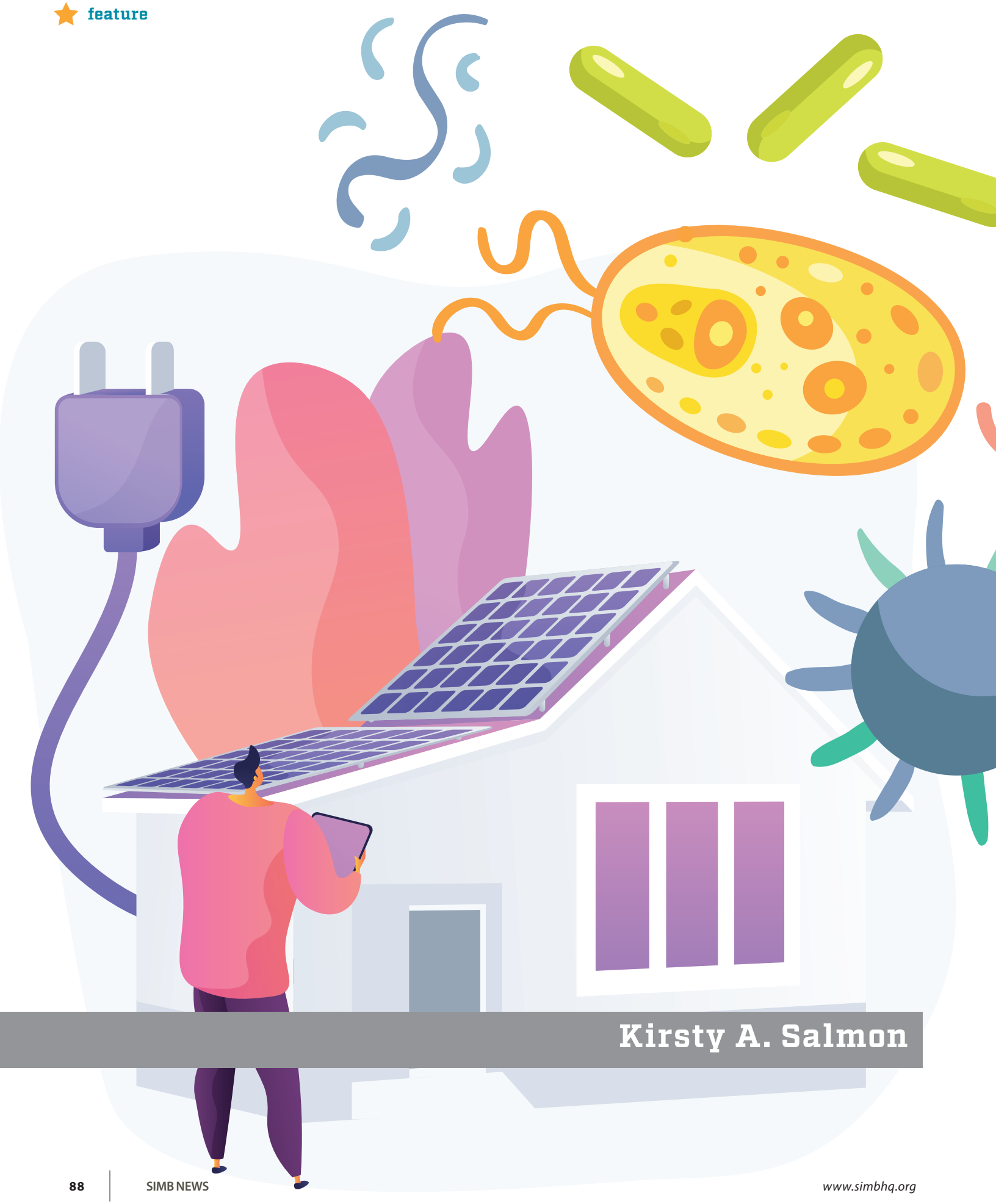


Kirsty A. Salmon

Microbes in Motion: Microbiology & Biotechnology's Impact on Achieving a Net Zero World

I was honored to be asked to deliver the keynote address to open the 74th SIMB Annual Conference held in Boston, August 4th – 6th 2024. When John Evans and Mike Resch asked me to do this, the ask was to give an overview of my own career and to highlight the choices out there for amazing career opportunities not just in academia but also in industry as the world embarks on a huge endeavor, we call the energy transition and the need to get to net zero.

Photo illustration by vectorjuice/FreePik

My talk opened with my own career story and some advice I can give sitting back after 25+ years of a science career. I then sought to highlight some of the amazing areas of a career path and the serious need to train future microbiologists and biotechnologists so that we can one day get to a true net zero, sustainable future. I finally presented a short view of bp's take on bio and our vision for getting our company and the rest of the world to one where low carbon energy is the reality.

A winding career

The only way to summarize my own career path in science is one is that is truly not straight. No other way to put it. Many in the audience at the SIMB Annual are PhD students, postdocs or even early career researchers. I can remember sitting at that same point many years ago, wondering where my PhD or my postdoc research was going to take me – what I can say? – I was totally wrong! I would never have dreamed I'd be doing what I do today at that point in my early career. So, an overview of my career:

The start

Like most I started with my bachelor's degree – mine in biology from a very small school (at the time) in Canada, Brock University. I did my undergraduate research project (the honours thesis) working on characterizing a bovine adenovirus towards using it as a viral vaccine. It was an amazing opportunity – a small school gave me a lot of opportunity and I published a first author paper from my thesis work. From there my mentor, Dr. Yousef Haj-Ahmad, convinced me to apply for a scholarship and to do a master's degree to continue in my adenovirus research. I loved working in the lab, and it wasn't hard to convince me to further my education for 2 more years. However, one year into my master's he then sat me down and told me I needed to do a PhD. So, I'm going to admit to my own embarrassment and my naivety back then that I had no idea what this PhD was. My dad was a math teacher, and my mum was a mum. So, I told Yousef that I wasn't so sure because I didn't actually like philosophy! Of course he had a good laugh at my expense, and then proceeded to explain what entailed a PhD and a discussion over what I could do with a PhD degree. Thus, I was once again convinced to continue in my education. I received a national Canadian scholarship from NSERC (National Science and Engineering Research Council) to do my PhD and I went to McGill University where I did my PhD in microbiology and immunology – emphasis on the microbiology part! My PhD focused on the characterization of genetic transcriptional control of the lytic-lysogenic switch in a transposable bacteriophage from *Pseudomonas aeruginosa* called D3112. It was all about DNA-protein interactions, transcriptional control and lots and lots of molecular biology. Then it was off to do a Postdoc. My department at McGill encouraged us all to not just leave McGill to do a postdoc but to also preferably leave the country and prove ourselves somewhere else. I thereby chose to go to UCLA into the lab of Dr. Robert Gunsalus and to switch my research focus again to now work on methanogenesis and building what was then the first microarrays to study 3 species of *Methanosarcina*. I also had some side projects and used microarrays to study the genome-wide transcriptional profile of *Escherichia coli* under aerobic and anaerobic conditions, and to study the wider profile on the roles of FNR and ArcAB in the bacterium's response to oxygen.

At this point I had decided on an academic career, so it was off to UC Irvine where I took over a lab called the computational biology research lab (CBRL) and taught senior microbiology to undergraduates. My lab had several projects, but two intriguing ones were on p53 rescue mutants and on biofuels – specifically C5/C6 sugar utilisation in *Saccharomyces cerevisiae*.

See a trend? Maybe a small one with respect to molecular biology – but lots of different microbes, lots of different projects up to this point in my career. However, the biofuel project was a turning point and a small startup that had spun out of UCI, CODA (Codon Optimized DNA Assembly) Genomics, was very intrigued by my research and, long story short, ultimately completely reset the company into a new company called Verdezyne to work on biofuels and biochemicals and convinced me to leave the university and join the startup full time. So, in 2008 I did just that and made that big but slightly scary move into industry. The reality at this point is that I realized I'm an "applied" girl: I like problems that need a solution. However, by the end of 2010 I had come to realize that while I love the startup culture, it's fast paced, lots of exciting science and amazing camaraderie, in the biofuels world to do things at scale and not in a "coffee cup", it takes a much bigger company and much more expertise. It took me a while

to find the right place, but at the end of 2011 I joined bp biofuels as their head of research heading up the program on GEN2 lignocellulosic (LC) ethanol. My teams developed the biocatalysts including microbes and enzymes for the process. My team used to joke that we worked on the software for the hardware!

Little did I know that joining bp would set me off on a truly exciting career adventure. When I first went, my friends told me I'd either love it or hate it. I can't say it's always been love (I doubt any job never has its challenges), but it's been an amazing journey so far. I've started a bioscience center for the company that works on what biology does for an oil and gas company (which is a lot), defining what circularity needs to mean for our company, to having an opportunity to go on an expat assignment and move my family to the UK for 2 years and work as a senior advisor to the company on all things in bio and low carbon technologies. Ultimately, in 2021 I was named as a vice president, overseeing early stage, sustainable, low carbon technology development for the company. And that's where I am today, but so much more to do.

So, to the next generation of microbiologists and biotechnologists I offer some insights:

» Always be curious and courageous – you can only grow when you're uncomfortable – not super uncomfortable, but if you're comfortable, you're probably not growing!

» Be open to opportunities. You never know where they may lead you and take some chances because sometimes something new is really exciting!

» Forget the career map. I think it can limit you. Very few people at my level in industry had their career planned out at your stage, but succeeded because they welcomed new challenges.

And advice I like to offer:

» Follow your passion! Love what you do! You will spend most of your adult waking time at work so make sure what you do gets you up and out the door in the morning!

» Don't be quick to turn down an opportunity to challenge yourself: be a life-long learner.

» Find a mentor and be a mentor. Get helpful insights from those with more experience, increase your visibility, and take the chance to motivate and inspire others.

» Finally, learn to persevere. What we do isn't easy and being able to manage the ups and downs is critical for a successful career.

Microbiology: Exploring the connection to a sustainable future

Looking at the list of sessions of the 74th Annual Meeting, there was an incredible amount of research areas being presented and clearly outlining that there is still plenty to do whether you're interested in an academic career or one in industry, and if industry, whether you're interested in working for a small company like a startup or a larger corporation like bp. The opportunities to make a difference and have a meaningful career are out there.

Environmental Microbiology

So, let's start with the environment. Microbes play a huge role in our environment and the carbon cycle, whether it's in the soil or water, they're critical. From basic research on microbial ecology and biogeochemical cycling to industrial applications such as microbial biosensors, bioremediation, microbial surfactants and biotransformation, there are many areas for research and application.

Almost every surface is colonized by microbes. Some microbes can live in boiling hot springs, whereas others form microbial communities in frozen sea ice. But among their many roles, microbes are necessary for biogeochemical cycling, soil fertility, decomposition of dead plants and animals and biodegradation of complex organic compounds in the environment. The ability to harness some of that to improve plant growth, resist plant diseases for food production and restoring healthy soil ecosystems are the focus of quite a few companies – some of which was presented during the talks and poster sessions during the annual meeting.

Soil microbes are also essential for carbon sequestration, converting carbon dioxide into organic matter which is then stored in the soil. Other microbes play a critical role in the nutrient cycling process breaking down organic matter and releasing essential nutrients in the soil to be available to plants.

Bioremediation

Bioremediation is another area –that's crucial – plenty of contaminated sites out there from man-made issues – and there's multiple avenues to accomplish this and microbes play a key role – finding environmentally friendly ways to decontaminate sites is critical – and plays a role in both improving the environment but also human and other animal's health.

Companies like mine have remediation teams – and the microbiologists in these teams play a critical role in their success. Having experts in this area is important as we typically want to ensure that there is minimal disruption to the ecosystem for any augmentation input, that there's permanent elimination of the contaminants (so monitoring all of this), and for industry – it must have cheap operational costs. Ultimately remediation teams want to put themselves out of a job – a hefty goal with the work out there to do.

Microbiology in wastewater treatment

Another huge area where microbiology plays an important role is in wastewater and the breaking down of organic matter and helping to remove pollutants. Possibly harnessing this to energy generation is a key consideration – all with the aim to take non-potable water back to potable – and ensuring a clean supply of water to our communities and environments. In this process microbes have been said to be the little heroes of sanitation!

However, there remain lots of research needed to improve these processes at the academic level but also a never-ending career path in local community's wastewater treatment plants and water companies, that act as service providers, as well as larger corporations with industrial processes. Massive volumes of wastewater are cleaned up every single day - so plenty to do.

Biotechnology and net zero

Biotech – I probably don't need to push this too hard with this audience – but plays a massive role in the push towards net zero. This comes from multiple areas including sustainable agriculture, clean energy, and also 'green' molecules like biochemicals or biofuels, and in ensuring we can circularize our waste to reuse and recover resources and ensure we can become a more sustainable planet.

The healthcare industry is another hot area for microbiology and biotechnology – from prebiotics and probiotics to antimicrobials and beyond. Plenty of opportunities and areas to work on, some of which were presented at the annual meeting.

Another important area is the food industry where microbiology has always played a significant role – from the production of cheese to pickles and tofu and of course the role they also play in beverages such as wine and beer – but today we're also seeing the explosion of companies and research into the use of microbes to create proteins from sustainable feedstocks for human consumption to monitoring their presence to ensure food safety – many career paths here.

The modern biotech landscape spans a wide swath of innovations, from medicine and therapeutics, nutrition and natural products to new materials and biofuels and biochemicals. The annual meeting showcased several talks and lots of

posters in this space. This is where innovation can truly impact and for those pursuing this my advice is to not just think about the technology itself, but also to start early on your technoeconomics (what are all those inputs needed to get from feedstock to product?), but also the energy considerations, life cycle analysis (LCA) and how easy or hard it could be to scale? Chances for successful commercialization of a technology increase the more all of these are considered early on.

Net Zero and Energy

There are a lot more areas but one I wanted to focus on is energy.

Clean energy is critical to achieving a net zero world. Beyond renewables such as wind and solar, which are subject to the environment, bioenergy using biomass as a feedstock is a rapidly growing area.

Biotechnology can help us develop biofuels and biochemicals, and capture carbon from the atmosphere, all of which are needed to help decarbonise the energy system.

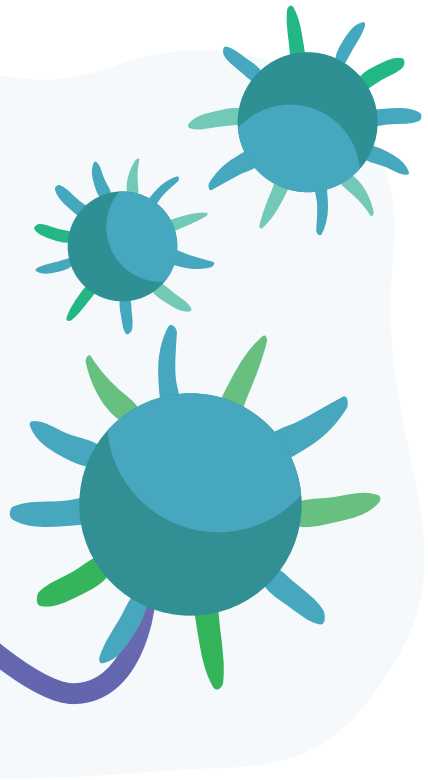


Photo illustration by vectorjuice/FreePik

Because sustainable feedstock is a major part of the value chain for bioenergy, research is needed to improve plant growth traits, increase biomass yields and improve resistance to environmental challenges like pests and drought. And of course, microbes can help transform biomass into energy-rich fuels which can directly replace petroleum-derived fuels.

Waste to Energy Technologies

Waste-to-energy technologies, such as anaerobic digestion and pyrolysis, can convert organic waste into renewable energy. Clearly microbiology and biotechnology can play a key role in optimizing the anaerobic digestion process and make it more efficient. But, even pyrolysis, a thermochemical process not yet at massive scale opens opportunity, potentially for microbiology and biotech – because the bio-oils produced from biomass using this method aren't drop in – they need a lot of cleanup to make them truly useable – a grand challenge that potentially microbes and/or enzymes could enable and help drive down costs.

Ultimately the reality is that consumers don't want to really pay anything extra for "green energy" (nor "green molecules). Therefore, we need to drive the costs of all these clean energy systems – to make them competitive and cost-effective to enable them to scale.

Waste-to-energy can also use other thermochemical processes, such as gasification – and the decision on which route to take has multiple decision points. However, I would like to keep in mind that you still need to track overall energy input, LCA, and emissions. Not all technologies are created equally, but scale considerations are often a critical component.

Biofuels and biochemicals

Biofuels, such as ethanol and biodiesel, can be produced from sustainable resources and have lower greenhouse gas emissions than fossil fuels. Biotechnology enables this (and there were lots of great talks and posters during the annual meeting in this area). While GEN1 biofuels are a reality today, whether from corn in the US or sugarcane in Brazil, we need to keep working on decarbonizing these (GEN1.5) and enabling GEN2 biofuels for the future, especially for the hard-to decarbonize transportation needs such as aviation, marine and heavy-duty transport

There's a lot of emphasis on sustainable aviation fuel (SAF) today, with reason: Aviation is hard to decarbonise as it has very specific fuel requirements and replacing this with 100% sustainable fuels is a huge goal for the future.

At bp we partnered with Virgin Atlantic in November 2023 for Flight100, which flew from London Heathrow to New York JFK. It was the world's first commercial aircraft to operate across the Atlantic on 100% SAF. However, we're a long way to be able to do this at scale, both from a fuel supply constraint but also compatibility restraints with plane engines. However, when SAF is produced from waste products, it can deliver lifecycle emission savings of up to 70%. Therefore, it is incredibly important that work continues in this space and that we continue to come up with new innovations to drive this forward.

Bioplastics

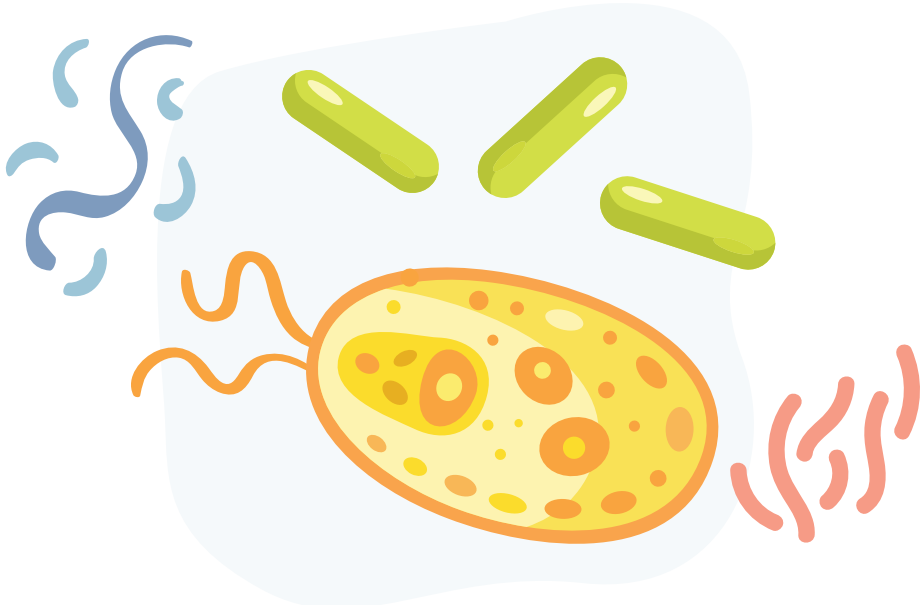
Bioplastics can be a sustainable alternative to conventional plastics, as they are made from sustainable resources. Microorganisms can be used to produce bioplastics from organic waste or other sustainable feedstocks. However, we do need to be careful of the difference between bioplastics and biodegradable plastics. Not all plastics are created equally and there are so many variations out there due to required properties for various applications that it can be quite a complex area to work in. As an example, if the plastic needs to keep the fizzy drinks fizzy or if they just need to hold water, the required properties are entirely different. On another side, ensuring a plastic container holding a lubricant gets to the store to be sold to a customer, or if it's a single-use plastic fork the materials making up those different types of plastic are not equal, nor are the costs nor the ability to recover and reuse the materials. All this needs to be considered.

There are lots of interesting areas out there in the plastics space from the production of polyhydroxyalkanoates (PHAs) which can produce fully biodegradable polymers and the discovery of enzymes that can degrade plastics such as PET. Biotechnology and microbiology can unlock this area, with opportunities for both academia and industry.

Energy industry and biofilms

One final area I wanted to comment on, where microbes play a huge role, especially in my industry, is biofilms. So just to comment about the energy sector, there are a few critical areas where biofilms play a huge role. While the list is long, one of the major negatives is MIC. So, while to most members of SIMB this stands for minimum inhibitory concentration (my first thought really) in a company like BP it means microbial influenced corrosion. Oil and fuels are moved in pipes, ships and held in storage tanks, all of which are made of metal.

While we do see MIC when fossil fuels are moved in these, biofuels are even more concerning for a few reasons. Small amounts of water tend to be present, and these biofuel hydrocarbons are great food for the microbes which can create a breeding ground, in particular we see this as a major problem for storage tanks, and there is a need to be really careful to check for the presence of water. Even minute amounts of water, which can condense in the storage tanks, can support microbial growth. Microbial biofilms can eat through 1–2-inch pieces of metal pipe if left alone ultimately resulting in a complete breach of the pipe leading to what industry would call a loss of primary containment. This is an active area of trying to see what can be done to prevent biofilms in the world of biofuels



from developing new biocides to specialized coatings on metal surfaces.

On the other side biofilms can also be positive such as in biogas production and wastewater treatment. In these applications biofilms can actually prevent microbial washout which can sometimes occur and lead to stalling or shutdown of these systems which can be costly and also be environmentally challenging.

Thoughts from a bp perspective

One of the sites I run for bp, and where I am normally located is the bp biosciences center in San Diego. The biosciences center has 4 core platforms: Bioenergy, helping to develop the next low carbon technologies for the company; Synthetic biology, developing new biocatalysts and bioprocesses for our low carbon and sustainability goals; Industrial microbiology, supporting bp's efforts in areas such as bioremediation, wastewater treatment, MIC and microbial support to some of our operations such as our Brazil bioethanol mills and our investment into biogas production; and Computational Sciences, using modeling, simulation, machine learning and artificial intelligence to support all of our technology development at this site and others.

Bioenergy: a vital part of the energy mix

At bp we don't believe there is a single pathway to decarbonize the world's energy systems. We see demand growing for bioenergy, for EV charging, for wind and solar energy, and for hydrogen. These energies have different applications, and we see a critical and complementary role for each of them.

How much bioenergy does the world need?

According to the International Energy Agency (IEA), demand for bioenergy is on the rise, and if the world wants to be on track with net-zero-by-2050 ambitions, there needs to be an industry-wide increase in production and attention to emissions. That's why bp is playing our part to meet this demand. We have recently announced our intention to buy out our bp Bunge Joint Venture in Brazil, where with 11 mills spread out across the country (but not near the Amazon) we are the 3rd largest footprint but 2nd largest producer. In Brazil we produce 4 products: sugar, ethanol, power and carbon credits.

We also announced the final acquisition of Archaea Energy last year, a leading provider of renewable natural gas, and that's just the beginning.

Conclusion

Microbiology plays a crucial role in our lives and the environment. It has the potential to help us create a more sustainable future by reducing our environmental footprint and helping us to transition to net zero. By harnessing the power of microorganisms, we can create a brighter and more sustainable future for all.

Final quote:

"Gentlemen, it is the microbes who will have the last word." – Louis Pasteur

Photo illustration by vectorjuice/FreePik

1st Connecting Microbiome Communities (CMiC)

Wyndham San Diego Bayside
San Diego, CA

November 3–6, 2024
www.simbhq.org/cmic

Registration and Programming

Online registration closes October 9: Onsite registration opens November 3-6

Online program now available!

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Attendee Pre-Meeting Workshop

November 3, 9am – 12pm Pacific Time

Ticketed, onsite registrations accepted November 3, 8am – 9am

Mastering Metadata: Utilizing NMDC Resources for Microbiome Research Reproducibility & Training the Next Generation for Microbiome Research Careers Across Academia, Government, and Industry

The first half of the workshop is designed to equip researchers with the knowledge and skills to effectively utilize NMDC (National Microbiome Data Collaborative) resources and adhere to sample metadata standards. By the end of the workshop, participants will gain insight into the importance of standardized metadata structure for microbiome research, learn how to navigate and utilize NMDC metadata resources for their projects, and acquire practical experience applying sample metadata standards to a training data set to enhance the quality and reusability of their own data via submission to the NMDC data portal.

Next, participants will be asked how do we prepare a diverse and skilled future workforce ready to understand and explore the complex challenges of microbiome research? The second half of the workshop aims to address the challenges to actively engage students in relevant research topics, while training them across the broad base of skills from field and clinic to computational analysis. We will also discuss the main challenges that recent graduates face when entering the next steps in their careers and what skills will better prepare students to enter the workforce.

Workshop Organizers:

Winston Anthony, Pacific Northwest National Laboratory
Michael Sieler, Oregon State University

Ellen G. Dow, Lawrence Berkeley National Laboratory
JP Dundore-Arias, California State University, Monterey Bay

2024 Program and Sessions

The conference will be held over a 4-day period, with traditional sessions intermixed with non-traditional elements such as panels, flash talks, or community lead discussions. CMiC aims to create a welcoming environment that encourages open, honest dialogue and fosters intriguing new ideas for collaboration across systems.

Biodiversity and Ecology of Microbial Communities

Session Conveners:

» Jen Martiny (UCI)
» Ying Wang (LBNL, Texas A&M)

What are the ecological and evolutionary principles needed to engineer microbiomes and capitalize on microbiome-derived products? This session will focus on the understanding of the biodiversity and ecology of microbial communities, and how that understanding might be employed in the development of microbiome engineering and technologies. The session welcomes topics that apply broadly across ecosystems, including microbial dispersal and invasibility, microdiversity, evolutionary adaptation, resilience, and defining the health of a microbial system.

Decoding Structural and Functional Processes of Microbial Communities

Session Conveners:

» Ann Gregory (OSU, Calgary)
» Ariane Peralta (E Carolina)

Microbial communities are critical for sustaining the ecosystem processes that drive nutrient cycling. By disentangling their structure and understanding their functions, we can gain deeper insights into these essential processes. This session will focus on studies that uncover unique processes and/or develop novel methods to explore microbiome structure and function. We are interested in studies that explore microbial processes in organisms, ranging from picoeukaryotes to bacteria and archaea to viruses, spanning across various temporal, spatial, and

phylogenetic scales. The session welcomes talks and posters studying microbiomes across any ecosystem including oceans, soils, lakes and human body sites.

Bioinformatics and Machine Learning for Microbiome Data Science

Session Conveners:

» Maria Sardi (Cargill)
» Ben Tully (Branchpoint Biosciences, USC)

This session seeks to transcend the foundational aspects of taxonomic classification, venturing into the integrative realms of omics, genome mining, network analysis, and predictive algorithms to uncover the intricate functions, interactions, and associations within microbiomes. This session is dedicated to the application of bioinformatics in unraveling the mysteries of microbiomes across diverse ecosystems, including soil, aquatic, and human environments. We aim to showcase research that leverages genomic, transcriptomic, and/or proteomic data, and encourage submissions that integrate multiple approaches to foster a holistic understanding of microbial life. We encourage abstracts that delve into the intricacies of microbiome function, aiming to unlock the roles and capabilities of microbiomes across various ecosystems, or utilize statistical methods, machine learning, and artificial intelligence to identify microbiome-based biomarkers for health, disease, and environmental assessment. Additionally, we invite research that explores the complex symbiotic and antagonistic relationships within microbiomes and their responses to environmental conditions. And lastly, we welcome work that showcases advancements in microbiome technologies, highlighting novel tools and software designed to address unanswered questions in microbiome research.

Engineering Microbiomes for Health, Agricultural, and Industrial Applications

Session Conveners:

» Jan Claesen (Cleveland Clinic)
» JP Dundore-Arias (CSU Monterey Bay)

Microbiomes play crucial roles in health, agriculture, and industrial processes. Recent methodological and analytical advances have enhanced our capacity to engineer microbes, facilitating advancements in food production, human and animal health, as well as environmental preservation and restoration efforts. This session aims to highlight the latest advancements, applications, and challenges that must be overcome in the strategic utilization of microbiomes for beneficial outcomes.

Harnessing Microbial Diversity for a Sustainable Bioeconomy: Opportunities and Challenges

Session Conveners:

» Myunghee (KMB)
» Nigel Mouncey (LBNL, SIMB)

The microbial world, with its vast diversity and metabolic capabilities, holds immense potential for shaping the future of sustainable biotechnological solutions in support of a global bioeconomy. Understanding and manipulating microbial communities can revolutionize sectors such as agriculture and soil health, human health and food, industrial processes, waste management, bioresilience and technology development. We will discuss the latest research and innovations in the development and application of microbiome-based approaches and the opportunities and challenges in the transformative potential of microbiomes for advancing the bioeconomy.

Microbiome Policy, Advocacy and Regulation to Advance Microbiome Research and Development

Session Conveners:

- Efrain Rodriguez Ocasio (Iowa State, Sandia, SIMB)
- Amalia Corby (ASM)
- Andrew Bartko (UCSD, AMI)

From funding sources to regulatory constraints, public policy plays a significant role in shaping microbiome research and commercialization. This session will welcome speakers from government and advocacy groups to discuss the current landscape and emerging priorities of microbiome policy, advocacy, and regulation. The presentations and panel discussion in this session will offer valuable insights for anyone working in the microbiome field.

Diversity Travel Award Winners

Congratulations to the two award winners, who will be formally recognized at the November 5th CMiC Awards Banquet.

Mai Vu Beauclaire
University of Minnesota-Twin Cities

Sarah Preston
Case Western Reserve University

4th International Conference on Natural Product Discovery and Development in the Genomic Era

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San Diego, CA

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www.simbhq.org/np

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Bradley Moore, University of California, San Diego
Jaclyn Winter, University of Utah
Alessandra Eustaquio, University of Illinois, Chicago

Keynote Speaker

Jennifer Doudna, PhD

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Banquet Speaker

Barry O'Keefe

NATIONAL CANCER INSTITUTE

2025 Program

The program will consist of seven sessions over four and a half days, two poster sessions, networking receptions, two optional ticketed workshop tutorials available to attendees only, and free evening to network and explore San Diego.

You can join the program through submitting a poster abstract. The oral sessions are by invitation only.

Session 1 and Keynote Speaker

Convener

» Brad Moore, University of California, San Diego

Speakers:

» KEYNOTE: Jennifer Dounda, University of California, Berkeley
» Sarah O'Connor, Max Planck Institute for Chemical Ecology
» Wilfred van der Donk, University of Illinois, Urbana-Champaign

Session 2

Conveners

» Richiro Ushimaru, University of Tokyo
» Ryan Nett, Harvard University

Speakers:

» Wenjun Zhang, University of California, Berkeley
» Josh Armstrong, Corteva
» Anne Osbourn, John Innes Center
» Mengbin Chen, Merck
» Jon Chekanm, University of North Carolina at Greensboro
» Keniichi Matsuda, Hokkaido University
» Christine Beemelmanns, Helmholtz Institute for Pharmaceutical Research Saarland

Session 3

Conveners

» Ben Shen, University of Florida
» Serina Robinson, Swiss Federal Institute of Aquatic Science and Technology

Speakers:

» Brad Moore, University of California, San Diego
» Alessandra Eustaquio, University of Illinois, Chicago
» Brian Bachmann, Vanderbilt University
» Rishiro Ushimaru, University of Tokyo
» Katherine Ryan, University of British Columbia
» Neha Garg, Georgia Institute of Technology
» Seokhee Kim, Seoul National University
» Stefano Donadio, Naicons

Session 4

Conveners

» Jaclyn Winter, University of Utah
» Yit-Heng Chooi, University of Western Australia

Speakers:

» Hsiaoching Lin, Academic Sinica
» Martin Schmeing, McGill University
» Emily Parker, Victoria University of Wellington
» Kyo Bin Kang, Sookmyung Women's University
» Bo Li, University of North Carolina
» Michael Freeman, University of Minnesota
» Pieter Dorrestein, University of California, San Diego

Session 5

Conveners

» Martin Schmeing, McGill University
» April Lukowski, University of California, San Diego

Speakers:

» Rebecca Butcher, University of Florida
» Min-Kyn Oh, Korea University
» Louise Charkoudian, Haverford College
» Ben Shen, University of Florida
» Colin Harvey, Hexagon Biosciences
» Michio Sato, University of Shizuoka
» Yanran Li, University of California, San Diego

Session 6

Conveners

» Alessandra Eustaquio, University of illinois, Chicago
» Jon Chekan, University of North Carolina at Greensboro

Speakers:

» Elizabeth Parkinson, Purdue University
» Mohamed Donia, Princeton University
» April Lukowski, University of California, San Diego
» Roger Linington, Simon Fraser University
» Serina Robinson, Swiss Federal Institute of Aquatic Science and Technology
» Paco Barona-Gomez, Leiden Univeristy
» Sang Hee Shim, Seoul National University

Session 7

Conveners

» Wenjun Zhang, University of California, Berkeley
» Seokhee Kim, Seoul National University

Speakers:

» Ryan Nett, Harvard University
» Yit-Heng Chooi, University of Western Australia
» Robin Teufel, University of Basel
» Dairi Tohku, Hokkaido University
» Michael Burkart, University of California, San Diego
» Lone Gram, Technical University of Denmark
» Mo Seyedsayamdost, Princeton University
» Jaclyn Winter, University of Utah

Poster Sessions Conveners:

» Hsiao-Ching Lin
» Yanran Li

Attendee Only Ticketed Workshops

GNPS 2.0/CMMCkb Enrichment for Microbial Natural Product Discovery

Instructor

» Prof. Pieter Dorrestein, PhD, University of California, San Diego

New Capabilities to Study Secondary Metabolism

Instructors

» Hiroshi Otani, DOE Joint Genome Institute
» Dan Udwary, DOE Joint Genome Institute
» Drew Doering, DOE Joint Genome Institute
» Nigel Mouncey, DOE Joint Genome Institute

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Microbes: The Unseen Agents of Climate Change

by Elisabeth Elder

David L. Kirchman
ISBN 9780197688564 (hardback)
Oxford University Press, New York, New York
2024

While Kristien Mortelmans and I were talking about options for a book to review for *SIMB News*, she commented that the involvement of microbes in climate change could be of interest to many members of the Society. Pursuit of this topic led me to *Microbes: The Unseen Agents of Climate Change*. This was a fortuitous search since the book was published by Oxford University Press which supports the Society through publication of *JIMB*. The book was written by David L. Kirchman who received a BA from Lawrence University and a PhD from Harvard University. He was the Mildred H. Harrington Professor of Marine Studies at the University of Delaware until his retirement in 2020. His research covered global views of the carbon cycle which were published in *Microbial Ecology* and in *Dead Zones: The Loss of Oxygen from Rivers, Lakes, Seas, and the Oceans*. The current book pushes readers to consider essential microbial solutions to address climate change mitigation. A large portion of the book is dedicated to carbon dioxide/global.

Please bear with the bold print on **microbes**. There is a method to the madness.

The Introduction (Chapter 1) points out the current, immense, complicated, and fascinating roles of **microbes** in controlling the Earth's climate. It points out the importance of the carbon cycle in which heterotrophic **microbes** (archaea, bacteria, fungi, and protists) degrade organic matter into carbon dioxide. In reverse, the **microbes** and other photosynthetic organisms (algae, cyanobacteria, and plants) incorporate water in the production of organic chemicals and oxygen. In addition to carbon dioxide cycling, the importance of microbes in elemental cycles (including nitrogen and sulfur), as well as production/degradation of methane, nitrous oxide, dimethyl sulfide, water vapor, and halogenated gases can't be overlooked. Neither can the impacts of global warming on the **microbes** be ignored. Carbon dioxide accounts for approximately 70% of human-caused global warming.

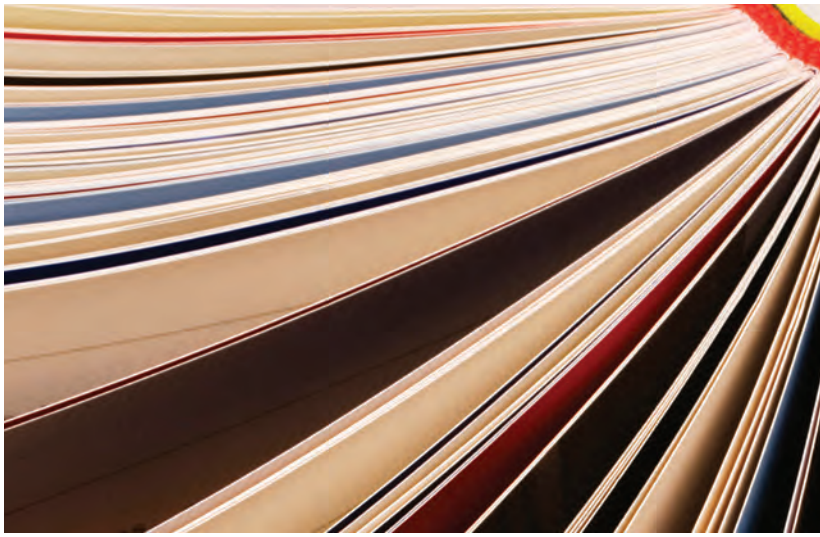
The Natural Carbon Cycle and Fossil Fuels (Chapter 2) focuses on relative carbon fluxes. It should be noted that release of carbon dioxide from fossil fuels/human activities is small compared to global primary production and respiration. But the release of carbon dioxide is large compared with the slight imbalances between the two natural fluxes (primary production and respiration). This means carbon dioxide is increasing in the atmosphere, the natural carbon cycle will change, and the **microbes** will respond differently. It should

also be noted that **microbes**/other biota emit more carbon dioxide than the flux from fossil fuels and human activities. The carbon dioxide from this assortment of **microbes**/biota goes into photosynthetic organisms including **microbes**. Bear in mind, land plants use more carbon than is released by soil **microbes**. Also bear in mind that primary production usually exceeds respiration in nearly all oceanic regions and has a strong dependence on **microbes**.

Carbon Sinks and Sources on Land (Chapter 3) addresses multiple terrestrial processes involved in carbon cycling. These include plant biomass sequestering massive amounts of carbon dioxide, massive **microbes** populations providing nutrients for photosynthesis, roots interacting with mycorrhiza, historical delays in enzymatic carbon degradation by saprophytes, plate tectonics, and sunlight availability. These, along with application of nitrogen fertilizers and global warming, control how much carbon dioxide is released and how much is sequestered as soil organic matter. Melting of permafrost increases degradation of plant detritus and soil organic matter with releases of carbon dioxide, methane, and nitrous oxide. Similar changes occur in peat bogs. Even with these changes, land is still a sink for carbon dioxide. (Okay, more **microbes** should be credited in this chapter.)

Chapter 4, Carbon Pumps in the Oceans, discusses the vast expanses of oceans; high heat capacity of water; gas solubility in cold water; survival in high pressures; minimal nutrient requirements; degradation characteristics of carbon compounds; and presence of hydrothermal vents that impact the participation of massive populations of **microbes** in carbon sequestration. Studies have found that the massive populations of **microbes** in deeper waters are the main participants in the biological pump and the **microbes** carbon pump. Changes in pH, oxygen/carbon dioxide levels, and temperature will continue as will changes in the forms of carbon dioxide undergoing formation and degradation.

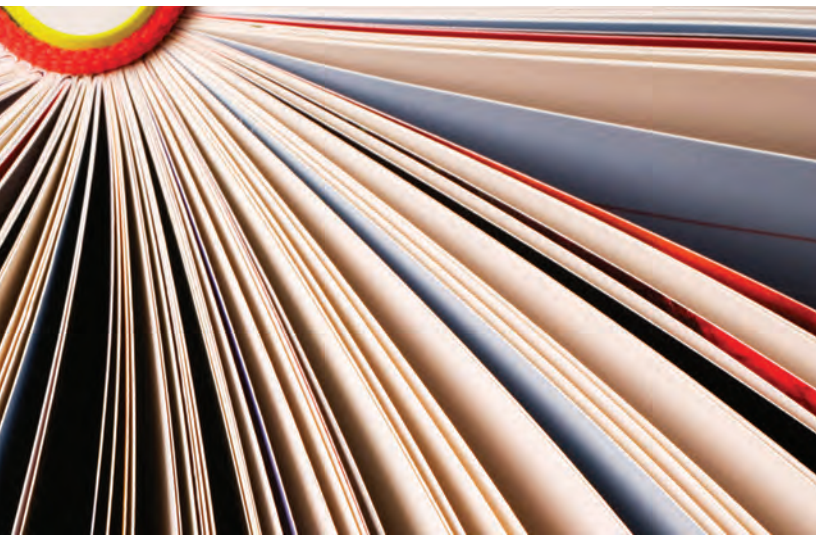
Chapter 5 covers Clouds, CLAW, and a Greek Goddess. One focus of this chapter is the crediting of clouds with the potential to slow global warming. A second focus is CLAW, an acronym for the researchers Bob Charlson, James Lovelock,



M. O. Andreae, and S. G. Warren who studied dimethyl sulfide (DMS) involvement in the global sulfur cycle and cloud formation. The third focus is Gaia, based on work by James Lovelock, Lynn Margulis, and Carl Sagan among many. The basic thrust was for Earth's biota to modify greenhouse gas levels to maintain the planet's temperature. With the flaws that have been found in CLAW and Gaia, this chapter deals with the importance of **microbes** in shaping the planet's atmosphere, heat budget, and climate.

Parts of Slow Carbon and Deep Time (Chapter 6) points to the long, slow processes involved in the research pursued by Thomas Henry Huxley (sea water buffering, ocean sediment formation, formation of chalk and the White Cliffs of Dover), John McPhee (formation of calcium carbonate in reefs), Charles Darwin (coral reef contributions to Dolomite Mountains in Italy), and Manford von Richthofen (Red Baron, linking coral reefs with the Dolomite Mountains). These link symbiotic **microbes** with reefs, impacts of acidification on reefs, lime-stone rich mountains, and calcified microbial mats. Microbial involvement in weathering of carbonate and silicate rocks highlight regulation of atmospheric carbon dioxide and setting the Earth's global temperature. Coccolithophores contribute 10 to 40% of oceanic primary production. Diatoms, dinoflagellates, cyanobacteria, and coccolithophores dominate phytoplankton communities. All these contributions are on small scales over long times.

The major topic in Natural Gas (Chapter 7) moves from carbon dioxide to methane, a potent greenhouse gas with a



much stronger impact and a shorter turn-around time than carbon dioxide. Symbiotic methanogens produce much more methane than do fossil fuels. Methane production is tied to the use of fossil fuels, agricultural emissions, alterations of environments such as wetlands and marshes, and global warming/melting permafrost. On the other hand, methane degradation is largely due to methane interacting with hydroxyls, methanotroph activity, and partnerships with sulfate-reducing bacteria. Decreasing methane would result in less global warming and less ozone near the Earth's surface.

Laughing Gas (Chapter 8) or nitrous oxide is the third most important greenhouse gas with levels that have bounced around and increased relentlessly for the last 800,000 years. Nitrous oxide destroys more ozone than chlorofluorocarbons do. The increases are the result of human activities: agriculture, atmospheric deposition, fossil fuels, biomass burning and nitrogen in fertilizers. The nitrogen cycle (nitrification/denitrification) is linked strongly to increasing laughing gas levels. **Microbes** need to be mentioned here as the bacterial/archaeal chemolithotrophs are involved. Sergei Winogradsky had an early, major role in understanding these organisms. Laughing gas is also associated with Craig Venter and his applications of metagenomics. This work showed the competition of ammonia-oxidizing archaea plus ammonia-oxidizing bacteria and comammox bacteria in nitrous oxide emissions. The work of Fritz Haber and Carl Bosch (Haber-Bosch process) covered nitrogen gas to nitrate based on agriculture and use of fossil fuels. The chapter also covers the potential problems of nitrates in aquatic environments and photochemical degradation of nitrous oxide. These studies have provided insight into how temperature, soil moisture, nitrogen availability, and other environmental properties regulate nitrification and denitrification.

Microbial Solutions (Chapter 9). While **microbes** can drive fluxes of carbon dioxide, methane, and nitrous oxide, they can also stop the rise in these gases. The possible solutions include reducing methane release, reducing nitrous oxide release, and increasing production of biofuels and other types of green energy rather than using fossil fuels. The chapter deals with biomethane from biogas digesters, microbial fuel cells/batteries made by bacteria fed organic matter, microbial conversion of sunlight into biofuels, and ethanol production. It also deals with decreasing livestock emissions. Agriculture accounts for nearly 40% of methane produced by human activities. A further solution would be using nitrogen-fixing **bacteria** as biofertilizers that would contribute to solving the nitrous oxide problem. Geoengineering of land includes combinations of unusual ideas such as solar shields and sunlight-blocking aerosols. More reasonable ideas include reforestation, adding biochar to absorb pollutants and increase crop yields, plus maintaining peatlands and wetlands which can increase carbon storage. In geoengineering of oceans, using upwelling/downwelling pumps to redistribute nutrients, growing kelp to replace reforestation, and fertilizing the ocean to enhance phytoplankton growth and strengthen the biological pump. Ocean fertilization brings the book back to a major topic – **microbes** can be harnessed to solve greenhouse gas problems/climate change.

The final parts of the book are Acknowledgements, Notes, Glossary, Selected Bibliography, and Index. These are very supportive of the text. The book will be of interest to microbiologists as well as ecologists from the undergraduate level through postdocs/faculty members. The final sentence is "More urgently than ever, understanding and solving the most serious environmental problem facing us today depends on the smallest organisms, the microbes". This was the reason for the bold-face type to point out the overall importance of microbes in climate change.

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https://acsbiot.org/2025-meetings

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Amsterdam, The Netherlands

https://biofuels.c2pforum.com

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https://www.embl.org/about/info/course-and-conference-office/events/ees25-08

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