# Curriculum Vitae

# William Clarence Ray

#### Personal Data

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#### Education

06/2000 The Ohio State University; Ph.D. Biophysics.

06/1993 The Ohio State University; M.S. Computer and

Information Science.

06/1990 The Ohio State University; B.S. Mathematics,

honors program, Computer Science minor.

#### **Present Position**

03/2011–Present Assistant Professor of Pediatrics;

The Ohio State University College of Medicine

The Research Institute at Nationwide Children's Hospital,

Columbus, Ohio.

07/2010-Present Curriculum Director, The Ohio State University

Interdisciplinary Program in Biophysics.

07/2002-Present Director, Computational Biology and Bioinformatics Division,

The Ohio State University Interdisciplinary Program in

Biophysics.

# Experience

02/2008-03/2011	Research Assistant Professor of Pediatrics, The Ohio State University College of Medicine.
10/2002-01/2008	Research Scientist. Columbus Children's Research Institute, Columbus, Ohio.
06/2000-09/2002	Postdoctoral Fellow. Columbus Children's Research Institute, Columbus, Ohio. Laboratory of Robert S. Munson Jr., Ph.D.
01/1998-06/2000	Research Assistant. The Ohio State University, Columbus, Ohio. College of Biological Sciences. Laboratory of Charles J. Daniels, Ph.D.
06/1994-01/1998	Research Assistant. System Administrator, Acting Manager. The Ohio State University, Columbus, Ohio. College of Biological Sciences. College Computational Biology Facility.
02/1989-06/1994	Senior Programmer Analyst. Online Computer Library Center, Dublin Ohio. Office of Research.
11/1985-03/1991	Undergraduate Research Assistant/Volunteer. The Ohio State University, Columbus, Ohio. College of Mathematical and Physical Sciences, Department of Physics. Laboratory of Carl Neilsen Ph.D., Solar Ponds Research Group.

# Faculty Appointments

03/2011-Present	Assistant Professor of Pediatrics, The Ohio State University College of Medicine.
10/2004-Present	Adjunct Assistant Professor, The Ohio State University Department of BioMedical Informatics.
07/2002-Present	Faculty, The Ohio State University Interdisciplinary Program in Biophysics.
02/2008-03/2011	Research Assistant Professor of Pediatrics, The Ohio State University College of Medicine.
10/2002-01/2008	Adjunct Auxilliary Assistant Professor, The Ohio State University Department of Pediatrics.

# **University Committees**

10/2008–Present Chair, Online Resources and Web Presence Committee, Bat-

telle Center for Mathematical Medicine.

04/2008-Present Member, Faculty Search Committee, Battelle Center for Math-

ematical Medicine.

11/2002–Present Member, The Ohio State University Biophysics Program Grad-

uate Studies Committee.

03/2001–03/2003 Member, The Ohio State University Biophysics Program, Bioin-

formatics and Computational Biology Division Steering Com-

mittee.

# Memberships

International Society for Computational Biology

Association for Computing Machinery

# Teaching Responsibilities

Faculty Research Advisor: OSU Biophysics Program:

- Kevin Segall Entered program Sept 2010
- Mithila Agnihotri Entered program Sept 2010 (Coadvisor)
- Nicholas Callahan Candidacy Exam Oct 2011 (Co-advisor)
- Shareef Dabdoub PhD expected Dec 2011
- Adam Davis ABD January 2011
- Hatice Gulcin Ozer Graduated with Ph.D. June 2008
- Selnur Erdal Graduated with M.S. June 2006

Faculty Research Co-Advisor: OSU Computer Science Program

• Edward Worbis - Entered program Sept 2009 (Co-advisor with Raghu Machiraju)

#### Lab Rotations and Internships Supervised:

- 2003 Selnur Erdal (OSU Biophysics)
- 2004 Hatice Gulcin Ozer and Abhilash Mohan (OSU Biophysics)
- 2005 Keith Taschner and Matt Danielson (Capital University Undergraduate Summer Interns)
- 2008 Shareef Dabdoub (OSU Biophysics)
- 2009 Nicholas Callahan (OSU Biophysics)
- 2011 Kevin Segall (OSU Biophysics)

#### Non-Advisee Candidacy Exam and Dissertation Committees:

- 2008 Wei Zhang (Dissertation OSU Biophysics),
  Heather Costello (Candidacy Exam OSU IGBP),
  Guadalupe Canahuate (Dissertation OSU Computer Science)
- 2009 Brandon Sullivan (Candidacy Exam OSU Chemistry)
- 2010 Christopher Mcdaniel (Dissertation OSU Chemistry)
- 2011 Cai Chan (Candidacy Exam OSU Biophysics)
- Curriculum Director: OSU Biophysics 702 Advanced Experimental Methods: Bioinformatics and Computational Biology. Au 2010, Wi 2011, Au 2011.
- Course Developer and Instructor: OSU Biophysics 702 Advanced Experimental Methods: Bioinformatics and Computational Biology. Au 2001, 2002, Wi 2004, 2005, 2006, 2007, 2008, 2009, 2010, Au 2010, Wi 2011, Au 2011.
- Course Developer and Instructor: OSU Biophysics 702 Advanced Experimental Methods: Special Topics in Bioinformatics. Sp 2008, Su 2008, Sp 2009.
- Course Developer and Instructor: Miami University of Ohio, Center for Bioinformatics and Functional Genomics, Oxford, Ohio. Summer Bioinformatics Workshop, Su 2001.
- Teaching Assistant: OSU Microbiology H610 Bioinformatics and Molecular Biology. Charles J. Daniels Instructor, Sp 1999, Sp 2000.

#### Selected Professional Service

- Faculty advisor: The *Biophysics Student Organization* (graduate student social and professional society), and *Animate! Ohio State* (undergraduate student social society). 2007-Present.
- Tutorial Track Co-Chair: 1st Annual BioVis Symposium for the 17th Annual IEEE conference on Information Visualization (IEEE InfoVis) and 6th Annual IEEE conference on Visual Analytics Science and Technology (IEEE VAST). Providence RI. October 2011.
- Data Contest Developer and Chair IEEE VisWeek: 1st Annual BioVis Symposium, Providence RI. October 2011.
- Organizing Committee Member: IEEE VisWeek: 1st Annual BioVis Symposium, Providence RI. October 2011.
- Program Committee Member: IEEE VisWeek: 1st Annual BioVis Symposium, Providence RI. October 2011.
- Abstract Reviewer, Award selection committee: IEEE VisWeek: 1st Annual Bio-Vis Symposium, Providence RI. October 2011.
- Session Developer and Chair: "The Biophysics Program Research Divisions", Student lightning talks, The 2010 Robert Ross Memorial Lecture and Symposium in Biophysics. Columbus, Ohio. 2010.
- Abstract Reviewer, Speaker Selection Committee, Poster Judge, Staff: The 3rd Annual OSU Molecular Life Sciences Interdisciplinary Graduate Programs Symposium. Columbus, Ohio. May 2010.
- Abstract Reviewer, Poster Judge: The 2nd Annual OSU Molecular Life Sciences Interdisciplinary Graduate Programs Symposium. Columbus, Ohio. May 2009.
- Abstract Reviewer, Poster Judge: The 10th Annual Rustbelt RNA Meeting. Deercreek State Park, Mt. Sterling, Ohio, Oct 2008.
- Abstract Reviewer, Speaker Selection Committee, Poster Judge: The 1st Annual OSU Molecular Life Sciences Interdisciplinary Graduate Programs Symposium. Columbus, Ohio. May 2008.
- Local Program Developer, Summer Internship Mentor: Children's Research Institute and Capital University Department of Computer Science Internship Program. 2004-Present.

# **Editorial Responsibilities**

Acquisition & Publication Editor BioVis Contest, 1st Annual IEEE Symposium

on Biological Data Visualization, eQTL data visualization chal-

lenge submissions.

Acquisition Editor Software Reviews, HMS Beagle division of BioMedNet. 2001-

2002.

Technical Editor "Linux Socket Programming by Example", Que Corporation,

2000.

Proposal Reviewer "MySQL and PHP From Scratch", Que Corporation, 2000.

# **Grants and Funding: Current**

#### 1. **Co-PI**: R56 AI095684 (NIH/NIAID)

"Mechanism of Respiratory Syncytial Virus Fusion".

The goal of this project is to identify the attachment and triggering sites on the F protein and to determine whether the triggering by low molarity that we have discovered is involved in F protein function during virus entry into a target cell.

Mark Peeples PI, William Ray Co-PI. 09/01/2011-08/13/2012 Total award 362,000. (20% FTE) Unsolicited pre-R01 Bridge Award.

#### 2. **Co-PI**: R01 AI095684 (NIH/NIAID)

"Mechanism of Respiratory Syncytial Virus Fusion".

The goal of this project is to identify and characterize the triggering mechanism of the RSV fusion protein. The RSV F protein makes an ideal model system for studying the critical initiating step for enveloped viral invasion.

Mark Peeples PI, William Ray Co-PI. 07/01/2012-06/30/2017 Total proposed award \$1,800,000. (20% FTE) Scored 3%.

#### 3. Co-Investigator: GM094732 (NIH AREA)

"In Silico Exploration of Alternative Polyadenylation Using Next-Generation Sequencing".

The goal of this project is to identify and quantitatively characterize the genetic markers that influence alternative-polyadenylation and APA-mediated expression regulation.

Chun Liang (Miami University of Ohio) PI. 05/01/2011-04/30/2013 Total award \$428,080. (9.4% FTE)

#### 4. Co-PI: Medimmune, LLC research support

"Collaborative Research Agreement: Production of Stabilized, Soluble RSV F protein and Monoclonal Antibodies to the Pre-Triggered F Protein"

The goal of this project is to transfer stabilizing elements into soluble F protein and to characterize monoclonal antibodies made against the pretriggered F protein.

William Ray, Mark Peeples PIs. 01/01/2011-06/30/2012 Total award \$188,206

#### 5. Co-PI: Tibotec BVBA (Johnson & Johnson) research support

"Collaborative Research Agreement: the Respiratory Syncytial Virus Fusion Protein as an Antiviral Target"

The goal of this project is to use the sF protein to identify the mechanism of action of experimental drugs that target the RSV F protein.

William Ray, Mark Peeples PIs. 07/01/2011-12/31/2012 Total award \$442,462

#### 6. **Consultant**: R01 AI077897-01A2 (NIH/NIAID)

"Heme, Iron and Oxidative Stress, Regulation of Iron Homeostasis in H. influenzae".

The goal of this project is to investigate the iron-regulated transcriptome of H. influenzae and its role in mediating oxidative stress.

Robert S. Munson Jr. PI. 07/01/2009-06/30/2014

Total proposed award \$1,785,600.

#### 7. Collaborator: RO1 DC007464 (NIH/NIDCD)

"NTHi Type IV Pili: Expression and Vaccine Potential".

The goal of this project is to identify the genes required for type IV pilus biogenesis and twitching motility, determine how expression is regulated, determine how the structure is assembled and finally to determine whether a component of the pilus would be a promising vaccine candidate.

Robert S. Munson Jr. PI. 12/01/2005–11/30/2011

Total proposed award \$1,921,746.

# Completed

# 1. **Subcontract PI**: W911NF-06-C-0174 (U.S. Army Medical Research) STTR Phase 2 Proposal for Topic A05-T014

"Fast docking with fewer degrees of freedom, combined with intelligent optimization of small molecules".

The goal of this project is to produce a prototype application for predicting inactivating compounds for protein/enzyme and other biotoxins, using a simplified physics model to screen unlikely candidate compounds.

Mark Carroll small-business PI. Subcontract D+I \$230,000. 10/01/2006-09/30/2008.

# 2. Subcontract PI: W911NF-05-C0082 (U.S. Army Medical Research)

STTR Phase 1 Proposal for Topic A05-T014

"Development of Innovative Computer Hardware and Software for in Silico Screening".

The goal of this project is to test a simplified physics model's utility for application to problems in molecular modeling and computational chemistry. Mark Carroll small-business PI. Subcontract D+I 30,000. 08/01/2005-01/30/2006.

#### 3. Consultant: 5R01AI051388-03 (NIH/NIAID)

"AAV Vector Targeting Strategies for Gene Therapy".

The goal of this project is the development of adeno-associated virus vector targeting strategies for the apeutic gene delivery.

Jeffrey Bartlett PI. 02/15/2004-01/31/2009.

#### 4. Consultant: 5R01EY015480-03 (NIH/NEI)

"The Role of Rx in Retinal Progenitor Cell Development".

The goal of this project is to gain an understanding of the role of Rx in eye development, by elucidating the molecular mechanisms of Rx function and the components of the Rx genetic pathway.

Heithem El-Hodiri PI. 05/01/2004–04/30/2010.

#### 5. Collaborator: R21 NSO64351 (NIH/NINDS)

"Adeno-associated Viral Vector Modification for Targeted Motor Neuron Therapy".

The goal of this project is to study the effect of surface modifications of the AAV viral capsid, and the potential for modulating viral targeting specificity. Jeffry Bartlett PI. 07/01/2009–06/30/2011

# Pending or Active Revision

1. Collaborator: Clinical and Translational Intramural Application

"Finding genetic variants that predict and influence epilepsy treatments and surgical outcomes"

The purpose of this application is to support acquisition of eQTL data in epileptogenic brain tissue of high and low relative electrical activity.

Christopher Bartlett PI. 01/01/2012–12/31/2012

Total proposed award \$25,000. Submitted Oct 2011.

2. **Co-I**: #1 R13 RR033169-01 (NIH/NCRR)

"Symposium on Biological Data Visualization (BioVis)"

The goal of this application is to support an international scientific meeting at the intersection of the disciplines of Scientific Visualization, Bioinformatics, and Bio/Life Sciences.

Raghu Machiraju PI. 10/01/2011-9/30/2012

Total proposed award \$10,000. Scored, in revision.

3. **Project Director/PI**: (internally 739211) component of 1U01NS077385 proposal in response to RFA-NS-11-007

"Centers without Walls for Collaborative Research in the Epilepsies" (NIH/NINDS) "Finding Loci & Identifying Seizure-Related Genetic Variants in Common Epilepsies".

The goal of this project is to identify "biophysical alleles" encoded within genome sequences that are linked with epilepsy phenotypes.

William Ray PD/PI. 2014–2016

Total proposed award \$563,423. (10% FTE) Scored, in revision.

4.  $\mathbf{PI}$ : #112498 In response to NSF 11-502 "Cyber-Enabled Discovery and Innovation" (NSF/CISE)

"CDI-Type I : Developing a visual taxonomy for relationships in heterogenous data".

The goal of this project is the development and validation of a symbolic "language" for representing possibly-conditional relationships within measured data. An adjunct goal is the elucidation of the differential requirements of "relationship networks" for representation, as compared to formally correct graph-theoretic networks.

William Ray and Chris Bartlett PIs. 10/1/2011–9/30/2013

Total proposed award \$626,458. (16.66% FTE) Submitted January 2011, not scored, in revision for Dec. 2011 resubmission.

5. **PI**: #1062476 In response to NSF 10-567 "Advances in Biological Informatics" (NSF/DBS)

"ABI Innovation: Collaborative Research: Quantitative Evaluation of a

Visualization Method for Analyzing Protein Sequence Families".

The goal of this project is the investigation and quantitation of a visualanalytics method for identifying signature inter-residue dependencies within protein families.

William Ray and Raghu Machiraju PIs. 03/01/2011–2/28/2014 Total proposed award \$1,056,072. (16.66% FTE) Submitted August 2010, scored Meritorious, in revision for NSF CAREER resubmission August 2012.

#### 6. **Co-PI**: GRANT10420488 (NIH/NIMH)

"Identifying eQTLs: Analysis and Visualization of Multiple Tissues Withinsubjects".

The goal of this project is to investigate the application of multi-tissue eQTLs using both advanced statistical and visualization methods.

William Ray and Christopher Bartlett PIs. Scored. In Revision.

#### Not Awarded or Tabled

1. **PI**: 1 R01 GM098432-01 In response to NIH PAR-08-010 "Continued Development and Maintenance of Software" (NIH/NIGMS)

"Enhancing visualization tools for decision support in personalized medicine" The goal of this project is the extension of StickWRLD as a decision support and validation tool using Visual Analytics for conveying "important related factors" within complex personalized-medicine data.

William Ray and Raghu Machiraju PIs. 03/01/2011-2/28/2015

Total proposed award \$1,292,679. (20% FTE) Submitted September 2010, not scored, tabled for future revision.

#### 2. **CoI**: (ACS)

"Alternative splicing in rhabdomyosarcoma: MDM2 as a regulatory paradigm". The main focus of this study is to understand the regulation of the MDM2 gene by a process called alternative splicing. This new regulatory paradigm may provide novel targets for therapeutic intervention in the future.

Dawn Chandler PI. 06/01/2010-05/31/2114

Total Proposed Award \$960,000. Scored, tabled for future revision.

#### 3. **PI**: (ACS #IRG-67-003-47)

"Application for a Seed Grant from American Cancer Society Institutional Research Grant #IRG-67-003-47".

The goal of this project is to apply our lab-developed IP/method StickWRLD to patient trajectory data.

William Ray PI. Scored. Resubmission invited. Tabled for future revision.

#### 4. **CoI**: GRANT10341741 (NIH/NCI)

"Stress-induced alternative splicing: MDM2 as a regulatory paradigm.

The primary goal of this project is to understand the mechanisms of premRNA splicing in response to stress.

Dawn Chandler PI. 04/01/2010-03/31/2015.

Total proposed award \$1,800,000. Not Funded.

#### 5. **CoPI**: 1 R21 LM009981-01 (NLM)

"Development of GeneDisco, Visualization of causal inference in expression data".

The goal of this project is to investigate the applicability of causal analysis to the identification of regulatory regimes from microarray data, and to validate a MA visualization method that clusters in the biological domain, rather than the expression-level domain.

William C. Ray and Federica Montanaro CoPIs. Scored. Tabled for future revision.

#### 6. **CoPI**: R01DK079919-01 (NIH/NIDDK)

"Filamentous UPEC & Innate Immune Evasion".

The goal of this project is to characterize the role of a UPEC morphological phenotype variant in perpetuating UPEC infection.

Sheryl Justice and William C. Ray CoPIs. Tabled for future revision.

#### 7. CoPI: 1 R21 EY018949-01 (NIH/NEI)

"Bioinformatic identification and characterization of Rx gene targets". The goal of this project is to identify targets of Rx transcription factors, using a binding site model derived from our previous experimental work, and the ongoing sequencing and annotation results of the Xenopus sequencing project. Heithem El-Hodiri and William C. Ray CoPIs. Not Funded.

#### 8. Faculty: (NIH)

"Coordinately regulated alternative splicing in DNA damage and cancer". The goal of this project is to elucidate the control mechanisms employed in regulation of alternative splicing, specifically in damage-induced alternative splicing and regulation of the p53 pathway.

Dawn Chandler PI. Not Funded

#### **Patents**

Peeples, M.E., Kennedy, M. and Ray, W. Methods and Compositions Relating to Viral Fusion Proteins (60/942,456). Provisional Patent filed with the USPTO June 7, 2007. Regular Patent filed as an International PCT (Patent Cooperation Treaty) Application (US2008/66223), June 6, 2008. International Publication Number: WO 2008/154456 A3. Published December 18, 2008.

# Other Experience

Lead programmer and developer for full-text SGML-based database and GUI data browser supporting embedded images, dynamic extraction and creation of hypertext links. Documented in Online Computer Library Center (OCLC) White-Paper: "The Design and Implementation of XSCEPTER, an X-Windows Graphical User Interface to the CORE project".

Lead programmer and developer for database design, SGML extraction, interface design in project documented in Annual Review of OCLC Research (1992-1993), "The CORE Project: Technical Shakedown Phase and Preliminary User Studies".

Founder and Coordinator: Animate! Ohio State. Ohio State University student organization for the promotion of Japanese Film, 1993-2000.

Developer, Methanobacterium thermoautotrophicum online database, http://www.biosci.ohio-state.edu/~genomes/, The Ohio State University College of Biological Sciences, 1997.

#### Selected Publications

- 1. William C. Ray and Christopher Bartlett, Invited Letter: "The BioVis Contest: Open letter from the BioVis Contest Organizers", Proceedings of the 1st Annual IEEE Symposium on Biological Data Visualization, pp xvi, Oct 2011, Providence RI.
- 2. Eddie Worbis, Raghu Machiraju, Christopher Bartlett and William C. Ray, "Visual Interactive Quality Assurance of Personalized Medicine Data and Treatment Subtype Assignment", Accepted, Proceedings of IEEE/ACM VisWeek, Workshop on Visual Analytics in Healthcare (Acceptance Rate ~20%), Oct 2011, Providence RI.
- 3. Shareef Dabdoub, Brian Vanderbrink, Sheryl Justice and William C. Ray, "Quantitating pathogenic biofilm architecture in biopsied tissue", Accepted, Proceedings of IEEE/ACM VisWeek, Workshop on Visual Analytics in Healthcare (Acceptance Rate ~20%), Oct 2011, Providence RI.
- 4. Heather M. Costello, <u>William C. Ray</u>, Supranee Chaiwatpongsakorn, and Mark E. Peeples, "Targeting RSV with Vaccines and Small Molecule Drugs", submitted April 4th, 2011. Review pending (still! but it's going to be accepted in a heartbeat when they finally get around to reviewing it!).
- 5. Shareef M. Dabdoub, <u>William C. Ray</u> and Sheryl S. Justice, "FIND: A new software tool and development platform for enhanced multicolor flow analysis", BMC Bioinformatics, **12:145**, Accepted March 2011, published March 2011.
- 6. Kevin M. Mason, Forrest K. Raffel, William C. Ray, and Lauren O. Bakaletz, "Heme Utilization by Nontypeable Haemophilus influenzae is Essential and Dependent on Sap Transporter Function", Journal of Bacteriology, **193** pp 2527-2535, accepted March 2011, published May 2011.
- 7. William C. Ray, "Dramatically Reduced Precision in Microarray Analysis Retains Quantitative Properties, and Provides Additional Benefits", Software Tools and Algorithms for Biological Systems (a part of Advances in Experimental Medicine and Biology), Springer. (Acceptance Rate 15%) pp 101-111, Accepted Dec 2009, published 2011.
- 8. Shareef Dabdoub, Sheryl S. Justice and William C. Ray, "A Dynamically Masked Gaussian Can Efficiently Approximate a Distance Calculation for Image Segmentation", Software Tools and Algorithms for Biological Systems (a part of Advances in Experimental Medicine and Biology), Springer. (Acceptance Rate 15%) pp 425-432, Accepted Dec 2009, published 2011.

- 9. William C. Ray, Extended Abstract "A Visual Analytics Approach to Identifying Protein Structural Constraints", Proceedings of the 5th Annual IEEE Conference on Visual Analytics Science and Technology (IEEE VAST). pp 249–250, 2010.
- 10. Rita Wen Kaspar, Hugh D. Allen, William C. Ray, Carlos E. Alvarez, John T. Kissel, Alan Pestronk, Robert B Weiss, Kevin M. Flanigan, Jerry R. Mendell and Federica Montanaro. "Analysis of Dystrophin Deletion Mutations Predicts Age of Cardiomyopathy Onset in Becker Muscular Dystrophy", Circulation: Cardiovascular Genetics, 2, pp 544-551, 2009.
- 11. Ranyia Matta, Xianxi Wang, Hui Ge, William Ray, Leif D. Nelin, and Yusen Liu. "Triptolide induces anti-inflammatory cellular responses", American Journal of Translational Research 1, pp 267-282, Accepted Mar 5th 2009.
- 12. William C. Ray, Hatice G. Ozer, David W. Armbruster, and Charles J. Daniels. "Beyond identity when classical homology searching fails, Why, and What you can do about it", Proceedings of the 8th Ohio Collaborative Conference on Bioinformatics, IEEE Press. pp 51-56, 2009.
- 13. Hatice Gulcin Ozer and William C. Ray. "Informative Motifs in Protein Family Alignments", Lecture Notes in Bioinformatics **4645**, pp 161-170, 2007.
- 14. Glen McGillivary, William C. Ray, Charles L. Bevins, Robert S. Munson Jr., and Lauren O. Bakaletz. "A member of the cathelicidin family of antimicrobial peptides is produced in the upper airway of the chinchilla and its mRNA expression is altered by common viral and bacterial co-pathogens of otitis media", Molecular Immunology, vol 44, pp 2446-2458, 2007.
- 15. Alistair Harrison, William C. Ray, Beth D. Baker, David W. Armbruster, Lauren O. Bakaletz, and Robert S. Munson Jr. "The OxyR Regulon in Nontypeable *Haemophilus influenzae*", Journal of Bacteriology, vol **189**, no. 3, pp 1004-1012, 2007.
- 16. Hatice Gulcin Ozer and William C. Ray. "MAVL/StickWRLD: Analyzing Structural Constraints using Interpositional Dependencies in Biomolecular Sequence Alignments", Nucleic Acids Research, vol **34**, Web Server Issue, pp W133-W136, 2006.
- 17. Alistair Harrison, David W. Dyer, Allison Gillaspy, William C. Ray, Rachna Mungur, Matt Carson, Huachun Zhong, Jenny Gipson, Mandy Gipson, Linda S. Johnson, Lisa Lewis and Robert S. Munson Jr. "Genomic Sequence of an Otitis Media Isolate of Nontypeable *Haemophilus influenzae*: Comparative Study with *H. influenzae* Serotype D. Strain KW20", Journal of Bacteriology, vol 187, no. 13, pp 4627-4636, 2005.

- 18. William C. Ray. "MAVL/StickWRLD: Visualizing Protein Sequence Families to Detect Non-Consensus Features", Nucleic Acids Research, vol 33, Web Server Issue, pp W315-W319, 2005.
- 19. Robert S. Munson Jr., Alistair Harrison, David W. Dyer, Allison Gillaspy, William C. Ray, Rachna Mungur, Matt Carson, Huachun Zhong, Jenny Gipson, Mandy Gipson, Linda S. Johnson, Lisa Lewis, and Lauren O. Bakaletz. "Haemophilus influenzae strain 86-028NP". GenBank Accession no. NC 007146, 2005.
- 20. William C. Ray. "MAVL/StickWRLD: Visually Exploring Relationships in Nucleic-Acid Sequence Alignments", Nucleic Acids Research, vol **32**, Web Server Issue, pp W59-W63, 2004.
- 21. William C. Ray and Robert S. Munson Jr. "Microbial-pathogenesis.org, an Experimental System for Simultaneous Genomics Research and Data Sharing: Preliminary Report", WSEAS Transactions on Computers, vol 3, no. 5, pp 1264-1267, November 2004.
- 22. Selnur Erdal, Ozgur Ozturk, Dave Armbruster, Hakan Ferhatosmanoglu, and William C. Ray. "A Novel Approach to Time Series Analysis of Microarray Data", Transactions of the IEEE Fourth International Symposium on Bioinformatics and Bioengineering (BIBE2004), pp 366-378, May 2004.
- 23. Robert S. Munson Jr., Alistair Harrison, Allison Gillaspy, <u>William C. Ray</u>, Matt Carson, David Armbruster, Jenny Gipson, Mandy Gipson, Linda Johnson, Lisa Lewis, David W. Dyer and Lauren O. Bakaletz. "Partial Analysis of the Genomes of Two Nontypeable *Haemophilus influenzae* Otitis Media Isolates", Infection and Immunity, vol 72, no. 5, pp 3002-3010, 2004.
- 24. Robert S. Munson Jr., Huachun Zhong, Rachna Mungur, William C. Ray, Robin J. Shea, Gregory G. Mahairas and Martha H. Mulks. "Haemophilus ducreyi strain ATCC 27722 contains a genetic element with homology to the Vibrio RS1 element that can replicate as a plasmid and confer NAD independence to Haemophilus influenzae", Infection and Immunity, vol 72, no. 2, pp 1143-1146, 2004.
- 25. N. Karoline Sheffler, Arnold M. Falick, Steven C. Hall, <u>William C. Ray</u>, Deborah M. Post, Robert S. Munson Jr., and Bradford W. Gibson. "Proteome of *Haemophilus ducreyi* by 2-D SDS-PAGE and Mass Spectrometry: Strain Variation, Virulence, and Carbohydrate Expression", Journal of Proteome Research, vol 2, pp 523-533, 2003.

- 26. R. S. Munson Jr., W. C. Ray, G. Mahairas, P. Sabo, R. Mungur, L. Johnson, D. Nguyen, J. Wang, C. Forst, and L. Hood. "Haemophilus ducreyi strain 35000HP". GenBank Accession no. NC\_002940, 2003.
- 27. William C. Ray and Charles J. Daniels, "PACRAT: a database and analysis system for archaeal and bacterial intergenic sequence features", Nucleic Acids Research, vol 31, no. 1, pp 109-113, 2003.
- 28. William C. Ray, Robert S. Munson Jr., and Charles J. Daniels, "Tricross: Using dot-plots in sequence-id space to detect uncataloged intergenic features", Bioinformatics, vol 17, no. 12, pp 1105-1112, 2001.
- 29. William C. Ray and Charles J. Daniels, "The PACRAT system: an extensible WWW-based system for correlated sequence retrieval, storage and analysis", Bioinformatics, vol 17, no. 1, pp 100-104, 2001.
- 30. Roni Yagel and <u>William C. Ray</u>, "Visibility Computation for Efficient Walkthrough of Complex Environments", Presence: Special Issue on Virtual Environments, vol 5, no. 1. pp 45-60. MIT Press, 1996.
- 31. Stuart Weibel, Mark Bendig and Will Ray, "The CORE Project: Formatting Chemistry Information for Screen Display in *HyperCard*", Macintoshed Libraries, vol 5, pp 78-84. Apple Library Users' Group, 1992.

# Art in Science

- 1. Story Lead Image, *The art of medicine*, The Columbus Dispatch, Sunday Oct 16th, p G3.
- 2. Cover and Content art, *IEEE BioVis Symposium Sponsor Prospectus*, IEEE VisWeek/BioVis Prospectus, 2011.
- 3. Chapter Figure, Genome Map for H. influenzae, McGraw-Hill Biology Raven/Mason et al. 8th Edition (2007), p 349.
- 4. SIGGRAPH Juried Exhibit, *Perfectly Rendered*, SIGGRAPH 2006 Program, p 148.
- 5. SIGGRAPH Juried Exhibit, Tea43, SIGGRAPH 2006 Program, p 149.
- 6. Honorable Mention, StickWRLD Figure, CCRI Art in Science competition, April 2006.
- 7. Invited Cover, Nucleic Acids Research, Webserver Issue 2004.

#### **Books**

- 1. John Ray, William C. Ray, and Joan Ray, "Mac OS X Tiger Unleashed", SAMS Publishing, Indianapolis, Indiana, 2005.
- 2. John Ray, William C. Ray, and Joan Ray, "Mac OS X Panther Unleashed", SAMS Publishing, Indianapolis, Indiana, 2003.
- 3. John Ray, William C. Ray, and Joan Ray, "Maximum Mac OS X Security", SAMS Publishing, Indianapolis, Indiana, 2003.
- 4. John Ray, William C. Ray, and Joan Ray, "Mac OS X Unleashed, Second Edition", SAMS Publishing, Indianapolis, Indiana, 2002.
- 5. John Ray and William C. Ray, "Mac OS X Unleashed", SAMS Publishing, Indianapolis, Indiana, 2001.
- 6. Joan Ray and Will Ray, "SAMS Teach Yourself UNIX System Administration in Twenty One Days", Macmillan Computer Publishing, 1999.
- 7. Will Ray, "SAMS Teach Yourself UNIX in Ten Minutes", Macmillan Computer Publishing, 1999.

# Chapters in Books

1. John Ray "Special Edition Using TCP/IP", Ch 22, pp 437-453, Que Corporation, 1998.

#### Invited Reviews

- 1. William C. Ray, VMD Visual Molecular Dynamics. HMS Beagle division of BioMedNet. Oct 2001. http://news.bmn.com/hmsbeagle/110/reviews/sreview
- 2. William C. Ray, The StarOffice suite. HMS Beagle division of BioMedNet. Mar 2001. http://news.bmn.com/hmsbeagle/103/reviews/sreview
- 3. William C. Ray, The GCG software suite. HMS Beagle division of BioMed-Net. Feb 2001. http://news.bmn.com/hmsbeagle/99/reviews/sreview

#### **Invited Presentations**

- 1. Invited speaker, The 1st Annual IEEE Symposium on Biological Data Visualization (BioVis), Providence RI. "The eQTL problem: Challenges in Visualizing expression Quantitative Trait Locus data", Oct 2011.
- 2. Invited speaker, The 1st Annual IEEE Symposium on Biological Data Visualization (BioVis), Providence RI. "The BioVis Contest BOF", Oct 2011.
- 3. Invited speaker, The 5th Annual IEEE Conference on Visual Analytics Science and Technology (IEEE VAST), Salt Lake City UT. "A Visual Analytics Approach to Identifying Protein Structural Constraints", October 2010.
- 4. Invited speaker, The 36th International Conference on Computer Graphics and Interactive Techniques, by invitation of the NIH/NICHD, New Orleans LA. "Science Lessons for the Entertainment Industry", August 2009.
- 5. Invited speaker, The 8th Ohio Collaborative Conference on Bioinformatics, Case Western Reserve University, Cleveland Ohio. "Beyond identity when classical homology searching fails, Why, and What you can do about it", June 2009.
- 6. Invited speaker, Visiting speaker lecture series, Miami University of Ohio, Oxford Ohio. "Beyond Identity when classical homolgy modeling fails, why, and what you can do about it", Feb 2009.
- Invited speaker, Rustbelt RNA Meeting, Deer Creek State Park, Mt. Sterling, Ohio. "Visualizing non-consensus interpositional requirements in nucleic-acid families", Oct 2008.
- 8. Invited Speaker, Mechanisms of Human Health and Disease, Columbus, Ohio. "A Day in the Life of a Bioinformatics Geek", Jul 2007.
- 9. Invited Speaker, SuperComputing '06, representing the Ohio Supercomputer Center and Ohio Bioinformatics topics to the SuperComputing conference, Tampa, Florida. "Acidification of the adeno-associated virus capsid confers a persistent conformational change", Nov 2006.
- Invited Speaker, Capital University Lectures in Computer Science Seminar Series, Columbus, Ohio. "Bioinformatics: Frontier Science for the new Millennium", Dec 2004.
- 11. Invited Speaker, World Scientific and Engineering Academy and Society (WSEAS) 4th Int. Conference on Information Science, Communications and Applications (ISA 2004), Miami Lakes, Florida. "Microbial-pathogenesis.org, an Experimental System for Simultaneous Genomics Research and Data Sharing: Preliminary Report", Apr 2004.

- Invited Speaker, The Ohio State University Biophysics Program seminar series, Columbus, Ohio. "StickWRLD: Visually exploring relationships in nucleicacid sequence", Jan 2004.
- 13. Invited Speaker, Context Science and the Future Symposium, Columbus, Ohio. "Bioinformatics, interpreting the Rosetta Stones of the Bio/Life Sciences", Oct 2003.
- 14. Invited Speaker, O'Reilly Bioinformatics Technology Conference, Lightning Talk Series, Tucson, Arizona. "Applying Confidence Scores to Biological Annotations", Jan 2002.
- 15. Invited Speaker, The Ohio State University Biophysics Program seminar series, Columbus, Ohio. "Visualization: Snapshots", Nov 2001.
- 16. Invited Speaker, The Ohio State University Biophysics Program seminar series, Columbus, Ohio. "Bioinformatics: The Big Picture", Nov 2001.
- 17. Invited speaker, Children's Research Institute, Children's Research Forum, Columbus, Ohio. "The *Haemophilus ducreyi* genome project", May 2001.
- 18. Invited speaker, The Ohio State University Dept. of Computer and Information Science, Columbus, Ohio. "Bridging the Bioinformatics Concept Barrier", May 2001.
- 19. Panel member, The Ohio State University Biophysics Program, Bioinformatics Symposium, Columbus, Ohio. "The Future of Bioinformatics and Computational Biology in Biophysics and Other Disciplines", Apr 2001.
- 20. Invited speaker, Miami University of Ohio seminar series, Oxford, Ohio. "Bioinformatics: The Big Picture", Apr 2001.
- 21. Invited speaker, TIGR/ASM Conference on Microbial Genomes. Short podium presentation, Monterey, California. "Intergenic Region Data Mining", Jan 2001.
- 22. Invited speaker, The Ohio State University Biophysics Program seminar series, Columbus, Ohio. "Bioinformatics: The Big Picture", Dec 2000.
- 23. Invited speaker, Children's Research Institute, Work in Progress Presentation, Columbus, Ohio. "Bioinformatics: Improving the Utility of Online Data Sources and Tools", Oct 2000.
- Invited speaker, Rustbelt RNA Meeting, Deer Creek State Park, Mt. Sterling, Ohio. "RNA Bioinformatics: Looking for Intron Endonuclease Targets" Fall 1999.

25. Invited speaker, Rustbelt RNA Meeting, Salt Fork State Park, Ohio. "Visualization of Nucleic Acid Helices" Fall 1998.

#### Selected Abstracts

- 1. William C. Ray, "Discovering Relationships in Biosequences". 2nd Annual Workshop on Visualizing Biological Data, Cambridge Mass. March 2011.
- 2. Shareef Dabdoub and William C. Ray, "Aesthetics and Understanding in Molecular Motion", The 2011 IEEE Information Visualization Conference (IEEE InfoVis), Salt Lake City, Utah. October 2010.
- 3. William C. Ray. "Protein Structure Through Sequence Visualization". 5th Annual Ohio Collaborative Conference on Bioinformatics, Columbus, Ohio. June 2010.
- 4. Shareef Dabdoub and William C. Ray. "Flow Visualization for Studying Molecular Motions". 5th Annual Ohio Collaborative Conference on Bioinformatics, Columbus, Ohio. June 2010.
- 5. Costello, H.M., Chaiwatpongsakorn, S., <u>Ray, W.</u>, and Peeples, M.E. "Identification of a likely trigger site in respiratory syncytial virus fusion protein structural models implies cholesterol involvement". 9th Annual Ohio State University Medical Center Research Day, Columbus, OH. 2010.
- 6. Costello, H.M., Chaiwatpongsakorn, S., <u>Ray, W.</u>, and Peeples, M.E. "The pre-HRA domain of the respiratory syncytial virus fusion protein contains a likely trigger for the proteins conformational rearrangement that implicates cholesterol involvement". 2010 Center for Microbial Interface Biology Retreat, Columbus, OH. 2010.
- 7. Costello, H.M., Chaiwatpongsakorn, S., <u>Ray, W.</u>, and Peeples, M.E. "Key Residues Required for Fusion Activity in the Likely Trigger Domain of the Respiratory Syncytial Virus F Protein". 27th Annual Meeting for the American Society for Virology, Vancouver, BC, Canada. 2009.
- 8. Shareef Dabdoub, Abhilash Mohan, <u>William C. Ray</u>. "Visualizing molecular uncertainty: A path to the path", Association for Computing Machinery SIG-GRAPH, 35th International Conference on Computer Graphics and Interactive Techniques, Los Angeles, CA. August 2008.
- 9. Supranee Chaiwatpongsakorn, Heather M. Costello, J.J. Manaloor, William C. Ray, Hatice G. Ozer, Mark E. Peeples. "Residues within the middle helix of the HR1 domain of the pre-triggered respiratory syncytial virus F protein is important for fusion activity", American Society for Virology Annual Meeting, Cornell University, Ithaca, New York. July 2008.

- Shareef Dabdoub, Sheryl S. Justice and William C. Ray. "Exploiting Biological Coherency in Classification and Segmentation", 2nd Annual Ohio Collaborative Conference on Bioinformatics, Oxford, OH. July 2007.
- 11. Hatice Gulcin Ozer and <u>William C. Ray</u>. "Exploring Structural Implications of Positional Dependencies in Protein Sequence Alignments", First Joint Symposium of the OSU Molecular Life Sciences Interdisciplinary Graduate Programs, Columbus, OH. May 2007.
- 12. Abhilash Mohan, <u>William C. Ray</u>, and Jeffrey S. Bartlett. "Homology Modeling of Adeno-Associated Virus Serotypes and the Importance of Conserved and Variable Domains", First Joint Symposium of the OSU Molecular Life Sciences Interdisciplinary Graduate Programs, Columbus, OH. May 2007.
- 13. Chaiwatpongsakorn, S., Costello, H.M., <u>Ray, W.</u>, Ozer, H., and Peeples, M.E. "Generation of Soluble Respiratory Syncytial Virus Fusion Glycoprotein to Study Triggering during Membrane Fusion", 26th Annual Meeting of the American Society for Virology, Corvallis, OR. 2007.
- 14. Alistair Harrison, <u>William C. Ray</u>, Beth D. Baker, Lauren O. Bakaletz and Robert S. Munson Jr. "Regulation of Iron Homeostasis in Nontypeable *Haemophilus influenzae*", 13th Annual Midwest Microbial Pathogenesis Conference, Cincinnati, OH. October 2006.
- 15. William C. Ray, Abhilash Mohan, and Jeffrey Bartlett. "Using Flow-Visualization for Studying Sub-Molecular Motions", Association for Computing Machinery SIGGRAPH, 33rd International Conference on Computer Graphics and Interactive Techniques, Boston, MA. July/August 2006.
- 16. <u>William C. Ray</u> and Hatice Gulcin Ozer. "Discovering Biostructure Constraints using VRML Visualization", Inaugural Ohio Collaborative Conference on Bioinformatics, Athens, OH. June 2006.
- 17. Hatice Gulcin Ozer and William C. Ray. "MAVL/StickWRLD for visualizing interpositional dependencies in biomolecule sequence alignments", 50th Annual Meeting of the Biophysical Society, Salt Lake City, UT. February 2006.
- 18. Keith Taschner, William C. Ray and Ignatios Vakalis. "Virtual Chinchilla", BioOhio2005, Columbus, OH. October/November 2005.
- 19. William C. Ray and Joseph A. Jurcisek. "Modeling the Fluffy Lens: Construction of the Virtual Chinchilla", Association for Computing Machinery SIGGRAPH, 32nd International Conference on Computer Graphics and Interactive Techniques, Los Angeles, CA. July/August 2005.

- 20. William C. Ray and Hatice Gulcin Ozer. "Discovering Biostructure Constraints using VRML Visualization", Association for Computing Machinery SIGGRAPH, 32nd International Conference on Computer Graphics and Interactive Techniques, Los Angeles, CA. July/August 2005.
- 21. Glen McGillivary, Charles L. Bevins, <u>William C. Ray</u>, Robert S. Munson Jr. and Lauren O. Bakaletz. "A cDNA with Similarity to the Antimicrobial Peptide Cathelicidin is Expressed in the Upper Airway of the Chinchilla and can be Overexpressed in a Bacterial host to Produce Recombinant Protein", American Society for Microbiology, 105th General Meeting, Atlanta, GA. June 2005.
- 22. James E. Bookwalter, Laura A. Novotny, Robert S. Munson Jr. Beth D. Baker, William C. Ray and Lauren O. Bakaletz. "Expression of the nontypeable Haemophilus influenzae Type IV pilA promoter is up-regulated under conditions that mimic those found in the mammalian airway", American Society for Microbiology, 105th General Meeting, Atlanta, GA. June 2005.
- 23. Alistair Harrison, <u>William C. Ray</u> and Robert S. Munson Jr. "The Characterization of a Genomic Island Conserved Between Pathogenic Strains of *Haemophilus* Species", American Society for Microbiology, 105th General Meeting, Atlanta, GA. June 2005.
- 24. Alistair Harrison, Robert S. Munson Jr., Allison Gillaspy, William C. Ray, Rachna Mungur, Matt Carson, Jenny Gipson, Mandy Gipson, Linda Johnson, Lisa Lewis, Lauren O. Bakaletz and David W. Dyer. "Genomic sequence of an otitis media isolate of nontypeable *Haemophilus influenzae*", American Society for Microbiology, 104th General Meeting, New Orleans, LA. May 2004.
- 25. Alistair Harrison, Robert S. Munson Jr., Allison Gillaspy, <u>William C. Ray</u>, Rachna Mungur, Matt Carson, Jenny Gipson, Mandy Gipson, Linda Johnson, Lisa Lewis, Lauren O. Bakaletz and David W. Dyer. "Genomic sequence of an otitis media isolate of nontypeable *Haemophilus influenzae*", Children's Research Institute Annual Research Conference, Newark, OH. April 2004.
- 26. William C. Ray. "MAVL/StickWRLD: Novel analysis tools from the Advanced Computing Core", Children's Research Institute Annual Research Conference, Newark, OH. April 2004.
- 27. Selnur Erdal, Ozgur Ozturk, Dave Armbruster, Hakan Ferhatosmanoglu, and William C. Ray. "A Time Series Analysis of Microarray Data", Children's Research Institute Annual Research Conference, Newark, OH. April 2004.
- 28. Alistair Harrison, Robert S. Munson Jr., Allison Gillaspy, William C. Ray, Rachna Mungur, Matt Carson, Jenny Gipson, Mandy Gipson, Linda Johnson, Lisa Lewis, Lauren O. Bakaletz and David W. Dyer. "Genomic sequence of

- an otitis media isolate of nontypeable *Haemophilus influenzae*", 10th Annual Midwest Microbial Pathogenesis Meeting, Iowa City, IA. October 2003.
- 29. Robert S. Munson Jr., Alistair Harrison, Allison Gillaspy, William C. Ray, Rachna Mungur, Matt Carson, Jenny Gipson, Mandy Gipson, Linda Johnson, Lisa Lewis, Lauren O. Bakaletz and David W. Dyer. "Genomic Sequence of an Otitis Media Isolate of Nontypeable *Haemophilus influenzae*", The 11th International Conference on Microbial Genomes, Durham, NC. September 2003.
- 30. A.M. Falick, B.W. Gibson, A. Graber, P. Juhasz, N.G. Khainovski, J. Marchese, S.A. Martin, R.S. Munson Jr., K.C. Parker, D. H. Patterson, W. C. Ray, N. K. Scheffler and B. L. Williamson. "High-throughput Identification of *H. ducreyi* Proteins by Means of 2-Dimensional Chromatography and Tandem Time-of-Flight Mass Spectrometry", American Society for Mass Spectrometry, 50th Annual Conference, Orlando, FL. June 2002.
- 31. Robert S. Munson Jr., Lauren O. Bakaletz, <u>Will Ray</u>, Allison Gillaspy, Matt Carson, Linda Johnson and David Dyer. "Genomic Sequence of an Otitis Media isolate of nontypeable *Haemophilus influenzae*", Canada Society Meeting, Banff Center, Alberta. May 2002.
- 32. William C. Ray and Robert S. Munson Jr. "www.microbial-pathogenesis.org: A Working Experiment in the Development of a Content Management System for Microbial Genome Annotation Projects and Microbial Genomic Data.", Children's Research Institute Annual Research Conference, Newark, OH. April 2002.
- 33. Robert S. Munson Jr., Lauren O. Bakaletz, Will Ray, Allison Gillaspy, Matt Carson, Linda Johnson and David Dyer. "Genomic Sequence of an Otitis Media isolate of nontypeable *Haemophilus influenzae*", Children's Research Institute Annual Research Conference, Newark, OH. April 2002.
- 34. William C. Ray and Robert S. Munson Jr. "Comparative Analysis of the Organization of the *Haemophilus ducreyi* and *Haemophilus influenzae* genomes", O'Reilly Bioinformatics Technology Conference, Tucson, AZ. January 2002.
- 35. Bakaletz, L.O., <u>Ray, W.</u>, Gillaspy, A., Carson, M., Johnson, L., Munson, R.S., Dyer, D. "Genomic Sequence of an Otitis Media Isolate of Nontypeable *Haemophilus influenzae*", 2002 Midwinter Meeting, Association for Research in Otolaryngology, St. Petersburg Beach, FL. January 2002.
- 36. William C. Ray and Robert S. Munson Jr. "Comparative Analysis of the organization of the *Haemophilus ducreyi* and *Haemophilus influenzae* Genomes", Children's Research Institute, Children's Research Forum, Columbus, OH. May 2001.

- 37. Ray WC, Forst C, Mahairas G, Sabo P, Johnson LS, Nguyen D, Hood L, and Munson RS Jr. "The *Haemophilus ducreyi* Genome Project", American Society for Microbiology, 101st General Meeting, Orlando, FL. May 2001.
- 38. Munson R.S. Jr., Johnson L.S., <u>Ray W.C.</u>, Zhong H. and Bakaletz L.O. "Identification of Unique Genes in Nontypeable *Haemophilus influenzae* by Subtractive Hybridization", American Society for Microbiology, 101st General Meeting, Orlando, FL. May 2001.
- 39. William C. Ray and Robert S. Munson Jr. "Comparative Analysis of the Organization of the *Haemophilus ducreyi* and *Haemophilus influenzae* Genomes", The Ohio State University Biophysics Program, Bioinformatics Symposium, Columbus, OH. April 2001.
- 40. W. Ray, P. Sabo, L. Johnson, D. Nguyen, L. Hood, G. Mahairas and R. S. Munson Jr. "The *Haemophilus ducreyi* Genome Project", The Ohio State University Biophysics Program, Bioinformatics Symposium, Columbus, OH. April 2001.
- 41. William C. Ray and Robert S. Munson Jr. "Comparative Analysis of the organization of the *Haemophilus ducreyi* and *Haemophilus influenzae* Genomes", TIGR/ASM conference on Microbial Genomes, Monterey, CA. January 2001.
- 42. W.C. Ray, D.W. Armbruster and C.J. Daniels. "The occurrence and function of Archaeal Introns", Rustbelt RNA meeting, Deer Creek State Park, OH. November 1999.
- 43. W.C. Ray and C.J. Daniels. "The PACRAT Online Sequence Collection System", Canadian Institute for Advanced Research: Genome Evolution, Banff, Canada. Fall 1999.
- 44. W.C. Ray and C.J. Daniels. "The PACRAT Online Sequence Collection System", The Ohio State University Biophysics Program Symposium, Columbus, OH. April 1999.
- 45. C.J. Daniels, J.R. Palmer, D.K. Thompson and <u>W.C. Ray</u>. "Multiple TBP and TFB genes in the Archaeon *Haloferax volcanii* and evidence for their differential expression", Transcriptional Mechanisms. Keystone Symposia, Taos, NM. 1998.