David R. Dodds, Ph.D.

SUMMARY

Directed multi-disciplinary process development groups in major pharmaceutical corporations, and worked with academics and scientists in 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 project management experience covering process chemistry, molecular biology, biotransformations and biocatalysis, plus fermentation of natural products and recombinant enzymes. Excellent communication skills; frequently invited to explain technical issues to patent, licensing, regulatory, and business groups, and to serve on due-diligence teams. Expert witness experience. Service as North American Editor of international peer-reviewed journal and as chairs of international symposia. Established successful interdisciplinary consulting practice. United States and Canadian citizenships.

PROFESSIONAL EXPERIENCE

Independent Consultant, Dodds & Associates, LLC**;** WWW.Techdiligence.net: 2002-present

Founded Dodds & Associates to provide strategic technical planning and project management to the pharmaceutical, biotech, and chemical industries. Work with small and start-up companies needing interdisciplinary experience at a senior level to establish technical strategy and execute project management. Extensive industrial and academic network. Client references available. Completed and current projects include:

- Service on technical Advisory Boards; technical presentations to Corporate Board
- Intellectual property review and strategy, technical assessment and due-diligence
- Project Management:
  - Process review, development, and scale-up
  - Contractor selection, site visits and reporting, technology transfer
  - Interim technical executive for small entities
  - Expert witness experience and service

Director, Fermentation and Biocatalysis Development, Bristol-Myers Squibb Company: 2000-2001
Associate Director, Enzyme Development, Bristol-Myers Squibb Company: 1999-2000

Invited to BMS to lead a new group of over 40 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 and evaluated these with outsourcing group. Developed chiral chemical processes, plus fermentations for natural products, enzyme production, and biocatalysis.

- Solved production problems with enzymatic process experienced by an external supplier. Recovered over three tons of in-process material critical to launch supply to meet specifications.
- Developed process to chiral intermediate for HIV therapeutic via biological reduction, allowing significant cost-savings over vendor pricing of tonne quantities.
- Developed natural product fermentation process that gave a three-fold increase in production within 12 months. Re-wrote and updated all documentation necessary for GMP compliance.
- Conceived and managed chemical gene synthesis and expression project to replace bovine enzyme and eliminate TSE/BSE regulatory issues in an existing commercial process.
- Directed submission of six chemical and fermentation process patent applications in 18 months.

- Responsible for multi-million dollar TAXOL® project with external partner. Reviewed all outside technology sent to BMS concerning new TAXOL® production technology, and wrote technical reports for formal corporate response.
- With neither a budget nor formally assigned project, managed preparation of an existing facility designed for other purposes for first half of TAXOL® cell culture production process. Included facilities issues, writing and reviewing all SOPs, master batch records, plus equipment calibration and validation protocols to permit GMP operation.
- Supported filing for commercial antibiotic synthesis using biocatalysis. Advised patent counsel on cross-licensing of production technology, avoided patent conflicts and preserved future rights.

Manager, Biotransformations Group, Schering-Plough Research Institute: 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 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 kilograms 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. To date, six have issued as patents, and one has been kept a trade secret. Group had a total of 37 public releases (papers or presentations).
- 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 equipment is still in use, for its intended purpose.
- Planned and ran the first company-wide poster session for Development Operations, with over 90 presentations from chemical, biotech, formulations, and engineering development groups. Managed legal clearance and publicity.

Senior Protein Biochemist, Sepracor, Inc.: 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 intermediate, including enzymatic transformation of waste by-product to a commercially valuable fine chemical. (Process is still in operation.)

With VP R&D, wrote all patent applications for enzyme processes, and assisted in their prosecution. Chief technical witness in patent interference suit, settled in favor of Sepracor.

- Solely responsible for NRC licensing, radiation safety compliance, and de-commissioning of company's radio-isotope lab.

EDUCATION

PDF, Molecular Biology, University of Colorado, Boulder Prof. Marvin H. Caruthers: 1984-86

Ph.D., University of Toronto Prof. J. Bryan Jones: 1979-84
Major: Organic Synthesis

M.Sc., University of Toronto: 1977-79
Major: Biological Chemistry

B.Sc., Trinity College, University of Toronto: 1973-77
Major: Biochemistry

APPOINTMENTS

2002 - President, Dodds and Associates LLC

2002 - ZuChem Scientific Advisory Board

2002 - Codexis Industrial Advisory Board

1998-02 North American Editor, *Journal of Molecular Catalysis B: Enzymatic*

CONFERENCE CHAIRS

1. 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, Ontario, June 1999
2. Gordon Research Conference, *Biocatalysis*, Kimball Union Academy, Meriden, NH, July 1998 (Vice Chair for 1996 *Biocatalysis* Gordon conference)
3. 5TH North American Chemistry Congress, Symposium on *Chemical Syntheses Using Biotransformations*, Cancun, Mexico, November 1997

INVITED LECTURES

1. *Dry Pipelines; The Future of the Pharmaceutical Industry* ACS New York Chapter, Chemical Marketing & Economics Group, New York City, June 2003
2. *Biocatalysis in Development: Playing in the Viola Section* CSIRO Workshop on Biocatalysis, Canberra, Australia, November 2002
3. *Biocatalysis in Pharmaceutical Development:* BIO 2002 Conference, Toronto, Canada, June 2002
4. *Biocatalysis in the Pharmaceutical Industry* Center for Biocatalysis and Bioprocessing, Iowa City, Iowa, October 1999
5. *Biocatalysis in the Pharmaceutical Industry: Practical Challenges and Experience* Society for Industrial Microbiology Annual Meeting, Denver, Colorado, August 1998
6. *Industrial Biocatalysis; Current Trends and Future Opportunities* New Frontiers in Screening for Microbial Biocatalysts, Ede, Netherlands, December 1996

7. *Screening and Use of Enzymes for Synthetic Applications in the Pharmaceutical Industry* Chiral Europe 95, London, U.K., September 1995
8. *Applications of Biocatalysis in the Pharmaceutical Industry* BRIDGE Final Sectorial Meeting on Biotransformations, Wageningen, Netherlands, October 1994
9. *Novel Water-soluble Esters as Substrates for Enantiomeric Resolution by Proteases* Biocatalysis for the 90's, Lake Buena Vista, Florida, June 1991
10. *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 at internal and external poster sessions

REVIEWED PUBLICATIONS

1. 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(2004), 789-797
2. 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)
3. 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)
4. 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
5. Aleksey Zaks, David R. Dodds, "Biotransformations in the Discovery and Development of Pharmaceuticals", *Current Opinions in Drug Discovery & Development*, 1(3), 290-303 (1998)
6. Aleksey Zaks, David R. Dodds, "Enzymatic Glucuronidation of a Novel Cholesterol Absorption Inhibitor, SCH 58235", *Appl. Biochem. Biotech*., 73, 205-214 (1998)
7. 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)
8. David R. Dodds, Aleksey Zaks, "Application of Biocatalysis and Biotransformations to the Synthesis of Pharmaceuticals", *Drug Discov. Today*, 2(12), 513-531 (1997)
9. 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)
10. 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)

11. 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)
12. Aleksey Zaks, David R. Dodds, "Chloroperoxidase-Catalyzed Asymmetric Oxidations: Substrate Specificity and Mechanistic Study", *J. Am. Chem. Soc.*, 117(42), 10419-10424 (1995)
13. 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)
14. 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)
15. D.R. Dodds, E. Toone, Eds., "Biological Catalysis: Models, Methods and Applications -Parts I & II", Symposia-in-Print No.1, *Bioorganic and Medicinal Chemistry*, 2, issues 6&7 (1994)
16. 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)
17. 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)
18. 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)
19. 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, cI, and RNA Polymerase with Operators and Promoters", *UCLA Symp. Mol. Cell. Biol.*, 1(Prot. Struct. Fold. Des.), 221-228 (1986)
20. 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)
21. 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)
22. 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)
23. 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
24. 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)

U. S. PATENTS and PUBLISHED APPLICATIONS

1. US 6 521 455 B1: "Process for Preparing Optically Active Glycidate Esters", Dodds, David R.; Lopez, Jorge L.; Zepp, Charles M.; Brandt, Steven
2. US 5 274 300: "Enzymatic Hydrolysis of Glycidate Esters in the Presence of Bisulfite Anion", Dodds, David R.; Lopez, Jorge L.
3. US 5 198 568: "Compounds Useful In Enzymatic Resolution Systems and Their Preparation", Zepp, Charles M.; Wald, Stephen A.; Dodds, David R.
4. US 5 196 568: "Compounds Useful In Enzymatic Resolution Systems and Their Preparation", Zepp, Charles M.; Wald, Stephen A.; Dodds, David R.
5. 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.
6. US 5 077 217: "Method For membrane reactor resolution of stereoisomers", Matson, Stephen L.; Wald, Stephen A.; Zepp, Charles M.; Dodds, David R.
7. US 5 057 427: "Method for Resolution of Stereoisomers", Wald, Stephen A.; Matson, Stephen L.; Zepp, Charles M.; Dodds, David R.
8. 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.
9. EP 0 461 043 A2: "Enantiomer Separation by Transesterification", Dodds, David R.; Zepp, Charles M.; Rossi, Richard F.
10. EP 0 440 723 B1: "Process for Preparing Optically Active Glycidate Esters", Dodds, David R.; Lopez, Jorge L.; Zepp, Charles M.; Brandt, Steven
11. 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.