

CURRICULUM VITAE

E. Sally Ward, Ph.D.

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UNIVERSITY EDUCATION

1979-1982: B.A., First Class Honours in Natural Sciences (Part II course, Biochemistry), University of Cambridge, U.K.

1982-1985: Ph.D. in Biochemistry at the Department of Biochemistry, University of Cambridge, U.K. Dissertation title: Molecular genetics of an insecticidal delta-endotoxin from *Bacillus thuringiensis* var. *israelensis*. (Research supervisor: Prof. D.J. Ellar).

ACADEMIC APPOINTMENTS

1985-1988: Junior Research Fellow at Gonville and Caius College, Cambridge, whilst working at the Department of Biochemistry, University of Cambridge, U.K.

1988-1990: Stanley Elmore Senior Medical Research Fellow at Sidney Sussex College, Cambridge whilst working at the MRC Laboratory of Molecular Biology, Cambridge, U.K.

1990-1996: Assistant Professor in the Department of Microbiology, UT Southwestern Medical Center, Dallas, Texas, U.S.A.

1996-2002: Associate Professor with tenure, Department of Microbiology, UT Southwestern Medical Center, Dallas, Texas, U.S.A.

1998-2002: Associate Professor with tenure, Center for Immunology (Center formed in 1998; became Department of Immunology in 2007), UT Southwestern Medical Center, Dallas, Texas, U.S.A.

2002-2014: Professor, Department of Immunology, UT Southwestern Medical Center, Dallas, Texas, U.S.A.

2004-2014: Paul and Betty Meek-FINA Professorship in Molecular Immunology, UT Southwestern Medical Center, Dallas, Texas, U.S.A.

2014-present: Professor, Department of Molecular and Cellular Medicine and Department of Microbial Pathogenesis and Immunology, Texas A&M Health Science Center, College Station, Texas, U.S.A.

2014-present: Adjunct Professor, Department of Immunology, UT Southwestern Medical Center, Dallas, Texas, U.S.A.

HONORS, FELLOWSHIPS AND PROFESSORSHIPS

1979-1981: Entrance Exhibition at Gonville and Caius College, Cambridge, U.K.

1981-1982: Senior Scholarship at Gonville and Caius College, Cambridge, U.K.

1982-1985: Graduate Scholarship at Gonville and Caius College, Cambridge, U.K.

1985: Elected into Junior Research Fellowship at Gonville and Caius College, Cambridge, U.K. Held from October 1985-September 1988.

1988: Elected into 'Stanley Elmore Senior Medical Research Fellowship' at Sidney Sussex College, Cambridge, U.K. Held from October 1988-August 1990.

1997-2000: Established Investigator Award, American Heart Association.

2004-2014: Paul and Betty Meek-FINA Professorship in Molecular Immunology, UT Southwestern Medical Center, Dallas, Texas, U.S.A.

2009-present: Board of Distinguished Advisors, The Antibody Society.

2011: Visiting Professor, University of Oslo, Norway.

REVIEW PANELS, EDITORIAL BOARDS AND SCIENTIFIC ADVISORY BOARDS

1994: Department of Energy, Medical Applications and Biophysical Research Division.

1996-present: Member of special emphasis panels or ad hoc reviewer (for Immunological Sciences, Allergy and Immunology/Cellular and Molecular Immunology A Study sections), National Institutes of Health.

1996-present: ad hoc reviewer for Wellcome Trust (U.K.), Biotechnology and Biological Sciences Research Council (U.K.), Swiss National Science Foundation, Israel Science Foundation, Swedish Research Council for Engineering Sciences, Human Science Frontier Program and French National Research Agency.

1997-1999: American Heart Association, Texas Affiliate.

1993-2003: Editorial Advisory Board, Journal of Bioconjugate Chemistry.

2003-present: Editorial Board, Protein Engineering, Design and Selection (formerly Protein Engineering).

2009-present: Member, Fellowship Review Committee, National Multiple Sclerosis Society.

2009-present: Editorial Board of mAbs.

2012: Programme Advisory Committee, Regional Centre for Biotechnology, Gurgaon, New Delhi, India.

CONFERENCE ORGANIZATION

March-April 2009: Co-organizer of Keystone Meeting, ‘Antibodies as Drugs’, Whistler, Vancouver, Canada.

March 2010: Lead co-organizer of a new Gordon Research Conference, ‘Antibody Biology and Engineering’ held in Ventura, CA.

June 2016: Co-organizer of FASEB Science Research Conference (‘Immunoreceptors’), Snowmass, CO.

INVITED SEMINARS AND CONFERENCE PRESENTATIONS (2006 -)

March 2006: MedImmune, Gaithersburg, MD (invited seminar).

May 2006: 1st International Symposium on Transplant Immunotolerance, Alicante, Spain (invited speaker).

June 2006: National Biotechnology Conference (‘AAPS Workshop on Current Trends in Monoclonal Antibody Development and Manufacturing’), Boston, MA (invited speaker).

June 2006: 5th International Congress on Recombinant Antibodies, Zürich, Switzerland (Keynote address).

November 2006: University of Cincinnati College of Medicine Graduate Student Research Forum, Cincinnati, OH (Keynote address).

December 2006: University of Texas at Arlington (‘UT Metroplex Day’ meeting), Arlington, TX (invited speaker).

February 2007: Keystone meeting (‘Antibodies as Drugs: from Basic Biology to the Clinic’), Lake Louise, AB, Canada (invited speaker, session chair and workshop chair).

February 2007: Cambridge Antibody Technology, Cambridge, U.K. (invited seminar).

February 2007: British Society for Immunology Congress (‘Immunoglobulin Function and Therapeutic Applications’), Glasgow, U.K. (invited speaker).

March 2007: Wyeth Research, Cambridge, MA (invited seminar).

April 2007: University of Glasgow, U.K. (invited seminar).

April 2007: MRC Laboratory of Molecular Biology, Cambridge, U.K. (invited seminar).

April 2007: University of Texas Health Science Center, Fort Worth, TX (invited seminar).

May 2007: New York Academy of Sciences, Biochemical Pharmacology Discussion Group, New York, NY (invited speaker).

June 2007: Max Planck Institute for Immunobiology, Freiburg, Germany (invited seminar).

June 2007: Novartis, Basel, Switzerland (invited seminar).

June 2007: ETH, Zürich, Switzerland (invited seminar).

November 2007: Merck, West Point, PA (invited seminar).

January 2008: Crump Institute for Molecular Imaging, UCLA, CA (invited seminar).

March 2008: Biology-Chemistry Annual Spring Symposium, UT Dallas (Keynote address).

June 2008: 7th International Congress on Recombinant Antibodies, Dublin, Ireland (Keynote address).

August 2008: FASEB Science Research Conference ('*Immunoreceptors*'), New Haven, CT (invited speaker).

September 2008: University of Oslo, Oslo, Norway (invited seminar).

March 2009: The 3rd International Symposium on Antibody Engineering and Antibody-based Therapeutics, Taipei, Taiwan (invited speaker; unable to attend).

March-April 2009: Keystone meeting ('*Antibodies as Drugs*'), Whistler, BC, Canada (co-organizer, speaker, chair of two sessions).

October 2009: University of Dundee, Dundee, Scotland (invited seminar).

October 2009: University of New Mexico, Albuquerque, NM (invited seminar).

December 2009: IBC's 20th Antibody Engineering Conference, San Diego, CA (invited speaker).

February 2010: Department of Pathology, UT Southwestern Medical Center (invited seminar).

May 2010: Syntonix (Biogen), Waltham, MA (invited seminar).

May 2010: 2010 American Association of Pharmaceutical Scientists meeting, San Francisco, CA (invited participant in round table discussion).

June 2010: Recombinant Antibodies 2010, Berlin (invited speaker; unable to attend).

June 2010: Cellular Delivery of Therapeutic Macromolecules, Cardiff University, U.K. (invited speaker).

July 2010: FASEB Science Research Conference ('*Immunoreceptors*') Snowmass, CO (invited speaker).

September 2010: Symposium to mark Sir Alan Fersht's retirement from Directorship of Centre for Protein Engineering, Cambridge (invited speaker).

September-October 2010: OzBio2010, Melbourne, Australia (invited speaker; unable to attend).

November 2010: Annual Meeting of the French Society for Immunology, Marseille, France (invited speaker).

December 2010: IBC's 21st Antibody Engineering Conference, San Diego, CA (Session Keynote address).

February 2011: Department of Pathology, University of Massachusetts, MA (invited seminar).

February 2011: Oregon Health and Science University, Portland, OR (invited seminar).

June 2011: University of Oslo, Oslo, Norway (invited visiting Professor).

September 2011: ‘Immune-related pathologies: understanding leukocyte signaling and emerging therapies’, Budapest, Hungary (invited speaker).

November 2011: Tykeson Fellows Conference (National Multiple Sclerosis Society), Dallas, TX (Keynote speaker and round-table discussion participant).

December 2011: 2011 Imaging in Immunology Workshop, University of Alabama at Birmingham, AL (invited speaker).

March 2012: Gordon Research Conference (‘*Antibody Biology and Engineering*’), Galveston, TX (invited speaker).

April 2012: UCSF, San Francisco, CA (invited seminar).

May 2012: 8th Annual Protein Engineering Summit (PEGS), ‘Phage and Yeast Display of Antibodies’, Boston, MA (invited speaker).

June 2012: GTC Antibody Design and Discovery Conference, San Diego, CA (invited speaker: could not attend).

July 2012: FASEB Science Research Conference (‘*Immunoreceptors*’) Snowmass, CO (invited speaker).

September 2012: Regional Centre for Biotechnology, Gurgaon, New Delhi, India (invited seminar).

October 2012: National Institute of Immunology, New Delhi, India (invited seminar).

February 2013: Shire Human Genetic Therapies, Lexington, MA (invited seminar).

June 2013: 2013 European Society for Animal Cell Technology meeting, Lille, France (invited speaker).

June 2013: XXIV Congress for the International Society for Thrombosis and Haemostasis, Amsterdam, Netherlands (invited speaker; unable to attend).

September 2013: IMPULSE 2013 meeting, Hungary (invited speaker).

November 2013: Texas A and M University, College Station, TX (invited seminar).

December 2013: Beckman Symposium, City of Hope, CA (invited speaker).

December 2013: IBC Antibody Engineering and Therapeutics, San Diego, CA (invited speaker).

January 2014: Single Cell and Single Molecule Imaging and Biochemistry, Albuquerque, NM (invited speaker; unable to attend).

March 2014: Gordon Research Conference ('*Antibody Biology and Engineering*'), Il Ciocco, Italy (discussion leader).

May 2014: New York Academy of Sciences Symposium 'Hot technologies for generating next-gen biologics', New York, NY (invited speaker).

June 2014: FASEB Science Research Conference ('*Immunoreceptors*') Steamboat Springs, CO (session chair and invited speaker).

July 2014: Gordon Research Conference ('*Drug Metabolism*'), Holderness, NH (invited speaker; unable to attend).

October 2014: Texas FreshAIR Annual Conference, Houston, TX (invited speaker and session co-chair).

February 2015: MD Anderson Cancer Center, Houston, TX (invited seminar).

March 2015: Antibodies: an evolving force in cancer treatment, Royal Society of Medicine, London, U.K. (invited speaker).

April 2015: 2nd Texas A&M Eng-Life Symposium, Texas A&M University, TX (Keynote address).

May 2015: 15th Beaune Seminar in Transplant Research, Beaune, France (invited speaker).

June 2015: 32nd Conference on Monoclonal Antibodies in Oncology and Symposium on Cancer Stem Cells, Greece (invited speaker; unable to attend).

July 2015: Gordon Research Conference ('*Drug Metabolism*'), Holderness, NH (invited speaker).

October 2015: 3rd Antibody and Protein Therapeutics Conference, Boston, MA (Keynote address).

October 2015: Fourth AACR International Conference on Frontiers in Basic Cancer Research. Philadelphia, PA (invited talk).

November 2015: International Conference for Antibody Therapeutics, Taipei (invited speaker; unable to attend).

January 2016: 2016 Peptalk Cancer Immunotherapy Conference, San Diego (invited speaker).

March 2016: Gordon Research Conference ('*Antibody Biology and Engineering*'), Galveston, TX (Keynote address).

June 2016: FASEB Science Research Conference ('*Immunoreceptors*') Steamboat Springs, CO (session chair and invited speaker).

PUBLICATIONS

i) Papers in refereed journals

1. Ward, E.S. and Ellar, D.J. (1983) Assignment of the delta-endotoxin gene of *Bacillus thuringiensis* var. *israelensis* to a specific plasmid by curing analysis, *FEBS Letts.*, **158**, 45-49.
2. Ward, E.S., Ellar, D.J. and Todd, J.A. (1984) Cloning and expression in *Escherichia coli* of the insecticidal delta-endotoxin gene of *Bacillus thuringiensis* var. *israelensis*, *FEBS Letts.*, **175**, 377-381.
3. Ward, E.S. and Ellar, D.J. (1986) *Bacillus thuringiensis* var. *israelensis* delta-endotoxin: Nucleotide sequence and characterisation of the transcripts in *Bacillus thuringiensis* and *Escherichia coli*, *J. Mol. Biol.*, **191**, 1-11.
4. Ward, E.S., Ridley, A.R., Ellar, D.J. and Todd, J.A. (1986) *Bacillus thuringiensis* var. *israelensis* delta-endotoxin: Cloning and expression of the toxin in sporogenic and asporogenic strains of *Bacillus subtilis*, *J. Mol. Biol.*, **191**, 13-22.
5. Haider, M.Z., Ward, E.S. and Ellar, D.J. (1987) Cloning and heterologous expression of an insecticidal delta-endotoxin gene from *Bacillus thuringiensis* var. *aizawai* IC1 toxic to both lepidoptera and diptera, *Gene*, **52**, 297-302.
6. Ward, E.S. and Ellar, D.J. (1987) Nucleotide sequence of a *Bacillus thuringiensis* var. *israelensis* gene encoding a 130 kD delta-endotoxin, *Nucleic Acids Res.*, **15**, 7195.
7. Earp, D.J., Ward, E.S. and Ellar, D.J. (1987) Investigation of possible homologies between crystal proteins of three mosquitocidal strains of *Bacillus thuringiensis*, *FEMS Microbiol. Letts.*, **42**, 195-199.
8. Ward, E.S. and Ellar, D.J. (1988) Cloning and expression of two homologous genes of *Bacillus thuringiensis* var. *israelensis* which encode 130-kilodalton mosquitocidal proteins, *J. Bacteriol.*, **170**, 727-735.
9. Ward, E.S., Ellar, D.J. and Chilcott, C. N. (1988) Single amino acid changes in the *Bacillus thuringiensis* var. *israelensis* delta-endotoxin affect the toxicity and expression of the protein, *J. Mol. Biol.*, **202**, 527-535.
10. Ward, E.S., Güssow, D., Griffiths, A., Jones, P.T. and Winter, G. (1989) Binding activities of a repertoire of single immunoglobulin variable domains secreted from *Escherichia coli*, *Nature*, **341**, 544-546.
11. Boulot, G., Eisele, J.L., Bentley, G.A., Bhat, T.N., Ward, E.S., Winter, G. and Poljak, R.J. (1990) Crystallization and preliminary X-ray diffraction study of the bacterially expressed Fv from the monoclonal anti-lysozyme antibody D1.3 and its complex with the antigen, lysozyme, *J. Mol. Biol.*, **213**, 617-619.
12. Ward, E.S. (1991) Expression and secretion of T cell receptor V α and V β domains using *Escherichia coli* as a host, *Scand. J. Immunol.*, **34**, 215-220.
13. Ward, E.S. (1992) Secretion of T cell receptor fragments from recombinant *Escherichia coli* cells, *J. Mol. Biol.*, **224**, 885-890.

14. Borrebaeck, C.A., Malmborg, A-C., Furebring, C., Michaelsson, A., Ward, S., Danielsson, L. and Ohlin, M. (1992) Kinetic analysis of recombinant antibody-antigen interactions: relation between structural domains and antigen binding, *Bio\technol.*, **10**, 697-698.
15. Cumber, A.J., Ward, E.S., Winter, G., Parnell, G.D. and Wawrzynczak, E.J. (1992) Comparative stabilities *in vitro* and *in vivo* of a recombinant mouse antibody FvCys fragment and a bisFvCys conjugate, *J. Immunol.*, **149**, 120-126.
16. Kim, J-K., Tsen, M-F., Ghetie, V. and Ward, E.S. (1994) Identifying amino acid residues that influence plasma clearance of murine IgG1 fragments by site-directed mutagenesis, *Eur. J. Immunol.*, **24**, 542-548.
17. Fields, B.A., Ysern, X., Poljak, R.J., Shao, X., Ward, E.S. and Mariuzza, R.A.(1994) Crystallization and preliminary X-ray diffraction study of a bacterially produced T-cell antigen receptor V α domain, *J. Mol. Biol.*, **239**, 339-341.
18. Kim, J-K., Tsen, M-F., Ghetie, V. and Ward, E.S. (1994) Catabolism of the murine IgG1 molecule: evidence that both CH2-CH3 domain interfaces are required for persistence of IgG1 in the circulation of mice, *Scand. J. Immunol.*, **40**, 457-465.
19. Kim, J-K., Tsen, M-F., Ghetie, V. and Ward, E.S. (1994) Localisation of the site of the murine IgG1 molecule that is involved in binding to the murine intestinal Fc receptor, *Eur. J. Immunol.*, **24**, 2429-2434.
20. Ciubotaru, M. and Ward, E.S. (1994) Expression of soluble T cell receptor fragments derived from a T cell clone associated with murine collagen induced arthritis, *Immunol. Letts.*, **43**, 139-141.
21. Filikov, A.V., Jones, J.R., Myasoedov, N.F. and Ward, E.S. (1994) Application of solid state catalytic hydrogen isotope exchange to the tritium labeling of lysozyme, *J. Label. Cmpds. Radiopharm.*, **XXXVI**, 179-185.
22. Ward, E.S. (1995) VH shuffling can be used to convert an Fv fragment of anti-hen egg lysozyme specificity to one that recognises a T cell receptor V α , *Mol. Immunol.*, **32**, 147-156.
23. Kim, J-K., Tsen, M-F., Ghetie, V. and Ward, E.S. (1995) Evidence that the hinge region plays a role in maintaining serum levels of the murine IgG1 molecule, *Mol. Immunol.*, **32**, 467-475.
24. Ober, R.J. and Ward, E.S. (1995) Correcting for phase distortion of NMR spectra analyzed using singular value decomposition of Hankel matrices, *J. Magn. Res.*, **114**, 120-123.
25. Jahn, S., Roggenbuck, D., Niemann, B. and Ward, E.S. (1995) Expression of monovalent fragments of human IgM autoantibody in *E. coli*. The input of somatically mutated CDR1/CDR2 and of the CDR3 into antigen binding specificity, *Immunobiol.*, **193**, 400-419.
26. Falcioni, F., Vidovic, D., Ward, E.S., Bolin, D., Singh, G., Shah, H., Ober, B. and Nagy, Z.A. (1995) Self tolerance to T cell receptor V β sequences, *J. Exp. Med.*, **182**, 249-254.
27. Rosloniec, E.F., Brand, D.D., Whittington, K.B., Stuart, J.M., Ciubotaru, M. and Ward, E.S. (1995) Vaccination with a recombinant V α domain of a T cell receptor prevents the development of collagen induced arthritis, *J. Immunol.*, **155**, 4504-4511.

28. Fields, B.A., Ober, B., Malchiodi, E.L., Lebedeva, M.I., Braden, B., Ysern, X., Kim, J-K., Shao, X., Ward, E.S. and Mariuzza, R.A. (1995) Crystal structure of the V α domain of a T cell antigen receptor, *Science*, **270**, 1821-1824.
29. Ghetie, V., Hubbard, J.G., Kim, J-K., Tsen, M-F., Lee, Y. and Ward, E.S. (1996) Abnormally short serum half lives of IgGs in β 2-microglobulin deficient mice, *Eur. J. Immunol.*, **26**, 690-696.
30. Popov, S.P., Hubbard, J. G. and Ward, E.S. (1996) A novel and efficient route for the isolation of antibodies that recognise T cell receptor V α s, *Mol. Immunol.* **33**, 493-502.
31. Popov, S.P., Hubbard, J. G., Kim, J-K., Ober, B., Ghetie, V. and Ward, E.S. (1996) The stoichiometry and affinity of the interaction of murine Fc fragments with the MHC class I related receptor, FcRn, *Mol. Immunol.* **33**, 521-530.
32. Medesan, C., Radu, C., Kim, J-K., Ghetie, V. and Ward, E.S. (1996) Localization of the site of the IgG molecule that regulates maternofetal transmission in mice, *Eur. J. Immunol.*, **26**, 2533-2536.
33. Ober, R.J. and Ward, E.S. (1996) A system theoretic formulation of NMR experiments, *J. Math. Chem.*, **20**, 47-65.
34. Medesan, C., Matesoi, D., Radu, C., Ghetie, V. and Ward, E.S. (1997) Delineation of the amino acid residues involved in transcytosis and catabolism of mouse IgG, *J. Immunol.*, **158**, 2211-2217.
35. Li, H., Lebedeva, M.I., Ward, E.S. and Mariuzza, R.A. (1997) Dual conformations of a T cell receptor V α homodimer: implications for variability in V α V β domain associations, *J. Mol. Biol.*, **269**, 385-394.
36. Ghetie, V., Popov, S., Borvak, J., Radu, C., Matesoi, D., Medesan, C., Ober, R.J. and Ward, E.S. (1997) Increasing the serum persistence of an IgG fragment by random mutagenesis, *Nature Biotech.*, **15**, 637-640.
37. Kumar, V., Coulsell, E., Ober, B., Hubbard, G., Sercarz, E. and Ward, E.S. (1997) Prevention and treatment of EAE using recombinant T cell receptor molecules, *J. Immunol*, **159**, 5150-5156.
38. Ober, R.J. and Ward, E.S. (1997) On the class of attainable multidimensional NMR spectra, *J. Math. Chem*, **22**,1-10.
39. Radu, C., Ober, B.T., Colantonio, L., Qadri, A. and Ward, E.S. (1998) Expression and characterization of recombinant, soluble peptide:I-A complexes associated with murine experimental autoimmune diseases, *J. Immunol.*, **160**, 5915-5921.
40. Medesan, C., Cianga, P., Mummert, M., Stanescu, D., Ghetie, V. and Ward, E.S. (1998) Comparative studies of rat IgGs to further delineate the Fc:FcRn interaction site, *Eur. J. Immunol.*, **28**, 2092-2100.
41. Borvak, J., Richardson, J., Medesan, C., Antohe, F., Radu, C., Simionescu, M., Ghetie, V. and Ward, E.S. (1998) Functional expression of the MHC Class I related receptor, FcRn, in endothelial cells of mice, *Int. Immunol.*, **10**, 1289-1298.
42. Thatte, J., Qadri, A., Radu, C. and Ward, E.S. (1999) Molecular requirements for T cell recognition by an MHC Class II restricted T cell receptor: the involvement of the fourth hypervariable loop of the V α domain, *J. Exp. Med.*, **189**, 509-519.

43. Aroeira, L.S., Mouton, C.G., Toran, J.L., Ward, E.S. and Martinez-A, C. (1999) Anti-V β antibodies induce and maintain staphylococcal enterotoxin B-triggered V β 8 cell anergy, *Eur. J. Immunol.*, **29**, 437-445.
44. Qadri, A., Radu, C., Thatte, J., Ober, B. and Ward, E.S. (1999) Characterization of the interaction of a T cell receptor alpha chain variable domain with major histocompatibility class II I-A molecules, *Int. Immunol.*, **11**, 967-977.
45. Ober, R.J., Ramakrishna, V. and Ward, E.S. (1999) On the role of reachability and observability in the analysis of NMR experiments, *J. Math. Chem.*, **26**, 15-26.
46. Ober, R.J. and Ward, E.S. (1999) The choice of reference cell in the analysis of kinetic data using BIAcore, *Anal. Biochem.*, **271**, 70-80.
47. Ober, R.J. and Ward, E.S. (1999) The influence of signal noise on the accuracy of kinetic constants measured by surface plasmon resonance experiments, *Anal. Biochem.*, **273**, 49-59.
48. Cianga, P., Medesan, C., Richardson, J., Ghetie, V. and Ward, E.S. (1999) Identification and function of FcRn in mammary gland of lactating gland, *Eur. J. Immunol.*, **29**, 2515-2523.
49. Kim, J-K., Firan, M., Radu, C., Kim, C-H., Ghetie, V. and Ward, E.S. (1999) Mapping of the site on human IgG1 for binding of the MHC class I related receptor, FcRn, *Eur. J. Immunol.*, **29**, 2819-2815.
50. Schuck, P., Radu, C. and Ward, E.S. (1999) Sedimentation equilibrium analysis of recombinant mouse FcRn with murine IgG1, *Mol. Immunol.*, **36**, 1117-1125.
51. Qadri, A., Radu, C.G., Thatte, J., Cianga, P., Ober, B.T., Ober, R.J. and Ward, E.S. (2000) A role for the region encompassing the c' strand of a T cell receptor V α domain in T cell activation events, *J. Immunol.*, **165**, 820-829.
52. Radu, C., Anderton, S.M., Firan, M., Wraith, D.C. and Ward, E.S. (2000) Detection of autoreactive T cells in H-2^u mice using peptide-MHC multimers, *Int. Immunol.*, **12**, 1553-1560.
53. Anderton, S.M., Radu, C.G., Lowrey, P.A., Ward, E.S. and Wraith, D.C. (2001) Negative selection during the peripheral immune response to antigen, *J. Exp. Med.*, **193**, 1-11.
54. Kumar, V., Maglione, J., Thatte, J., Pederson, B., Sercarz, E. and Ward, E.S. (2001) Induction of a type I regulatory CD4 T cell response following V β 8.2 DNA vaccination results in immune deviation and protection from experimental autoimmune encephalomyelitis, *Int. Immunol.*, **13**, 835-841.
55. Firan, M., Bawdon, R., Radu, C.G., Ober, R.J., Eaken, D., Antohe, F., Ghetie, V. and Ward, E.S. (2001) The MHC Class I related receptor, FcRn, plays an essential role in the maternofetal transfer of gammaglobulin in humans, *Int. Immunol.*, **13**, 993-1002.
56. Garcia, K.C., Radu, C.G., Ho, J., Ober, R.J. and Ward, E.S. (2001) Kinetics and thermodynamics of T cell receptor-autoantigen interactions in murine experimental autoimmune encephalomyelitis, *Proc. Natl. Acad. Sci. USA*, **98**, 6818-6823.
57. Machius, M., Cianga, P., Deisenhofer, J. and Ward, E.S. (2001) Crystal structure of a T cell receptor V α 11 (AV11S5) domain: new canonical forms for the first and second complementarity determining regions, *J. Mol. Biol.*, **310**, 689-698.

58. Ober, R.J., Radu, C.G., Ghetie, V. and Ward, E.S. (2001) Differences in promiscuity for antibody-FcRn interactions across species: implications for therapeutic antibodies, *Int. Immunol.*, **13**, 1551-1559.
59. Qadri, A. and Ward, E.S. (2001) Activation of a T cell hybridoma by alloligand results in differential effects on IL-2 secretion and activation induced cell death, *Eur. J. Immunol.*, **31**, 3825-3832.
60. Deng, C., Minguela, A., Hussain, R.Z., Lovett-Racke, A.E., Radu, C.G., Ward, E.S. and Racke, M.K. (2002) Expression of the tyrosine phosphatase SHP-1 determines T cell activation threshold and severity of experimental autoimmune encephalomyelitis, *J. Immunol.*, **168**, 4511-4518.
61. Bäcklund, J., Treschow, A., Firan, M., Malmström, V., Issazadeh-Navikas, S., Ward, E.S. and Holmdahl, R. (2002) Reversal of tolerance induced by transplantation of skin expressing the immunodominant T cell epitope of rat type II collagen entitles development of collagen-induced arthritis but not graft rejection, *Eur. J. Immunol.*, **32**, 1773-1783.
62. Ober, R.J. and Ward, E.S. (2002) Compensation for loss of ligand activity in surface plasmon resonance experiments, *Anal. Biochem.*, **306**, 228-236.
63. He, X., Radu, C., Sidney, J., Sette, A., Ward, E.S. and Garcia, K.C. (2002) Structural snapshot of aberrant antigen presentation linked to autoimmunity: the immunodominant epitope of myelin basic protein complexed with I-A^u, *Immunity*, **17**, 83-94.
64. Spiekermann, G.M., Finn, P.W., Ward, E.S., Dumont, J., Dickinson, B.L., Blumberg, R.S. and Lencer, W.I. (2002) Receptor-mediated IgG transport across mucosal barriers in adult life: Functional expression of FcRn in the mammalian lung, *J. Exp. Med.*, **196**, 303-310 .
65. Dall'Acqua, W.F., Woods, R.M., Ward, E.S., Palaszynski, S.R., Patel, N.K., Brewah, Y.A., Wu, H., Kiener, P.A. and Langermann, S. (2002) Increasing the affinity of a human IgG1 to the neonatal Fc receptor: biological consequences, *J. Immunol.*, **169**, 5171-5180.
66. Ober, R.J., Lin, Z., Ye, H. and Ward, E.S. (2002) Achievable accuracy of parameter estimation for multidimensional NMR experiments, *J. Magn. Res.*, **157**, 1-16.
67. Ober, R.J., Caves, J. and Ward, E.S. (2002) Analysis of exponential data using a non-iterative technique: application to surface plasmon resonance experiments, *Anal. Biochem.*, **312**, 57-65.
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ISSUED PATENTS

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- 1) Filed 1985: "Gene coding for insecticidal crystal protein" (U.S. patent number: 4,918,006). Co-inventors: D.J. Ellar and E. S. Ward.

2) Filed 1989: “Single domain ligands, receptors comprising said ligands, method for their production and use of said ligands” (U.S. patent numbers: 6,248,516 and 6,545,142). Co-inventors: D. Güssow, E.S. Ward and G.P. Winter.

3) Filed 1994: “Secretion of T cell receptor fragments from recombinant *Escherichia coli* cells” (U.S. patent number: 6,399,368). Inventor: E. S. Ward

4) Filed 1994: “Recombinant production of immunoglobulin-like domains in prokaryotic cells” (U.S. patent number: 6,165,745). Inventor: E.S. Ward.

5) Filed 1997: “Immunoglobulin-like domains with increased half-lives” (U.S. patent numbers: 6,277,375 and 6,821,505). Inventor: E. S. Ward.

6) Filed 2001: “Molecules with extended half lives, composition and uses thereof” (U.S. patent number: 7,083,784). Inventors: W. F. Dall’Acqua, L.S. Johnson and E.S. Ward.

7) Filed 2006: “Immunoglobulin molecules with improved characteristics”. (U.S. patent number: 8,163,881). Inventor: E.S. Ward.