

# ALAN REED KETRING

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Research Reactor  
University of Missouri  
Columbia, MO 65211-3400

## EDUCATION

Post-Doctoral Research Fellow for Prof. Edward A. Deutsch, University of Cincinnati, Cincinnati, OH, January 1982-June 1984

PhD, Chemistry, May 1982, University of Missouri-Columbia; "The Synthesis of Several Tetraaza Macrocyclic Amine Ligands and the Biodistribution of Their Tc-Complexes"

MA, Chemistry, December 1978, University of Missouri-Columbia; "The Biological Distribution and *In Vivo* Stability of a Tc-99m Complex with tetradeca-4,11-Diene"

BS, Biology, August 1974, Wright State University, Dayton, OH

Honors: University Scholarships, 1970-1971, Graduated Cum Laude

## EXPERIENCE

**Associate Director, MURR Radiopharmaceutical Research and Development Program** (University of Missouri Research Reactor, October 2000-present); **Research Professor** (University of Missouri-Columbia Department of Radiology, July 1986-Present); **Adjunct Professor** (University of Missouri-Columbia Department of Chemistry, July 1992-Present). **Joint Faculty Member** (University of Missouri-Columbia Nuclear Science and Engineering Institute, 2003-present) Direct the research and development programs at the MU Research Reactor with a focus on radiopharmaceuticals and medical isotopes. Supervision of PhD research scientists and technicians in the R&D programs at MURR (i.e., production and supply of cGMP radioisotopes and radiopharmaceuticals, isotope purification and radiolabelling of biomedical compounds; development of cGMP program components; outreach/partnerships)

**Associate Director, Reactor Research and Development Programs** (University of Missouri Research Reactor, February 1998-September 2000). Direct and expand the research and development programs at the MU Research Reactor. Supervision of 10-15 PhD research scientists and 10-15 technicians in the various research programs at MURR (i.e., radiopharmaceuticals, neutron activation analysis and neutron scattering)

**Interim Scientific Director** (University of Missouri Research Reactor, October 1996-1998). Oversight of research programs at the University of Missouri Research Reactor. Management of 13 fulltime scientists in nine research groups in three programs (Biomedical, Nuclear Analysis and Neutron Material Science)

**Program Coordinator** (Biomedical Program, University of Missouri Research Reactor, April 1992-1998), **Group Leader** (Radiopharmaceutical Group, University of Missouri Research Reactor, April 1992-December 1998). Oversight of laboratories and instrumentation for program. Coordination and supervision of administrative positions associated with the program for the benefit of research groups in the program. Development and maintenance of budgets for staff, equipment, operating supplies and other functions of the program/group. Development of research plan for group, obtain outside funding for research and carry out research using reactor produced radioisotopes to develop therapeutic and diagnostic radiopharmaceuticals. Design and teach courses for Radiopharmaceutical Chemistry Minor

**Senior Research Scientist** (Radioisotope Applications Group, University of Missouri Research Reactor, July 1986-1998). Development of radiotherapeutic agents for the treatment of various types of cancer. Design protocols for and supervise the execution of preclinical studies according to GLP guidelines. Production of radioisotopes by neutron activation. Design and teach courses for Radiopharmaceutical Chemistry Minor

**Senior Research Chemist** (Department of Radiology, University of Missouri, July 1985-July 1986). Development of radiotherapeutic agents for the treatment of various types of cancer. Design protocols for and supervise the execution of preclinical studies according to GLP guidelines. Production of radioisotopes by neutron activation

**Research Chemist** (Radiochemistry Division, Diagnostic Products Group, Mallinckrodt, Inc., June 1984-July 1985). Radiopharmaceutical products development including: improvement of current products, kit formulation for new products, quality control and bioassay procedures for new products, as well as the design, preparation and efficacy determination of novel Tc-99m labeled compounds as potential radiodiagnostic agents

**Post-Doctoral Fellow** (Department of Chemistry, University of Cincinnati, January 1982-June 1984). Synthesis and characterization of cationic diphosphine complexes of Tc and the determination of their potential as myocardial imaging agents. Preparation and HPLC purification of diphosphonate complexes of the beta-emitting isotopes, Re-186 and Re-188, as possible therapeutic agents for metastatic bone cancer

**GS-17 Research Chemist** (Nuclear Medicine Laboratory, Harry S. Truman Memorial Veterans Hospital, January 1979-December 1981). Synthesis of macrocyclic amine ligands and their corresponding Tc-99m complexes to examine the possible utility of these complexes as radiodiagnostic agents

**Freshman Chemistry Lecturer** (University of Missouri, Fall Semester, 1980). Lecturer for Introductory Chemistry for non-majors

**Graduate Teaching Assistant** (University of Missouri, August 1975-December 1978). Instructor for freshman chemistry labs and recitations

#### **ADDITIONAL TRAINING**

*Foundations of Leadership*, Center for Creative Leadership, March 1999

*Finance and Accounting for the Non-Financial Manager*, The Wharton School, University of Pennsylvania, November 2000

*Writing Standard Operating Procedures to Meet cGMP Requirements*, The Center for Professional Advancement, February 2001

*Active Pharmaceutical Ingredients Production*, The Center for Professional Advancement, April 2001

#### **ORGANIZATIONS**

American Chemical Society (1977)

Society of Nuclear Medicine (1982)

Radiopharmaceutical Chemistry Council (1989)

Therapy Council (1995)

Phi Lambda Upsilon Honorary Chemical Society (1977)

President of Beta Iota Chapter (1979)

Alumni Secretary of Beta Iota Chapter (1980)

Sigma Xi (1980)

International Association of Radiopharmacology (1991)

#### **HONORS AND AWARDS**

**World Federation of Nuclear Medicine and Biology Clinical and Basic Science Award and honorarium** for the co-authored paper on "Production and Supply of High Specific Activity Radioisotopes for Radiotherapy Applications," World Congress of Nuclear Medicine held in Santiago, Chile, September 29-October 4, 2002

**American Nuclear Society June 2002 Operations and Power Division (OPD) Award for Best Paper**, "MURR—The Next Generation of Utilization of Research Reactors for Medical Applications," co-authored with J.C. McKibben, C.S. Cutler, R.A. Butler and J.S. Morris, awarded March 2003

#### **PUBLICATIONS**

1. Simon, J., A.R. Ketring, D.E. Troutner, W.A. Volkert and R.A. Holmes, "Labeling of a Macrocyclic Tetraaza Ligand with  $^{99m}\text{Tc}$ ," *Radiochem Radioanal Letters* **38**:133-142, 1979
2. Troutner, D.E., J. Simon, A.R. Ketring, W.A. Volkert and R.A. Holmes, "Complexing of  $^{99m}\text{Tc}$  with Cyclam," *J Nucl Med* **21**:443-448, 1980
3. Ketring, A.R., D.E. Troutner, W.A. Volkert and R.A. Holmes, "Synthesis and Characterization of  $^{99m}\text{Tc}$ -N-octylcyclam and  $^{99m}\text{Tc}$ -dimethyldiphenylcyclam," *Nucl Med Biol Adv, Proc World Cong* **2**:1624-7, 1983
4. Ketring, A.R., D.E. Troutner, W.A. Volkert, T.J. Hoffman and R.A. Holmes, "Biodistribution of Lipophilic  $^{99m}\text{Tc}$  Complexes of Cyclam Derivatives," *Internatl J Nucl Med Biol* **11**:113-119, 1983
5. Vanderheyden, J.-L., K. Libson, D. L. Nosco, A.R. Ketring and E.A. Deutsch, "Preparation of and Characterization of  $[\text{}^{99m}\text{Tc}(\text{DMPE})_2\text{X}_2]^+$ , X=Cl,Br, DMPE=1,2=bis(dimethylphosphino)ethane," *Internatl J Appl Radiat Isotopes* **34**:1611-1618, 1983
6. Vanderheyden, J.-L., A.R. Ketring, K. Libson, L. Roecker, P. Motz, R. C. Elder and E.A. Deutsch, "Synthesis and Characterization of the Cationic Diphosphine Technetium Complexes  $[\text{Tc(V)}(\text{DMPE})_2\text{O}_2]^+$ ,  $[\text{Tc(III)}(\text{DMPE})_2\text{Cl}_2]^+$  and  $[\text{Tc(I)}(\text{DMPE})_3]^+$ . Single Crystal Structural Analyses of  $[\text{Tc}(\text{DMPE})_2(\text{OH})\text{O}](\text{F}_3\text{CSO}_3)$ , where DMPE=1,2-bis(dimethylphosphino)ethane," *Inorg Chem* **23**:3184-3191, 1984
7. Gerson, M.C., E.A. Deutsch, K.F. Libson, A.R. Ketring, R.J. Adolph, J.-L. Vanderheyden, C.C. Williams and E.L. Saenger, "Myocardial Scintigraphy with Technetium-99m Tris-DMPE in Man," *Eur. J Nucl Med* **9**:403-407, 1984
8. Weininger, J., A.R. Ketring, E.A. Deutsch and H.R. Maxon, " $^{186}\text{Re}$  HEDP: A Potential Therapeutic Bone Agent," *Nuklearmedizin. Nucl. Med (Stuttgart)* **23**:81-82, 1984
9. Deutsch, E.A., K. Libson, J. L. Vanderheyden, A.R. Ketring and H. R. Maxon, "The Chemistry of Rhenium and Technetium as Related to the Use of Isotopes of these Elements in Therapeutic and Diagnostic Nuclear Medicine," *Internatl J. Radiat. Appl. Instrum., Part B. Nucl Med Biol* **13**:465-477, 1986
10. Garlich, J. R., S. A. Baughman, J. Simon, K. McMillan, A.R. Ketring, W.A. Volkert, W.F. Goeckeler and D.E. Troutner, "Chemical Considerations of  $^{153}\text{Sm}$ -EDTMP, a New Therapeutic Bone Agent," *J. Labl. Compds. Radiopharm.* **23**:1341-1343, 1986
11. Ehrhardt, G.J., A.R. Ketring and W.A. Volkert, "Production of  $^{153}\text{Sm}$  for Radiotherapeutic Applications," *J. Labl. Compds. Radiopharm.* **23**:1370-1371, 1986
12. Ketring, A.R., " $^{153}\text{Sm}$ -EDTMP and  $^{186}\text{Re}$ -HEDP as Bone Therapeutic Radiopharmaceuticals," *Internatl J Radiat Appl Instrum, Part B, Nucl Med Biol* **14**:223-232, 1987
13. Appelbaum, F.R., B. Sandmaier, P. A. Brown, D. Kaplan, A.R. Ketring, W.F. Goeckeler, T. Graham, F. Schuening and R. Storb, "Myelosuppression and Mechanism of Recovery Following Administration of  $^{153}\text{Samarium}$ -EDTMP," *Antibody, Immunoconjugates and Radiopharmaceuticals* **1**:263, 1988
14. Appelbaum, F.R., P. A. Brown, B. Sandmaier, A. Shields, J. Bianco, T. Graham, F. Schuening, A.R. Ketring, D. Kaplan and R. Storb, "Development of Improved Marrow Transplant Preparative Regimens: II. Use of Aminophosphonic Acid-Radionuclide Conjugates," *Technical Proceedings of the ACNP-SNM Joint Symposium on Biology of Radionuclide Therapy*, 1989
15. Deutsch, E.A., A.R. Ketring, K.F. Libson, J-L Vanderheyden and W. W. Hirth, "The Noah's Ark Experiment: Species Dependent Biodistributions of Cationic  $^{99m}\text{Tc}$  Complexes," *Internatl J Radiat Appl Instrum Part B, Nucl Med Biol* **16**:191-232, 1989
16. Singh, A., R.A. Holmes, M. Farhangi, W.A. Volkert, A. Williams, L.M. Stringham and A.R. Ketring, "Human Pharmacokinetics of Samarium-153 EDTMP in Metastatic Cancer," *J Nucl Med* **30**:1814-1818, 1989
17. Volkert, W.A., J. Simon, A.R. Ketring, R.A. Holmes, L. C. Lattimer and L. A. Corwin, "Radiolabeled Phosphonic Acid Chelates: Potential Therapeutic Agents for Treatment of Skeletal Metastases," *Drugs of the Future* **14**:799-811, 1989

18. Ehrhardt, G.J., A.R. Ketring, T.A. Turpin, M.S. Razavi, J-L. Vanderheyden, F.M. Su and A.R. Fritzberg, "A Convenient Tungsten-188/Rhenium-188 Generator for Radiotherapeutic Applications Using Low Specific Activity Tungsten-188," *Technetium and Rhenium in Chemistry and Nuclear Medicine* **3**:631-634, 1989
19. Lattimer, J.C., L.A. Corwin, Jr., J. Stapleton, W.A. Volkert, G.J. Ehrhardt, A.R. Ketring, J.E. Hewett, J. Simon and W.F. Goeckeler, "Clinical and Clinicopathologic Effects of Samarium-153-EDTMP Administered Intravenously to Normal Beagle Dogs," *J Nucl Med* **31**:586-593, 1990
20. Lattimer, J.C., L. A. Corwin, Jr., J. Stapleton, W.A. Volkert, G.J. Ehrhardt, A.R. Ketring, S. K. Anderson, J. Simon and W.F. Goeckeler, "Clinical and Clinicopathologic Response of Canine Bone Tumor Patients to Treatment with Samarium-153-EDTMP," *J Nucl Med* **31**:1316-1325, 1990
21. Volkert, W.A., W.F. Goeckeler, G.J. Ehrhardt and A.R. Ketring, "Therapeutic Radionuclides: Production and Decay Property Considerations," *J Nucl Med* **32**:174-185, 1991
22. Ehrhardt, G.J., A.R. Ketring and W.A. Volkert, "Production of Isotopes at Nuclear Reactors," *Synthesis and Applications of Isotopically Labeled Compounds* 159-164, 1991
23. Hassan, N. M., A.L. Hines, T.K. Ghosh, S.K. Loyalka and A.R. Ketring, "New Apparatus for Measuring Radon Adsorption on Solid Adsorbents," *Ind. Eng. Chem. Res.* **30**:2205-2211, 1991
24. Johnson, J.C., S.M. Langhorst, S.K. Loyalka, W.A. Volkert and A.R. Ketring, "Calculation of Radiation Dose at a Bone-to-Marrow Interface Using Monte Carlo Modeling Techniques (EGS4)," *J Nucl Med* **33**:623-628, 1992
25. Singh, P.R., M. Corlija, D.E. Troutner, A.R. Ketring and W.A. Volkert, "Synthesis, Characterization and Biodistribution Studies of a Neutral-Lipophilic Tc-99m N<sub>3</sub>S<sub>2</sub> Chelate," *Internatl J Radiat Appl Instrum Part B, Nucl Med Biol* **19**:791-795, 1992
26. Katti, K.V., P.R. Singh, W.A. Volkert, A.R. Ketring and K.K. Katti, "A New Neutral-Lipophilic <sup>99m</sup>Tc Complex With a Bis-Hydrazide-Phosphine (BHP) Ligand," *Internatl J Radiat Appl Instrum Part A, Appl Rad Isot* **43**:1151-1154, 1992
27. Appelbaum, F.R., P. A. Brown, B. M. Sandmaier, R. Storb, D. R. Fisher, H. M. Shulman, T. C. Graham, F. G. Schuening, H. J. Deeg, J. A. Bianco, A.R. Ketring and D. Kaplan, "Specific Marrow Ablation Before Marrow Transplantation Using an Aminophosphonic Acid Conjugate <sup>166</sup>Ho-EDTMP," *Blood* **80**:1608-1613, 1992
28. Ehrhardt, G.J., A.R. Ketring and Q. Liang, "Improved <sup>188</sup>W/<sup>188</sup>Re Zirconium Tungstate Gel Radioisotope Generator Chemistry," *Radioactivity & Radiochemistry* **3**:38-41, 1992
29. Volkert, W.A., P.R. Singh, K.K. Katti, A.R. Ketring and K.V. Katti, "A New and Versatile Multifunctional Phosphorus Hydrazide Ligand for Formulating Neutral-Lipophilic Complexes of <sup>99m</sup>Tc, <sup>186</sup>Re and <sup>109</sup>Pd Radionuclides," *J Labelled Compds Radiopharm* **32**:15-17, 1993
30. Singh, P.R., W.A. Volkert, A.R. Ketring, D.E. Troutner, K.K. Katti and K.V. Katti, "A New Chelating Heterodifunctional Phosphorus-Nitrogen Ligand for Radiolabelling of Proteins," *J Labelled Compds Radiopharm* **32**:362-365, 1993
31. Katti, K.V., P.R. Singh, K.K. Katti, K. Kopicka, W.A. Volkert and A.R. Ketring, "First Examples of Heteroatomic Chelaton of ReO<sub>4</sub><sup>-</sup>/<sup>99m</sup>TcO<sub>4</sub><sup>-</sup> and PdCl<sub>4</sub><sup>2-</sup>/<sup>109</sup>PdCl<sub>4</sub><sup>2-</sup> with a Phosphinephosphineoxide (or Phosphinimine) Bridged Bifunctional System," *J Labelled Compds Radiopharm* **32**:407-409, 1993
32. Katti, K.V., P.R. Singh, H. Jimenez, C. L. Barnes, A.R. Ketring and W.A. Volkert, "The Potential of Phosphinimines as Building Blocks for a New Generation of Radiopharmaceuticals," *Phosphorus, Sulfur and Silicon* **75**:55-58, 1993
33. Katti, K.V., P.R. Singh, A.R. Ketring and W.A. Volkert, "Functionalized Phosphorous Hydrazides as Novel Chelating Ligands to Transition Metals," *Phosphorous, Sulfur and Related Elements* **77**:267, 1993
34. Katti, K.V., P.R. Singh, C. L. Barnes, K.K. Katti, K. Kopicka, A.R. Ketring and W.A. Volkert, "Organometallic Phosphinimines as Building Blocks for Potential New Radiopharmaceuticals. Synthesis, Structure and Reactivity of Ph<sub>3</sub>P=NH<sub>2</sub><sup>+</sup>ReO<sub>4</sub><sup>-</sup>," *Zeitschrift Naturforsch* **486**:1381-1385, 1993

35. Singh, P.R., K.K. Katti, K.V. Katti, M. Corlija, A.R. Ketring, W.A. Volkert and R.A. Holmes, "A New  $^{99m}\text{Tc}$ -Complex with a Germanium-Hydrazide (GeTH) Ligand," *Nucl Med Biol* **21**(8):1115-1118, 1994
36. Volkert, W.A., T.J. Hoffman, M. Corlija, P.R. Singh, H. Jiminez, K.K. Katti, K.V. Katti, P. Lusiak, A.R. Ketring and R.A. Holmes, "Unsymmetrical Phosphorus Hydrazide Chelating Systems as Potential BFCA's for Proteins and Peptides," *J Labelled Compds Radiopharm* **35**:3-5, 1994
37. Katti, K.K., P.R. Singh, W.A. Volkert, C.J. Anderson, M.J. Welch, T. Hoffman, K.V. Katti, A.R. Ketring and M. Wang, "Synthesis and Characterization of a Neutral and Lipophilic  $\text{Ph}_3\text{PN}^{99m}\text{TcO}_3$  Complex," *Internatl J Appl Radiat Isot* **46**(1):53-58, 1995
38. Singh, P.R., P. Lusiak, K.V. Katti, W.A. Volkert, A.R. Ketring and R.A. Holmes, "Transition Metal Chemistry of Main Group Hydrazides, Part 14: Evaluation of New Tc-99m Chelates of Thiol Functionalized Phosphorus Hydrazides," *Nucl Med Biol* **22**(7):849-857, 1995
39. Katti, K.V., P.R. Singh, K.K. Katti, W.A. Volkert and A.R. Ketring, "Applications of Functionalized Azaphosphanes as Novel Scavenging Agents for  $\text{TcO}_4^-$ ," *Radio Chimica Acta* **66/67**:129-131, 1995
40. Singh, P.R., W.A. Volkert, A.R. Ketring and K.V. Katti, "Potential of Phosphinimine Monimers and Polymers as Scavenging Agents for the Extraction of  $^{99}\text{TcO}_4^-$  From Aqueous Media," *Technetium and Rhenium in Chemistry and Nuclear Medicine* **4**:239-242, 1995
41. Ehrhardt, G.J., A.R. Ketring Q. Liang, R.A. Miller, R.A. Holmes and R.G. Wolfangel, "Refinement of the Peroxide Process for Making W-188/Re-188 and Mo-99/Tc-99m Gel Radioisotope Generators for Nuclear Medicine," in *Technetium and Rhenium in Chemistry and Nuclear Medicine*, M. Nicolini, G. Bandoli and U. Mazzi, eds, SG Editoriali, Padova, **4**:313-317, 1995
42. Jia, W., G.J. Ehrhardt, K. Zinn, N. Wang and A.R. Ketring, "Re-186/Re-188 Labelled Polypeptide Microspheres as a Potential Radiation Synovectomy Agent," *J Radioanal Nucl Chem Articles* **206**(1):107-117, 1996
43. Venkatesh, M., N. Goswami, W.A. Volkert, E. O. Schlemper, A.R. Ketring, C.L. Barnes and S.S. Jurisson, "An Rh-105 Complex of Tetrathiacyclohexadecane Diol with Potential for Formulating Bifunctional Chelates (BFCs)," *Nucl Med Biol* **23**:33-40, 1996
44. Ketring, A.R., D. Ma, G.J. Ehrhardt and W. Jia, "Production of Radiolanthanides and Radiotherapy Research at MURR," *J Radioanal Nucl Chem Articles* **206**(1):119-126, 1996
45. Li, N., L.A. Ochrymowycz, W.A. Volkert, A.R. Ketring, C. Barnes, "Comparisons of  $^{105}\text{Rh(III)}$  chloride complexation with [14]aneNS3, [14]aneN2S2 and [14]aneN4 macrocycles in aqueous solution," *Radiochimica Acta* **75**:83-95, 1996
46. Singh, P.R., P. Lusiak, W.A. Volkert, A.R. Ketring, R.A. Holmes, K.V. Katti, "Transition Metal Chemistry of Main Group Hydrazides, Part 14: Evaluation of new Tc-99m chelates of thiol functionalized phosphorus hydrazides," *Nucl Med Biol* **22**(7):849-857, 1996
47. Reddy, V.S., K.V. Katti, D.E. Berning, C.L. Barnes, W.A. Volkert and A.R. Ketring, "Chemistry in environmentally benign media Part 3: Synthesis and characterization of rhenium(V) complexes of hydroxymethyl bisphosphines," *Inorg Chem* **35**:1753-1757, 1996
48. Jia, W., A.R. Ketring, J.Schuh, J Lanigan, D Ma, L. Manson and D. Chanley, Production of Carrier-Free Phosphorus-33 at MURR," *Transactions of the American Nuclear Society* **74**:131, 1996
49. Ma, D., W. Jia and A.R. Ketring, "Method for Producing No-Carrier-Added  $^{161}\text{Tb}$ ," *Transactions of the American Nuclear Society* **74**:131-133, 1996
50. Berning, D.E., K.V. Katti, C.L. Barnes, W.A. Volkert, A.R. Ketring, "Chemistry in Environmentally Benign Media. 7. Chelating Hydroxymethyl-Functionalized Bisphosphines as Building Block to Water-Soluble and *in Vitro*-Stable Gold(I) Complexes. Synthesis, Characterization and X-ray Crystal Structures of  $[\text{Au}\{(\text{HOH}_2\text{C})_2\text{PC}_6\text{H}_4\text{P}(\text{CH}_2\text{OH})_2\}_2]\text{Cl}$  and  $[\text{Au}_2\{(\text{HOH}_2\text{C})_2\text{PCH}_2\text{CH}_2\text{P}(\text{CH}_2\text{OH})_2\}_2]\text{Cl}_2$ " *Inorg Chem* **36**:2765-2769, 1997

51. Smith, C.J., K.V. Katti, W.A. Volkert, A.R. Ketring, L.J. Barbour, "The synthesis and characterization of chemically-flexible, water-soluble dithio-bisphosphines. A systematic investigation of the effect of chain-length on the coordination chemistry of rhenium," *Inorg Chem* **36**:2765, 1997
52. Ketring, A.R., F. K. Ross, V. Spate, J.C. McKibben, "Unique Educational Opportunities at the Missouri University Research Reactor," *Transactions of the American Nuclear Society* **77**:126, 1997 (Invited)
53. Ehrhardt, G.J., A.R. Ketring and D. Ma, "Radionuclide Production at the University of Missouri Research Reactor," *Transactions of the American Nuclear Society* **77**:514-515, 1997 (Invited)
54. Ketring, A.R., G.J. Ehrhardt, D.E. Day, "Radiopharmaceuticals Developed at the University of Missouri Research Reactor," *Transactions of the American Nuclear Society* **77**:547-548, 1997 (Invited)
55. Jurisson, S., A.R. Ketring, W.A. Volkert, "Rhodium-105 Complexes as Potential Radiotherapeutic Agents," *Transition Metal Chem* **22**:315-317, 1997 (Invited)
56. Berning, D.E., K.V. Katti, W.A. Volkert, C. Higginbotham and A.R. Ketring, "<sup>198</sup>Au-labeled hydroxymethyl phosphines as models for potential therapeutic pharmaceuticals," *Nucl Med and Biol* **25**:557-583, 1998
57. Liang, Q., G.J. Ehrhardt, A.R. Ketring and R.A. Miller, "Effect of Stoichiometric and Preparation Parameters on W-188/Re-188 Gel Generator Performance," *Radiochemica Acta* **79**:137-140, 1997
58. Ehrhardt, G.J., A.R. Ketring and L.M. Ayers, "Reactor-produced Radionuclides at the University of Missouri Research Reactor," *Journal of Applied Radiation and Isotopes* **49**(4):295-297, 1998
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63. Ehrhardt, G.J., A.R. Ketring and D. Ma, "Radionuclide Production at the University of Missouri Research Reactor," *Transactions of the American Nuclear Society*, 1998
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66. Barnholtz, S.L., J.D. Lydon, G. Huang, M. Venkatesh, C.L. Barnes, A.R. Ketring and S.S. Jurisson, "Syntheses and Characterization of Gold(III) Tetradentate Schiff Base Complexes. X-ray Crystal Structures of [Au(sal<sub>2</sub>pn)]Cl•2.5H<sub>2</sub>O and [Au(sal<sub>2</sub>en)]PF<sub>6</sub>," *Inorg Chem* **40**:972-976, 2001
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70. Li W.; Smith C.J.; Cutler C.S.; Hoffman T.J.; Ketring A.R.; Jurisson S.S.; Aminocarboxylate Complexes and Octreotide Complexes with No Carrier Added <sup>177</sup>Lu, <sup>166</sup>Ho, and <sup>149</sup>Pm. *Nucl Med Bio* **30**:241-251, 2003
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#### PRESENTED PAPERS

1. Ketring, A.R., D.E. Troutner, W.A. Volkert and R.A. Holmes, "Stability and *In Vivo* Distribution Studies of Tc-99m-Methyl(6)-14-diene-(4,11)-N<sub>4</sub>," Missouri Valley Chapter of the Society of Nuclear Medicine Meeting, Kansas City, MO, October 26-28, 1978
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12. Ketring, A.R., W.A. Volkert, J. Simon, W.F. Goeckeler, D.E. Troutner and G.J. Ehrhardt, "Influence of Stability on the Skeletal Biodistribution of Rare-Earth Carboxylate Complexes," 37th Annual Meeting of the Society of Nuclear Medicine, Washington, D.C., June 19-22, 1990
13. Ketring, A.R. and Gary J. Ehrhardt, "Re-186 and Re-188 as Therapeutic Radioisotopes: Properties, Production and Potential," High Country Nuclear Medicine Conference, Vail, CO, March 18-22, 1991 (Invited)
14. Ketring, A.R., "Production of Radionuclides for Radiopharmaceutical Therapy," Categorical Seminar II, 38th Annual Meeting of The Society of Nuclear Medicine, Cincinnati, OH, June 11-14, 1991 (Invited)
15. K. M. Schaab, A.R. Ketring, G.J. Ehrhardt, L.M. Stringham and R.J. Hammar, "Potential for Production of W-188/Re-188 Gel Generator Using Natural Tungsten," 38th Annual Meeting of The Society of Nuclear Medicine, Cincinnati, OH, June 11-14, 1991
16. Ketring, A.R., "Radiotherapeutic Agents for the Treatment of Pain Associated with Metastatic Bone Cancer," Medical Department, Brookhaven National Laboratory and Associated Universities, Inc., Upton, Long Island, NY, April 29, 1992 (Invited)
17. Ketring, A.R., "Development of Therapeutic Bone Agents," Chemistry Department Seminar, University of Missouri-Columbia, June 24, 1992 (Invited)
18. Ketring, A.R., Q. Liang and G.J. Ehrhardt, "A New and Improved Method for the Preparation of W-188/Re-188 and Mo-99/Tc-99m Gel Generators," High Country Nuclear Medicine Conference, Vail, CO, March 6-11, 1993 (Invited)
19. Katti, K.V., P.R. Singh, H. Jimenez, C.L. Barnes, A.R. Ketring and W.A. Volkert, "Functionalized Phosphorus Hydrazides as Novel Chelating Ligands for Transition Metal Radioisotopes," High Country Nuclear Medicine Conference, Vail, CO, March 6-11, 1993 (Invited)
20. Ketring, A.R., "Production and Availability of Radioisotopes for Therapy," Zynaxis Cell Science, Inc., Malvern, PA, April 16, 1993 (Invited)
21. D. Ma, S.S. Jurisson, G.J. Ehrhardt, W.B. Yelon and A.R. Ketring, "Development of the Dy-166/Ho-166 *In Vivo* Generator for Radionuclide Radiotherapy," 40th Annual Meeting of the Society of Nuclear Medicine, Toronto, Ontario, Canada, June 8-11, 1993
22. Ketring, A.R., "Radioisotope Production at Research Reactors," NeoRx Corp., Seattle, WA, February 1994 (Invited)
23. Ehrhardt, G.J., A.R. Ketring, S.S. Jurisson, D. Ma, Q. Liang and R.G. Wolfangel, "Daughters of Transformation: Radionuclide Generator Research at MURR," High Country Nuclear Medicine Conference, Vail, CO, March 1994 (Invited)
24. Ketring, A.R., "Radioisotope Production at MURR," Johnson Matthey Inc., Philadelphia, PA, April 1994 (Invited)
25. Ketring, A.R., "Chemical Reaction by Isotope Selective Laser Activation (CRISLA) as a Method for Isotopic Enrichment," Johnson Matthey Inc., Philadelphia, PA, September 1, 1994 (Invited)
26. Ehrhardt, G.J., A.R. Ketring, Q. Liang, R. Miller and R.G. Wolfangel, "Refinement of the Peroxide Process for Making W-188/Re-188 and Mo-99/Tc-99m Gel Radioisotope Generators for Nuclear Medicine," Fourth International Symposium on Technetium in Chemistry and Nuclear Medicine, Bressanone Bolzano, Italy, September 10-12, 1994

27. Ketring, A.R., "Development of Sm-153-EDTMP as a Treatment for Pain Associated with Metastatic Bone Cancer," Missouri Valley Chapter of American Association of Physicist's in Medicine, Annual Scientific Meeting, October 29, 1994 (Invited)
28. Ehrhardt, G.J., A.R. Ketring, Q. Liang, R. Miller and R.G. Wolfangel, "Refinement of the Peroxide Process for Making Mo-99/Tc-99m Gel Radioisotope Generators for Nuclear Medicine," High Country Nuclear Medicine Conference, Vail, CO, March 1995 (Invited)
29. Ketring, A.R., "Radioisotope Production at MURR," Idaho National Engineering Laboratory University Research Consortium Annual Review, Idaho Falls, ID, July 28-30, 1996 (Invited)
30. Ketring, A.R., "Multi-Disciplinary Approach to the Development of a Bone Cancer Treatment," Lexington Section American Chemical Society Meeting, Lexington, KY, September 4, 1996 (Invited)
31. Ketring, A.R., "Radiopharmaceutical Research at MURR," Department of Chemistry Seminar, University of Kentucky, Lexington, KY, September 5, 1996 (Invited)
32. Ketring, A.R., "MURR Isotope Production Program," Isotope Availability Subcommittee, Society of Nuclear Medicine Mid-Winter Meeting, Palm Springs, CA, February 8-11, 1997 (Invited)
33. Ketring, A.R. and G.J. Ehrhardt, "Radioisotope Research and Production at the University of Missouri Research Reactor," American Institute of Chemical Engineers Meeting, Houston, TX, March 9-13, 1997 (Invited)
34. Ketring, A.R., "Radiopharmaceutical Chemistry," Nuclear and Radiochemistry in the Chemistry Curriculum Workshop, University of Kentucky, Lexington, KY, August 5-8, 1997 (Invited)
35. M.S. Evans-Blumer, G.J. Ehrhardt and A.R. Ketring, "Reactor-Produced Radionuclides at the University of Missouri Research Reactor," 2nd International Conference on Isotopes, Sydney, Australia, October 12-16, 1997 (Invited)
36. A.R. Ketring, G.J. Ehrhardt and D.E. Day, "Radiopharmaceuticals Developed at the University of Missouri Research Reactor," American Nuclear Society Winter Meeting, Albuquerque, NM, November 16-20, 1997 (Invited)
37. Deutsch, E.A., A.R. Ketring, G.J. Ehrhardt and C.S. Cutler, Radioisotope and Radiopharmaceutical Development at the University of Missouri Research Reactor, 9<sup>th</sup> South African Society of Nuclear Medicine Biennial Congress, Bloemfontein, South Africa, April 2000
38. Li W.P., C.J. Smith, C.S. Cutler; A.R. Ketring; S.S. Jurisson, Development of Receptor-Based Radiopharmaceuticals Using Carrier-Free Promethium-149: Synthesis, *In Vitro* Stability Studies and *In Vivo* Biodistribution Studies of DTPA, DOTA and DTPA-Octreotide Complexes, *Abstracts of Papers*, 47<sup>th</sup> SNM Annual Meeting, St. Louis, MO, June 2000
39. Ehrhardt, G.J., Ketring, A.R., and Cutler, C.S., Radioisotope Radiotherapy Research and Achievements at the University of Missouri Research Reactor, 14th Radiochemical Conference, April 14-19, 2002
40. McKibben, J.C., A.R. Ketring, C.S. Cutler, R.A. Butler and J.S. Morris, MURR—The Next Generation of Utilization of Research Reactors for Medical Applications, American Nuclear Society Annual Meeting, Hollywood, FL, June 2002
41. Ketring A.R., G.J. Ehrhardt, M.F. Embree, K.D. Bailey, T.T. Tyler, J.A. Gawenis, S.S. Jurisson, H.P. Engelbrect, C.J. Smith and C.S. Cutler, "Production and Supply of High Specific Activity Radioisotopes for Radiotherapy Applications," World Congress of Nuclear Medicine, Santiago, Chile, September 29-October 4, 2002
42. Cutler, C.S., H.P. Engelbrecht,, M.F. Embree, K.D. Bailey, J.M. Clark, M. Moustapha, S.S. Jurisson, and A.R. Ketring, "Production of Carrier Free Radioisotopes for Radiotherapy," 15th International Symposium on Radiopharmaceutical Chemistry & Biology, Sydney, Australia, August 10-14, 2003
43. Ketring, A.R.; Ehrhardt, G.J.; Cutler, C.S.; Production and Supply of Radioisotopes for Medical Research at the University of Missouri Research Reactor, 15th International Symposium on Radiopharmaceutical Chemistry & Biology, Sydney, Australia, August 10-14, 2003

44. Ehrhardt, G.J., A.R. Ketring, C.S. Cutler, "Current Research into Reactor Production of Medical Radioisotopes at the University of Missouri Research Reactor," 226th National Meeting of the American Chemical Society, New York, NY, September 7-11, 2003
45. Cutler, C.S., H.P. Engelbrecht, M.F. Embree, K.D. Bailey, J.M. Clark, M.E. Moustapha, S.S. Jurisson, A.R. Ketring; "Production of Carrier Free Radioisotopes for Radiotherapy," 15th International Symposium on Radiopharmaceutical Chemistry & Biology, Sydney, Australia August 10-14, 2003
46. Embree, M.F.; Geethapriya, S.; Mohsin, H.; Bailey, K.D.; Manson, L.H.; Jia, F.; Frank, R.K.; Simon, J.; Jurisson, S.J.; Cutler, C.S.; Ketring, A.R.; Lewis, M.R.; Production of Pm-149 and Comparison to Ho-166 and Lu-177 for Radioimmunotherapy, 38<sup>th</sup> Midwest Regional Meeting, Columbia, MO, November 5-7, 2003
47. Engelbrecht, H., D. Papagionnopolou, R. Kannan, K. Katti, A.R. Ketring, G.J. Ehrhardt, T. Hoffman, C.S. Cutler, S.S. Jurisson, "Evaluation of Ligands Containing S, P, and N Donors to Complex Rh-105 to Bombesin for the Potetnial Therapy of Prostate Cancer," 51<sup>st</sup> Society of Nuclear Medicine Annual Meeting, Philadelphia, PA, June 19-23, 2004
48. Lewis, M.R., H. Mohsin, G. Sivaguru, F. Jia, J.N. Bryan, T.D. Shelton, T.J. Hoffman, C.S. Cutler, A.R. Ketring, P.S. Athey, J. Simón, R.K. Frank, L.J. Theodore, D.B. Axworthy and S.S. Jurisson, "Radiolanthanides for Pretarget and Conventional Radioimmunotherapy of Cancer," World Conference on Magic Bullets, Celebrating Paul Ehrlich's 150<sup>th</sup> Birthday, Nürnberg, Germany, September 2004
49. Engelbrecht, H.P., L.J. Forbis, Liu, S., M.R. Lewis, J.R. Lever, L.D. Watkinson, T.L. Carmack, Ketring A.R.; and Cutler C.S.; Initial Investigation of Pm-149-SU015 as a  $\alpha_v\beta_3$  antagonist," MU Missouri Life Sciences Week 2005, Columbia, MO, April 11-15, 2005
50. Cutler, C.S., G.J. Ehrhardt, H.P. Englebrecht and A.R. Ketring, "Radiopharmaceutical Research at MURR," Chemical Engineering Division, Argonne National Laboratory, Chicago, IL, May 2005
51. Engelbrecht, H.P., L.J. Forbis, S. Liu, M.R. Lewis, J.R. Lever, L.D. Watkinson, T.L. Carmack, A.R. Ketring and C.S. Cutler, "Biodistribution and Stability Studies of Pm-149-DOTA-Conjugated Vitronectin Receptor ( $\alpha_v\beta_3$ ) Antagonist-SU015," 52<sup>nd</sup> Annual Meeting of the Society of Nuclear Medicine, Toronto, Canada June 18-25, 2005
52. Cutler, C.S., W.P. Li, N.Y. Hsu, H.P. Engelbrecht, L.J. Forbis, M.F. Embree, A.R. Ketring, C.J. Anderson and W.H. Miller, "Preparation and Biological Evaluation of Promethium-149-DOTA-TYR3-Octreotate," 52<sup>nd</sup> Annual Meeting of the Society of Nuclear Medicine, Toronto, Canada, June 18-25, 2005
53. Cutler, C.S., M.R. Lewis, H.P. Engelbrecht, Forbis, L., Embree, M.F. and A.R. Ketring, Evaluation of Radiolanthanides for Radiotherapy. 24th Rare Earth Research Conference, Keystone, CO, June 2005
54. Lewis, M.R., H. Mohsin, G. Sivaguru, F. Jia, J.N. Bryan, C.S. Cutler, A.R. Ketring, P.S. Athey, J. Simon, R.K. Frank, L.J. Theodore, D.B. Axworthy and S.S. Jurisson, "Therapeutic radiolanthanides for antibody pretargeting: comparisons of delivery platforms, dose rates, and radiation energetics," Pacifichem 2005, Honolulu, HI, December 2005
55. Lynch, W., P. Mayer, L. Murray, D. Ladderdash, C.S. Cutler and A.R. Ketring, "Quality Control of <sup>177</sup>Lu," Annual Meeting of the European Association of Nuclear Medicine, Istanbul, Turkey, October 2005, *Eur J Nucl Med* **32**:S208, 2005
56. (invited) Cutler, C.S., M.R. Lewis, H.P. Engelbrecht and A.R. Ketring, "Development and Evaluation of High Specific Activity Radioisotopes for Radiotherapy," International Conference on Radiopharmaceutical Therapy, Limassol, Cyprus, October 2005
57. (invited) Cutler, C.S., M.R. Lewis, T.J. Hoffman, Anderson, C.J., H.P. Engelbrecht, A.R. Ketring, "Production and Evaluation of High Specific Activity Radioisotopes," Plenary Lecture for the Final meeting of the COST (European Cooperation in the Fields of Science and Technology) Chemistry Action D18 entitled Lanthanide Chemistry for Diagnosis and Therapy, Orleans, France, March 31-April 1, 2006
58. Rold, T.L., J.C. Garrison, G.L. Sieckman, S.N. Carter, N.R. Bell, C.J. Smith, C.S. Cutler, A.R. Ketring and T.J. Hoffman, "Targeting BB2 Receptor Expression in Prostate Cancer Using Promethium-149 Labeled Peptides," 96th Annual Meeting of the American Association for Cancer Research, Washington, DC, April 16-20, 2006

59. Engelbrecht, H.P., M.F. Embree, S. Liu, T. Hoffman, T.L. Rold, A.R. Ketring and C.S. Cutler, "Evaluation of  $^{149}\text{Pm}$ -DOTA Conjugated Vitronectin Receptor ( $\alpha_v\beta_3$ ) Antagonist in a Human Prostate Cancer Tumor Model," 53<sup>rd</sup> Annual Meeting of the Society of Nuclear Medicine Meeting, San Diego, CA, June 3-7, 2006
60. Irwin, D., M.C. Chandia, T.L. Rold, H.P. Engelbrecht, Ehrhardt, G., T. Hoffman, A.R. Ketring and C.S. Cutler, " $^{177}\text{Lu}$  Labeled Radiopharmaceuticals as Potential Palliative Bone Agents," MU Life Sciences Week, Columbia, MO, April 17-21, 2006
61. Bommarito, D.A., J.N. Bryan, C.S. Cutler, J.C. Lattimer, A.R. Ketring and C.J. Henry, "Systemic Toxicity of Lu-177-DOTMP Administered Intravenously To Normal Dogs," Proceedings of the Veterinary Cancer Society Annual Conference, Fort Lauderdale, FL, November 1-4, 2007

### **SEMINARS, LECTURES AND OTHER PRESENTATIONS**

- "Radiopharmaceutical Research at MU," MU Asian Affairs Center, All China Youth Federation Doctors Group, Columbia, MO October 28, 2002
- "Radiopharmaceutical Research at the MU Research Reactor: Past and Present," MU Health Management and Informatics Seminar, Columbia, MO, April 8, 2003
- "Reactor Nuclide Availability from MURR," NIH/SNM Workshop on Radionuclide Availability: Research and Beyond, Gaithersburg, MD, September 15, 2003
- "Medical Research Using Radiopharmaceuticals," MU Department of Surgery Research Conference, Columbia, MO, February 3, 2005
- "Quality Control Testing of  $^{177}\text{Lu}$ ," poster presentation authored by W. Lynch, P. Mayer, L. Murray, D. Ladderbush, C. Cutler, A. Ketring, EANM'05 - Annual Congress of the European Association of Nuclear Medicine, Istanbul, Turkey, October 15 - 19, 2005
- "Radioisotope Production at MURR," Sandia National Laboratory, Albuquerque, NM, August 16, 2005
- "Workshop on "Strategic Planning for Sustainability and Networking—Latin Region," International Atomic Energy Agency, Vienna, Austria, August 30-September 2, 2005

### **SESSIONS ORGANIZED/CHAired AT NATIONAL/INTERNATIONAL MEETINGS**

- Radioisotope Production-I, Embedded Topical Meeting I: Isotope Production and Applications at the American Nuclear Society Winter Meeting, Albuquerque, NM, November 16-20, 1997, Session Organizer: Alan R. Ketring, Chair: Alan R. Ketring
- Radioisotope Production-II, Embedded Topical Meeting I: Isotope Production and Applications, American Nuclear Society Winter Meeting, Albuquerque, NM, November 16-20, 1997, Session Organizer: Alan R. Ketring, Chair: Alan R. Ketring
- Radiopharmacy/Radiochemistry-Techneium/Tumor Markers/PET: World Congress of Nuclear Medicine, Santiago, Chile, September 29-October 4, 2002, Chairs: Alan R. Ketring and August Schubiger
- Proposal Reviewer, US Civilian Research and Development Foundation, 1999-Present
- Ambassador, 15th International Symposium on Radiopharmaceutical Chemistry & Biology, Sydney, Australia, August 10-14, 2003, 2003-present
- Isotopes for Medicine and Industry, Embedded Topical Meeting II: Reactor Production of Medical Isotopes, American Nuclear Society Meeting, June 8-12, 2008, Session Organizers: Alan R. Ketring and Marc Garland, Chair: Alan R. Ketring

### **PATENTS**

#### ***Patents Filed, but not issued:***

- "Cationic Lipophilic Complexes of  $^{99\text{m}}\text{Tc}$ (I) for Use as Myocardial Imaging Agents," filed June 1984, E.A. Deutsch, K. Libson, A.R. Ketring and J.-L. Vanderheyden, at University of Cincinnati, Cincinnati, OH

- “Cationic Lipophilic Complexes of  $^{99m}\text{Tc}$  Containing Phosphonite, Phosphinite, Arsonite or Arsinite Ligands for Use as Myocardial Imaging Agents,” filed October 1984, E.A. Deutsch, J. Bhatia, W. Hirth and A.R. Ketring, at University of Cincinnati, Cincinnati, OH
- “Thioether Compounds for Use in Preparing Bifunctional Chelating Agents for Therapeutic Radiopharmaceuticals,” filed May 1994, M. Venkatesh, S.S. Jurisson, E.O. Schlemper, A.R. Ketring and W.A. Volkert, at University of Missouri, Columbia, MO

**Patents Issued:**

- “Metal Ion Labeling of Carrier Molecules,” No. 4,732,974, issued March 22, 1988, R.A. Nicoletti, K. Y. Pak and A.R. Ketring, at Mallinckrodt, Inc., St. Louis, MO
- “Procedure for Isolating and Purifying Radioactive Ligated Rhenium Pharmaceuticals and Use Thereof and Kit,” No. 4,935,222, issued June 16, 1990, E.A. Deutsch, H.R. Maxon, K.F. Libson and A.R. Ketring, at University of Cincinnati, Cincinnati, OH
- “Method for Treating Liquid Wastes,” No. 5,478,474, issued December 26, 1995, K.V. Katti, W.A. Volkert, P.R. Singh and A.R. Ketring, at University of Missouri, Columbia, MO
- “Multifunctional Ligand for Use as a Diagnostic or Therapeutic Pharmaceutical,” No. 5,516,940, issued May 14, 1996, K.V. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “New Multifunctional Ligands for Potential Use in the Design of Therapeutic or Diagnostic Radiopharmaceutical Imaging Agents,” No. 5,601,800, issued February 11, 1997, K.V. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “Hydroxyalkyl Phosphine Gold Complexes for Use as Diagnostic and Therapeutic Pharmaceuticals and the Method of Making Same,” No. 5,843,993, issued December 1, 1998, K.V. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “Hydroxymethyl Phosphine Compounds for Use as Diagnostic and Therapeutic Pharmaceuticals and the Method of Making Same,” No. 5,855,867, issued January 5, 1999, K.V. Katti, P.R. Singh, S. Reddy, K.K. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “Hydroxyalkyl Phosphine Compounds for Use as Diagnostic and Therapeutic Pharmaceuticals and the Method of Making Same,” No. 5,876,693, issued March 2, 1999, K.V. Katti, P.R. Singh, S. Reddy, K.K. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “Conjugate and Method for Forming Aminomethyl Phosphorus Conjugates,” No. 5,948,386, issued September 7, 1999, K.V. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “Hydroxymethyl Phosphine Compounds for Use as Diagnostic and Therapeutic Pharmaceuticals and Method of Making Same – Purifying by Exposing a Mixture of Uncoordinated Hydroxyalkyl Phosphine Groups and Coordinated Hydroxyalkyl Phosphine Groups to an Amine to Separate the Unbound Coordinated Groups from the Bound Uncoordinated Groups,” No. 5,855,867, issued April 25, 2000, K.V. Katti, P.R. Singh, S. Reddy, K.K. Katti, W.A. Volkert and A.R. Ketring, at University of Missouri, Columbia, MO
- “Hydroxymethyl Phosphine Compounds for Use as Diagnostic and Therapeutic Pharmaceuticals and Method of Making Same,” European Patent No. 1,009,447, issued August 10, 2005, Katti, Kattesh V., Srinivasa Rao Karra, Douglas E. Berning, C. Jeffrey Smith, Wynn A. Volkert and Alan R. Ketring, at University of Missouri, Columbia, MO

**DISSERTATIONS AND/OR THESES CO-DIRECTED**

- Fang Hu, MA Chemistry, University of Missouri, December 2000: “Pm-149 DOTA Bombesin Analog Studies”
- Dangshe MA, PhD Chemistry, University of Missouri, December 1996: “Radiotherapeutic Potential of the  $^{166}\text{Dy}/^{166}\text{Ho}$  *In-Vivo* Delayed Dose Generator and High Specific Activity  $^{166}\text{Ho}$ ”
- Wei Jia, PhD Chemistry, University of Missouri, May 1996: “Reactor Production of Some High Specific Activity Isotopes”



Mefang Wang, MS Chemistry, University of Missouri, December 1992: “New  $^{99m}\text{Tc}$  and  $\text{Pd}/^{109}\text{Pd}$  complexes of P-N Ligands”

Lixin Lang, PhD Chemistry, University of Missouri, May 1992: “Radiolabelled Proteins with Bifunctional Chelating Agents”

Wei Jia, MS Chemistry, University of Missouri, December 1991: “A Study of Rhenium Labelled HSA Microspheres as a Radiation Synovectomy Agent”

J. Christopher Johnson, PhD Engineering, University of Missouri, August 1989: “Determination of Dose Factors at Bone to Marrow Interface by Monte Carlo Methods”

Phillip Clark, MS Chemistry, University of Missouri, August 1988: “Solution Chemistry of EDTMP Complexes which are Potential Therapeutic Bone Agents”

Brent Grazman, MS Chemistry, University of Missouri, August 1986: “The Production and Purification of Rh-105”

### GRADUATE COURSES TAUGHT

Chemistry 335: Nuclear Chemistry, WS 1993 and FS 1994

Chemistry 461: Advanced Radiochemistry, FS 1992, FS 1995 and FS 1997

Radiology 400: Radiopharmaceutical Chemistry, FS 1991

### UNDERGRADUATE COURSES TAUGHT

Chemistry 31: General Chemistry 1, WS 1997

Chemistry 361: Introduction to Radiochemistry, WS 1991 (2 lec.) and WS 1996

### GRANTS ACTIVITY

Proposal Reviewer, US Civilian Research and Development Foundation, 1999-Present

#### *Awarded Grants*

Supply of Radioisotopes to Dow: Dow Chemical Co., Ketring (PI); (awarded 5/88-4/90 @ \$283,527 total) (Amendment: 4/89-4/90 additional \$15,632) (Renewal: 5/90-10/90 @ \$80,762) (Renewal: 11/90-4/91 @ \$80,762) (Renewal: 5/91-10/91 @ \$80,762) (Renewal: 11/91-4/92 @ \$80,762) (Renewal: 5/92-10/92 @ \$80,762) (Renewal: 11/92-4/93 @ \$80,762) (Renewal: 5/93-10/93 @ \$80,762). Total = \$864,493

Photoaffinity Labeling of MAbs: Department of Energy; Volkert (PI), Ketring (CoI) and Kuntz (CoI); Awarded: (9/89-8/92 @ \$502,974 total); Extension: (9/92-10/92 @ \$22,814); (Renewal: 11/92-10/95 \$589,310 total) Total = \$1,092,284

Bifunctional Chelates of Rh-105 and Au-199 as Potential Radiotherapeutic Agents: Department of Energy; Schlemper (PI), Ketring (CoI); Continuation: (6/90-5/91 \$144,353); (6/91-5/92 \$151,544); Extension: 7/92-6/93 \$142,000. Total = \$437,897

Further Development of the W-188/Re-188 Gel Generator for Radiotherapy, Mallinckrodt Medical Inc., Ehrhardt (PI), Ketring (CoI), Awarded: (6/91-5/92 @ \$39,587)

Development of New MRI Contrast Agents and Radiopharmaceuticals, Mallinckrodt Medical, Inc., Ketring (PI), Katti (Co-PI) and Volkert (Co-PI); Awarded: (6/1/92-5/31/94 @ \$307,815)

Development of Facilities for the Supply of Holmium-166 and Samarium-153, Mallinckrodt Medical, Inc., Ketring (PI), Awarded: (6/1/92-5/31/93 @ \$70,000)(Renewal: 6/1/93-5/31/94 @ \$73,398) (Renewal: 6/1/94-6/30/95 @ \$87,535) (Renewal: 7/1/95-6/30/96 @ \$96,605) (Renewal: 7/1/96-9/30/97 @ \$116,527) (Renewal: 10/1/97-9/30/98 @ \$138,770)(Renewal: 10/1/98-9/30/99 @ 145,689 Ehrhardt (CoI)). Total \$728,524

Development of Mo-99/Tc-99m Gel Generator, Mallinckrodt Medical, Inc., Ehrhardt (PI) and Ketring (CoI); Awarded: (11/92-10/93 @ \$49,990)

- Utility of Phosphinimine and Related Ligands for the Design of New Tc-99m or Re-186 Radiopharmaceuticals, Dupont Merck Radiopharmaceutical Co., Katti (PI), Volkert (CoI), Ketring (CoI) and Singh (CoI) Awarded: (12/1/93-11/30/94 @ \$118,922) (Renewal: 12/1/94-11/30/95 @ \$139,108) (Renewal: 12/1/95-11/30/96 @ \$140,617) (Renewal: 12/1/96-11/30/98 @ \$296,562). Total = \$695,210
- Development of New Procedures for Processing and Supply of Rh-105, Johnson Matthey Ltd., Ketring (PI); Awarded: 2/1/94-1/31/95 @ \$25,000
- Novel Strategies for the Formation of New Site-Directed Diagnostic and Therapeutic Radiopharmaceuticals, Department of Energy; Volkert (PI), Ketring (CoI), Kattesh Katti (CoI) and Forte (CoI); Awarded: 11/1/95-10/31/98 @ \$598,000
- Development of Procedures for the Processing and Supply of P-33, Dupont NEN Research Products, Ketring (PI); Awarded: 10/1/94-9/30/95 @ \$50,528
- Development of Mo-99/Tc-99m Gel Generator, Mallinckrodt Medical, Inc., Ehrhardt (PI) and Ketring (CoI); Awarded: 2/1/95-1/30/96 @ \$59,714
- Supercritical Fluid Extraction of Tc-99 from Radioactive Waste, UM Research Board, Jurisson (PI), Kauffman (CoI) and Ketring (CoI); Awarded 6/1/95-12/31/96 @ \$40,000
- Labelling Peptides with Rh-105 as Potential Radiotherapeutic Agents, Mallinckrodt Medical, Inc., Jurisson (PI) and Ketring (CoI): Awarded 3/1/96-12/31/97 @ \$70,664
- Receptor Seeking Lanthanides Complexes as Potential Radiopharmaceuticals, Mallinckrodt Medical, Inc., Ketring (PI) and Jurisson (CoI); Awarded 3/1/96-12/31/97 @ \$70,810
- Development of Production Methods and Supply of Reactor-Produced Radioisotopes, DuPont Merck Pharmaceutical Co., Ketring (PI) and Ehrhardt (CoI 1998)/Cutler (CoI 1999); Awarded 12/19/97-12/31/00 @ \$469,920
- Development of Facilities for the Supply of Holmium-166 and Samarium-153, Mallinckrodt Medical, Inc., Ketring (PI) and Ehrhardt (CoI), 6/1/92-9/30/99 @ \$728,524
- Reactor Sharing Program, DOE, Ketring, A.R (PI), 8/15/99-5/31/00 @ \$72,000 (total award \$1,269,000, 9/1/80-8/14/00)
- Development of Production Methods for Carrier-Free Lanthanides for Radiotherapy, DOE Advanced Nuclear Medicine Initiative (ANMI), Ketring A.R (PI) and Cutler C.S (Co-I), \$747,797, 10/1/00-9/30/06,
- Bryan, J.N. (PI) with C.J. Henry, C.S. Cutler, A.R. Ketring and J.C. Lattimer (Co-Is), "Systemic toxicity of <sup>177</sup>Lu-DOTMP administered intravenously to normal dogs," \$23,887, 9/1/06-9/1/07 [MU Research Reactor Partnership Initiatives and Scott Endowed Program in Veterinary Oncology]