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Nancy Ryan Gray, Ph.D.
Director

**2008 GORDON RESEARCH CONFERENCE
on MOLECULAR BASIS OF MICROBIAL ONE-CARBON METABOLISM**

FINAL PROGRESS REPORT

DEPARTMENT OF ENERGY
GRANT NO. DE-FG02-08ER15946

The Gordon Research Conference on MOLECULAR BASIS OF MICROBIAL ONE-CARBON METABOLISM was held at Bates College, Lewiston, Maine, July 20-25, 2008. The Conference was well-attended with 114 participants (attendees list attached). The attendees represented the spectrum of endeavor in this field coming from academia, industry, and government laboratories, both U.S. and foreign scientists, senior researchers, young investigators, and students.

In designing the formal speakers program, emphasis was placed on current unpublished research and discussion of the future target areas in this field. There was a conscious effort to stimulate lively discussion about the key issues in the field today. Time for formal presentations was limited in the interest of group discussions. In order that more scientists could communicate their most recent results, poster presentation time was scheduled. Attached is a copy of the formal schedule and speaker program and the poster program. In addition to these formal interactions, "free time" was scheduled to allow informal discussions. Such discussions are fostering new collaborations and joint efforts in the field.

Thank you for your support of this Conference. As you know, in the interest of promoting the presentation of unpublished and frontier-breaking research, Gordon Research Conferences does not permit publication of meeting proceedings. If you wish any further details, please feel free to contact me. Thank you.

Sincerely,
Stephen Ragsdale, PI & Conference Chairperson
UNIVERSITY OF MICHIGAN MEDICAL SCHOOL

MOLECULAR BASIS OF MICROBIAL ONE-CARBON METABOLISM

July 20-25, 2008

Bates College

Lewiston, ME

Chair:

Stephen W. Ragsdale

Vice Chair:

Madeline E. Rasche

One-carbon (C-1) compounds play a central role in microbial metabolism. C-1 compounds include methane, carbon monoxide, CO₂, and methanol as well as coenzyme-bound one-carbon compounds (methyl-B₁₂, CH₃-H₄folate, etc). Such compounds are of broad global importance because several C-1 compounds (e.g., CH₄) are important energy sources, some (e.g., CO₂ and CH₄) are potent greenhouse gases, and others (e.g., CH₂Cl₂) are xenobiotics. They are central in pathways of energy metabolism and carbon fixation by microbes and many are of industrial interest. Research on the pathways of one-carbon metabolism has added greatly to our understanding of evolution, structural biology, enzyme mechanisms, gene regulation, ecology, and applied biology. The 2008 meeting will include recent important findings in the following areas : (a) genomics, metagenomics, and proteomic studies that have expanded our understanding of autotrophy and C-1 metabolism and the evolution of these pathways; (b) redox regulation of carbon cycles and the interrelationship between the carbon cycle and other biogeochemical cycles (sulfur, nitrogen, oxygen); (c) novel pathways for carbon assimilation; (d) biotechnology related to C-1 metabolism; (e) novel enzyme mechanisms including channeling of C-1 intermediates during metabolism; and (f) the relationship between metal homeostasis and the global carbon cycle. The conference has a diverse and gender-balanced slate of speakers and session leaders. The wide variety of disciplines brought to the study of C-1 metabolism make the field an excellent one in which to train young researchers.

Contributors

Coy Laboratory Products, Inc.
Department of Energy
Mitsubishi Gas Chemical Company
NASA Astrobiology Institute
U.S. Department of Agriculture

SUNDAY

2:00 pm - 11:00 pm Arrival and Check-in

6:00 pm Dinner

7:30 pm - 7:40 pm	Welcome / Introductory Comments by GRC Site Staff
7:40 pm - 9:30 pm	GENOMICS AND METAGENOMICS OF C-1 METABOLISM
7:40 pm - 7:45 pm	Discussion Leader: Colin Murrell (University of Warwick, UK)
7:45 pm - 8:25 pm	Keynote Talk: Bärbel Friedrich (Humboldt-University, Berlin, Germany) "The Genome Of <i>Ralstonia eutropha</i> H16: A Blueprint For A Lithoautotrophic Organism"
8:25 pm - 8:40 pm	Discussion
8:40 pm - 9:00 pm	Stéphane Vuilleumier (Université Louis Pasteur) "Methylobacterium Genome Sequences: A Blueprint For Tracing Physiological Adaptation, Ecology And Evolution In The Context Of C1 Metabolism"
9:00 pm - 9:10 pm	Discussion
9:10 pm - 9:30 pm	Colin Murrell (University of Warwick, UK) "Methane Monooxygenases and Methanotrophy: A <i>Tribute to Professor Sir Howard Dalton FRS</i> "
9:05 pm - 9:20 pm	Discussion

MONDAY

7:30 am - 8:30 am	Breakfast
9:00 am - 12:30 pm	METHANOGENESIS
9:00 am - 9:05 am	Discussion Leader: Evert C. Duin (Auburn University)
9:05 am - 9:30 am	Michael Chan (Ohio State University) "Structure of the CO Dehydrogenase from <i>Methanosarcina barkeri</i> "
9:30 am - 9:40 am	Discussion
9:40 am - 9:55 am	Poster Talk 1: Kimberly Anderson (University Of Maryland Biotechnology Institute) "A 5' UTR Regulates Expression Of Methanosarcinal Carbon Monoxide Dehydrogenase (Cdh)"
9:55 am - 10:00 am	Discussion
10:00 am	Coffee Break / Group Photo
10:35 am - 10:55 am	Kerry Smith (Clemson University) "Enzymology and Molecular Evolution of acetyl activating enzymes in methanogens"
10:55 am - 11:05 am	Discussion
11:05 am - 11:25 am	David E. Graham (University of Texas) "2-Oxoacid metabolism in methanogenic CoM and CoB biosynthesis"
11:25 am - 11:35 am	Discussion
11:35 am - 11:55 am	Mishtu Dey (University of Michigan) "A Structural, Spectroscopic, and Kinetic Approach Towards Understanding the Mechanism of Biological Methane Formation"

11:55 am - 12:05 pm	Discussion
12:05 pm - 12:20 pm	Poster Talk 2: Gunter Wegener (Max Planck Inst for Marine Microbiology) "Carbon assimilation in anaerobic methanotrophy - Which secrets can be revealed by stable isotope labeling?"
12:20 pm - 12:25 pm	Discussion
12:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	Poster Session
6:00 pm	Dinner
7:30 pm - 9:30 pm	MECHANISMS AND REGULATION OF CO₂-FIXATION
7:30 pm - 7:35 pm	Discussion Leader: Joseph Krzycki (Ohio State University, Columbus)
7:35 pm - 8:10 pm	Keynote Talk: F. Robert Tabita (Ohio State University, Columbus) "Rubisco Structure and Function"
8:10 pm - 8:25 pm	Discussion
8:25 pm - 8:40 pm	Poster Talk 3: Andrew Dangel (Ohio State University) "Protein-Protein Interactions between CbbR and RegA (PrrA) Transcriptional Regulators, and the Control of CO ₂ Fixation in <i>Rhodobacter sphaeroides</i> "
8:40 pm - 8:45 pm	Discussion
8:45 pm - 9:05 pm	Hiroya Yurimoto (Kyoto University) "Physiological role of RuMP pathway enzymes and their application"
9:05 pm - 9:15 pm	Discussion

TUESDAY

7:30 am - 8:30 am	Breakfast
9:00 am - 12:30 pm	METHYL- AND METHANOTROPHY
9:00 am - 9:05 am	Discussion Leader: Julia Vorholt (ETH, Switzerland)
9:05 am - 9:30 am	Peter F. Dunfield (New Zealand) "What are we learning from the genomes of methanotrophs"
9:30 am - 9:40 am	Discussion
9:40 am - 9:55 am	Poster Talk 4: Ramakrishnan Balasubramanian (Northwestern University) "Isolation and characterization of methanobactin from <i>Methylococcus capsulatus</i> (Bath) and <i>Methylocystis</i> sp. strain M"
9:55 am - 10:00 am	Discussion
10:00 am	Coffee Break
10:30 am - 10:50 am	Victor Davidson (University of Mississippi Medical Center) "New Insights into the Mechanism of Biosynthesis of the Tryptophan

Tryptophylquinone Cofactor of Methylamine Dehydrogenase"

10:50 am - 11:00 am Discussion

11:00 am - 11:20 am **Lisa Stein** (University of Alberta, Canada)
"New insights into ammonia and nitrite metabolism by methanotrophic bacteria"

11:20 am - 11:30 am Discussion

11:30 am - 11:50 am **Marina Kalyuzhnaya** (University of Washington)
"A novel methanol dehydrogenase: implications to the origin of methylotrophy"

11:50 am - 12:00 pm Discussion

12:00 pm - 12:20 pm **Alan A. DiSpirito** (Iowa State University)
"Evidence for a Diiron Catalytic Center in the Membrane-Associated Methane Monooxygenase from *Methylococcus capsulatus* Bath"

12:20 pm - 12:30 pm Discussion

12:30 pm Lunch

1:30 pm - 4:00 pm Free Time

4:00 pm - 6:00 pm Poster Session

6:00 pm Dinner

7:30 pm - 9:30 pm **ANAEROBIC METHANE OXIDATION**

7:30 pm - 7:35 pm Discussion Leader: **Vicky Orphan** (Cal Tech)

7:35 pm - 8:10 pm Keynote Talk: **Samantha B. Joye** (University of Georgia, Athens)
"C1-Metabolism in antarctic dry valley lakes"

8:10 pm - 8:25 pm Discussion

8:25 pm - 8:50 pm **Seigo Shima** (Max Planck Institute for Terrestrial Microbiology, Marburg, Germany)
"Enzymology of reverse methanogenesis"

8:50 pm - 9:00 pm Discussion

9:00 pm - 9:15 pm Poster Talk 5: **Mirko Basen** (Federal Institute for Geosciences and Resources)
"Microbial Physiology and biogeochemistry of anaerobic methane oxidation"

9:15 pm - 9:30 pm Discussion

WEDNESDAY

7:30 am - 8:30 am Breakfast

9:00 am - 12:30 pm **C-1 METABOLISM, ECOLOGY, PHYSIOLOGY & THE ENVIRONMENT**

9:00 am - 9:05 am Discussion Leader: **Thomas E. Hanson** (University of Delaware, Newark)

9:05 am - 9:30 am **Ron Oremland** (US Geological Survey)
"Chemoautotrophy coupled to arsenic metabolism: Results with

	extremophiles isolated from soda lakes"
9:30 am - 9:40 am	Discussion
9:40 am - 10:00 am	Todd O. Yeates (University of Calif. Los Angeles) "Structural insights into the role of the carboxysome in CO ₂ fixation"
10:00 am - 10:10 am	Discussion
10:10 am	Coffee Break
10:40 am - 10:55 am	Poster Talk 6: Rich Boden (University Of Warwick) "Purification and properties of dimethylsulfide monooxygenase from <i>Hyphomicrobium sulfonivorans</i> "
10:55 am - 11:00 am	Discussion
11:00 am - 11:20 am	Steven Singer (Lawrence Livermore National Laboratory) "Using Proteogenomics to Understand Autotrophy in an Acidophilic Microbial Community"
11:20 am - 11:30 am	Discussion
11:30 am - 11:50 am	Kathleen F. Scott (University of South Florida) "Carbon isotopes to understand the biogeochemistry and enzymology of CO ₂ fixation"
11:50 am - 12:00 pm	Discussion
12:00 pm - 12:20 pm	Yasuyoshi Sakai (Kyoto University) "Syntrophic life style of C1-microorganisms on plant leaves"
12:20 pm - 12:30 pm	Discussion
12:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	Poster Session
6:00 pm	Dinner
7:00 pm - 7:30 pm	<u>Business Meeting</u> (Nominations for the next Vice Chair; Fill out Conference Evaluation Forms; Discuss future Site & Scheduling preferences; Election of the next Vice Chair)
7:30 pm - 9:30 pm	ACETOGENESIS AND CO METABOLISM
7:30 pm - 7:35 pm	Discussion Leader: David Grahame (Uniformed Services University)
7:35 pm - 7:55 pm	Michael Rother (Goethe University) "Genetic and Physiological analysis of Carbon Monoxide Metabolism in <i>Methanosarcina acetivorans</i> "
7:55 pm - 8:05 pm	Discussion
8:05 pm - 8:25 pm	Gary King (University of Maine, Walpole) "Diversity and ecology of aerobic CO-oxidizing bacteria"
8:25 pm - 8:35 pm	Discussion
8:35 pm - 8:55 pm	Catherine Drennan (Massachusetts Inst. Of Technology)

	"Channels and complexes involving the key proteins in acetogenesis and CO metabolism"
8:55 pm - 9:05 pm	Discussion
9:05 pm - 9:25 pm	Volker Müller (Goethe-University, Frankfurt, Germany) "The Bioenergetics of Acetogenic Bacteria"
9:25 pm - 9:30 pm	Discussion

THURSDAY

7:30 am - 8:30 am	Breakfast
9:00 am - 12:30 pm	AUTOTROPHY AND CHEMOLITHOTROPHY
9:00 am - 9:05 am	Discussion Leader: Biswarup Mukhopadhyay (Virginia Polytechnic Institute & State University)
9:05 am - 9:30 am	Dan Arp (Oregon State University) "Biochemistry and regulation of ammonia oxidation in <i>Nitrosococcus oceanii</i> "
9:30 am - 9:40 am	Discussion
9:40 am - 10:00 am	Michael Russell (Jet Propulsion Labs & California Institute of Technology) "One carbon compounds and the origin of metabolism"
10:00 am - 10:10 am	Discussion
10:10 am	Coffee Break
10:35 am - 10:55 am	Birgit Alber (Ohio State University) "A novel way to assimilate acetate in organisms lacking the glyoxylate cycle"
10:55 am - 11:05 am	Discussion
11:05 am - 11:20 am	Poster Talk 7: Rémi Peyraud (ETH Zurich, Switzerland) "Demonstration of the pathway leading to glyoxylate generation using ¹³ C metabolomics"
11:20 am - 11:25 am	Discussion
11:25 am - 11:45 am	Cornelius Friedrich (University of Dortmund, Germany) "Chemotrophic sulfur oxidizing activity by the Sox system is redox-regulated"
11:45 am - 11:55 am	Discussion
11:55 am - 12:20 pm	Michael S.M. Jetten (Radboud University Nijmegen, The Netherlands) "Proteome and molecular mechanism of anaerobic ammonium oxidation by fresh water and marine anammox bacteria"
12:20 pm - 12:30 pm	Discussion
12:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	Poster Session
6:00 pm	Dinner

7:30 pm - 9:30 pm	C-1 PERSPECTIVES
7:30 pm - 7:40 pm	Discussion Leader: Rolf Thauer (Max Planck Institute for Terrestrial Microbiology)
7:40 pm - 8:00 pm	Rathin Datta (Coscata, Inc., Warrenville, IL) "C1 Metabolism - Path to Fuels and Chemicals"
8:00 pm - 8:10 pm	Discussion
8:10 pm - 8:35 pm	Alfons J.M. Stams (University of Wageningen, The Netherlands) "One carbon compounds in sulfur biotechnology"
8:35 pm - 8:45 pm	Discussion
8:45 pm - 9:15 pm	Lars Ljungdahl (University of Georgia) "The anaerobic reductive acetyl-CoA pathway of CO ₂ fixation"
9:15 pm - 9:30 pm	Discussion
FRIDAY	
7:30 am - 8:30 am	Breakfast
9:00 am	Departure

Last Updated: July 21, 2008

Molecular Basis Of Microbial One-Carbon Metabolism (2008)

Name	Organization	Participation	Status
ALBER, BIRGIT	OHIO STATE UNIVERSITY	Speaker	Registered
ANDERSON, KIMBERLY L	UNIVERSITY OF MARYLAND BIOTECHNOLOGY INSTITUTE	Speaker	Registered
ARP, DAN	OREGON STATE UNIVERSITY	Speaker	Registered
BALASUBRAMANIAN, RAMAKRISHNAN	NORTHWESTERN UNIVERSITY	Speaker	Registered
BASEN, MIRKO	MAX PLANCK INSTITUTE FOR MARINE MICROBIOLOGY	Speaker	Registered
BERG, IVAN A	UNIVERSITAET FREIBURG	Poster Presenter	Registered
BIEGEL, EVA	UNIVERSITY OF FRANKFURT	Poster Presenter	Registered
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DUNFIELD, PETER	UNIVERSITY OF CALGARY	Speaker	Registered
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YURIMOTO, HIROYA	KYOTO UNIVERSITY	Speaker	Registered
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