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SUMMARY

Ten years of successful interdisciplinary consulting to small/start-up pharma, biotech, and industrial biotech / renewables companies. Provide CTO-level service and technical direction to staff, patent liaison, and IP strategy. Provide technical due diligence for investment, and expert witness service for patent infringement litigation. Directed multi-disciplinary process development groups in both major pharmaceutical corporations and small start-ups. Built new, practical technology base within both small company and large corporate environments. Delivered profitable IP, process scale-up, and novel automation. Extensive interdisciplinary management experience covering process chemistry, molecular biology, biotransformations & biocatalysis, plus fermentation of natural products and recombinant enzymes. Developed and scaled combined biological/chemical processes for the production of commodity chemicals from biomass, plus cost-analyses. Extensive experience under GMP for API production via fully synthetic processes, semi-synthetic, or natural product fermentations and with attendant CMC sections of IND & NDA filings. Service as North American Editor of international peer-reviewed journal and as Chairs of international symposia in the field of biocatalysis.

APPOINTMENTS

- 2002 - President, Dodds & Associates LLC
- 2009 - Kent BioEnergy Scientific Advisory Board
- 2005 - Sr. Advisor, Rondaxe Pharma LLC
- 2002 - zuChem Scientific Advisory Board & CSO, zuSyn Inc., (zuChem subsidiary)
- 2009-11 Sr. Advisor, Draths Corporation
- 2003-06 Sr. Advisor, Michigan Biotechnology Institute (MBI)
- 2002-08 Codexis Industrial Advisory Board
- 1999-01 Director, Fermentation & Biocatalysis Development, Bristol-Myers Squibb
- 1998-02 North American Editor, *Journal of Molecular Catalysis B: Enzymatic*
- 1991-99 Manager, Biotransformations Group, Schering-Plough Research Institute
- 1986-91 Sr. Protein Biochemist, Sepracor Inc.

PRESENTATIONS, PATENTS and PUBLICATIONS

Addendum attached.

EDUCATION

- 1984-86 MRC Post-doctoral Fellow in Molecular Biology, University of Colorado, Boulder;
Prof. Marvin H. Caruthers
- 1979-84 Ph.D. Organic Synthesis, University of Toronto; Prof. J. Bryan Jones
- 1977-79 M.Sc. Biological Chemistry, University of Toronto
- 1973-77 B.Sc. Biochemistry, Trinity College, University of Toronto

PROFESSIONAL EXPERIENCE

INDEPENDENT CONSULTING; DODDS & ASSOCIATES LLC

2002 -

Founded Dodds & Associates to provide strategic technical planning and project management to the pharmaceutical, biotech, industrial biotech, and green chemistry/clean-tech industries. Provide small and start-up companies with interdisciplinary experience at CTO / VP level to establish technical strategy. Executed contracts with over two dozen clients since 2002; two pharma client projects ended with licensing of the project by large pharma houses, and a non-pharma client was acquired for their IP. Client references available.

Completed and current projects include:

- Senior technical executive for small entities:
 - CTO service; intellectual property review and strategy, patent liaison, technical due-diligence
 - interim CSO for client; responsible for lab build-out, technology base, contract work & staffing
 - PI on multiple grant applications, presentations to regional development committees
- Experience with venture funding for industrial biotechnology
 - identification of technical opportunities and presentation to the fund, including white-papers for specific technical areas
 - significant experience with academic founders, university licensing groups, and senior management in an interdisciplinary start-up environment
- Service on Scientific Advisory Boards; technical presentations to Corporate Board and investors
- Project Management:
 - development, and scale-up for both pharma and non-pharma projects including biological/fermentation & chemical processes for the production of biobased commodity chemicals from renewable biomass plus attendant IP strategy and competitive analysis
 - drafting RFPs for development of both fermentations and chemical syntheses, plus CMO selection
 - single point of contact for clients' outsourced projects, direct technical support to CMO (both domestic and foreign) and liaison to corporate management after project awarded to contractors
 - technical transfer of process, analytical, and related documentation
 - management and technical support of contract API production via fully synthetic processes, semi-synthetic, or by natural product fermentation
 - drafting CMC sections for IND & NDA, batch record drafting and review for GMP production, process validation
- Expert witness service; experience in opinions, depositions, affidavits, and cross-examinations

BRISTOL-MYERS SQUIBB Co., SYRACUSE, NEW YORK

DIRECTOR, FERMENTATION & BIOCATALYSIS DEVELOPMENT

1999 - 2001

Invited to BMS to lead a new group of 50 scientists organized into chemical process development, molecular biology, fermentation development, and GMP analytical functions. Managed \$4 million in annual operating and capital budgets. Achieved cost-savings by applying biocatalysis in chemical syntheses. Developed chiral chemical processes, plus fermentations for natural products, enzymes, and biocatalysis.

- Solved production problems with enzymatic process experienced by an external supplier. Recovered over 3 tons of in-process material critical to launch supply.
- Developed process to chiral intermediate for HIV therapeutic via recombinant enzyme system, allowing significant cost-savings over vendor pricing of tonne quantities.
- Developed natural product fermentation process that gave a three-fold increase in production in 1 year.
- Conceived and managed chemical gene synthesis and expression project to replace bovine enzyme and eliminate TSE/BSE regulatory issues in an existing commercial process.
- Group submitted six chemical and fermentation process patent applications in 18 months.
- Responsible for multi-million dollar TAXOL[®] project with external partner. Reviewed all outside TAXOL[®] production technology, and wrote technical reports as part of formal corporate response.
- Supported filing for commercial antibiotic synthesis using biocatalysis. Advised patent counsel on cross-licensing of production technology, avoided patent conflicts and preserved future rights.

SCHERING-PLOUGH RESEARCH INSTITUTE, UNION, NEW JERSEY
MANAGER, BIOTRANSFORMATIONS GROUP**1991 – 1999**

Invited to SPRI to establish a new group for the development of biocatalysis for more efficient and cost-effective syntheses of pharmaceuticals. Reported to VPs of both Chemical and Biotechnology Development. Responsible for budget (operational, capital, grant), staffing and equipping, physical plant requirements, and all regulatory compliance (environmental, S&IH, GMP) for the Group.

- Successfully introduced biocatalysis in over a dozen projects, (including the approved POSACONAZOLE[®] antifungal) and handled all downstream processing required for product isolation and purification. Projects were at scales ranging from the lab-scale synthesis of metabolites, to plant processes providing 100s of kgs of intermediates in the synthesis of clinical material under GMP.
- Successfully doubled the capacity of a fermentation used to perform a chemical reaction in an existing manufacturing process, including downstream extraction and recovery.
- Directed group in filing of 13 patent disclosures. Six have issued as patents, and one was kept a trade secret. Group had a total of 37 public releases – extremely unusual for a development group.
- Planned new laboratory facilities and relocated the entire group from one site to another – *twice*.
- Independently proposed and initiated automation of enzyme screening activities, resulting in the approval of a \$1.25MM project. The project was completed, and the equipment used for several years.

SEPRACOR INC., MARLBOROUGH, MASSACHUSETTS
SENIOR PROTEIN BIOCHEMIST**1986 – 1991**

Responsible for biocatalysis research, reporting to the VP R&D. Mission was to create commercial opportunities for Sepracor's core membrane technology by identifying opportunities for the company's membrane bioreactor device. Included design and synthesis of substrates, design and implementation of enzyme/substrate screening assays, and technical support for engineering.

- Discovered unique class of ester substrates unusually susceptible to hydrolysis by proteolytic enzymes. Technology was successfully applied to the resolution of clinical quantities of NSAIDs.
- Established enzymology for multi-million dollar joint venture with Japanese pharmaceutical company for resolution of cardiac drug (DILTIAZEM[®]) intermediate, including enzymatic transformation of waste by-product to a commercially valuable fine chemical.
- With VP R&D, wrote all patent applications for enzyme processes, and assisted in their prosecution. Chief technical witness in patent interference suit in which Sepracor prevailed.

CONFERENCE CHAIRS

- BIO 2004 International Convention, *Biotechnology for Small Molecule Pharmaceutical Manufacturing*, San Francisco, June 2004
- 82ND Conference of the Chemical Society of Canada, Chair and speaker, “*Biocatalysis in the Service of Organic Chemistry: A Symposium in Honour of Professor J. Bryan Jones*”, Toronto, June 1999
- Gordon Research Conference, *Biocatalysis*, Kimball Union Academy, Meriden, NH, July 1998 (Vice Chair for 1996 *Biocatalysis* Gordon conference)
- 5TH North American Chemistry Congress, Symposium on *Chemical Syntheses Using Biotransformations*, Cancun, Mexico, November 1997

Plus service as session chair and panel moderator at numerous conferences.

INVITED LECTURES

- *Metabolic Routes to Aromatic Compounds*
Metabolic Design 2011, San Diego, CA, May 2011
- *Dry Pipelines; The Future of the Pharmaceutical Industry*
ACS New York Chapter, Chemical Marketing & Economics Group, New York City, June 2003
- *Biocatalysis in Development: Playing in the Viola Section*
CSIRO Workshop on Biocatalysis, Canberra, Australia, November 2002
- *Biocatalysis in Pharmaceutical Development:*
BIO 2002 Conference, Toronto, Canada, June 2002
- *Biocatalysis in the Pharmaceutical Industry*
Center for Biocatalysis and Bioprocessing, Iowa City, Iowa, October 1999
- *Biocatalysis in the Pharmaceutical Industry: Practical Challenges and Experience*
Society for Industrial Microbiology Annual Meeting, Denver, Colorado, August 1998
- *Industrial Biocatalysis; Current Trends and Future Opportunities*
New Frontiers in Screening for Microbial Biocatalysts, Ede, Netherlands, December 1996
- *Screening and Use of Enzymes for Synthetic Applications in the Pharmaceutical Industry*
Chiral Europe 95, London, U.K., September 1995
- *Applications of Biocatalysis in the Pharmaceutical Industry*
BRIDGE Final Sectorial Meeting on Biotransformations, Wageningen, Netherlands, October 1994
- *Novel Water-soluble Esters as Substrates for Enantiomeric Resolution by Proteases*
Biocatalysis for the 90's, Lake Buena Vista, Florida, June 1991
- *Synthesis of Oligonucleotide Probes for Specific Gene Selection*, - Third Annual Symposium on Cellular and Molecular Biology, Colorado State University, Fort Collins, Colorado, April 1985

Plus numerous poster presentations.

ISSUED PATENTS and PUBLISHED APPLICATIONS

- US 6 521 455 B1 "Process For Preparing Optically Active Glycidate Esters", Dodds, David R.; Lopez, Jorge L.; Zepp, Charles M.; Brandt, Steven
- US 5 274 300 "Enzymatic Hydrolysis of Glycidate Esters in the Presence of Bisulfite Anion", Dodds, David R.; Lopez, Jorge L.
- US 5 198 568 "Compounds Useful In Enzymatic Resolution Systems And Their Preparation", Zepp, Charles M.; Wald, Stephen A.; Dodds, David R.
- US 5 196 568 "Compounds Useful In Enzymatic Resolution Systems And Their Preparation", Zepp, Charles M.; Wald, Stephen A.; Dodds, David R.
- US 5 167 824 "Separation By Carrier Mediated Transport", Cohen, Charles; Dishman, Robert A.; Huston, James S.; Bratzler, Robert L.; Dodds, David R.; Zepp, Charles M.
- US 5 077 217 "Method For membrane reactor resolution of stereoisomers", Matson, Stephen L.; Wald, Stephen A.; Zepp, Charles M.; Dodds, David R.
- US 5 057 427 "Method For Resolution Of Stereoisomers", Wald, Stephen A.; Matson, Stephen L.; Zepp, Charles M.; Dodds, David R.
- EP 0 657 544 B1 "Process For Preparing Optically Active Glycidate Esters", Dodds, David R.; Lopez, Jorge L.; Zepp, Charles M.; Brandt, Steven; Rossi, Richard F.
- EP 0 461 043 A2 "Enantiomer Separation By Transesterification", Dodds, David R.; Zepp, Charles M.; Rossi, Richard F.
- EP 0 440 723 B1 "Process For Preparing Optically Active Glycidate Esters", Dodds, David R.; Lopez, Jorge L.; Zepp, Charles M.; Brandt, Steven
- EP 0 423 133 B1 "Enzymatic Resolution Systems And Compounds Useful In The Systems And Their Preparations", Matson, Stephen, L.; Wald, Stephen, A.; Zepp, Charles, M.; Dodds, David, R.

Plus numerous foreign filings.

REVIEWED PUBLICATIONS

- David R. Dodds, Richard A. Gross, "Chemicals From Biomass", *Science*, **318**, 1250-51, (2007)
- Michael J. Homann, Robert B. Vail, Edward Previte, Maria Tamarez, Brian Morgan, David R. Dodds, Aleksey Zaks, "Rapid Identification of Enantioselective Ketone Reductions Using Targeted Microbial Libraries", *Tetrahedron*, **60**, 789-797, (2004) Awarded "Most Referenced Paper", 2004-2007
- Michael J. Homann, Robert Vail, Brian Morgan, Vijay Sabesan, Cliff Levy, David R. Dodds, Aleksey Zaks, "Enzymatic Hydrolysis of a Prochiral 3-Substituted Glutarate Ester, An Intermediate in the Synthesis of NK1/NK2 Dual Antagonist", *Adv. Synth. & Catalysis*, **343**(6-7), 744-749, (2001)
- Brian Morgan, Aleksey Zaks, David R. Dodds, Jinchu Liu, Rama Jain, Sreeni Megati, F. George Njoroge, Viyyoor M. Girijavallabhan, "Enzymatic Kinetic Resolution of Piperidine Atropisomers: Synthesis of a Key Intermediate of the Farnesyl Protein Transferase Inhibitor, SCH66336", *J. Org. Chem.*, **65**(18), 5451-5459 (2000)
- Brian Morgan, Bashkar R. Sarikonda, David R. Dodds, Michael J. Homann, Robert Vail, "Enzymatic Synthesis of Enantio- and Diastereomerically Enriched *syn*-3-Nitro-2-pentanol", *Tetrahedron: Asymmetry*, **10**(1999), 3681-3690
- Aleksey Zaks, David R. Dodds, "Biotransformations in the Discovery and Development of Pharmaceuticals", *Current Opinions in Drug Discovery & Development*, **1**(3), 290-303 (1998)
- Aleksey Zaks, David R. Dodds, "Enzymatic Glucuronidation of a Novel Cholesterol Absorption Inhibitor, SCH 58235", *Appl. Biochem. Biotech.*, **73**, 205-214 (1998)
- Brian Morgan, Brent R. Stockwell, David R. Dodds, David R. Andrews, Anantha R. Sudhakar, Christopher M. Neilsen, Ingrid Mergelsberg, Arne Zumach, "Chemoenzymatic Approaches to SCH 56592, A New Azole Antifungal", *J. Amer. Oil Chem. Soc.*, **74**(11), 1361-1370 (1997)
- David R. Dodds, Aleksey Zaks, "Application of Biocatalysis and Biotransformations to the Synthesis of Pharmaceuticals", *Drug Discov. Today*, **2**(12), 513-531 (1997)
- Brian Morgan, David R. Dodds, Aleksey Zaks, David R. Andrews, Ricardo Klesse, "Enzymatic Desymmetrization of Prochiral 2-Substituted-1,3-propanediols: A Practical Chemoenzymatic Synthesis of a Key Precursor of SCH 51048, a Broad-Spectrum Orally Active Antifungal Agent", *J. Org. Chem.*, **62**(22), 7736-7743 (1997)
- D.R. Dodds, C. Heinzelman, M. Homann, W.B. Morgan, E. Previte, R.A. Roehl, R. Vail, A. Zaks, "Biocatalysis at The Schering-Plough Research Institute", *Chimica Oggi* **14**, 9 (1996)
- Aleksey Zaks, Asha V. Yabannavar, David R. Dodds, C. Anderson Evans, Pradip R. Das, Rodney Malchow, "A Novel Application of Chloroperoxidase: Preparation of *gem*-Halonitro Compounds", *J. Org. Chem.*, **61**(24), 8692-695 (1996)
- Aleksey Zaks, David R. Dodds, "Chloroperoxidase-Catalyzed Asymmetric Oxidations: Substrate Specificity and Mechanistic Study", *J. Am. Chem. Soc.*, **117**(42), 10419-10424 (1995)
- Dodds, D.R., Andrews, D.R., Heinzelman, C., Homann, M.J., Klesse, P., Morgan, W.B., Previte, E., Sudhakar, A., Roehl, R.A., Vail, R., Zaks, A., Zelazowski, A., *Proceedings of Chiral Europe '95 (London)*, pp. 55-62 (1995)
- Brian Morgan, Greg Bydlinski, David R. Dodds, "A Chemoenzymatic Synthesis of Both Enantiomers of 2-Phenyl-3-hydroxypropylcarbamate, a Metabolite of Felbamate", *Tetrahedron: Asymmetry*, **6**(7), 1765-1772 (1995)

PUBLICATIONS (cont'd)

- D.R. Dodds, E. Toone, Eds., "Biological Catalysis: Models, Methods and Applications - Parts I & II", Symposia-in-Print No. I, *Bioorganic and Medicinal Chemistry*, **2**, issues 6&7 (1994)
- David R. Dodds, J. Bryan Jones, "Enzymes in Organic Synthesis 38. Preparations of Enantiomerically Pure Chiral Hydroxydecalinones via Stereospecific Horse Liver Alcohol Dehydrogenase Catalyzed Reductions of Decalindiones", *J. Am. Chem. Soc.*, **110**(2), 577-583 (1988)
- J. Bryan Jones, David R. Dodds, "Enzymes in Organic Synthesis 37. Preparation and Characterization of Potential Substrates of Horse Liver Alcohol Dehydrogenase", *Can. J. Chem.*, **65**(10), 2397-2404 (1987)
- Caruthers, M.H., Barone, A.D., Beaucage, S., Dodds, D.R., Fisher, E. McBride, L.F., Matteucci, M., Stabinsky, I., Tang, J-Y., "Chemical Synthesis of Deoxyoligonucleotides by the Phosphoramidite Method", *Meth. Enzymol.*, **154** (Recomb. DNA Pt. E), 287-313 (1987)
- Caruthers, M.H., Barone, A.D., Beltman, J., Bracco, L.P., Dodds, D.R., Dubendorf, J.M., Eisenbeis, S.J., Gayle, R.B., Prosser, K., Rosendahl, M.S., Sutton, J., Tang, J-Y., "The Interaction of Cro, cl, and RNA Polymerase with Operators and Promoters", *UCLA Symp. Mol. Cell. Biol.*, **1**(Prot. Struct. Fold. Des.), 221-228 (1986)
- Eisenbeis, S.J., Nasoff, M.S., Noble, S.A., Bracco, L.P., Dodds, D.R., Caruthers, M.H., "Altered Cro Repressors From Engineered Mutagenesis of a Synthetic *cro* Gene", *Proc. Natl. Acad. Sci. USA*, **82**(4), 1084-1088 (1985)
- Caruthers, M.H., Barone, A.D., Bracco, L.P., Dodds, D.R., Eisenbeis, S.J., McBride, L.J., Nasoff, M.S., Noble S.A., Tang, J-Y., "Synthesis of Oligonucleotides Using the Phosphoramidite Method", *Stud. Org. Chem.*, **20** (Nat. Prod. Chem.), 213-225 (1985)
- Caruthers, M.H., Barone, A.D., Bracco, L.P., Dodds, D.R., Eisenbeis, S.J., Goldman, R.A., Mandecki, W., McBride, L.J., Nasoff, M.S., Noble, S.A., Tang, J-Y., "Chemical and Biochemical Studies of Gene Control Regions", *Proc. 16th FEBS Congr.*, Vol. C, 265-289, VNU Sci. Press (1985)
- David R. Dodds, J. Bryan Jones, "Selective And Stereospecific Enzyme Catalysed Reductions of cis- and trans-Decalindiones to Enantiomerically Pure Hydroxyketones; An Efficient Synthesis of (+)-4-Twistanone", *J. Chem. Soc. Chem. Comm.*, **1982**(18), 1080-1081
- David R. Dodds, J. Bryan Jones, "Enzymes in Organic Synthesis 17. Oxido-reductions of Alcohols, Aldehydes, and Ketones Using Chemically Modified Horse Liver Alcohol Dehydrogenase", *Can. J. Chem.*, **57**(19), 2533-2538 (1977)