File: Curriculum Vitae-CONRAD, Gary W-12-09-2010 Updated: 12-09-2010

Name Gary W. Conrad Year Born 1941

Title University Distinguished Professor

Degrees B.S., Union College, Schenectady, NY, 1963, with Honors in Biology
Mentor: Raymond Rappaport
M.S. in Biology, Yale University, New Haven, CT, 1965
Mentor: J.P. Trinkaus
Ph.D. in Biology, Yale University, New Haven, CT, 1968
Mentor: J.P. Trinkaus

Experience

Lillian J. Brychta Professor of Biology, 2008-2013
University Distinguished Professor, Division of Biology, Kansas State University, 1998-present
Sabbatical, Institut d'Embryologie Céllulaire et Moléculaire, Paris, France, 1991-1992 (with Dr. Nicole M. LeDouarin)
Sabbatical, Physiological Laboratory, Cambridge University, England, 1984-1985 (with Dr. Timothy J. Rink)
Sabbatical, Max-Planck-Institute für Biochemie, Munich, West Germany, 1977-1978 (with Dr. Klaus von der Mark)
Professor, Division of Biology, Kansas State University, 1980-1998
Associate Professor, Division of Biology, Kansas State University, 1975-1980
Assistant Professor, Division of Biology, Kansas State University, 1971-1975
Postdoctoral Fellow, Dept. of Pediatrics, University of Chicago, 1968-1970
Mentor: Albert Dorfman

Fields of Research Competence

General: Cellular and Developmental Biology

Specifically:
1) Differentiation of connective tissue cells, especially during eye development: molecular biology and biochemistry of proteoglycans and structural proteins and their roles in regulating innervation and transparency of the cornea.
2) Mechanisms of cytokinesis and changes in cellular shape: roles of "contractile proteins, changes in intracellular ionic activity, and effects of heavy metals.

Courses Taught at KSU

Developmental Biology (BIOL-510); Developmental Biology Laboratory (BIOL-511); Developmental Biology I (215-420); Developmental Biology II (215-665); Developmental Biology Laboratory (215-666); Advanced Cellular and Developmental Biology (215-868); Advanced Topics in Biology (Extracellular Macromolecules) (215-890 and 215-679); Problems in Biology (215-698) supervision of undergraduate research projects; Principles of Biology (215-198); Cellular and Developmental Biology (215-440); Embryology (215-510); Mechanisms of Embryogenesis (215-665);

Advanced Cell Biology (Biol-707); Developmental Biology of Plants and Animals (BIOL-405); Organized weekly seminar in Cellular and Developmental Biology (215-895); Growth Factors in Cellular and Developmental Biology (BIOL-890); Cellular and Developmental Biology of the Nervous System (BIOL-697, BIOL-890, and BIOL-622).

Honors and Awards

USPHS (NIH) Predoctoral Fellowship, 1965-1968 (5-F1-GM-32,877-02)
USPHS (NIH) Postdoctoral Fellowship, 1968-1970 (5-F02-AM-32,877-02)
Dahlgren Research Fellowship for marine research at Mount Desert Island Biological Lab, Maine - 1971. Same fellowship was offered for summer research during 1972 and 1973
Elected to membership in the International Society of Developmental Biologists, June, 1975
Selected for inclusion in American Men and Women of Science, 1977
Invited to be a member of grant review panels by NIH (1977, 1979, 1980, 1981, 1987) and by NASA (1978)
Invited to be a co-chairman of a platform session at Cell Biology Meetings: 1977, San Diego; Cincinnati, 1980
Invited to write a review on cytokinesis for book, Academic Press (1980)
Invited to chair a session of a Gordon Conference on Basement Membranes (1982)
Mid-America State Universities Association (MASUA) - Honors Lecturer (1982-1983)
Senior International Fellowship (#1) from The Fogarty International Center of NIH (for sabbatical in Cambridge, England, 1984-1985) (1-F06-TW00874-01)
Invited to give a lecture, Sixth Intl. Congress of Eye Research, Alicante, Spain (1984), Seventh Intl. Congress of Eye Research, Nagoya, Japan (1986), and Thirteenth Intl. Congress of Eye Research, Paris, France (1998)
Elected as a Fellow of the AAAS (1987)
Chairman of poster session, ARVO (1987) and of platform session (1988,1994,1996), and symposium speaker (1988)
Adhoc reviewer for NIH Study Sections on Pathobiochemistry (1987), and Anterior Eye Disease (2006)
Appointed to research peer review committee, American Heart Assoc., Kansas Affiliate (1988-1991)
Appointed to Fight For Sight, Inc., Fellowship Review Board (1989-1991)
Mount Desert Island Biological Laboratory: Elected Trustee (78-81; 88-94); Appointed member of Executive Committee (79-81), Scientific Advisory Committee (87-91), Seminar Committee (78,79, 82 (Chr, 83,84), 88-91, 94-), Library Committee (84, (Chr, 85-91; Co-Chr, 92-96)), Publication Committee (78,79), Fundraising Committee (80-84), Adhoc Long-Range Planning Committee (78,79), Development Committee (83-86), Governance Committee (Co-Chr, 79), Noon-time Seminar Committee (Co-Chr, 79,80), Nominating Committee (93), Nominated to be Director (92) Co-organizer/Co-editor with T.E. Schroeder of a Workshop on Cytokinesis: Mechanisms of Furrow Formation During Cell Division, co-sponsored by the Mount Desert Island Biological Laboratory (Salsbury Cove, Maine) and the New York Academy of Sciences (1989)

Senior International Fellowship (#2) from The Fogarty International Center of NIH (for sabbatical in Nogent-sur-Marne (Paris), France, 1991-1992) (1-F06-TW01688-01/ICP(6))
Recipient of the 1995 William Stamey Teaching Award - College of Arts and Sciences
Recipient of the 1996 CONOCO Distinguished Graduate Faculty Award (nominated in 1995)
Nominated for 1996 Burroughs Wellcome Fund Toxicology Scholar Award
Recipient of the 1996 Alcon Research Institute-Research Achievement Award in Ophthalmology (Award = $100,000) (9 such awards were made, world-wide)
Chair of local committee for a Symposium on Aqueous Humor Formation and the Development of New Carbonic Anhydrase Inhibitors, in honor of Dr. Thomas H. Maren, at the Mount Desert Island Biological Laboratory, Salsbury Cove, Maine, June 27, 1997. Sponsored by Merck and Co., Inc.
Invited to organize and be a speaker in a symposium on "Fibroblast Differentiation" as part of the XIIIth International Congress of Eye Research (ICER), Paris, France, July 26-31, 1998
Invited to contribute a review article on "Corneal Development and Innervation" to Progress in Retinal and Eye Research. Invitation from Dr. N. Osborne, Editor, Oxford University, England
Invited to contribute a review article on "Proteoglycans of the Cornea" to Cellular and Molecular Life Sciences. Invitation from Professeur P. Jollès, Editor-in-Chief, Muséum National d'Histoire Naturalle, Paris, France
Appointed KSU University Distinguished Professor, 1998
Invited to contribute a review for a 3-volume series entitled "Saccharides in Chemistry and Biology: A Comprehensive Handbook". Topic: "Biological Roles of Keratan Sulfate Proteoglycans", 2000
Nominated for the 1995, 1996, and 1998 Higuchi/Endowment Research Achievement Award (University of Kansas)
Recipient of the 2006 Dolph C. Simons, Sr., Research Achievement Award in the Biomedical Sciences, Higuchi Foundation, University of Kansas, Lawrence, KS (Award = $10,000).
Biology Graduate Student Association – Outstanding Graduate Faculty Award – 2010.

Membership in Professional Societies

Society for Complex Carbohydrates (Society for Glycobiology)
Society for Developmental Biology
American Society for Cell Biology (ASCB)
American Association for the Advancement of Science (AAAS)
Association for Research in Vision and Ophthalmology (ARVO)
International Society for Developmental Biology
American Society for Gravitational and Space Biology (ASGSB)
American Chemical Society (ACS)

Publications [all are peer-reviewed, unless noted otherwise]

1. Rappaport, R., and G. W. Conrad. 1963. An experimental analysis of unilateral cleavage in invertebrate eggs. J. Exptl. Zool. 153:99-112.

2. Conrad, G. W. 1970. Collagen and mucopolysaccharide biosynthesis in the developing chick cornea. Develop. Biol. 21:292-317.

3. Conrad, G. W. 1970. Collagen and mucopolysaccharide biosynthesis in mass cultures and clones of chick corneal fibroblasts in vitro. Develop. Biol. 21:611-635.

4. Conrad, G. W., D. Sherman, and A. Dorfman. 1972. An ultrastructural comparison of normal and Hurler syndrome dermal fibroblasts. Pediatric Res. 6:563-575.

5. Conrad, G. W., D. C. Williams, F. R. Turner, K. M. Newrock, and R. A. Raff. 1973. Microfilaments in the polar lobe constriction of fertilized eggs of Ilyanassa obsoleta. J. Cell Biol. 59:228-233.

6. Conrad, G. W. 1973. Control of polar lobe formation in fertilized eggs of Ilyanassa obsoleta Stimpson. Amerc. Zool. 13:961-980 (invited, non-refereed review).

7. Conrad, G. W., and D. C. Williams. 1974. Polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta. I. Ultrastructure and effects of cytochalasin B and colchicine. Develop. Biol. 36:363-378.

8. Conrad, G. W., and D. C. Williams. 1974. Polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta. II. Large bleb formation caused by high concentrations of exogenous calcium ions. Develop. Biol. 37:280-294.

9. Conrad, G. W. and A. Dorfman. 1974. Synthesis of sulfated mucopolysaccharides by chick corneal fibroblasts in vitro. Exptl. Eye Res. 18:421-433.

10. Conrad, G. W., and G. W. Hart. 1975. Heparan sulfate biosynthesis by embryonic tissues and primary fibroblast populations. Develop. Biol. 44:253-269.

11. Spooner, B. S., and G. W. Conrad. 1975. The role of extracellular materials in cell movement. I. Inhibition of mucopolysaccharide synthesis does not stop ruffling membrane activity or cell movement. J. Cell Biol. 65:286-297.

12. Conrad, G. W., G. W. Hart, and Y. Chen. 1977. Differences in vitro between fibroblast-like cells from cornea, heart, and skin of embryonic chicks. J. Cell Sci. 26:119-137.

13. Conrad, G. W., C. Hamilton, and E. Haynes. 1977. Differences in glycosamino-glycans synthesized by fibroblast-like cells from chick cornea, heart, and skin. J. Biol. Chem. 252:6861-6870.

14. Conrad, G. W., A. E. Kammer, and G. F. Athey. 1977. Membrane potential of fertilized eggs of Ilyanassa obsoleta during polar lobe formation and cytokinesis. Develop. Biol. 57:215-220.

15. Conrad, G. W., and S. E. Davis. 1977. Microiontophoretic injection of calcium ions or of cyclic AMP causes rapid shape changes in fertilized eggs of Ilyanassa obsoleta. Develop. Biol. 61:184-201.

16. von der Mark, K., and G. W. Conrad. l979. Cartilage cell differentation - A review. Clinical Orthopaedics 139:185-205 (invited, non-refereed review).

17. Garrett, D. M., and G. W. Conrad. 1979. Fibroblast-like cells from embryonic chick cornea, heart, and skin are antigenically distinct. Develop. Biol. 70:50-70.

18. Conrad, G. W., and S. E. Davis. 1980. Polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta. III. Large bleb formation caused by Sr^{+2}, Ionophores X537A and A23l87, and Compound 48/80. Develop. Biol. 74:152-172.

19. Schmidt, B. A., P. T. Kelly, M. C. May, S. E. Davis, and G. W. Conrad. 1980. Characterization of actin from fertilized eggs of Ilyanassa obsoleta during polar lobe formation and cytokinesis. Develop. Biol. 76:126-140.

20. Conrad, G. W., and M.-L. Woo. 1980. Synthesis of 3'-phosphoadenosine-5'-phosphosulfate (PAPS) increases during corneal development. J. Biol. Chem. 255:3086-3091.

21. Conrad, G. W., W. Dessau, and K. von der Mark. 1980. Synthesis of type III collagen by fibroblasts from the embryonic chick cornea. J. Cell Biol. 84:501-512.

22. Beckenhauer, D. M., and G. W. Conrad. 1981. The effect of thyroxine on transparency and PAPS synthesis in the avian cornea. Develop. Biol. 84:225-229.

23. Conrad, G. W., P. T. Kelly, K. von der Mark, and H. F. Edelhauser. 1981. A comparative study of elasmobranch corneal and scleral collagens. Exptl. Eye Res. 32:659-672.

24. Kelly, P. T., K. von der Mark, and G. W. Conrad. 1981. Identification of collagen types I, II, III, and V by two-dimensional fingerprinting of ^{125}I-peptides. Anal. Biochem. 112:105-116.

25. Conrad, G. W., and R. Rappaport. 1981. Mechanisms of cytokinesis in animal cells. In: "Cellular Dynamics: Mitosis and Cytokinesis," A.M. Zimmerman and A. Forer, eds.; Academic Press) pp. 365-396 (invited, non-refereed review chapter for a book).

26. Conrad, G. W., P. Ager-Johnson, and M.-L. Woo. 1982. Antibodies against the predominant glycosaminoglycan of the mammalian cornea, keratan sulfate-I. J. Biol. Chem. 257:464-471.

27. Bee, J. A., N. C. Unruh, D. L. Sommerfeld, and G. W. Conrad. 1982. Avian corneal innervation: Inhibition of nerve ring formation by 6-diazo-5-oxo-L-norleucine. Develop. Biol. 92:123-132.

28. Conrad, G. W. 1982. Authorship and responsibility in scientific publications and manuscript reviews. Trends in Biochem. Sciences 7:167-168 (invited, non-refereed opinion).

29. Rintoul, D.A., R.D. Creed, and G.W. Conrad. 1984. Changes in chick corneal lipids during development. Investigative Ophthalmology 25:1151-1155.

30. Conrad, G. W. 1984. Intracellular chloride activity and pH during polar lobe formation and cytokinesis in eggs and embryos of Ilyanassa obsoleta. J. Exptl. Zoology 232:107-115.

31. Bee, J.A., R.A. Hay, E.M. Lamb, J.J. Devore, and G.W. Conrad. 1986. Positional specificity of corneal nerves during development. Investigative Ophthalmology 27:38-43.

32. Conrad, G.W., and P.E. Vernon. 1986. Effects of local anesthetics on cytokinesis and polar lobe formation in fertilized eggs of Ilyanassa obsoleta. Intl. J. Invert. Reprod. Devel. 9:195-207.

33. Funderburgh, J.L., B. Caterson, and G.W. Conrad. 1986. Keratan sulfate proteoglycan during embryonic development of the chicken cornea. Develop. Biol. 116:267-277.

34. Conrad, G.W., and T.J. Rink. 1986. Platelet Activating Factor raises intracellular calcium ion concentration in macrophages. J. Cell Biol. 103:439-450.

35. Sturges, S.A., and G.W. Conrad. 1987. Acetylcholinesterase activity in the cornea of the developing chick embryo. Invest. Ophthalmol. Vis. Sci. 28:850-858.

36. Funderburgh, J.L., B. Caterson, and G.W. Conrad. 1987. Distribution of proteo-glycans antigenically related to corneal keratan sulfate proteoglycan. J. Biol. Chem. 262:11634-11640.

37. Conrad, G.W., P.V. Glackin, R.A. Hay, and R.R. Patron. 1987. Effects of calcium antagonists, calmodulin antagonists, and methylated xanthines on polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta. J. Exptl. Zool. 243:245-258.

38. Conrad, G.W. 1988. Heavy metal effects on cellular shape changes, cleavage, and larval development of the marine gastropod mollusk, Ilyanassa obsoleta Say. Bull. Environ. Contam. Toxicol. 41:79-85.

39. Funderburgh, J.L., C. Cintron, H.I. Covington, and G.W. Conrad. 1988. Immuno-analysis of keratan sulfate proteoglycan from corneal scars. Invest. Ophthalmol. Vis.

Sci. 29:1116-1124.

40. Funderburgh, J.L., and G.W. Conrad. 1989. Detection and purification of corneal keratan sulfate proteoglycan from non-corneal tissues. In: "Keratan Sulfate Proteoglycans: Chemistry, Biochemistry, Biology, and Chemical Pathology" (eds., H. Greiling and J.E. Scott), The Biochemical Society: London. pp. 39-52 (invited, non-refereed research paper).

41. Funderburgh, J.L., N. Panjwani, G.W. Conrad, and J. Baum. 1989. Altered keratan sulfate epitopes in keratoconus. Invest. Ophthalmol. Vis. Sci. 30:2278-2281.

42. J.J. Devore, G.W. Conrad, and R. Rappaport. 1989. A model for astral stimulation of cytokinesis in animal cells. J. Cell Biol. 109:2225-2232.

43. Funderburgh, J.L., M.L. Funderburgh, M.M. Rodriques, J.H. Krachmer, and G.W. Conrad. 1990. Altered antigenicity of keratan sulfate proteoglycan in selected corneal diseases. Invest. Ophthalmol. Vis. Sci. 31:419-428.

44. Conrad, G.W., A.R. Schantz, and R.R. Patron. 1990. Mechanisms of polar lobe formation in fertilized eggs of molluscs. Ann. New York Acad. Sci. 582:273-294 (invited, non-refereed research paper).

45. Funderburgh, J.L., and G.W. Conrad. 1990. Isoforms of corneal keratan sulfate proteoglycan. J. Biol. Chem. 265:8297-8303.

46. Conrad, A.H., W.A. Clark, and G.W. Conrad. 1991. Subcellular compartmentalization of myosin isoforms in embryonic chick heart ventricle myocytes during cytokinesis. Cell Motility and Cytoskel. 19:189-206.

47. Jost, C.J., J.L. Funderburgh, M. Mann, J.R. Hassell, and G.W. Conrad. 1991. Cell-free translation and characterization of corneal keratan sulfate proteoglycan core proteins. J. Biol. Chem. 266:13336-13341.

48. Funderburgh, J.L., M.L. Funderburgh, M.M. Mann, and G.W. Conrad. 1991. Unique glycosylation of three keratan sulfate proteoglycan isoforms. J. Biol. Chem. 266:14226-14231.

49. Funderburgh, J.L., M.L. Funderburgh, M.M. Mann, and G.W. Conrad. 1991. Arterial lumican: Properties of a corneal-type keratan sulfate proteoglycan from bovine aorta. J. Biol. Chem. 266:24773-24777.

50. Funderburgh, J.L., M.L. Funderburgh, M.M. Mann, and G.W. Conrad. 1991. Physical and biological properties of keratan sulfate proteoglycan. Biochem. Soc.Trans. 19:871-876 (non-refereed, invited review).

51. Conrad, G.W., and A.H. Conrad. 1992. Microtubules as key cytoskeletal elements in cellular transport and shape changes: Their expected responses to space environments.

Trans. Kans. Acad. Sci. 95(1-2):45-49 (non-refereed, invited review).

52. Conrad, G.W., and J.L. Funderburgh. 1992. Eye development and the appearance and maintenance of corneal transparency. Trans. Kans. Acad. Sci. 95(1-2):34-38 (non-refereed, invited review).

53. Conrad, A.H., A.Q. Paulsen, and G.W. Conrad. 1992. The role of microtubules in contractile ring function. J. Exp. Zool. 262:154-165.

54. Conrad, S.H., and G.W. Conrad. 1992. The Rowland Institute. Science 257:1027 (Letter).

55. Conrad, G.W., C.A. Luer, A.Q. Paulsen, and J.L. Funderburgh. 1993. Preliminary observations on the effects of selenate on the development of the embryonic skate, Raja eglanteria. Trans. Kans. Acad. Sci. 96(1-2):62-68.

56. Conrad, G.W., A.P. Stephens, and A.H. Conrad. 1993. Preliminary observations on the effects of vector-averaged gravity on the embryonic and larval development of the gastropod mollusk, Ilyanassa obsoleta Stimpson. Trans. Kansas Acad. Sci. 96(1-2): 20-27.

57. Funderburgh, J.L., M.L. Funderburgh, S.J. Brown, J.-P. Vergnes, J.R. Hassell, M.M. Mann, and G.W. Conrad. 1993. Sequence and structural implications of a bovine corneal keratan sulfate proteoglycan core protein: Protein 37B represents bovine lumican and proteins 37A and 25 are unique. J. Biol. Chem. 268:11874-11880.

58. Conrad, A.H., R.A. Consigli, and G.W. Conrad. 1993. Expression of an avian polyomavirus, BFDV, affects myofibril structure in chick ventricle cardiomyocytes. J. Exptl. Zool. 267:253-266.

59. Conrad, A.H., A.P. Stephens, A.Q. Paulsen, S.S. Schwarting and G.W. Conrad. 1994. Effects of silver ions (Ag^{+}) on contractile ring function and microtubule dynamics during first cleavage in fertilized eggs of Ilyanassa obsoleta. Cell Motility and the Cytoskeleton 27:117-132.

60. Conrad, G.W., J.A. Bee, S.M. Roche, and M.-A. Teillet. 1993. Fabrication of microscalpels by electrolysis of tungsten wire in a meniscus. J. Neuroscience Methods 50:123-127.

61. Conrad, A.H., A.P. Stephens, and G.W. Conrad. 1994. The effect of hexylene glycol-altered microtubule distributions on cytokinesis and polar lobe formation in fertilized eggs of Ilyanassa obsoleta. J. Exptl. Zool. 269:188-204.

62. Conrad, G.W., A.Q. Paulsen, and C.A. Luer. 1994. Embryonic development of the cornea in the eye of the clearnose skate, Raja eglanteria. I. Stromal development in the absence of an endothelium. J. Exptl. Zool. 269:263-276.

63. Conrad, A.H., T. Jaffredo, and G.W. Conrad. 1995. Differential localization of cytoplasmic myosin II isoforms A and B in avian interphase and dividing embryonic and immortalized cardiomyocytes and other cell types in vitro. Cell Motility and the Cytoskeleton.31:93-112.

64. Funderburgh, J.L., M.L. Funderburgh, N.A. Hevelone, M.E. Stech, M.J. Justice, C.-Y. Liu, W.W.-Y. Kao, and G.W. Conrad. 1995. Sequence, molecular properties, and chromosomal mapping of mouse lumican. Invest. Ophthalmol. Vis. Sci. 36:2296-2302.

65. Corpuz, L., J.L. Funderburgh, M.L. Funderburgh, G. Bottomley, S. Prakash, and G.W. Conrad. 1996. Molecular cloning and tissue distribution of Keratocan: Bovine corneal keratan sulfate proteoglycan 37A. J. Biol. Chem. 271:9759-9763.

66. Funderburgh, J.L., M.L. Funderburgh, M.M. Mann, S. Prakash, and G.W. Conrad. 1996. Synthesis of corneal keratan sulfate proteoglycans by bovine keratocytes in vitro. J. Biol. Chem. 271:31431-31436.

67. Funderburgh, J.L., R.R. Mitschler, M.L. Funderburgh, M.R. Roth, S.K. Chapes, and G.W. Conrad. 1997. Macrophage receptors for lumican. A corneal keratan sulfate proteoglycan. Invest. Ophthlamol. Vis. Sci. 38(6):1159-1167.

68. Funderburgh, J.L., L.M. Corpuz, M.R. Roth, M.L. Funderburgh, E.S. Tasheva, and G.W. Conrad. 1997. Mimecan, the 25 kDa corneal keratan sulfate proteoglycan is a product of the gene producing osteoglycin. J. Biol. Chem. 272:28089-28095.

69. Ying, S., A. Shiraishi, C.W.-C. Kao, R.L. Converse, J.L. Funderburgh, J. Swiergiel, M.R. Roth, G.W. Conrad, and W.W.-Y. Kao. 1997. Characterization and expression of the mouse lumican gene. J. Biol. Chem. 272:30306-30313.

70. Tasheva, E.S., L.M. Corpuz, J.L. Funderburgh, and G.W. Conrad. 1997. Differential splicing and alternative polyadenylation generate multiple mimecan mRNA transcripts. J. Biol. Chem. 272:32551-32556.

71. Funderburgh, J.L., N.D. Hevelone, M.R. Roth, M.L. Funderburgh, M.R. Rodriques, V.S. Nirankari, and G.W. Conrad. 1998. Decorin and biglycan of normal and pathologic human corneas. Invest. Ophthalmol. Vis. Sci. 39:1957-1964.

72. Liu, C.-Y., A. Shiraishi, C.W.-C. Kao, R.L. Converse, J.L. Funderburgh, L.M. Corpuz, G.W. Conrad, and W.W.-Y. Kao. 1998. The cloning of mouse keratocan cDNA and genomic DNA and the characterization of its expression during eye development. J. Biol. Chem. 273:22584-22588.

73. Funderburgh, J.L., A.L. Perchellet, J. Swiergiel, G.W. Conrad, and M.J. Justice. 1998. Keratocan (*Kera*), a corneal keratan sulfate proteoglycan, maps to the distal end of mouse chromosome 10. Genomics 52:110-111.

74. Tasheva, E.S., J.L. Funderburgh, L.M. Corpuz, and G.W. Conrad. 1998. Cloning,

characterization, and tissue-specific expression of the gene encoding bovine keratocan, a corneal keratan sulfate proteoglycan. Gene 218:63-68.

75. Koo, S.J., J.D. Clark-Alderfer, H. Tanaka, M.-A. Teillet, B.Schuler, N.M. LeDouarin, and G.W. Conrad. 1998. Species-specific immunostaining of embryonic corneal nerves: Techniques for inactivating endogenous peroxidases and demonstration of lateral diffusion of antibodies in the plane of the corneal stroma. J. Neuroscience Meth. 85:63-71.

76. Conrad, A.H., M.A. Behlke, T. Jaffredo, and G.W. Conrad. 1998. Optimal lipofection reagent varies with the molecular modifications of the DNA. AntiSense and Nucleic Acid Drug Development 8:427-434.

77. Tasheva, E.S., J.L. Funderburgh, M.L. Funderburgh, L.M. Corpuz, and G.W. Conrad. 1999. Structure and sequence of the gene encoding human keratocan. DNA Sequence 10: 67-74.

78. Conrad, A.H., C.R. Tramp, C.J. Long, D.C. Wells, A.Q. Paulsen, and G.W. Conrad. 1999. Ag^{+} alters cell growth, neurite extension, cardiomyocyte beating, and fertilized egg constriction. Aviation, Space, and Environmental Medicine 70:1096-1105.

79. Tasheva, E.S., M.L. Funderburgh, J. McReynolds, J.L. Funderburgh, and G.W. Conrad. 1999. The bovine mimecan gene: Molecular cloning and characterization of two major RNA transcripts generated by alternative use of two splice acceptor sites in the third exon. J. Biol. Chem. 274:18693-18701.

80. Barrett, J.E., D.C. Wells, and G.W. Conrad. 1999. Pretreatment methods to improve nerve immunostaining in corneas from long-term fixed embryonic quail eyes. J. Neuroscience Methods 92:161-168.

81. Barrett, J.E., D.C. Wells, A.Q. Paulsen, and G.W. Conrad. 2000. Embryonic quail eye development in microgravity. J. Applied Physiol. 88:1614-1622.

82. Tasheva, E.S., M. Pettenati, C. Von Kap-Her, and G.W. Conrad. 2000. Assignment of mimecan (OGN) gene to human chromosome 9 band q22 by *in situ* hybridization. Cytogenetics & Cell Genetics 88:326-327.

83. Tasheva, E.S., M. Pettenati, C. Von Kap-Her, and G.W. Conrad. 2000. Assignment of keratocan (KERA) gene to human chromosome 12 band q22 by *in situ* hybridization. Cytogenetics & Cell Genetics 88:244-245.

84. Long, C.J., M.R. Roth, E.S. Tasheva, M. Funderburgh, R. Smit, G.W. Conrad, and J.L. Funderburgh. 2000. Fibroblast growth factor-2 promotes keratan sulfate proteoglycan expression by keratocytes *in vitro*. J. Biol. Chem. 275:13918-13923.

85. Tasheva, E.S., A.H. Conrad, and G.W. Conrad. 2000. Identification and characterization of conserved *cis*-regulatory elements in the human keratocan gene promoter. Biochim. Biophys. Acta [Gene Structure and Expression] 1492:452-459.

86. Swiergiel, J.J., J.L. Funderburgh, M.J. Justice, and G.W. Conrad. 2000. Developmental eye and neural tube defects in the *eye blebs* mouse. Developmental Dynamics 219:21-27.

87. Corpuz, L.M., J.R. Dunlevy, J.R. Hassell, A.H. Conrad, and G.W. Conrad. 2000. Molecular cloning and relative tissue expression of keratocan and mimecan in embryonic quail cornea. Matrix Biology 19:693-698.

88. Corpuz, L.M., J.R. Dunlevy, J.R. Hassell, A.H. Conrad, and G.W. Conrad. 2000. Molecular cloning and relative tissue expression of decorin and lumican in embryonic quail cornea. Matrix Biology 19:699-704.

89. Conrad, G.W. 2000. Biological roles of keratan sulfate proteoglycans. In: Carbohydrates in Chemistry and Biology, Part II. Biology of Saccharides, vol. 4, Lectins and Saccharides Biology (eds., B. Ernst, G.W. Hart, and P. Sinaÿ), Wiley-VCH, Weinheim, pp. 717-727. (Invited, non-refereed review)

90. Tasheva, E.S., C.G. Maki, A.H. Conrad, and G.W. Conrad. 2001. Transcriptional activation of bovine mimecan by p53 through an intronic DNA-binding site. Biochim. Biophys. Acta [Gene Structure and Expression] 1517:333-338.

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Graduate Student Publications

(Note: I follow a pattern of letting my graduate students publish their thesis work under their own name. Rationale is presented in publication #28, p. 5)

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Other work supported by my research grants, performed in my lab by close associates:

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Conrad, A.H., and G.W. Conrad. 2003. Keratocan gene expression in developing chick ocular and non-ocular tissues. Invest. Ophthalmol. Vis. Sci. (IOVS) 44 (but not printed-only on a CD)(Abstract #864) (Poster B839) (full text of abstracts only available at www.arvo.org or go to www.iovs.org and select the "For an ARVO Abstract" link. The IOVS citation can be found at the top of each abstract).

Tasheva, E.S., and G.W. Conrad. 2003. The UV-responsive elements in the human mimecan promoter – Functional characterization. Invest. Ophthalmol. Vis. Sci. (IOVS) 44 (but not printed – only on a CD) (Abstract #870) (Poster B845) (full text of abstracts only available at www.arvo.org or go to www.iovs.org and select the "For an ARVO Abstract" link. The IOVS citation can be found at the top of each abstract).

Tasheva, E.S., and G.W. Conrad. 2004. Zinc affects cell proliferation and KSPG expression of corneal keratocytes. Invest. Ophthalmol. Vis. Sci. (IOVS) 45 (but not printed – only on a CD) (Abstract #3836) (Poster B297) (full text of abstracts only available at www.arvo.org or go to www.iovs.org and select the "For an ARVO Abstract" link. The IOVS citation can be found at the top of each abstract).

Zhang, Y., Y. Kariya, A.H. Conrad, E.S. Tasheva, and G.W. Conrad. 2004. Identification of corneal keratan sulfate oligosaccharides by electrospray ionization tandem mass spectrometry. 2004 Annual Meeting of Glycobiology 17 Nov 2004 to 21 Nov 2004 in Honolulu, HI (poster #23 in poster session 1 on Thurs., Nov. 18) (Abstract 93)

Zhang, Y., A.H. Conrad, E.S. Tasheva, K. An, L.M. Corpuz, Y. Kariya, K. Suzuki, and G.W. Conrad. 2005. Analysis of sulfated disaccharides from keratan sulfate and chondroitin/dermatan sulfate during chick corneal development by electrospray ionization tanden mass spectrometry. Annual Meeting of Glycobiology. 09 Nov 2005 to 12 Nov 2005

in Boston, MA. Abstract 103. Glycobiology 15(11), Nov. 2005. (Abstract #103. p. 1211) [presented as a poster]

Schmack, I., D.G. Dawson, Y. Zhang, H.E. Grossniklaus, G.W. Conrad**,** and H.F. Edelhauser. 2005. Analysis and quantification of sulfated glycosaminoglycan (GAG) dissacharides in human LASIK corneal wounds using single sections microdissected by laser capture microdissection (LCM) and evaluated by electronspray ionization tandem mass spectrometry (ESI–MS/MS). Invest. Ophthalmol. Vis. Sci. 46: E-Abstract 2132.

Zhang, Y., Y. Kariya, A.H. Conrad, E.S. Tasheva, and G.W. Conrad. 2005. Electrospray ionization tandem mass spectrometry for direct identification of corneal keratan sulfate oligosaccharides without prior purification. Invest. Ophthalmol. Vis. Sci. 46: E-Abstract 3562 [presented as a poster]

Zhang, Y., A.H. Conrad, E.S. Tasheva, K. An, L. M. Corpuz, Y. Kariya, K. Suzuki, G. W. Conrad**.** 2006. Determination of keratan sulfate and chondroitin /dermatan sulfate disaccharides during chick corneal development by electrospray tandem mass spectrometry. 2006 Annual Meeting of the American Society of Biochemistry and Molecular Biology (AMBSB). April 1-5, 2006, San Francisco, CA. Abstract 315. [presented as a poster]

Zhang, Y., I. Schmack, D.G. Dawson, H.E. Grossniklaus, A.H. Conrad, Y. Kariya, K. Suzuki, H.F. Edelhauser, and G.W. Conrad. Analysis of oligosaccharides derived from keratan sulfate and chondroitin/dermatan sulfate disaccharides in post-morten human LASIK corneas using laser capture microscopy and mass spectrometry. 2006. Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). 04/29/2006 – 05/04/2006, Fort Lauderdale, FL. Abstract 06-A-849-ARVO 3002-B102. [presented as a poster]

Conrad, A.H., Y. Zhang, A.R. Walker, L. A. Olberding, A. Hanzlik, A.J. Zimmer, R. Morffi, and G.W. Conrad. 2006. Thyroxine alters the expressions of transparency-related genes in the embryonic chicken cornea. 2006 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). 04/29/2006 – 05/04/2006, Fort Lauderdale, FL. 3007-B107. [presented as a poster]

Zhang, Y., A.H. Conrad, E.S. Tasheva, K. An, L.M. Corpuz, Y. Kariya, K. Suzuki, and G.W. Conrad. Determination of keratan sulfate and chrondroitin/dermatan sulfate disaccharides during chick corneal development by electrospray tandem mass spectrometry. 2006. Annual Meeting of the American Society of Biochemistry and Molecular Biology (AMBSB). April 1-5, 2006, San Francisco, CA. Abstract 315. [presented as a poster]

Zhang, Y. A.H. Conrad, and G.W. Conrad. Detection and quantification of 3,5,3'-triiodothyronine and triiodothyronine by electrospray ionization tandem mass spectrometry. 54th ASMS Conference on Mass Spectrometry. May 28 - June 1, 2006, Seattle, WA. Poster #242. [presented as a poster]

Zhang, Y., A.H. Conrad, Y. Kariya, K. Suzuki, G. W. Conrad. MALDI-TOF/TOF-MS for the analysis of pyrenebutyric hydrazide-derivatized keratan sulfate oligosaccharides.

2006 Annual Meeting of Glycobiology. 15 Nov 2006 to 19 Nov 2006 in Los Angeles, CA. Abstract 77. [presented as a poster]

Zhang, Y., T. Iwamoto, G. Radke, Y. Kariya, K. Suzuki, A.H. Conrad, J.M. Tomich, and G.W. Conrad. 2007. Identification of corneal keratan sulfate by MALDI-TOF/TOF mass spectrometry. 2007 Annual Meeting of the Associattion for Research in Vision and Ophthalmology (ARVO). 05/06/2007-05/10/2007, Fort Lauderdale, FL. [1481/B975--Monday, 8:30 a.m. - 10:15 a.m.]

Conrad, A.H., J.M. Strafuss, M.D. Wittman, S. Conway, and G.W. Conrad. 2007. Thyroxine Stimulates Innervation of the Embryonic Chick Cornea. 2007 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). 05/06/2007-05/10/2007, Fort Lauderdale, FL. [4928--Thursday, 9:00 a.m. - 9:15 a.m]

Zhang, Y., G.W. Conrad. 2008. MALDI Mass Spectrometry Imaging of Biomolecules in Non-Fixed Sections of Corneas. 2008 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: D624/3918. Wednesday, Apr 30, 2008, 8:30 AM - 10:15 AM.

Conrad, A.H., M. Albrecht, M. Pettit-Scott, G.W. Conrad. 2008. Schwann Cell Differentaition in the Embryonic Chick Cornea. 2008 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: D643/4810. Wednesday, Apr 30, 2008, 3:00 PM - 4:45 PM.

Conrad, A.H., M.A. Albrecht, M.L. Pettit-Scott, G.W. Conrad. 2009. Embryonic Corneal Schwann Cells Express Some Schwann Cell Marker mRNAs, but No Schwann Cell Marker Proteins, an Example of Translational Regulation. 2009 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: 2585/ D1052. Tuesday, May 05, 2009, 8:30 AM -10:15 AM.

Zhang, Y., Y. Hiromasa, T. Iwamoto, A.H. Conrad, J.M. Tomich, G.W. Conrad. 2009. Direct Profiling of Crystallines Distribution in Cornea Tissue Sections by MALDI Imaging Mass Spectrometry. 2009 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: 4523/D768. Wednesday, May 06, 2009, 1:45 PM - 3:30 PM.

McCall, A.S., S. Kraft, H.F. Edelhauser, G.W. Kidder, R.R. Lundquist, H.E. Bradshaw, Z. Dedeic, M.J. Chase, E. Clement, G.W. Conrad. 2009. Mechanism of Action of Riboflavin + Ultraviolet Radiation Treatment in Corneal Strengthening. 2009 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: 5493/ A464. Thursday, May 07, 2009, 8:30 AM -10:15 AM.

Littlechild, S.L., G.A. Brummer, G.W. Conrad. 2010. Fibrinogen, Riboflavin and UVA to Immobilize the LASIK Flap in Cornea. 2010 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: 1163/D985. Sunday, May 2, 2010 2:45 - 4:30 PM.

Conrad, A.H., Y. Zhang, E.S. Tasheva, G.W. Conrad. 2010. Proteomic Analysis of Potential Keratan Sulfate, Chondroitin Sulfate A, and Hyaluronic Acid Molecular Interactions. 2010 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Session Number:406; Program#/Poster#:3835; Presentation Start/End Time: Wednesday, May 05, 2010, 9:45 AM -10:00 AM.

Zhang, Y., A.H. Conrad, Y. Hiromasa, J.M. Tomich, G.W. Conrad. 2010. Biochemical Mechanism of Collagen Cross-Linking in a Model Reaction System. 2010 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: 4994/D790. Wednesday, May 5, 2010 3:45 - 5:30 PM

Brummer, G.A., A.S. McCall, S. Littlechild, G.W. Conrad. 2010. Testing the Effects of Pyridoxal-5'-Phosphate on Riboflavin-Ultraviolet-A Induced Crosslinking for the Treatment of Keratoconus. 2010 Annual Meeting of the Association for Research in Vision and Ophthalmology (ARVO). Program#/Poster#: 6223/D788. Thursday, May 6, 2010 11:15 AM - 1:00 PM

Abstracts Published in the Bulletin of the Mount Desert Island Biological Laboratory:

Conrad, G. W. 1972. Effects of cytochalasin-B and colchicine on polar lobe formation in eggs of the marine mudsnail, Ilyanassa obsoleta. MDIBL Bull. 12:17 (#6).

Conrad, G. W. 1972. Studies on the mechanisms of polar lobe formation in eggs of the marine mudsnail, Ilyanassa obsoleta. MDIBL Bull. 12:17-19 (#7).

Conrad, G. W. 1974. Role of calcium ions in polar lobe formation by fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 14:14-15 (#5).

Conrad, G. W., and G. L. Pakstis. 1975. Control of polar lobe formation and connective tissue biosynthesis in embryos of Ilyanassa obsoleta. MDIBL Bull. 15:20-21 (#3).

Conrad, G. W., and S. E. Davis. 1976. Effects of microiontophoretic injection of calcium ions and cyclic AMP on cell shape. MDIBL Bull. 16:13-15.

Conrad, G. W., B. Schmidt, S. E. Davis, M. May, and L. Foresman. 1977. Mechanism of cell shape changes in fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 17:4-5.

Schmidt, B., M. May, and G. W. Conrad. 1978. Actin-like microfilaments associated with cell shape changes in Ilyanassa eggs. MDIBL Bull. 18:9-10.

Duffey, M. E., B. A. Schmidt, and G. W. Conrad. 1979. Calcium selective microelectrodes. MDIBL Bull. 19:108-109.

Conrad, G. W., P. T. Kelly, K. von der Mark, and H. F. Edelhauser. 1980. A comparative study of elasmobranch corneal and scleral collagens. MDIBL Bull. 20:47.

Conrad, G. W., and P. J. Vernon. 1980. Effects of local anesthetics on polar lobe

formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 20:56-57.

Conrad, G. W., and P. J. Vernon. 1981. Role of Ca^{2+}, kinases and phosphodiesterases in polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 21:7-8.

Conrad, G. W., and D. L. Sommerfeld. 1982. Polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta and Mytilus edulis. MDIBL Bull. 22:8-9.

Conrad, G. W., A. R. Schantz, D. L. Sommerfeld, and R. R. Alley. 1983. Polar lobe formation and cytokinesis in fertilized eggs of Ilyanassa obsoleta and Mytilus edulis. MDIBL Bull. 23:27-28.

Conrad, G. W., and A. R. Schantz. 1984. Free calcium ion concentration rises at the onset of cellular constrictions in Ilyanassa obsoleta. MDIBL Bull. 24:81.

Conrad, G. W., and R. R. Patron. 1985. Permanent inactivation of one microfilament-dependent shape change (polar lobe formation) without inactivation of another (cytokinesis) in fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 25:8-9.

Conrad, G. W., and R. R. Patron. 1986. Regulation of cellular shape change in fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 26:101-102.

Conrad, G. W. 1987. Heavy metal effects on cleavage and larval development of the marine gastropod mollusk, Ilyanassa obsoleta Stimpson. MDIBL Bull. 27:74-75 (1987/1988).

Ubels, J. L., H. F. Edelhauser, G. W. Conrad, and S. M. Edelhauser. 1987. The effect of heavy metals on in vitro corneal epithelial wound healing in the sculpin (Myoxocephalus octodecemspinosus). MDIBL Bull 27:100-101 (1987/1988).

Conrad, G. W. 1989. Cleavage and polar lobe formation in fertilized eggs of Ilyanassa obsoleta in the presence of altered substrata. MDIBL Bull. 28:1-2.

Conrad, A. H., and G. W. Conrad. 1990. Actin, myosin, and tubulin distributions at first cleavage in Ilyanassa obsoleta (mudsnail) and Echinarachnius parma (sand dollar) embryos. MDIBL Bull. 29:12.

Conrad, G. W., and C. A. Luer. 1990. Development of the cornea in the eye of the clearnose skate (Raja eglanteria). MDIBL Bull. 29:13.

Conrad, A. H., and G. W. Conrad. 1991. The role of microtubules in the formation and relaxation of contractile rings in Ilyanassa obsoleta. MDIBL Bull. 30:2.

Conrad, G. W., and C. A. Luer. 1991. Effects of metal ion on corneal development in the eye of the clearnose skate (Raja eglanteria). MDIBL Bull. 30:3.

Conrad, A. H., A. Stephens, and G. W. Conrad. 1992. The effect of hexylene glycol on contractile ring behavior in determinant egg development of Ilyanassa obsoleta. MDIBL Bull. 31:2.

Conrad, A. H., A. P. Stephens, A. Q. Paulsen, and G. W. Conrad. 1993. Effects of silver ions (Ag^+) on first cleavage in Ilyanassa obsoleta embryos. MDIBL Bull. 32:2-3.

Conrad, G. W., A. P. Stephens, S. S. Schwarting, and A. H. Conrad. 1994. Effect of clinostat rotation on larval heart development in Ilyanassa obsoleta. MDIBL Bull. 33:17-18.

Conrad, A. H., A. P. Stephens, S. S. Schwarting, and G. W. Conrad. 1994. Atrial Natriuretic Peptide (ANP) gene expression as a marker for cardiac muscle differentiation in Ilyanassa obsoleta. MDIBL Bull. 33:15-16.

Conrad, A. H., M. J. Janasek, S. S. Schwarting, and G. W. Conrad. 1995. The effects of heavy metals on cytoskeletal components involved in cell shape changes during first cleavage in Ilyanassa obsoleta. MDIBL Bull. 34:4-5.

Conrad, A. H., S. S. Schwarting, and G. W. Conrad. 1995. Natriuretic peptide expression in Ilyanassa obsoleta. MDIBL Bull. 34:103-104.

Conrad, G.W., M.J. Janasek, N.M. Martinez, and A.H. Conrad. 1996. Mechanisms of silver ion (Ag^+) toxicity. MDIBL Bull. 35:5-6.

Conrad, A.H., and G.W. Conrad. 1996. Molecular characterization of myosin and the sodium-proton antiporter in Ilyanassa obsoleta. MDIBL Bull. 35:17-18.

Conrad, A.H., S.J. Koo, G.L. Hébert, and G.W. Conrad. 1997. Expression and localization of myosin in fertilized eggs and adult tissues of Ilyanassa obsoleta. MDIBL Bull. 36:11-13.

Conrad, A.H., P. Reddy, and G.W. Conrad. 1998. Expression of cytoskeletal, membrane transport, and transcription factor mRNAs in embryonc and adult Ilyanassa obsoleta. MDIBL Bull. 37:2-3.

Conrad, G.W., and D.C. Wells. 1998. Effects of silver ion (Ag^+) on a cellular shape change in the absence of microtubules in fertilized eggs of Ilyanassa obsoleta. MDIBL Bull. 37:4-5.

Conrad, A.H. and G.W. Conrad. 1999. Expression of a vacuolar proton ATPase and transcription factor mRNAs in lobed and lobeless embryos of Ilyanassa obsoleta. MDIBL Bull. 38:61-62.

Conrad, G.W., A.H. Conard, I.N. Martyanov, and K.J. Klabunde. 2006. Ability of Invertebrates and algae to colonize biocidal nanoparticles. MDIBL Bull. 45:121-123.

Conrad, G.W., A.H. Conrad, and H.E. Bradshaw. 2007. Analysis of Corneas of Sharks, Skates, Scallops, and Chicken Embryos: Spiny dogfish shark (Squalus acanthias), Little Skate (Leucoraja erinacea), Common scallop (Pecten irradians), and White Leghorn chicken (Gallus domesticus). MDIBL Bull. 46: 51-53.

Conrad, A.H., M.J. Chase, Z. Dedaic, and G.W. Conrad. 2008. Attempts to produce adhesion of the LASIK corneal flap using sharks (*Squalus acanthias)*, skates (*Leucoraja erinacea*), and embryonic chicks (*Gallus domesticus*) and Japanese quail (*Coturnix japonica*). MDIBL 47: 72-75 (online pages)

McCall, A.S., S. Kraft, H.F. Edelhauser, G.W. Kidder, R.R. Lundquist, H.E. Bradshaw, Z. Dedeic, M.J. Chase, E. Clement, and G.W. Conrad. 2009. Mechanism of action of riboflavin + ultraviolet radiation treatment in corneal strengthening: spiny dogfish sharks (*Squalus acanthias*) vs. rabbits (New Zealand White). MDIBL Bull. 48: (online pages 64-65)

Conrad, A.H. and G.W. Conrad. 2009. Expression of sutural fiber-related genes in corneas of embryonic sharks (*Squalus acanthias)*. MDIBL Bull. 48: (online pages 66-68).

Littlechild, S., G. Brummer and G.W. Conrad. 2010. The use of fibrinogen, riboflavin and UVA to immobilize the LASIK flap in corneas of spiny dogfish shark (*Squalus acanthias*). MDIBL Bull. 49: (online page 24).

Brummer, G.A., A.S. McCall, S. Littlechild and G.W. Conrad. 2010. Testing the effects of pyridoxal-5'-phosphate on riboflavin-ultraviolet-A (UVA)-induced crosslinking of the corneas of spiny dogfish sharks (*Squalus acanthias*) for the treatment of keratoconus. MDIBL Bull. 49: (online page 25).

Description of Research:

Long-range objectives, recent studies, and current goals:

Project 1

Our present data suggest that tissue-specific populations of fibroblasts arise during embryonic development. However, it is not known whether the tissue-specific characteristics of each fibroblast-type appear before or after these cells are incorporated into the extracellular matrices of each differentiating tissue. During tissue morphogenesis, the interactions which occur between fibroblasts, epithelial cells, and nerve cells are mediated by extracellular matrices. It therefore is of importance to examine how extracellular macromolecules influence the adhesion, movement, and differentiation of tissue-specific populations of such cells and to elucidate the factors which normally control the biosynthesis and polymerization of extracellular matrices by fibroblasts and epithelial cells. These questions are being studied in the context of the developing eye, with particular emphasis on the cornea.

Populations of fibroblast-like cells from cornea, heart, and skin of embryonic chicks are distinguishable by morphology, culture behavior, sensitivity to dissociating agents, types of

glycosaminoglycans synthesized, and by antigenicity. The degree of sulfation of corneal glycosaminoglycans is controlled during development by levels of PAPS (the sulfate donor), which in turn appear to be regulated by thyroxine. Corneal nerves can now be stained during embryonic development, their movement can be inhibited by at least one inhibitor of glycosylation. What determines the unique pathways of the corneal nerve growth cones and, reciprocally, what roles do the nerves play in regulating corneal development? Polyclonal antisera and monoclonal antibodies now allow cytolocalization of keratan sulfate proteoglycan (KSPG) polysaccharide and core protein moieties in the developing cornea. HPLC techniques together with quantitation by ELISA, also allow these antigens to be measured in extracts from cornea and other tissues. N-terminal and internal sequences of the core proteins of keratan sulfate proteoglycans have been determined in our lab, allowing us to chemically synthesize peptides for use as antigens. We have identified three paralogs of the KSPG core protein in corneas (keratocan, mimecan, and lumican) and demonstrated that they arise from separate mRNAs. Within individual paralogs, further specialization occurs by differential splicing and alternative polyadenylation. This work has been performed on corneas and mRNAs from bovine, human, mice, chickens, and quail.

As a result of a '91-'92 sabbatical with Dr. N. Le Douarin (Paris), we are beginning to perform reciprocal grafting of tissues between chick and quail embryos, together with use of appropriate antisense oligonucleotide vectors, to follow and regulate the differentiation of corneal nerves from the trigeminal ganglion.

Current questions being studied:

1) Are there tissue-specific forms of keratan sulfate proteoglycan? Can they be distinguished by use of antibodies, peptide mapping, or molecular probes?

2) What factors in extracellular environment regulate the biosynthesis of keratan sulfate proteoglycan in the cornea?

3) Is there any relationship between corneal innervation and keratan sulfate proteoglycan biosynthesis during development?

Project 2

The mechanism of cytokinesis in eukaryotic cells is not known in detail. A bundle of microfilaments at the base of the cleavage furrow appears to be involved, but the exact locations of component structural proteins (except for actin) and possible regulatory proteins are not known. Moreover, the intracellular ionic environment, which may control the activity of microfilament bundles, has not been well-defined during cytokinesis. The phenomenon of polar lobe formation in fertilized eggs of Ilyanassa obsoleta, a marine mollusk, involves the formation of a constriction which is very similar to a cleavage furrow in ultrastructure and response to ions and drugs. Using the formation of polar lobe constrictions as a model for cytokinesis offers several experimental advantages in asking such questions as: What controls where microfilaments are polymerized? By what molecular mechanism do microfilament bundles "contract"? How are they depolymerized? By what mechanism are microfilament-generated forces transmitted to the plasma membrane? Why do constrictions encircling

microtubule bundles go to completion ("cleave"), whereas those lacking encircled microtubule bundles relax? By what mechanisms do silver ions (Ag^+) cause increased numbers of microtubules to form and cause a normally transient constriction to cleave? The major general questions are: What molecules are present in the cleavage furrow? What properties of the cell change during cytokinesis? Which of the molecules present and the changes that occur are necessary for cytokinesis?

Particularly interesting cells in which to study cytokinesis are the cardiac muscle cells (cardiomyocytes) of embryonic hearts. These are differentiated cells (contain striated myofibrils and contract/"beat" regularly even as single cells in vitro) that are able to disassemble their myofibrils, stop beating, undergo mitosis and cytokinesis, then reassemble their contractile apparatus and resume beating. Using monoclonal antibodies isolated in our lab against cytoplasmic (non-muscle) myosin, we are studying the molecular mechanisms involved in differential mobilization/demobilization of muscle and non-muscle myosin isoforms during cytokinesis.

Current questions being studied:

1) What dynamic interactions does myosin undergo during cytokinesis? Can these be visualized or perturbed with monoclonal antibodies to cytoplasmic (non-muscle) myosin?

2) What roles do microtubules play in assuring the completion of cytokinesis, i.e., final cleavage of the mid-body neck containing the spindle remnant?

3) By what mechanisms do heavy metals, such as Ag^+, interfere with microtubule- and microfilament-dependent functions in cytokinesis and similar cell shape changes?

4) Will fertilized Ilyanassa eggs develop normally while tilted or inverted and under constant compressive or tensile stress?

Extramural Research Support (Direct Costs)

A. Fibroblast Differentiation

1972 - $33,634 NIH-Eye Institute - Fibroblast Differentiation During Corneal Development - EY00952-01

1973 - $23,145 " " - EY00952-02

1974 - $23,654 " " - EY00952-03

1975 - $38,643 NIH-Eye Institute - Fibroblast Differentiation During Eye Development - EY00952-04

1976 - $26,621 " " - EY00952-05

1977 - $27,522 " " - EY00952-06
$3,983 " " - EY00952-06S1

1978 - $76,077 NIH-Eye Institute - Fibroblast Differentiation
During Development - EY00952-07

1979 - $54,025 " " - EY00952-08

1980 - $52,729 " " - EY00952-09

1981 - $55,051 " " - EY00952-10

1982 - $55,632 " " - EY00952-11

1983 - $103,695 NIH-Eye Institute - Fibroblast Differentiation
During Eye Development - EY00952-12

1984 - $72,980 " " - EY00952-13

1985 - $78,716 " " - EY00952-14

1986 - $75,883 " " - EY00952-15

1987 - $89,374 " " - EY00952-16

1988 - $115,092 NIH-Eye Institute - Fibroblast Differentiation
During Eye Development - EY00952-17

1989 - $104,019 " " - EY00952-18

1990 - $106,026 " " - EY00952-19

1991 - $106,349 " " - EY00952-20
$ 8,000 NASA-NSCORT (NAGW-2328)
Effects of Microgravity on Eye Development

1992 - $115,481 " " - EY00952-21
$ 8,500 NASA-NSCORT (NAGW-2328)

1991-1992 $ 28,640 NIH Fogarty Senior Inter- - TW01688-01/ICP(6)
national Fellowship

1993- $165,811 NIH-Eye Institute-Fibroblast - EY00952-22
Differentiation During Eye
Development

$ 10,000 NASA-NSCORT (NAGW-2328)
$ 3,000 NASA/ARC/Lockheed

1994- $151,212 NIH-Eye Institute:Fibroblast - EY00952-23
Differentiation During Eye
Development
$ 33,500 NASA-NSCORT (NAGW-2328)

1995 - $157,266 NIH-Eye Institute:Fibroblast - EY00952-24
Differentiation During Eye
Development

$ 42,399 NASA (NAG 2-1005) - Year 01
Effects of Microgravity on Quail Eye Development

1996 - $163,562 NIH-Eye Institute:Fibroblast - EY00952-25
Differentiation During Eye
Development

$ 41,760 NASA (NAG 2-1005) - Year 02
Effects of Microgravity on Quail Eye Development

$ 23,500 NASA-NSCORT (NAGW-2328)
Effects of Microgravity on Eye Development

$100,000 ALCON Recognition Award for Outstanding Contributions
in the Field of Vision Research

1997 - $169,734 NIH-Eye Institute - EY00952-26
Fibroblast Differentiation
During Eye Development

$ 7,000 NASA (NAG 2-1005) - Year 03 (Partial year)
Effects of Microgravity on
Quail Eye Development

1998 - NIH-Eye Institute - EY00952-27 □ 31
Fibroblast Differention
During Eye Development
A 5-year competitive renewal grant was funded
(04/01/98) for $1,139,293. Direct Costs over
5 years (Yrs 27-31), as follows:

1998 - $235,070 (Yr 27)
1999 - $216,222 (Yr 28)
2000 - $222,648 (Yr 29)
2001 - $229,267 (Yr 30)
2002 - $236,086 (Yr 31)

2001 - NIH-Eye Institute -EY13395-
Transcriptional Regulation of Keratocan
and Mimecan. Direct costs over 4 years: $750,000.
An outgrowth of one of the specific Aims of the
grant above; a new, more detailed study of the molecular
mechanisms regulating biosynthesis of 2 corneal proteoglycans

2001 - $225,000
2002 - $l75,000
2003 - $175,000
2004 - $175,000

2004- NIH-NEI (National Eye Institute) -EY00952-32 A1
Fibroblast Differentiation During Eye Development.
A 5-year competitive renewal grant was funded
(04/01/04) for $1,250,000. Direct costs over 5 years
(Yrs 32-36) are as follows:

2004 - $250,000 (Yr 32)
2005 - $250,000 (Yr 33)
2006 - $250,000 (Yr 34)
2007 - $250,000 (Yr 35)
2008 - $250,000 (Yr 36)

2006 - $10,000 Dolph C. Simons, Sr., Research Achievement Award in the
Biomedical Sciences, from the Higuchi Foundation, University of
Kansas, Lawrence, KS.
(A one-time award: recognition for excellence in biomedical research)

2008- NIH-NEI (National Eye Institute) -EY00952-37
Fibroblast Differentiation During Eye Development.
A new 5-year competitive renewal grant was recently funded (04/01/08) for $1,250,000. Direct costs over 5 years (Yrs 37-41) are as follows:

2008- $250,000 (Yr 37)
2009 - $250,000 (Yr 38)
2010 - $250,000 (Yr 39)
2011 - $250,000 (Yr 40)
2012 - $250,000 (Yr 41)

B. Cytokinesis/Cell Division/Cytoskeleton

1974 - NIH-Child Health and Human Development - Molluscan Polar Lobes - Role in Embryonic Development
$16,492 " " - HD07193-01

1975 - $13,957 " " - HD07193-02

1976 - $15,273 " " - HD07139-03

1977 - $34,762 NIH-Child Health and Human Development - Molluscan Polar Lobes - Role in Embryonic Development - HD07193-04

1978 - $29,924 " " - HD07193-05

1979 - $30,731 " " - HD07193-06

1980 - $31,613 " " - HD07193-07

1981 - $32,548 " " - HD07193-08

1982 - $63,887 NIH-Child Health and Human Development - Mechanisms of Cytokinesis in Animal Cells - HD07193-09

1983 - $55,682 " " - HD07193-10

1984 - $60,634 " " - HD07193-11
and
$26,617 NIH-Fogarty Senior International Fellowship 1-F06-TW00874-01

1985 - $64,940 " " - HD07193-12

1986 - $61,217 " " - HD07193-13

1987 - $21,200 American Heart Association (Kansas Affiliate) - Myosin Mobilization During Cytokinesis of Cardiac Myocytes - KS-87-G-12

$ 4,300 NIEHS - 1-P30-ES03828
Center for Membrane Toxicity Studies: Pilot Project: Heavy Metal Effects on Cleavage and Larval Development of the Marine Gastropod Mollusk, Ilyanassa obsoleta.

$14,000 NASA-BioServe - NAGW-1197
Mechanisms of Heavy Metal Interactions with the Cytoskeleton Under Microgravity, Unit Gravity, and Higher Gravity Conditions.

1988 - $21,200 American Heart Association (KS-87-G-12) (2nd yr)

$ 7,000 NASA-BioServe (NAGW-1197)

$20,000 Wesley Foundation (Wichita, KS)
Postdoctoral research fellowship for Cancer Research. Project: Myosin Mobilization During Cytokinesis by Cardiac Myocytes.

1989 - $21,200 American Heart Association (KS-89-G-5) (3rd yr)

$ 8,700 NASA-BioServe (NAGW-1197)

$20,000 Wesley Foundation (Wichita, KS)
Postdoctoral research fellowship for Cancer Research. Project: Myosin Mobilization During Cytokinesis by Cardiac Myocytes.

1990 - $21,200 American Heart Association (KS-89-G-5) (4th yr)

$ 8,700 NASA-BioServe (NAGW-1197)

$20,000 Wesley Foundation (Wichita, KS)
Postdoctoral research fellowship for Cancer Research. Project: Myosin Mobilization During Cytokinesis by Cardiac Myocytes.

1991 - $22,000 American Heart Association (KS-91-G-32)
Control of Cardiac Myocyte Cell Division

$10,613 NASA-BioServe (NAGW-1197)

$21,579 NASA-NSCORT (NAGW-2328)
Effects of Microgravity on Cytoskeleton Function

1992 - $22,000 (no cost extension from 1991)
American Heart Association (KS-91-G-32)

$ 6,000 NASA-BioServe (NAGW-1197)

$21,833 NASA-NSCORT (NAGW-2328)

1993 - $22,000 American Heart Association (KS-93-GS-25)

$ 6,000 NASA-BioServe (NAGW-1197)

$14,422 NASA-NSCORT (NAGW-2328)

$ 2,000 American Heart Association (Maine Affiliate)
Summer Fellowship to Mr. Andy P. Stephens, Undergraduate from Southwestern College, Winfield, KS.

1994 - $22,000 American Heart Association (KS-93-GS-25)

$ 5,000 NASA-BioServe (NAGW-1197)

$21,438 NASA-NSCORT (NAGW-2328)

1995 - $ 7,000 NASA-BioServe (NAGW-1197)
Effects of Silver Ion (Ag^{+}) on the Cytoskeleton of Human Cells

$85,064 NASA - (NAGW-4491) - Year 01
Effects of Silver and Other Metals on the Cytoskeleton.

$22,000 American Heart Association (KS-95-GS-15)
Changes in Growth and Biochemical Differentiation in Immortalized Cardiomyocytes Following v-myc Protein Abrogation

1996 - $88,468 NASA - (NAGW-4491) - Year 02
Effects of Silver and Other Metals on the Cytoskeleton

$22,000 American Heart Association (KS-95-GS-15)
Changes in Growth and Biochemical Differentiation in Immortalized Cardiomyocytes Following v-myc Protein Abrogation

1997 - $92,003 NASA - (NAGW-4491) - Year 03
Effects of Silver and Other Metals on the Cytoskeleton

$22,000 American Heart Association (KS-95-GS-15)
Changes in Growth and Biochemical Differentiation in Immortalized Cardiomyocytes Following v-myc Protein Abrogation

1998-Present – None

Current members of my laboratory

1) Dr. Yuntao Zhang – Research Assistant Professor
Mass spectrometric analyses of corneal proteoglycans

2) Dr. Tyler Schwend – Postdoctoral Fellow

3) Dr. Xiuli Mao – Postdoctoral Fellow

4) 5 undergraduates

Past students and their current positions

Ph.D.

Gerald W. Hart, Ph.D., 1977.
Director
Department of Biological Chemistry
Johns Hopkins University
School of Medicine
Baltimore, MD

James A. Bee, Ph.D., 1981.
Senior Staff Scientist*
Department of Veterinary Basic Sciences
Royal College of Veterinary Medicine
London, England
*Deceased, 08/11/95

Chung L. Lau, Ph.D., 1992.
Investigator
Yokohama Biomedical Laboratory

Yokohama, JAPAN

Peter Y. Lwigale, 2001
Assistant Professor
Dept. of Biochemistry and Cell Biology
Rice University
Houston, TX

M.S.

David M. Garrett, M.S., 1978.
Staff Manager, Labor Relations
Southwestern Bell Telephone
St. Louis, MO

Stephen D. Glacy, M.S., 1982/ + M.D., Univ. KS Medical Center
Practicing anaesthesiologist
Phoenix, AZ

Allen R. Schantz, M.S., 1984.
Staff, Research Associate for Immune Responses
Centocor Corp.
Rockville, MD

Sharon A. Sturges, M.S., 1984/ + Law degree, Washington U. Law School;
Practicing attorney, pharmaceutical patent law
St. Louis, MO

Corey J. Jost, M.S., 1991 / + M.D., Univ. KS Medical Center
Practicing physician,
Wichita, KS

Past Postdoctoral Fellows

Barbara Schmidt Johnson. 1978-1980.
St. Louis, MO
Industrial laboratory.

Jennifer Swiergiel. 1995-1997.
Staff Scientist
Pierce Chemical Co.
Rockford, IL

Joyce Barrett. 1995-1998.
Staff Position, as nutritionist in charge of designing diets for rodents to be flown in microgravity.

NASA
Ames Research Center
Moffett Field, CA

Past Senior Colleagues

Dr. James L. Funderburgh, Research Professor, 1983-1999.
NIH Principal Investigator: Proteoglycans in Normal and Scarred Corneas
Currently (August, 1999-):
The Jules and Doris Stein Research to Prevent Blindness Professor
Department of Ophthalmology
University of Pittsburgh School of Medicine, Pittsburgh, PA

Dr. Elena Tasheva
Biotechnologyl research

Lolita Corpuz. 1993-2007
Retired.

Abigail H. Conrad – 1983-2009
Retired

Committee Positions Held at the Mount Desert Island Biological Laboratory During the Years Indicated

Executive Committee: 79,80,81
Scientific Advisory Committee: 87,88,89,90,91
Seminar Committee: 78,79,82,88,89,90,91,95
Chair: 83,84
Library Committee: 84
Chair: 85,86,87,88,89,90,91/98
Co-Chair: 92,93,94,95,96,97
Publications Committee: 78,79
Fundraising Committee: 80,81,82,83,84
Adhoc Long-Range Planning Committee: 78,79
Development Committee: 83,84,85,86
Governance Committee, Co-Chair: 79
Noon-time Seminar Committee, Co-Chair: 79,80,95,96,97,98
Nominating Committee: 93,96,97,98
Board of Trustees: 78,79,80,81/ 88,89,90,91/ 92,93,94,95
Ecology of Frenchman Bay Committee: 2006

Committee Assignments at Kansas State University

Division of Biology

Appointed member: Tenure/Promotion Committee
Appointed member: New Biology Building Committee
Appointed member: Space Distribution Evaluation Committee
Appointed member: Microscopy Facility
Appointed member: Recruitment committee, Molecular, Cellular, and Developmental Biology

University

Appointed member: University Distinguished Professors

University of Kansas (Lawrence, Kansas)

Appointed member: Nominations Committee, Higuchi Foundation

Community Service/Extracurricular Activities

1983-1985	Elementary school soccer coach
1985,1986	Cub Scout Den Leader
1987	Webelos Den Leader
1987-2002	Assistant Scout Master, Troop 75 (United Methodist Church) Manhattan, Kansas
2002-present	Assistant Scout Master Troop 76 (First Christian Church)

Adult Co-advisor on Boy Scout High Adventure treks:

August, 1989: Ely, MN - Canoe trip into the Quetico, Canada
December, 1989 - January, 1990: Ely, MN - Okpik cross-country skiing and camping trip into Canada
August, 1990: Philmont, NM - Backpacking trip
August, 1992: Philmont, NM - Backpacking trip into Kit Carson National Forest
December 1993 - January 1994: Ely, MN - Okpik cross-country skiing and camping trip into Canada
August, 1995: Bissett, Manitoba, Canada - canoe trip
August, 1996: Philmont, NM: Backpacking trip
August, 1997: Bissett, Manitoba, Canada - canoe trip
December, 1997-January 1998: Ely, MN - Okpik cross-country skiing and camping trip near U.S.-Canada boundary
December, 1999-January 2000: Ely, MN - Okpik cross-country skiing and camping trip near U.S.-Canada boundary
July, 2000: Philmont, NM - Backpacking trip
August, 2001: Bissett, Manitoba, Canada - canoe trip
July, 2003 Bissett, Manitoba, Canada – canoe trip
July, 2004 Pincher Creek/Lethbridge, Alberta & British Columbia, Canada –

backpacking trip

December, 2005-January 2006: Ely, MN – Okpik cross-country skiing and camping trip near U.S.-Canada boundary

Adult Co-advisor on local Boy Scout activities: Monthly campouts
June, 1999: Topeka, KS: Summer camp