

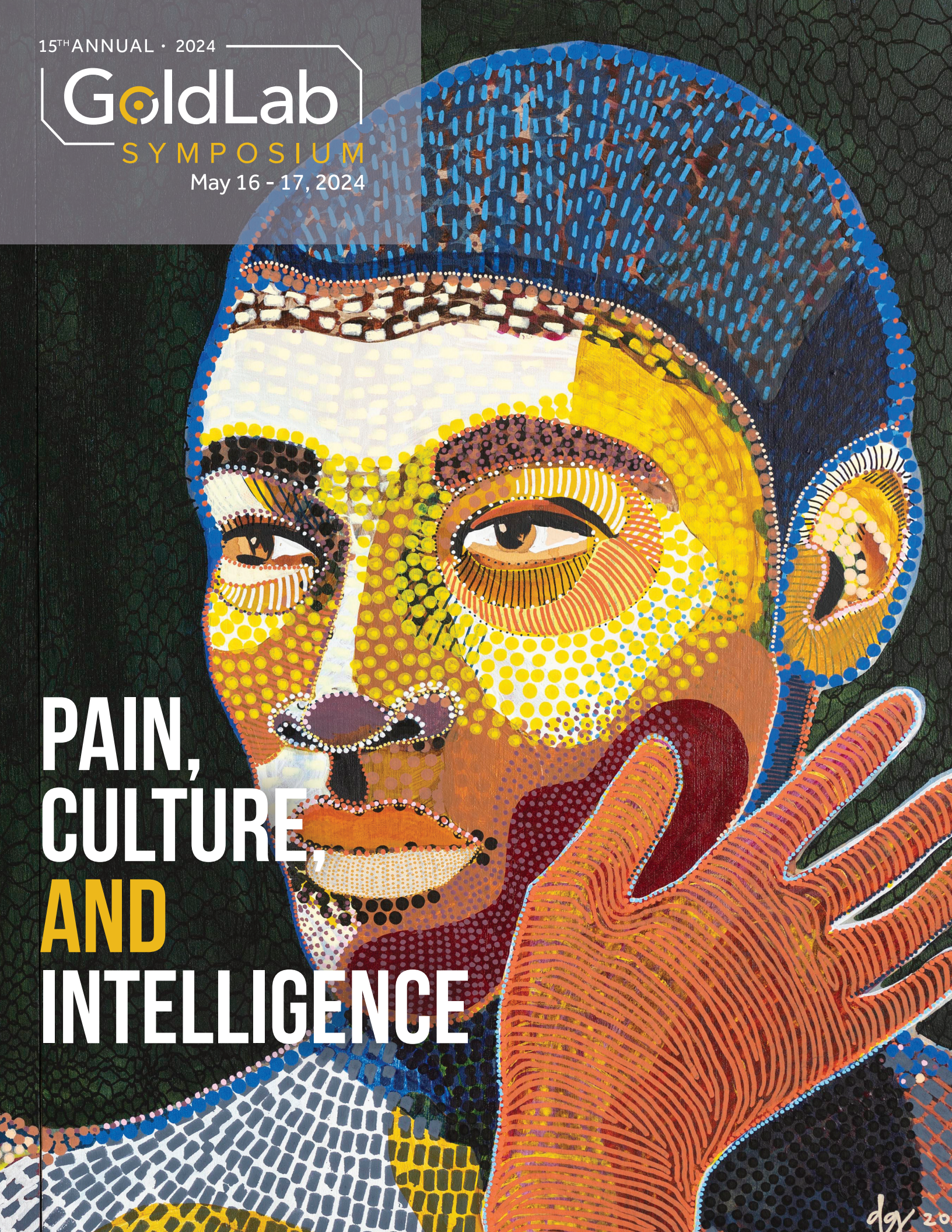
15TH ANNUAL • 2024

GoldLab

SYMPOSIUM

May 16 - 17, 2024

PAIN, CULTURE, AND INTELLIGENCE



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ABOUT THE COVER ART

'Study of the Selves'

Acrylic on mounted twin panels, 2024



A Message from the Artist

This painting depicts two figures facing toward each other at 3/4 angles. They may or may not hold the others' gaze. Their relationship would only be comprised of physical proximity, if it weren't for a hand reaching from the bottom of the frame toward the face of the figure on the right side – seemingly belonging to the person on the left. This pair is constructed from a network of layered dots and pattern, forming the surface of their bodies — or perhaps the composition of them.

To begin this piece, I had a 'conversation' with Midjourney, the generative Ai image-making program. I prompted, "two human figures, head and shoulders, black and white photograph, looking at one another". The computer responded again and again with overly-romantic and overtly sexual imagery of two people poised to kiss. Some were sweaty, sometimes their lips were just millimeters away from one another.

I had not typed in anything about their relationship other than, 'looking at one another'. And yet, an AI trained on the pervasiveness and popularity of imagery couldn't imagine something outside of a sexual relationship. Out of sheer curiosity, I found myself trying to use words to pull these two characters apart without losing their specific (non-sexual) connection.

While this process of inquiry and brainstorming was entertaining, ultimately Midjourney provided little to reference visually and proved a shallow jumping-off point. I wanted to convey broader realms of relationships; the kinds we examine here at Gold Lab Symposium. None so singular as Midjourney's proposal, but rather a suggestion of our physical and metaphysical ecology: our pain, our culture, our intelligence.

To our Selves; the ones that exist both inside and outside our bodies.

The future selves we create and the Ones we imagine to be inextricable members of clans, groups, and clubs.

Such enigmas as Me
Such enigmas as You

Identity, robots, alter-egos,
Entanglement that defines the health of such human structures.

Rage, intricacy
proliferation, desire
and healing.

Against –and
existing solely
because of this self and the other.

Involvement;
an act of desire,
The Nature of a Pair.
One might be The Self.
One might be a reflection or projection of the self.

To be connected and singular at once.

About the Artist:

Darin Grassman is a Colorado-based artist who works primarily as a bookbinder. She studied painting at the California College of Art and received her masters in printed textiles from the Royal College of Art in London.

She has developed a series of hand-held tools for printing patterns and has an online shop where she sells small editions of handmade stationery and journals.

Her favorite types of commissions and collaborations are paintings, drawings, and photobook design.

Website: dgrassman.com

Social Media:

@dgrassman
@l.a.bookmaker
@linesandbookmaker

SYMPOSIUM AGENDA

PAIN, CULTURE, AND INTELLIGENCE

DAY 1 : THURSDAY, MAY 16TH

9:00am-9:05am **Larry Gold**
Symposium Welcome

SESSION 1: PAIN

Moderator: Richard Deckelbaum

9:05am-9:40pm **Glenn Treisman**
Chronic Pain & Pain Amplification:
Seeing the Whole Elephant

9:40am-10:15pm **Scott Falci**
Novel Approaches to
Understanding and Treating
Spinal Cord Injury
Neuropathic Pain

10:15am-10:45am **Break**

10:45am-10:50pm **Richard Deckelbaum**
Omega-3 Fatty Acids: New Frontiers

10:50am-11:25am **Ru-Rong Ji**
Using Molecular Pathways of
Omega-3 Fatty Acids to Block
Inflammatory & Neuropathic Pain

11:25am-12:00pm **Adina Michael-Titus**
Omega-3 Fatty Acids for the
Treatment of Spinal Cord and
Traumatic Brain Injuries

12:00pm-12:30pm **Roundtable Discussion of Pain**

12:30pm-2:00pm **Lunch**

SESSION 2: HUMAN DEVELOPMENT & AGING

Moderator: Roy Parker

2:00pm-2:45pm **Duey Freeman**
Exploring Attachment: The
Foundation of Our Relational Lives

2:45pm-3:30pm **Dayna Matthew**
What to Do When the Law Is
Bad for Your Patients' Health

3:30pm-4:00pm **BREAK**

4:00pm-4:45pm **Tony Wyss-Coray**
Young Blood for Old Brains

4:45pm-5:30pm **Larry Gold**
Broad Proteomics and Health
Management

DAY 2 : FRIDAY, MAY 17TH

9:00am-9:10am **Larry Hunter**
Day 2 Welcome

SESSION 3: BIOLOGY & CULTURE

Moderator: Tim Harris

9:10am-9:55pm **Tom Cech**
RNA – A Catalyst for Public
Engagement With Science

9:55am-10:40am **Colin Hill**
Digital Twins and the Discovery
of New Drugs for Rare Diseases

10:40am-11:10am **BREAK**

11:10am-11:55am **Keolu Fox**
Guns, Germs, and Alleles

11:55pm-12:40pm **Julie Gerberding**
Re-Earning Trust in Science:
A Health Imperative

12:40pm-2:00pm **LUNCH**

SESSION 4: BIG DATA & INTELLIGENCE

Moderator: Michelle Holko

2:00pm-2:45pm **Chris Lunt**
Discovery Through Scale.
The All of Us Research Program.

2:45pm-3:30pm **John Wilbanks**
A Small Matter of (Scientific)
Programming

3:30pm-4:00pm **BREAK**

4:00pm-4:45pm **Max Bennett**
The Evolution of Human
Intelligence: Why It Matters
and What It Teaches Us About
Ourselves, Neuroscience, and AI

4:45pm-5:30pm **Alex Morgan**
Ten Years to Be an Overnight
Success: Investing in the Future
Takes Time

All times are in Mountain Time | MDT UTC-06:00



WELCOME FROM LARRY GOLD

Welcome to our 15th GLS. All of us have been thinking about the pleasure of seeing so many old friends again, both virtually and in person. We are back at our old venue, and we are also virtual. Probably we will have more attendees than ever, for which we are grateful. As I have aged—it does seem inexorable—I have come to love our event even more. The chance to integrate biology, mathematics, and life-stuff feels like the right thing for me, and I am grateful to all of you for continuing to think these days are worthy ways to spend your time.

I should add here that Meredith and I were like an old couple, saying the same things to each other year after year, hoping one of us would surprise the other. Last year we invited Larry Hunter (the other Larry) to join us permanently, and our discussions have improved. Larry Hunter knows things we have never understood, and the integration of thinking about biology with mathematics/computation has been a pleasure. Meredith and I are more thoughtful people after two years of weekly discussions with Larry Hunter – why we did not invite him into our lives earlier is a mystery to us.

I also want to thank all our sponsors and the many of you who sent us unsolicited gifts. The three of us take those donations as a way of saying “don’t stop” and we commit to not stopping. We already have a nearly complete list of speakers for next year. And we do owe a special thank you to SomaLogic (now within the Standard Biotech entity) who has been a major sponsor each year since we started this event in 2010. While companies often are accused of caring only about the earnings for the next quarter, SomaLogic understood that an informed citizenry is good for everyone. We believe that an informed citizenry is one of our major goals!

It seems useful to explore a question that has been on our minds at these symposia since we started. That question is: What are the roles of basic science and applied science in the lives of scientists and in our thinking about having better lives? In a new favorite book, *Before the Big Bang*, written in 2022 by Laura Mersini-Houghton, there is a wonderful story about Michael Faraday, who studied and helped us understand electromagnetism. The British chancellor of the exchequer—whatever that is...—visited Faraday’s lab one day. At the end of the visit, the chancellor said, “This is all incredibly impressive, but what is it good for?” Faraday replied: “I don’t know, sir, but I am sure you will tax it one day.” We are talking about the uses of electricity in our lives, today, and Laura Mersini-Houghton’s entire book is about the existence of the multiverse! Will her basic science (theoretical physics!) have applications we cannot imagine?

This journey we have been taking for fifteen years is about the pleasures of basic science AND applied science. One feeds the other, and the nurturing can go from either one to the other. It is with that spirit of wondering that we welcome you once again for whatever we might learn in the next two days. Thanks to all of you for coming to Boulder or for joining us online.

Larry Gold

FROM LARRY HUNTER

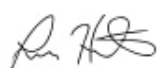
This symposium is always one of my favorite events of the year. Time with old friends, learning interesting new things, and the opportunity to work closely with Meredith and Larry to organize these events brings me such joy. One of the things that makes this meeting so unusual is the fact that previous speakers keep coming back, sometimes as moderators, and sometimes just to listen and join the conversation. The community that has built up over the years is truly beautiful and brings together such diverse and interesting people. Sadly, we have lost some treasured members of our community last year, and the program includes brief tributes to memorialize them.

This year's speakers are, as usual, a fascinating bunch. Sharing a little of what goes on behind the curtains in organizing will give you an idea of the serendipity involved. As we start thinking about symposium speakers, Larry, Meredith, and I share about the topics we are excited about, the books and articles we have read that engaged us, and the people who inspire us. From the outside, it looks as if that sort of coherent, systematic approach drives the symposium, but nothing could be further from the truth. As originally noted by 19th century military strategist Helmuth von Moltke (although at much greater length and in German), no plan survives contact with reality. As we start reaching out to potential speakers, our thoughts begin to drift. Some people we can't reach or have conflicts. Everyone we talk to has ideas about who we should invite or what topics we should cover. As speakers begin to fall into place, we have further thoughts about who might be complementary, or how we could shift the topics to organize speakers more coherently. Trying to explain our intended themes to Darin Grassman, the artist who makes such wonderful art each year, often catalyzes new ideas about what our themes really should have been, and who else we need to invite. What comes out in the end has always been fascinating (to me at least), yet never much resembles what we conceived at the beginning. Luck plays such an important role it almost feels as if once we get the ball rolling, the symposium organizes itself into whatever form it most wants to be that year.

Of course, that's just setting the agenda. I know you all see the nearly flawless execution every year, but there's a lot less serendipity and a lot more work required to pull that off – especially now that we are live streaming as well as doing an in-person event. All that organizing, from the logistics of bringing hundreds of people to Boulder to the high touch production that makes our streaming and web video collections so good, is almost entirely Meredith's doing. She is truly a miracle worker, and I want you all to know how much respect and appreciation she deserves.

Finally, I want to expose one more critical component that makes this meeting special. Running the symposium is expensive, and our sponsors are the ones who let us know that it's worth the price. Their ongoing support means we can keep doing this, year after year. Thank you, thank you, thank you! If the symposium matters to you and you have the resources, maybe you would consider joining them? Please reach out.

Thanks to Larry and Meredith for including me in this wonderful adventure, to the speakers who make it so interesting, and to this lovely community for coming with open minds and full hearts. I treasure you all.



Larry Hunter





SCHEDULE DAY ONE

SESSION 1: PAIN

Moderator: Richard Deckelbaum

- | | |
|-----------------|--|
| 9:05am-9:40pm | Glenn Treisman
Chronic Pain & Pain Amplification: Seeing the Whole Elephant |
| 9:40am-10:15pm | Scott Falci
Novel Approaches to Understanding and Treating
Spinal Cord Injury Neuropathic Pain |
| 10:15am-10:45am | Break |
| 10:45am-10:50pm | Richard Deckelbaum
Omega-3 Fatty Acids: New Frontiers |
| 10:50am-11:25am | Ru-Rong Ji
Using Molecular Pathways of Omega-3 Fatty Acids to Block
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| 11:25am-12:00pm | Adina Michael-Titus
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| 12:30pm-2:00pm | Lunch |

DAY ONE

MODERATOR SESSION ONE



RICHARD J. DECKELBAUM, MD, CM, FRCP(C)

**Robert R. Williams Professor of Nutrition, Professor of Pediatrics and Epidemiology,
Columbia University Irving Medical Center**

Dr. Richard J. Deckelbaum is the Robert R. Williams Professor of Nutrition and the immediate past Director of the Institute of Human Nutrition at Columbia University, where he also holds professorships in pediatrics and epidemiology.

He founded and directed divisions of pediatric gastroenterology, hepatology, and nutrition at the Hebrew University of Jerusalem and Columbia. In addition to his basic research in the cell biology of lipids, he has been active in translating basic science findings to practical application in humans with a long involvement in issues of human nutrition and cardiovascular diseases. His primary laboratory-based interests bridged from human plasma, lipoproteins, and now the metabolism of intravenous lipid emulsions, to cellular and gene regulatory effects of dietary fats and different types of fatty acids. His recent research has emphasized molecular mechanisms whereby acute injections of omega-3 lipid emulsions provide cardio- and neuro-protection after acute organ injury. This latter work led to establishing DeckTherapeutics Inc., a Columbia University spin-out developing novel first-in-class intravenous omega-3 diglyceride emulsions for blocking the adverse molecular pathways of devastating and costly organ injuries caused by acute hypoxia-ischemia, such as in ischemic stroke, myocardial infarction, and hypoxia near delivery in newborns. Richard has led program projects relating to gastrointestinal diseases in the Mideast and the USA, funded by the National Institutes of Health (NIH), and the United States Agency for International Development (USAID), in addition to programs funded by industry.

Richard has published over 400 research and other publications, as well as being Co-Editor of a number of books, such as Preventive Nutrition, now in its 5th edition. He has chaired task forces for the American Heart Association, the European Atherosclerosis Society, the Institute of Medicine, and the March of Dimes, and has served on and/or chaired advisory committees of the NIH, RAND Corporation, the USA National Academy of Sciences, and WHO.

Richard has coordinated working groups on “eco-nutrition”, an evolving field integrating agriculture and ecology with food security, climate change, and nutrition. He served on the Food and Nutrition Board of the National Academy of Sciences, and is a Senior Fellow of the Synergos Institute. Among named lectureships and other honors, he is the recipient of the lifetime achievement awards from the Global Health Education Consortium and McGill University. He received his education at McGill University in Montreal, Canada.

GLENN TREISMAN, MD, PhD

Director, AIDS Psychiatry Service; Director, Pain Treatment Program; and Co-Director, Amos Center at Johns Hopkins

ABSTRACT



Chronic Pain and Pain Amplification: Seeing the Whole Elephant

Due to increasing specialization, medicine has created “silos” that are barriers to a holistic view of patients. Patients who currently do not fit into the algorithms of diagnosis are shunted from doctor to doctor and have costly repetitive unhelpful workups. When diagnostic studies do not give a clear answer, their problems are often presumed to be psychosomatic. One group of these patients present with overlapping complaints that include cognitive impairment, “brain fog”, depression, chronic fatigue (chronic fatigue syndrome, CFS), diffuse pain (fibromyalgia), postural change intolerance (postural orthostatic tachycardia syndrome, POTS, and neurally mediated hypotension, NMH), GI dysmotility, chronic nausea, migraine, temporomandibular joint syndrome (TMJ), tinnitus, dizziness, mixed connective tissue disorder, interstitial cystitis, and several others. The symptoms often begin after an infection (such as long-COVID, chronic Lyme disease, chronic Epstein-Barr) or another illness but may be lifelong. A significant number of the patients have an autoimmune disorder and others have hyperflexible joints or other Ehlers-Danlos spectrum disorders. They seem to have both genetic and environmental elements to their illness. These patients share dysfunction of the autonomic nervous system, chronic inflammation, and immune dysregulation. They fall into the spaces (interstitium) between medical specialties and need interstitial care, usually from multidisciplinary clinical teams.

At Johns Hopkins’ Pain Treatment Program, we have had remarkable success with many of these patients using neuromodulating and immunomodulating medications, autonomic nervous system manipulations, a program of autonomic and physical rehabilitation, and a structured plan to help them recover.

BIOGRAPHY

Glenn Jordan Treisman is the Eugene Meyer III Professor of Psychiatry and Medicine at the Johns Hopkins University School of Medicine. He is the Director of the AIDS Psychiatry Service and the Pain Treatment Program at Johns Hopkins. The Pain Treatment Program provides care for chronic pain syndromes and is a national referral resource for patients with intractable pain. He is the Co-Founder and Co-Director of the Amos Center, a program that studies atypical GI disorders and the relationship between food, the nervous system of the GI tract, the microbiome, and disease. Glenn is internationally known for his engaging presentations, his efforts to promote the integration of psychiatry and medicine, and his vigorous commitment to the betterment of patient care for underserved populations.

SCOTT P. FALCI, MD

Neurosurgeon, Falci Institute for Spinal Cord Injuries

ABSTRACT



Novel Approaches to Understanding and Treating Spinal Cord Injury Neuropathic Pain

Neuropathic pain is among the most disabling sequelae of spinal cord injuries (SCIs), with prevalence estimated from 65-80%. Common pain descriptors include “sharp, burning, electrical, stabbing, pins-and-needles, squeezing, pressure” sensations. These pains are always perceived in body regions of partial or complete sensory loss from the SCI. Scientific understanding of these pain perceptions has been perplexing, particularly in individuals experiencing these pains in regions of the body of complete paralysis, who are otherwise unable to detect any painful stimulus—no matter how severe—to that paralyzed body region. Historically, failed attempts to treat this pain through spinal cord transection at the SCI site have led to the prevailing thought that changes to the brain’s pain-perceiving centers were the primary source of these pains.

Our work at the Falci Institute for Spinal Cord Injuries has shown that plasticity of second-order neurons in the dorsal root entry zone (DREZ)—where pain signals are normally processed—leads to spontaneous electrical hyperactivity, sending pain signals to brain pain centers, even without first receiving painful peripheral stimuli for processing. We have also learned that these hyperactive DREZs follow a novel somatotopic map of pain generation and body region perception, implicating the sympathetic nervous system as a route for transmission to the brain.

With detection and surgical ablation of these DREZs, we achieve 100% relief of pain in approximately 85% of patients suffering severe SCI neuropathic pain that has been refractory to all pharmacological management. Biopsy of this pain-causal DREZ tissue along with interspersed electrically “normal” non-pain-causal DREZ tissue, before ablation, has enabled comparative proteomic analyses that have revealed proteins that are associated with neuropathic pain. In our largest analysis to date (approximately 5,000 proteins analyzed for each comparative sample) we found that approximately 1% of the proteins showed more than a two-fold over-abundance in the pain causal tissue with statistical significance ($FDR < 0.05$). We have established proof of principle for our drug target discovery platform with an ongoing Phase 3 clinical trial investigating a repurposed drug to one of our overly abundant proteins. While our analyses have focused on SCI neuropathic pain, we believe the insights from this work may inform therapies for neuropathic pain more broadly.

BIOGRAPHY

Scott P. Falci is the Founder and Director of the Falci Institute for Spinal Cord Injuries. As a neurosurgeon, he has focused on the surgical treatment of the injured spinal cord for more than 30 years. Scott’s research includes the exploration of the underlying molecular mechanisms of the debilitating neuropathic pain associated with spinal cord injuries. He founded TenZero Biosciences to advance this work, including the proteomic analysis of pain mechanisms that may lead to new treatments.

Scott received his MD and completed his residency at Georgetown University. He holds an AB from Princeton University.

RU-RONG JI, PhD

William Maixner Professor in Anesthesiology; Distinguished Professor; and Director, Center for Translational Pain Medicine at Duke University



ABSTRACT

Using Molecular Pathways of Omega-3 Fatty Acids to Block Inflammatory & Neuropathic Pain

Increasing evidence suggests that resolution of acute pain is an active molecular process and requires the production of specialized pro-resolving mediators (SPMs). SPM superfamily, including resolvins, protectins, and maresins, are derived from omega-3 fatty acids DHA and EPA. Ru-Rong will present evidence that synthetic SPMs produce potent analgesic actions in animal models of acute pain and chronic pain after inflammation, surgery, and nerve injury. He will also demonstrate the mechanisms by which SPMs control pain via neuronal, glial, and immune regulations. He will also discuss new SPM receptors that mediate the pro-resolution, anti-inflammatory, and analgesic actions of SPMs.

BIOGRAPHY

Ru-Rong Ji, PhD is the William Maixner Professor in Anesthesiology and Distinguished Professor at Duke University. Additionally, he is a Professor of Neurobiology and Cell Biology at the Duke University Medical Center and the Director of the Center for Translational Pain Medicine (CTPM). Before his tenure at Duke University, he was a faculty member at Massachusetts General Hospital and Brigham and Women's Hospital, and Harvard Medical School.

Ru-Rong has dedicated over 25 years to exploring the mechanisms and treatments for chronic pain. His laboratory focuses on the role of glial and immune cells in the onset and resolution of pain. His research has led to breakthroughs in understanding the involvement of non-neuronal cells in pain, including glial modulation, neuroimmune interactions, and neuroinflammation. His team was the first to demonstrate the significant analgesic effects of specialized pro-resolving mediators (SPMs) in animal pain models and to elucidate the molecular and cellular mechanisms underlying SPMs' actions. In his early career, his work on the MAP kinase pathways in inflammatory and neuropathic pain paved the way for understanding peripheral and central sensitization in the development of chronic pain. His recent studies have uncovered the critical roles of the STING/interferon pathway and the PD-L1/PD-1 checkpoint pathway in immunotherapies for pain management. His findings are comprehensively detailed in his 2023 Springer publication, *Neuroimmune Interactions in Pain: Mechanisms and Therapeutics*.

His scholarly contributions include 250 publications in medical and neuroscience journals. These works have been cited 45,000 times, earning him an H-index of 115 on Google Scholar. For five consecutive years, Dr. Ji has been recognized as a Highly Cited Researcher by Clarivate. His achievements include receiving the NIH Transformative Award, the American Society of Anesthesiologists (ASA) Research Excellence Award, and the American Academy of Pain Medicine (AAPM) Founder's Award. Over his career, he has mentored more than 100 scientists and currently holds positions on the editorial boards of the *Journal of Neuroscience*, *Anesthesiology*, and *Pain*, as well as serving as Co-Chief Editor of *Neuroscience Bulletin*.

Ru-Rong earned his PhD from the Shanghai Institute of Physiology at the Chinese Academy of Sciences. He furthered his education with postdoctoral training at Peking University, Karolinska Institute, and Johns Hopkins University.



ADINA MICHAEL-TITUS, PhD

Professor of Neuroscience, Barts and The London School of Medicine and Dentistry, Queen Mary University of London



ABSTRACT

Omega-3 Fatty Acids for the Treatment of Spinal Cord and Traumatic Brain Injuries

Traumatic neurological injury can be an event with life-changing consequences. When injury occurs in the central nervous system, there are major obstacles to regenerative processes, therefore, recovery of function is limited. At present, there are no clinical interventions that support the patient by providing neuroprotection in the immediate aftermath of injury, or specific treatments in the chronic recovery period, to restore disrupted neural circuits. Data reported over the last two decades in various models of traumatic injury show that long-chain omega-3 fatty acids such as docosahexaenoic acid (DHA), limit the impact of the injury and support neural repair. DHA significantly reduces neuronal loss after traumatic brain injury (TBI) and spinal cord injury (SCI), modulates neuroinflammation, and promotes neuroplasticity. There is now time to consider translating to the clinic these promising experimental findings, clarifying key questions that would enhance the prospect of clinical success.

BIOGRAPHY

Adina Michael-Titus is a Professor of Neuroscience at Barts and The London School of Medicine and Dentistry, Queen Mary University of London. She is the Lead of the Centre for Neuroscience, Surgery and Trauma at the Blizard Institute. Professor Michael-Titus is a Fellow of the British Pharmacological Society and she spent a period of work early in her career in drug discovery in the pharmaceutical industry. In the last two decades, her research has been focused on neuroprotective and neurorepair strategies in traumatic spinal cord injury and brain injury. Studies in her group illustrate the significant potential of neuroactive lipids such as the long-chain omega-3 fatty acids, in the management of neurotrauma. Professor Michael-Titus is the President-Elect of the International Society for the Study of Fatty Acids and Lipids.



SCHEDULE DAY ONE

SESSION 2: HUMAN DEVELOPMENT & AGING

Moderator: Roy Parker

2:00pm-2:45pm

Duey Freeman

Exploring Attachment: The Foundation of Our Relational Lives

2:45pm-3:30pm

Dayna Matthew

What to Do When the Law Is Bad for Your Patients' Health

3:30pm-4:00pm

BREAK

4:00pm-4:45pm

Tony Wyss-Coray

Young Blood for Old Brains

4:45pm-5:30pm

Larry Gold

Broad Proteomics and Health Management

DAY ONE

MODERATOR SESSION TWO



ROY PARKER, PhD

Investigator with the Howard Hughes Medical Institute; Executive Director, BioFrontiers Institute; Cech-Leinwand Endowed Chair of Biochemistry and Distinguished Professor at the University of Colorado Boulder

Roy Parker is an Investigator with the Howard Hughes Medical Institute; Executive Director, BioFrontiers Institute; Cech-Leinwand Endowed Chair of Biochemistry and Distinguished Professor at the University of Colorado Boulder. He has a joint appointment with the Department of Molecular, Cellular and Developmental Biology. His research focuses on the translation, localization and degradation of eukaryotic RNA, how cells regulate different steps in this process to modulate gene expression, and how alterations in RNA regulation lead to human disease. He has served on, and chaired, the NIH CDF-1 study section, and co-organized the Nucleic Acids Gordon Conference (1997), the RNA Processing Meeting at CSHL (2001), and the 2004 FASEB Conference on Post-Transcriptional Control (2004). He is, or has been, on the editorial boards of MCB, Science, Cell, RNA, Nucleic Acids Research, and was an editor of the Journal of Cell Biology and eLife. He was the President of the RNA Society (2010). He is an elected Fellow of the American Academy of Arts & Sciences (2010) and Member of the National Academy of Sciences (2012). He received his Ph.D. from the University of California, San Francisco and completed his Postdoctoral work at the University of Massachusetts, Worcester.

DUEY FREEMAN, LPC

Licensed Therapist



ABSTRACT

Exploring Attachment: The Foundation of Our Relational Lives

The pervasiveness and effects of trauma are well represented in many helping and scientific professions. In fact, these professions are currently expected to be 'trauma-informed.' What is under-represented and more foundational to the emotional health of individuals, families, and communities is the quality of our early, original attachment.

This bond provides the blueprint for all relationships, thus uniquely guiding how we love, lead, parent, and work.

Through decades of attachment research, thousands of client case studies, and direct personal experience, Duey Freeman presents an updated and practical attachment model that supports understanding and healing from such wounding. By exploring the origins of issues such as addiction, eating disorders, and domestic violence as attachment issues, we can offer a path forward, creating safety and belonging. Becoming 'Attachment Informed' is essential to understanding and supporting all relationships.

BIOGRAPHY

Duey Freeman is a sought-after teacher, trainer, licensed therapist, and equine professional worldwide. He has taught worldwide and developed a practical attachment theory and human development theory taught to thousands of university students. He has nearly 80,000 direct client hours and co-founded the Gestalt Equine Institute and the Gestalt Institute of the Rockies. He supervises therapists and graduate students and does business and land consultations for new equine therapy sites.

Duey embodies both tenderness and strength in all his relations and work. His quality of contact and relationship with others is authentic and unique. People come from around the world to study with him. He is a true elder and mentor, exploring new horizons in facilitating men's growth work. Gestalt and Relational Horsemanship are not just approaches to Duey; they are how he walks through the world.

DAYNA MATTHEW, JD, PhD

Dean, and Harold H. Greene Professor of Law, George Washington University

ABSTRACT



What to Do When the Law Is Bad for Your Patients' Health

Access to a good education has empirically been shown to significantly increase one's chances of enjoying good health. Conversely, a poor education virtually guarantees poor health outcomes. Yet, over the past half-century, the United States Supreme Court has steadily marched away from the guarantees of equal educational opportunity for underrepresented children, and thus marched deliberately towards widening already egregious health disparities. Most recently, in *SFFA v. President and Fellows of Harvard College et al.*, the Supreme Court pronounced, "Today, the Court holds that the Equal

Protection Clause of the Fourteenth Amendment does not tolerate this practice [admitting or rejecting applicants based in part on race] . . . " explaining that the Court is unsure how to measure the benefits of affirmative action when framed as "whether leaders have been adequately 'train[ed]' or whether the exchange of ideas is 'robust' or whether 'new knowledge' is being developed."

This presentation will propose measures of the harms caused by educational inequality, such as the facts that only 25.2% of college graduates are black or Latino, 29% of college professors are from underrepresented minority groups, and black and brown children in America attend public school districts whose budgets are \$23 billion smaller than the budgets for predominately white public school districts. I will explore the multiple mechanisms that connect good education to good health, and the evidence that increases in morbidity and mortality are closely correlated to lack of educational attainment. With these data as a backdrop, this presentation will apply the tools of legal epidemiology to analyze recent Supreme Court decisions, such as the Harvard/UNC affirmative action case, to conclude that the current Court's educational law jurisprudence is bad for all Americans' health. Dean Matthew will conclude with proposed solutions.

BIOGRAPHY

Dayna Bowen Matthew is the Dean and Harold H. Greene Professor of Law at the George Washington University Law School. A leader in public health and civil rights law who focuses on disparities in health, healthcare, and the social determinants of health, Dayna joined GW Law in 2020. She is also the Founder and inaugural faculty Director of GW's newly chartered Equity Institute, an interdisciplinary research hub dedicated to addressing racial, ethnic, and socioeconomic injustice. A prolific writer, Dayna is the author of two bestselling books, *Just Medicine: A Cure for Racial Inequality in American Health Care*, and the recently released *Just Health: Treating Structural Racism to Heal America*, and the Co-Author of a case book on public health law, ethics, and policy.

TONY WYSS-CORAY, PhD

D.H. Chen Distinguished Professor of Neurology and Neurological Sciences, and Director of the Phil and Penny Knight Initiative for Brain Resilience at Stanford University

ABSTRACT



Young Blood for Old Brains

Aging leads to the degradation of function and the onset of diseases in nearly all tissues and organs. Our research has been centered on brain aging, which results in cognitive decline and is a major risk factor for sporadic neurodegenerative diseases such as Alzheimer's. While brain cell- and tissue-intrinsic factors are likely essential in driving the aging process, recent studies document a remarkable sensitivity of the brain to circulatory factors. Thus, blood-borne factors from young mice or humans are sufficient to counteract aspects of brain aging and improve cognitive function in old mice. Conversely, factors from old mice are detrimental to young mice and impair cognition. We found evidence that the cerebrovasculature is an important target of circulatory factors and that brain endothelial cells show prominent age-related transcriptional changes in response to plasma. Furthermore, plasma proteins are taken up broadly into the young brain through receptor-mediated transport at the vasculature, a process that decreases with age. At the same time, proteins originating in the brain can be detected in plasma. This allows us to observe physiological shifts related to brain aging in the blood and offers novel methods to monitor individual brain physiology and aging. These findings open opportunities to identify biomarkers and regulators of aging, in general, and for the brain and other organs specifically.

BIOGRAPHY

Tony Wyss-Coray is the D.H. Chen Distinguished Professor of Neurology and Neurological Sciences and the Director of the Phil and Penny Knight Initiative for Brain Resilience at Stanford University. His lab studies brain aging and neurodegeneration with a focus on age-related cognitive decline and Alzheimer's disease. The Wyss-Coray research team discovered that circulatory blood factors can modulate brain structure and function, and factors from young organisms can rejuvenate old brains. Current studies focus on the molecular basis of the systemic communication with the brain by employing a combination of genetic, cell biology, and -omics approaches in mice and humans. Wyss-Coray has presented his ideas at Global TED, the Tencent WE Summit, the World Economic Forum, and he was voted *Time Magazine's* "The Health Care 50" most influential people transforming healthcare in 2018. He co-founded Alkahest Inc. and several other companies targeting Alzheimer's and neurodegeneration and has been the recipient of an NIH Director's Pioneer Award, a Zenith Award from the Alzheimer's Association, and a NOMIS Foundation Award.

LARRY GOLD, PhD

Chairman and Founder of the GoldLab Foundation and the Colorado Longitudinal Study; Professor, University of Colorado Boulder; Founder of SomaLogic, NeXstar Pharmaceuticals, and Synergen

ABSTRACT



Broad Proteomics and Health Management

More than a decade ago, SomaLogic published the first paper to accurately quantify the concentrations of many human proteins (epitopes really, since we used as binding reagents SOMAmers/aptamers that contacted a small domain of a target protein – about a thousand square angstroms or so). The emphasis since that early paper has been on expanding the number of proteins measured (now at more than 11,000 at SomaLogic), making sure that the accuracy/CV's of the measurements were high. Many clinical samples—largely plasma, some sera, urine, and even some tissue extracts—were used to get a feel for the kinds of human biology that might be revealed through proteomics of this kind. Our North Star was to provide something equivalent to thousands of individual ELISA's done easily on small volumes of precious samples.

SomaLogic has run about 700,000 samples on SomaScan, while making it possible for others to use SomaScan for their own research purposes. Hundreds of papers have been published using SomaScan and other broad proteomic platforms. The shared goal has been to enable researchers to do proteomics as easily as they do genomics. It is common today for scientists to couple genomics, transcriptomics, and proteomics to study biology.

What will it take for the clinical community to embrace broad proteomics with the same fervor as has the basic research community? SomaLogic has studied samples from clinical cohorts with common diseases and with rare diseases. Disease detection/occurrence, staging, sensible interventions, and outcomes are available from proteomics. Could we anticipate that proteomics, done frequently over time, will become a health management tool used for large fractions of the global population? The required pieces toward that end will include: precision diagnoses that are more frequent than without proteomics, improved health outcomes, and small costs for healthcare systems relative to those improved outcomes. Published suggestions assert that the first two requirements are on the way. In this presentation, Larry will focus on his understanding that today's costs for broad proteomics (for SomaScan as the example) could fall precipitously in the years ahead.

BIOGRAPHY

Larry Gold is the Founder and former Chairman of the Board and CEO of SomaLogic. Prior to SomaLogic, he founded NeXagen, Inc., which later became NeXstar Pharmaceuticals, Inc. During his nearly 10 years at NeXstar, Larry held numerous executive positions. In 1999, NeXstar merged with Gilead Sciences, Inc. to form a global organization committed to the discovery, development, and commercialization of novel products that treat infectious diseases. Before forming NeXagen, he also co-founded and served as Co-Director of Research at Synergen, Inc., a biotechnology company later acquired by Amgen, Inc.

Since 1970, Larry has been a Professor at the University of Colorado Boulder (CU Boulder), where he established the Gold Lab in 1971. Starting with basic research on bacteria and bacteriophage, the lab shifted its focus to human disease following the invention of the SELEX process in 1989. While at CU Boulder, he served as the Chairman of the Molecular, Cellular, and Developmental Biology Department from 1988 to 1992. Since then, Larry has received the CU Distinguished Lectureship Award, the National Institutes of Health Merit Award, the Career Development Award, the Lifetime Achievement Award from the Colorado Biosciences Association, the Chiron Prize for Biotechnology, and the 8th International Steven Hoogendijk Prize by the Dutch Batavian Society of Experimental Philosophy.

Larry is a member of the American Academy of Arts and Sciences and the National Academy of Sciences. He is also a fellow of the National Academy of Inventors.



SCHEDULE DAY TWO

SESSION 3: BIOLOGY & CULTURE

Moderator: Tim Harris

9:10am-9:55pm	Tom Cech RNA – A Catalyst for Public Engagement With Science
9:55am-10:40am	Colin Hill Digital Twins and the Discovery of New Drugs for Rare Diseases
10:40am-11:20am	BREAK
11:20am-12:05pm	Keolu Fox Guns, Germs, and Alleles
12:05pm-12:50pm	Julie Gerberding Re-Earning Trust in Science: A Health Imperative
12:50pm-2:00pm	LUNCH

DAY TWO

MODERATOR SESSION THREE



TIM HARRIS, PhD, DSc

Biotechnology Consultant and Science Advisor

Tim Harris is a molecular biologist, biochemist, and geneticist. He started work in the biotech industry almost at its inception. He began his scientific career in 1974, working on animal viruses - cloning picornavirus RNAs. He was one of the first molecular biologists to join the UK biotech company Celltech (now UCB Pharma) in 1981. He spent nearly five years from 1989 to 1993 at Glaxo Group Research (now GSK) as Director of Biotechnology.

Harris moved to the United States in 1993 to be Executive Vice President (EVP) of R&D at Sequana Therapeutics. It was acquired by Arris Pharmaceutical to form Axys Pharmaceuticals in 1998. Harris founded SGX Pharmaceuticals in 1999 (formerly Structural Genomix), where he built the company to more than 130 employees, raised \$85M in capital, and generated more than \$20 million/annum in revenue during his six years as CEO, before the company was sold to Eli Lilly. He served briefly as President and CEO of Novasite Pharmaceuticals before moving in 2006, to become the Chief Technology Officer and Director of the Advanced Technology Program (ATP) at SAIC-Frederick, Inc. (now Leidos). In 2011, Harris moved to Biogen as Senior Vice President of Translational Medicine, before joining the Hematology spin out Bioverativ, as EVP R&D in March 2017. Bioverative was acquired by Sanofi in June of 2018. From April 2020 until April 2022, Harris was EVP and Chief Science Adviser at Repertoire Immune Medicines, a private Flagship Pioneering company working on T cell engineering and antigen decoding.

Harris is presently a consultant to several biotechnology companies focusing mainly on matters of R&D and R&D management. He is also a Venture Partner at SV Health Investors. In this role he founded Caraway Therapeutics, an autophagy company in 2016 and in 2018 Catamaran Bio, a company developing NK cell therapeutics. He is chairman of the Scientific Advisory Board of both companies and an observer on the Board. He is also on the Board of Directors of PhenoTX in Edinburgh, a company focusing on remyelination.

Harris has published over 110 peer reviewed research papers and reviews. He has written several book reviews and is a contributor at the annual GoldLab Symposium. He has written several commentaries for BioCentury and other industry magazines. His book, *In Pursuit of Unicorns*—about the history of the biotech industry—has just been published by Cold Spring Harbor Laboratory Press.

THOMAS R. CECH, PhD

Distinguished Professor, CU Boulder; Investigator, HHMI

ABSTRACT



RNA – A Catalyst for Public Engagement With Science

For half a century, the RNA research community has seen RNA emerge from being simply a copy of the information stored in DNA to an active participant in the chemistry of life. But these breathtaking discoveries went largely unnoticed by the general public, even as people became more conversant with DNA. Then in 2020, the Covid-19 mRNA vaccines put RNA in the spotlight – and opened the door for sharing the wonders of RNA science with the world.

Among its many activities, RNA powers the immortality enzyme, telomerase, which contributes to aging and cancer. RNA guides CRISPR gene editing, which gives hitherto unthinkable power to rewrite the code of life. And RNA may provide the answer to life's most fundamental mystery — how did living things first arise on our planet? In this talk, Tom will summarize his attempt to illuminate RNA science for the general public by means of a book, *The Catalyst*.

BIOGRAPHY

Tom Cech is a Howard Hughes Medical Institute Investigator and Distinguished Professor of Chemistry and Biochemistry at the University of Colorado Boulder (CU Boulder). In 1982, Cech and his research group announced that an RNA molecule from *Tetrahymena*, a single-celled pond organism, cut and rejoined chemical bonds in the complete absence of proteins. This discovery of self-splicing RNA provided the first exception to the long-held belief that biological reactions are always catalyzed by proteins. In addition, it has been heralded as providing a new, plausible scenario for the origin of life because RNA can be both an information-carrying molecule and a catalyst; perhaps the first self-reproducing system consisted of RNA alone. From 2000-2009, he served as President of the Howard Hughes Medical Institute, the largest private biomedical research organization in the U.S.A. He then returned to full-time research and teaching at CU Boulder, also serving as the Founding Director of the university's BioFrontiers Institute.

Cech's work has been recognized by many national and international awards and prizes, including the Heineken Prize of the Royal Netherlands Academy of Sciences (1988), the Albert Lasker Basic Medical Research Award (1988), the Nobel Prize in Chemistry (1989), and the National Medal of Science (1995). He has been elected to the U.S. National Academy of Sciences (1987) and National Academy of Medicine (2000) and is a lifetime professor of the American Cancer Society.

Tom received his PhD in Chemistry from the University of California, Berkeley, and did postdoctoral research at the Massachusetts Institute of Technology,

COLIN HILL

CEO and Co-Founder, Aitia Bio

ABSTRACT



Digital Twins and the Discovery of New Drugs for Rare Diseases

The emergence of combined multi-omic and clinical data directly from patient tissue, along with the availability of ultra-scale computing, and recent developments in AI that can reverse-engineer causal mechanisms from observational data, have converged to enable the creation of Gemini Digital Twins, replicas of human disease biology. Gemini Digital Twins are computational representations of human disease that capture a critical mass of the known and unknown genetic and molecular interactions that causally drive clinical and physiological outcomes. “Virtual experiments” or simulations are conducted on these human disease replicas to discover hidden drivers of disease progression and drug response. This approach is especially important in diseases such as neurodegenerative diseases and rare diseases where the preclinical models—animals, cell lines, stem cells—are especially poor proxies of human disease. When this technology and approach is applied to rare diseases, it has the potential to discover and develop new therapeutics that can effectively treat disease in ways that are significantly more effective than has been possible to date. While rare diseases such as sickle cell anemia and Huntington’s Disease have known disease drivers at the genetic level, discovering and developing effective drugs has been elusive as “the cause is not always the cure.” The Huntington gene was discovered by Jim Gusella at Massachusetts General Hospital over 30 years ago as the definitive genetic cause of the disease, but we still do not have an effective disease-modifying therapy. Here we will present an approach and early evidence of the application of this approach to Huntington’s Disease that has yielded a compelling discovery program that is advancing towards the clinic. The approach may be the first true example of a drug candidate moving into clinical development based on an entirely hypothesis-free approach to unraveling previously unknown human biology.

BIOGRAPHY

Colin Hill is a leading voice in AI and precision medicine and brings impressive leadership experience in developing and commercializing AI solutions and discoveries in biopharmaceutical drug discovery and development and in managed care industries. Colin currently serves on the board of Centrexion Therapeutics, a biotech company focused on developing and commercializing non-opioid, non-addictive chronic pain drugs.

Colin previously served on the boards of Biotelemetry Inc. (NASDAQ: BEAT), the leading mobile health information company (acquired by Philips in 2021), and PPD Inc. (NASDAQ: PPD), a leading global contract research organization (acquired by Thermo in 2021), and was a founding member of the Board of Directors of AesRx, a biopharmaceutical company dedicated to the development of new treatments for sickle cell disease (acquired by Baxter in 2014).

He was also a founding board member of TMed (Transforming Medicine: The Elizabeth Kauffman Institute), a non-profit foundation (501c3) dedicated to the advancement of personalized medicine. In 2016, he was appointed by Massachusetts Governor Charlie Baker to the Massachusetts Digital Health Council. Colin was the founding Chairman of O’Reilly Media’s Strata Rx in 2012, the first healthcare big data conference in the industry. In 2004, Colin was named to MIT Technology Review’s TR100 list of the top 100 innovators in the world under the age of 35.

He is a frequent speaker at national and international scientific and industry conferences and has appeared in numerous publications and television programs, including *The Wall Street Journal*, *CNBC Morning Call & SquawkBox*, *Nature*, *Boston Globe*, *Politico*, *Forbes*, *Wired*, and *The Economist*.

KEOLU FOX, PhD

Co-Founder and Co-Director, UCSD Indigenous Futures Institute; Assistant Professor, University of California San Diego

ABSTRACT



Guns, Germs, and Alleles

In the following lecture, we will explore three key topics related to Oceania, using genomic data and modeling studies to illuminate historical migrations, disease origins, and health trends in the Pacific region.

1. Peopling of Polynesia: Genomic Insights: This segment examines the migration pathways to Polynesia, leveraging genomic networks to delineate the timing and routes of these ancient voyages, enhancing our understanding of Polynesian ancestry.

2. Origins of Leprosy in Oceania: We will investigate the historical introduction and spread of leprosy in the Pacific through genomic data, tracing its adaptation to new environments and revealing evolutionary trends.

3. Gout Epidemic in French Polynesia: Our final discussion utilizes data from the Ma'i u'u epi-survey to model the recent surge in gout cases, identifying trends and potential interventions.

This lecture will highlight the importance of genetic and epidemiological research in addressing the complex health and historical issues facing Oceania.

BIOGRAPHY

Keolu Fox is Co-Founder of the Native BioData Consortium, a nonprofit research institute led by Indigenous scientists and tribal members. He is also an assistant professor at the University of California San Diego, where he is Co-Founder and Co-Director of the UCSD Indigenous Futures Institute. The first Kānaka Maoli to receive a doctorate in genome sciences, his work focuses on the connection between data as a resource and the emerging value of genomic health data from Indigenous communities.

JULIE LOUISE GERBERDING, MD, MPH

President and Chief Executive Officer, Foundation for the National Institutes of Health

ABSTRACT



Re-Earning Trust in Science: A Health Imperative

The rapid pace of biomedical research insights and their translation into new diagnostics and treatments have enormous potential to improve health and well-being. Yet, despite the promise of these discoveries, preventable mortality is actually increasing, in part because too many people are unwilling or unable to take advantage of them. One major obstacle to uptake is the erosion of trust – trust in the innovations themselves, trust in the institutions that create them, and trust in the experts who advocate for their adoption. The unprecedented speed, reach, and scale with which misinformation and disinformation spread are critical accelerants of mistrust. We must take effective steps to re-earn trust and ensure that people have confidence in the reliable information they need to make appropriate health decisions.

BIOGRAPHY

Julie Louise Gerberding is the President and CEO of the Foundation for the National Institutes of Health (FNIH), a non-profit organization that builds public-private research partnerships to support the mission of the NIH. She co-chairs the CSIS Bipartisan Alliance on Global Health Security and is a member of the Commonwealth Fund Commission on a National Public Health System. Previously, she served as President of Merck Vaccines and as Executive Vice President and the Chief Patient Officer at Merck & Co., Inc. From 2003-2009, Julie led the U.S. Centers for Disease Control and Prevention (CDC).

She serves on the boards of HilleVax, Mayo Clinic, National Health Council, and Case Western Reserve University. Gerberding is a member of the National Academy of Medicine and the adjunct faculties of the University of California, San Francisco, and Case Western Reserve University.



SCHEDULE DAY TWO

SESSION 4: BIG DATA & INTELLIGENCE

Moderator: Michelle Holko

2:00pm-2:45pm

Chris Lunt

Discovery Through Scale. The All of Us Research Program.

2:45pm-3:30pm

John Wilbanks

A Small Matter of (Scientific) Programming

3:30pm-4:00pm

BREAK

4:00pm-4:45pm

Max Bennett

The Evolution of Human Intelligence: Why It Matters and What It Teaches Us About Ourselves, Neuroscience, and AI

4:45pm-5:30pm

Alex Morgan

Ten Years to Be an Overnight Success: Investing in the Future Takes Time

MODERATOR SESSION FOUR



MICHELLE HOLKO, PhD, PMP

Innovating at the intersection of biology, technology, and security

Michelle Holko, PhD, PMP, is a scientist and strategic innovator working at the intersection of biology, technology, and security. She is currently VP of Biorisk at Airfinity, the disease forecasting company, and also holds appointments as a Senior Policy Advisor to the National Security Commission on Emerging Biotechnology, Adjunct Senior Fellow at the Center for a New American Security, and PI at the International Computer Science Institute (ICSI) at Berkeley. Her technical expertise is in genomics, bioinformatics, biosecurity, biodefense, biological and sensor data; she has research experience in academia on cancer, immunology and infectious diseases, and in the public sector at NIH's NCBI and DARPA. She recently served in government as a White House Presidential Innovation Fellow and led projects with NIH, DHS CISA, HHS BARDA and DOD Chem Bio Defense, and was a Strategic Business Executive & Scientist at Google, focused on technologies for healthcare and life sciences in the public sector.

CHRIS LUNT

Chief Technology Officer, All of Us Research Program



ABSTRACT

Discovery Through Scale. The All of Us Research Program.

The NIH All of Us Research Program is working to advance precision medicine by building the largest, most diverse biomedical data resource in the world. Launched in May 2018, All of Us seeks to gather health data from one million or more participants across the United States, representing a wide array of backgrounds, ages, geographic regions, and health statuses.

All of Us has more than 750k consented participants, 85% of whom are underrepresented in biomedical research. With biosamples for more than 550k participants, we have made available 245k whole genome sequences, including 1,000 long-read sequences. We have made available electronic health records for more than 250k participants.

The data is available on the All of Us Researcher Workbench, which has more than 10k registered researchers, including researchers from six continents. Researchers have produced more than 400 publications, including promising discoveries in genomics, risk prediction, health disparities, and activity measurement.

Chris will discuss the innovative technologies and methodologies employed by the program, including electronic health record integration, genomics through whole genome sequencing, and mobile health data collection. These elements are instrumental in creating a comprehensive health database that supports a broad spectrum of research endeavors aimed at understanding and improving health outcomes.

Challenges such as data security, participant privacy, and maintaining engagement over the long term will be addressed, along with the solutions and safeguards that have been implemented. We will also explore how the program is facilitating access to its diverse dataset for researchers internationally, which is already enabling new health insights and discoveries.

BIOGRAPHY

Chris Lunt is the Chief Technology Officer for the All of Us Research Program. Chris has more than 20 years of experience designing web services and other data platforms, and has spent the last 10 years working as a technology executive. He joins the NIH from GetInsured, where he served as the Vice President of Government Solutions for the previous four years. There, he worked with the federal government, states, and the vendor community to improve health insurance shopping and enrollment systems. Previously, Chris worked as an HHS entrepreneur. He has also served as the Vice President of Engineering at Readyforce, the Chief Executive Officer of Nombray, the Founder and Vice President of Engineering at WisdomArk, and the Senior Director of Engineering at Friendster.



JOHN WILBANKS

Head of Product, Data Sciences Platform at the Broad Institute

ABSTRACT



A Small Matter of (Scientific) Programming

Why is it so hard for scientists in healthcare and biology to command programming power? Data has dominated the field for decades, and wave after wave of scientists have been exciting graduate students trained in informatics at some level. However, the field has (so far) successfully resisted network effects in data and systemic end-user programming as a day-to-day practice. If we are going to afford scientists real programming power, we need better software systems to support science at scale. It's just a small matter of programming.

BIOGRAPHY

John Wilbanks works at the intersection of data, software, policy, and science. He is currently Head of Product for the Data Sciences Platform at the Broad Institute, which serves 65,000+ data scientists on more than 80PB of biomedical data. He also serves as Senior Advisor to the Milken Institute's FasterCures, and as Senior Fellow at the Datasphere Initiative.

He was most recently Head of Data at Biogen Digital Health, where he led teams running real-world digital studies, building data products, and implementing data science software platforms. Before Biogen, he was Chief Commons Officer at Sage Bionetworks, where he led efforts in governance and informed consent. Sage's informed consent toolkit has been integrated into Apple's ResearchKit, Android ResearchStack, and has supported the enrollment of hundreds of thousands of participants in mobile studies since its open source release in 2016.

John's technical background includes a stint in web standards at the World Wide Web Consortium, as the Founder and CEO of a venture-backed graph bioinformatics company, and in voice/pen human-computer interface. His policy background includes leading open science at Creative Commons (when he was also a visiting scientist at the MIT Project on Mathematics and Computation), serving on the national advisory board for the US National Library of Medicine's PubMed Central, and as a Legislative Assistant in the US House of Representatives.

John holds a B.A. in Philosophy from Tulane University in New Orleans.

MAX S. BENNETT

Author of *A Brief History of Intelligence*

ABSTRACT



The Evolution of Human Intelligence: Why it Matters and What It Teaches Us About Ourselves, Neuroscience, and AI

In this talk, Bennett will review the research and key conclusions in his new book *A Brief History of Intelligence: Evolution, AI, and the Five Breakthroughs That Made Our Brains*. Despite centuries of effort, we still do not understand how the human brain works. The brain is full of messy redundancy that makes it difficult to reverse engineer by trying to decompose brain structures into various functions. Bennett will propose an alternative approach for reverse engineering the algorithms in the human brain: instead of trying to decompose the algorithms within the modern human brain, we can track the key evolutionary breakthroughs through which the modern human brain emerged. This gives us a new tool in our toolbox for trying to interpret many perplexing aspects of human intelligence. Bennett proposes that human brain evolution can be approximated as the culmination of five algorithmic breakthroughs.

BIOGRAPHY

Max Bennett is an entrepreneur and researcher. He has co-founded multiple AI companies, holds several patents for AI technologies, and has published numerous scientific papers on the topics of evolutionary neuroscience and intelligence. He has been featured on the Forbes 30 Under 30 list and the Built In NYC's 30 Tech Leaders Under 30. Most notably, Bennett was the Co-Founder and Chief Product Officer of Bluecore, a company that helps the largest brands in the world use AI to personalize their marketing. Bluecore has been featured in the annual Inc. 500 fastest growing companies, as well as Glassdoor's 50 Best Places to Work in the U.S. Bluecore was recently valued at over \$1 billion. Bennett graduated from Washington University in St. Louis, summa cum laude, with a degree in economics and mathematics.



ALEXANDER MORGAN, MD, PhD

Partner, Khosla Ventures

ABSTRACT

Ten Years to Be an Overnight Success: Investing in the Future Takes Time



The path to significant innovation and change can be long, but if you work on major problems creatively and hard enough, you can have a major impact. Khosla Ventures has been actively investing in a number of areas in biology and medicine over the last decade that are now poised to improve the world in a variety of ways. These include efforts in neurotechnology, fetal-maternal medicine, tissue engineering, whole organism engineering, fundamental approaches to age-related diseases, and AI in healthcare and drug discovery. However, the path to impact can take time, and it is important to get the incentive structures for all parties appropriately aligned along the journey, including right at the start of the journey, but they should also be iterated as time unfolds.

BIOGRAPHY

Alex Morgan is a Partner at Khosla Ventures, a Silicon Valley VC fund that invests broadly in technology from seed stage funding to later stage capital investments. Alex has a special focus on biotechnology, healthcare, and data-driven innovation. He serves on the boards of a number of Khosla Ventures portfolio companies and works on company incubation and new investments.

Alex has an undergraduate degree in Physics, MS in Biology, MS and PhD in Biomedical Informatics, an MD, and did a postdoctoral fellowship in biochemistry. Before studying biology and medicine, he spent six years as an AI researcher. As a scientist, Alex has published over 50 scientific publications, primarily at the intersection of computer science, biology, and healthcare, and has licensed IP to three separate companies.

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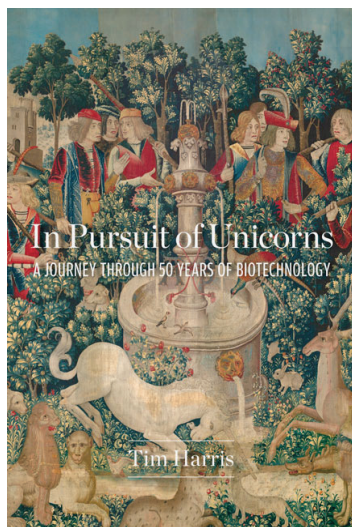
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BOOKS BY OUR SPEAKERS



In Search of Unicorns: A Journey Through 50 Years of Biotechnology

By Tim Harris

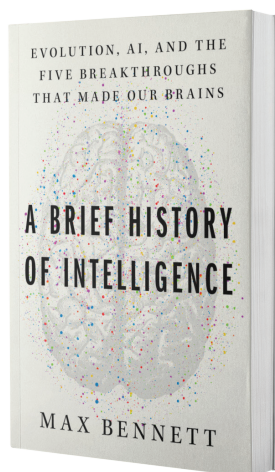
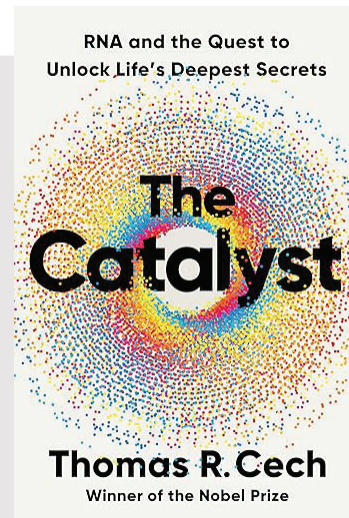
Tim Harris combines accounts of scientific successes and failures with a personal story of ambition, challenge, and discovery. From the pioneering early days of gene cloning and monoclonal antibodies to the current cutting-edge advancements in cell therapy, gene editing, and personalized medicine, Harris provides a candidly honest insider's view of biotech's remarkable evolution and its profound impact on health care.



The Catalyst RNA and the Quest to Unlock Life's Deepest Secrets

By Tom Cech

For over half a century, DNA has dominated science and the popular imagination as the "secret of life." But over the last several decades, a quiet revolution has taken place. In a series of breathtaking discoveries, the biochemist Thomas R. Cech and a diverse cast of brilliant scientists have revealed that RNA—long overlooked as the passive servant of DNA—sits at the center of biology's greatest mysteries: How did life begin? What makes us human? Why do we get sick and grow old? In *The Catalyst*, Cech finally brings together years of research to demonstrate that RNA is the true key to understanding life on Earth, from its very origins to our future in the twenty-first century.



A Brief History of Intelligence

By Max Bennett

Equal parts *Sapiens*, *Behave*, and *Superintelligence*, but wholly original in scope, *A Brief History of Intelligence* offers a paradigm shift for how we understand neuroscience and AI. Max Bennett chronicles the five "breakthroughs" in the evolution of human intelligence and reveals what brains of the past can tell us about the AI of tomorrow.



DEDICATION

FRANK PRENDERGAST

Frank Prendergast died this year. He had been a long time member of the Mayo faculty, a member of the Eli Lilly Board of Directors, and a remarkable presence. There was not a thing outside of his interests, and, more remarkably, his knowledge. Those interests included literature (he taught me about Thomas Paine, a hero we each adored), humanitarian action, and life. The talk he gave at GLS in 2011 followed an erotic talk by the previous speaker. Frank started his talk about cancer by admitting that he would rather be at home with his wife. That was the kind of person he was – always mindful of the meaningful center of any discussion. He was a true biochemist, a fact he brought to his science and thoughts. His last years were spent in Colorado, where he maintained his deep friendships with many people he first met at our symposia. Frank was a deep student of human behavior and held the proper contempt for small-minded people. He was a good one, judgmental but thrilling to be around.



- Larry Gold

DANIEL DENNETT

Earlier this year, we lost Daniel Dennett, who spoke at GLS in 2018. I had known and admired Dan's work since I was a graduate student, and was delighted to be able to enjoy a few days of his company that year. Many moving tributes to this remarkable man have been published, but I know he would most want to be remembered for his ideas. He produced an enormous volume of deeply insightful writing, well described on his wikipedia page, but I want to share a personal favorite. His great book *Intuition Pumps and Other Tools for Thinking*, among other things, lays out his approach to "criticizing with kindness." A lovely example of him doing exactly that is an old paper of his discussing Julian Jaynes' book on the origins of consciousness. He begins by saying, "What a philosopher would usually do on an occasion like this is to begin to launch into a series of devastating arguments, criticisms, and counter-examples, and I am not going to do that today..." and ends with "That, I think, is an absolutely wonderful idea, and if Jaynes is completely wrong in the details, that is a darn shame, but something like what he proposes has to be right...". That, as another dear departed friend of GLS, Charlie Butcher, used to say, shows real generosity of spirit. We should all try to learn from his example.



- Larry Hunter



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