

**BIOGRAPHICAL SKETCH**

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NAME: Ward, David C.

eRA COMMONS USER NAME (credential, e.g., agency login): davidward

POSITION TITLE: Associate Director of Basic Sciences and Translational Research, University of Hawaii Cancer Center

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Memorial Univ. of Newfoundland, Canada	B.S.	1961	Microbiology
Univ. of British Columbia, Vancouver	M.SC	1963	Biochemistry
Rockefeller University, New York	Ph.D.	1969	Biochemistry

**A. Personal Statement**

I have been a research scientist for over 40 years; during that time I developed significant expertise in virology, molecular genetics, cytogenetics and biotechnology. I have co-authored over 330 peer-reviewed papers and more than 40 issued patents. Based on my laboratory research at Yale University, I was elected to the National Academy of Sciences of the United States in 1998. I became the initial Deputy Director of the Nevada Cancer Institute in Las Vegas (from May 2004 to December 2009), and helped build the institute into a thriving research and treatment center with ~ 500,000 sf of space and over 400 employees. Unfortunately, this institution, under new leadership, went bankrupt in 2011. Since Jan. 2010, my scientific and administrative skills have been applied to the reorganization and expansion of the University of Hawaii Cancer Center (UHCC) and the creation of a vibrant alliance with clinical institutions throughout the state, now formally designated the Hawaii Cancer Consortium.

Although my major responsibilities since arriving in Honolulu have been administrative, I still maintain an active interest in scientific research (17 peer-reviewed papers published since the beginning of 2010). For the past 4.5 years, I also have been an active member of the Internal Advisory Committee for the U54 grant supporting the partnership between the University of Hawaii and the University of Guam that focuses on building cancer research capacity in Guam and addressing cancer disparities in Pacific Islanders. In February of 2013, I was asked by NCI to assume a leadership position (as Principal Investigator) in this U54 grant. I am fully committed to achieving the goals of the U54 UH/UOG Partnership in the coming years.

**B. Positions and Honors****Professional Experience**

Aug 1969-Aug 1971 Postdoctoral Fellow (Leukemia Society of America), Imperial Cancer Research Fund, London, England  
Advisors: Drs. I. Macpherson and L. Crawford

Sept 1971-June 1976 Assistant Professor, Dept. of Molecular Biophysics and Biochemistry, Yale University School of Medicine, New Haven, CT

July 1976-June 1982 Associate Professor, Depts. Of Genetics, Molecular Biophysics and ABiochemistry, Yale University School of Medicine, New Haven, CT

July 1982-June 2004	Professor, Depts. Of Genetics, Molecular Biophysics and Biochemistry, Yale University School of Medicine, New Haven, CT
July 1995-June 1998	Acting Chair, Dept. of Genetics, Yale School of Medicine, New Haven, CT
June 2004-Dec 2009	Deputy Director, Nevada Cancer Institute, Las Vegas, NV
Sept 2007-Sept 2011	USTAR Professor (part-time) in Personalized Medicine, Dept. of Nutrition, Utah State University, Logan, UT
Jan 2010-present	Associate Director of Basic Sciences and Translational Research, University of Hawaii Cancer Center, Honolulu, HI

### **Selected Honors**

1989	Eastman Kodak Prize, American Association of Clinical Chemistry
1992	Biochemical Analysis Prize, German Society for Clinical Chemistry
1992	Fellow, American Association for the Advancement of Science
1998	Member, National Academy of Sciences
1998	Member, Connecticut Academy of Sciences and Engineering
1998	Honorary Doctor of Science, Memorial University of Newfoundland

### **Patents and Provisionals**

Dr. D.C. Ward filed over 40 US patent applications while a member of the Yale University faculty. More than twenty of the issued patents are still being utilized in the clinical diagnostic and therapeutic areas. Applications include non-isotopic nucleic acid labeling techniques (using biotinylation or fluorophore labeled tags), single and multiparametric fluorescence in situ hybridization (FISH) in cancer diagnostics (including analysis of tumor cell aneuploidy and gene copy number, the Abbott Urovision™ test for bladder cancer and the LabCorp 6-plex protein blood test for detection of ovarian cancer), molecular cytogenetics (M-FISH or spectral karyotyping [SKY]) and prenatal diagnosis of Down Syndrome and other disorders with chromosomal abnormalities. Given below is a partial list of patents issued to D.C. Ward and colleagues during the past 25 years.

### **Patents Issued (Selected from over 40)**

7,666,583	Identification of cancer protein biomarkers using proteomic techniques
6,861,222	Nucleic acid detection using structured probes
6,686,157	Signal amplification with lollipop probes
6,548,259	Multiparametric fluorescence in situ hybridization
6,506,563	Multiparametric fluorescence in situ hybridization
6,391,564	Methods and compositions utilizing Rad51
6,203,977	Delineation of individual human chromosomes in metaphase and interphase cells by in situ suppression hybridization
6,090,539	Methods and compositions utilizing Rad51
6,060,251	Amplification karyotyping
6,007,994	Multiparametric fluorescence in situ hybridization
5,885,924	Halogenated supports and supported activators
5,869,237	Amplification karyotyping
5,759,781	Multiparametric fluorescence in situ hybridization
5,476,928	Modified nucleotides and polynucleotides and complexes there from
5,449,767	Modified polynucleotides and methods of preparing same
5,328,824	Methods of using labeled nucleotides
4,888,274	RecA nucleoprotein filament and methods
4,711,955	Modified nucleotides and methods of preparing and using same
4,687,732	Visualization polymers and their application to diagnostic medicine
4,093,716	Compositions containing 5-amino-5-deoxythymidine and pharmaceutically acceptable salts thereof
4,093,715	5-Iodo-5'-amino-2',5'-dideoxycytidine and the pharmaceutically acceptable salts thereof
4,000,260	Anti herpes simplex viral compounds and their synthesis

## C. Contribution to Science

1. Drug Nucleic Acid Interactions and Naturally Fluorescent Nucleotides. The earliest portion of my scientific career focused on drug-nucleic acid interactions and nucleotide analog biochemistry. Several seminal observations in this field were reported in the following publications.
  - a. Ward DC, Reich E, Goldberg IH. Base specificity in the interaction of polynucleotides with antibiotic drugs. *Science*, 1965 Sep 10;149(3689), 1259-63. PMID: 5318292.
  - b. Ward DC, Reich E. Conformational properties of polyformycin: a polyribonucleotide with individual residues in the syn conformation. *Proc Natl Acad Sci USA*, 1968 Dec;61(4), 1494-501. PMID: PMC225282.
  - c. Ward DC, Fuller W, Reich E. Stereochemical analysis of the specificity of pancreatic RNase with polyformycin as substrate: differentiation of the transphosphorylation and hydrolysis reactions. *Proc Natl Acad Sci USA*, 1969 Feb;62(2), 581-8. PMID: PMC277847.
  - d. Ward DC, Reich E, Stryer L. Fluorescence studies of nucleotides and polynucleotides. I. Formycin, 2-aminopurine riboside, 2,6-diaminopurine riboside, and their derivatives. *J Biol Chem*, 1969 Mar 10;244(5), 1228-37. PMID: 5767305.
2. Replication of Mammalian Viruses. Upon joining the Yale faculty in 1971 I worked on the molecular biology of viruses, including Herpes simplex, retroviruses and parvoviruses. Notable contributions in the field included:
  - a. Ward DC, Humphries KC, Weinstein IB. Synthetic RNA-dependent DNA polymerase activity in normal rat liver and hepatomas. *Nature*, 1972 Jun 30;237(5357), 499-503. PMID: 12635194.
  - b. Tattersall P, Ward DC. Rolling hairpin model for replication of parvovirus and linear chromosomal DNA. *Nature*, 1976 Sep 9;263(5573), 106-9. PMID: 967244.
  - c. Astell CR, Smith M, Chow MB, Ward DC. Structure of the 3' hairpin termini of four rodent parvovirus genomes: nucleotide sequence homology at origins of DNA replication. *Cell*, 1979 Jul;17(3), 691-703. PMID: 225040.
  - d. Astell CR, Thomson M, Merchlinsky M, Ward DC. The complete DNA sequence of minute virus of mice, an autonomous parvovirus. *Nucleic Acids Res*, 1983 Feb 25;11(4), 999-1018. PMID: PMC325773.
3. Non-isotopic labeling of Nucleic acids; biological and clinical applications. A post-doctoral fellow from Hungary in 1978 (beyond the Iron Curtain at the time), who had come to my lab to learn cloning technology, informed me that he could not work with radioactive molecules in his home institution. We therefore embarked on a project to identify methods to label DNA and RNA non-isotopically so they could be more readily used in research and clinical laboratories. It soon became apparent that this methodology had many inherent advantages over radioactive detection methods. Some of the seminal papers resulting from this work are provided below.
  - a. Langer PR, Waldrop AA, Ward DC. Enzymatic synthesis of biotin-labeled polynucleotides: novel nucleic acid affinity probes. *Proc Natl Acad Sci USA*, 1981 Nov;78(11), 6633-7. PMID: PMC349103.
  - b. Brigati DJ, Myerson D, Leary JJ, Spalholz B, Travis SZ, Fong CK, Hsiung GD, Ward DC. Detection of viral genomes in cultured cells and paraffin-embedded tissue sections using biotin-labeled hybridization probes. *Virology*, 1983 Apr 15;126(1), 32-50. PMID: 6302989.
  - c. Lichter P, Cremer T, Tang CJ, Watkins PC, Manuelidis L, Ward DC. Rapid detection of human chromosome 21 aberrations by in situ hybridization. *Proc Natl Acad Sci USA*, 1988 Dec;85(24), 9664-8. PMID: PMC282830.
  - d. Lizardi PM, Huang X, Zhu Z, Bray-Ward P, Thomas DC, Ward DC. Mutation detection and single-molecule counting using isothermal rolling-circle amplification. *Nat Genet*, 1998 Jul;19(3), 225-32. PubMed PMID: 9662393.
4. Gene Mapping by Fluorescent In Situ Hybridization (FISH). Our laboratory at Yale mapped over 2,000 genes on human and murine metaphase chromosomes during the 1990s. Some of the relevant papers are cited below.
  - a. Lichter P, Tang CJ, Call K, Hermanson G, Evans GA, Housman D, Ward DC. High-resolution mapping of human chromosome 11 by in situ hybridization with cosmid clones. *Science*, 1990 Jan 5;247(4938), 64-9. PMID: 2294592.

- b. Lichter P, Ward DC. Is non-isotopic in situ hybridization finally coming of age? Nature, 1990 May 3;345(6270), 93-4. PMID: 1691830.
  - c. Haas M, Aburatani H, Stanton VP Jr, Bhatt M, Housman D, Ward DC. Isolation and FISH mapping of 80 cosmid clones on the short arm of human chromosome 3. Genomics, 1993 Apr;16(1), 90-6. PMID: 8486389.
  - d. Bray-Ward P, Menninger J, Lieman J, Desai T, Mokady N, Banks A, Ward DC. Integration of the cytogenetic, genetic, and physical maps of the human genome by FISH mapping of CEPH YAC clones. Genomics, 1996 Feb 15;32(1), 1-14. PMID: 8786094.
5. Molecular Cytogenetics and Cancer Diagnostics. Having developed various FISH methods in our lab we next applied this technology to various diagnostic applications. A few papers in this endeavor are listed below.
- a. Speicher MR, Gwyn Ballard S, Ward DC. Karyotyping human chromosomes by combinatorial multi-fluor FISH. Nat Genet, 1996 Apr;12(4), 368-75. PMID: 8630489.
  - b. Speicher MR, Ward DC. The coloring of cytogenetics. Nat Med, (1996) Sep;2(9), 1046-8. Review. PMID: 8782466.
  - c. Henegariu O, Heerema NA, Bray-Ward P, Ward DC. Colour-changing karyotyping: an alternative to M-FISH/SKY. Nat Genet, 1999 Nov;23(3), 263-4. PMID: 10545937.
  - d. Speicher MR, Howe C, Crotty P, du Manoir S, Costa J, Ward DC. Comparative genomic hybridization detects novel deletions and amplifications in head and neck squamous cell carcinomas. Cancer Res, 1995 Mar 1;55(5), 1010-3. PMID: 7866983.

**Complete List of Published Work in MyBibliography:**

<http://www.ncbi.nlm.nih.gov/sites/myncbi/1VaB9QbYQXJkV/bibliograpahy/47570039/public/?sort=date&direction=ascending>

**D. Research Support**

**Ongoing Research Support**

NCI U54 CA143727

Vogel/Ward/Palafox (PI)

09/01/09-08/31/15 (nce)

**University of Guam/Cancer Research Center of Hawaii Partnership (1 of 2)**

This grant supports the partnership between UHCC and UOG in cancer research, training education, and outreach.

Role: PI

**Completed Research Support**

None