

THE RICHARD WESLEY HAMMING LEGACY PROJECT

**A presentation held at the
Naval Postgraduate School (NPS)
Monterey, CA on 18 July 2019
1500 – 1600 in Reid Hall**

Planned Speakers:

1. **Tom Rosko**, Head Librarian of Dudley Knox Library.
2. **Martin Mandelberg, Ph.D.**, Guest Lecturer, NPS, Founder and Researcher for this Hamming Legacy Project
3. **Herschel Loomis, Ph.D.**, Distinguished Professor, NPS, Close friend of Hamming for 22 Years
4. **Donald Brutzman, Ph.D.**, Associate Professor, NPS, Former student of Hamming at NPS



Figure 1: 25-year Richard Wesley Hamming when he entered the PhD program at the University of Illinois, 1940. [Source: Karen Hamming Werner.]



Figure 2: Wedding Picture of Wanda and Richard Hamming, Chicago, 1942. [Source: Karen Hamming Werner.]



Figure 3: Richard Wesley Hamming during his highly productive years at Bell Labs, 1956. [Source: Nokia Bell Labs.]

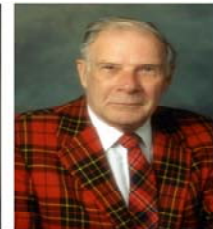


Figure 4: Richard Hamming, NPS 1982. [Source: Karen Hamming Werner.]

Martin Mandelberg 18 July 2019 lecture at NPS, "The Richard Wesley Hamming Legacy Project"

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Agenda

Speaker 1: Martin Mandelberg will discuss his Legacy Project, and some of the findings from 30-months of research documenting the life and influence of Hamming.

Speaker 2: Herschel Loomis will provide comments about on this Legacy Project, and on Hamming.

Speaker 3: Donald Brutzman will discuss the status and plans for the digitally remastered videos of Hamming class lectures at NPS and will add his own comments on Hamming.

Speaker 4: Tom Rosko will discuss the current status and future plans for the Dudley Knox Library Archive for Hamming.

AGENDA

1. Acknowledgements and recognition of special guests
2. Background on this Legacy Project about Richard Wesley Hamming.
3. Overview of my Research findings for this Legacy Project
 - A. Man
 - B. Mathematician
 - C. Mentor
 - D. Legacy Ripples
4. Conclusion and Areas for Future Research.
 - A. What Hamming attempted and accomplished.
 - B. Summarize what contributed to his success.
 - C. Leave you with some messages he might say if he was here today.
 - D. Finally, leave you with some thoughts of my own.

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1. Acknowledgements and recognition of special guests
2. Background on this Legacy Project about Richard Wesley Hamming.
3. Overview of my Research findings for this Legacy Project, which is a tribute to a world-class man, mathematician and mentor.
 - A. Man
 - B. Mathematician
 - C. Mentor
 - D. Ripples
4. Conclusion and Areas for Future Research.
 - A. What Hamming attempted and accomplished.
 - B. Summarize what contributed to his success.
 - C. Leave you with some messages he might say if he was here today.
 - D. Finally, leave you with some thoughts of my own.

ACKNOWLEDGEMENT AND RECOGNITION

NPS Faculty, Administration, and Staff

1. Herschel Loomis, Ph.D., Distinguished Professor, NPS
2. Donald Brutzman, Ph.D., Associate Professor, NPS
3. Tom Rosko, Head Librarian, NPS
4. Eleanor Uhlinger, Former Head Librarian, NPS
5. Steven Lerman, Ph.D., Provost, NPS
6. Irene Berry, **Head of Special Collections, Dudley Knox Library, NPS**
7. Eduard Corrado, Assistant Librarian, NPS
8. Mr. James Paterson, President, NPS Foundation and staff.

Special Guests

1. Karen Hamming Werner, niece of Richard Wesley Hamming along with James Werner, nephew of Richard Wesley Hamming, and their family.
2. Edward William O'Keeffe, my son.
3. Carla Orvis Hunt, my writing coach and editor.
4. Lawrence Reeves, President, AFCEA International Monterey Bay.
5. Bruce Weaver, Ph.D., Director, Monterey Institute for Research in Astronomy (MIRA) and staff.

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Overview of the Biography

Chapter 1: Introduction

Chapter 2: Man describes Hamming's heritage, family upbringing, social development, role models, education and early academic career.

The focused pursuit of education helped prepare Hamming for the challenges and opportunities he would face, the world-class individuals from whom he would learn, and the big questions on which he would ultimately focus. I make the case that Hamming was influenced early in life by many individuals, including his maternal grandfather Casper Lavater Redfield and Doctoral advisor Waldemar J. Trjitzinsky.

Chapter 3: Mathematician details Hamming's early conceptual challenges starting with the responsibilities that he was given and the world-class scientists with whom he would work on a classified government project to help end World War II, followed by his 30 years as a Research Mathematician at AT&T Bell Labs.

Hamming's focus and reputation for excellence resulted in him being recruited to work with many of the world's best and brightest scientists, engineers, and mathematicians. Instead of only doing the work or being in awe of his colleagues, Hamming sought to understand the factors that drove these individuals to success and, by so doing, developed his own special insights and expertise. Chapter 3 ends with a discussion of how Hamming's traits, abilities, and dedication to excellence resulting in his working on very important problems and thereby earning mathematics' highest awards.

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Overview of the Biography (Continued)

Chapter 4: Mentor explores Hamming's choice to focus on helping and empowering many others through his professional work, books, articles, teachings, philanthropy, and mentoring, including my own story about the significant benefits that I received from knowing and being mentored by Hamming as his doctoral student between 1978-1982.

To the best of my ability, I captured and presented important stories obtained through interviews with 15 individuals who knew, interacted with, and were helped by Hamming. Their personal stories and written recollections demonstrate Hamming's positive impact, and their stories helped grow the vision I had for this project.

Chapter 5: Hamming Ripples proposes a legacy for Richard Wesley Hamming, based on a fundamental philosophical and pragmatic understanding that learning creates more learning, inspiration more inspiration. It discusses those individuals who influenced Hamming and those that he influenced in turn, who are continuing to influence successive future generations for good. The book closes with my recollection of my last correspondence with Hamming and my closing tribute to him.

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2017

January - Started thinking about starting a Legacy Project when I was reviewing some filed papers I my home

February - Conducted initial Research at Librar of Congress, Washington, DC

March - Originally Contacted NPS Head Librarian Eleanor Uhlinger, and discovered the special collection boxes that had been sealed for 18 years.

Scanned/photographed over 10,000 pages – the contents of Hamming's NPS desk and Home Office

May - Met with number of NPS Professors including Herschel Loomis, Tri Ha, Charles Robertson, Donald Brutzman, and others.

First focused on finding and interviewing individuals who knew Hamming.

June - Met and Worked with the Bell Labs Historian Ed Eckert to research their archives of information about Hamming during the period 1946 – 1976.

July - Talked with Robert Fossum, Former NPS Dean when Hamming was considered for a faculty job at NPS.

December - Wrote first article (unpublished) Richard Wesley Hamming: A Mind at Work" and circulated it for review

2018

March - Interviewed about this Legacy Project by Cindy Kelly, President of the Atomic Heritage Foundation – March 2018

February - Talked with Alan Carr, Historian at Los Alamos National Labs, and the

Historians at the Bradley Science Museum in Los Alamos, NM

May - Presented an invited Lecture at NPS: Richard Wesley Hamming: 9 May 2018

August - Obtained copies of 17 internal Bell Labs Technical Memorandum that Hamming authored or co-authored between 1946 – 1976.

September - Interviewed additional professionals who knew Hamming.

October - Received email from James Werner, nephew of Hamming, followup phone calls, and travelled to Seattle, WA to meet he and his wife, the sole heirs of Hamming. Given access to 3500 pages of documents and photographs from Wanda Hamming's personal files that the Werner's had inherited.

December - Completed the first version of my research results and copyrighted.

2019

2. TIMELINE OF THE HAMMING LEGACY PROJECT



2017

- January - Started thinking about a Legacy Project while reviewing some filed papers in my home.
- February - Conducted initial research at Library of Congress, Washington, DC
- March - Contacted NPS Head Librarian Eleanor Uhlinger and discovered the special collection boxes that had been sealed for 18 years. Scanned/photographed over 10,000 pages – the contents of Hamming's NPS desk and Home Office
- May - Met with NPS Professors including Herschel Loomis, Tri Ha, Charles Robertson, Donald Brutzman, and others.
- June - Worked with Bell Labs Historian Ed Eckert to research archives about Hamming during the period 1946 – 1976.
- July - Talked with Robert Fossum, Former NPS Dean when Hamming was considered for a faculty job at NPS.
- December - Wrote first article (unpublished) "Richard Wesley Hamming: A Mind at Work" and circulated it for review

2018

- January – Developed detailed outline and themes of book
- March - Interviewed about this Legacy Project by Cindy Kelly, President of the Atomic Heritage Foundation
- February - Talked with Alan Carr, Historian at Los Alamos National Labs, and others at Bradley Science Museum in Los Alamos, NM
- May - Presented an invited Lecture at NPS: *Richard Wesley Hamming: A Mentor at Work* - 9 May 2018
- August - Obtained copies of Bell Labs Technical Memo's authored or co-authored by Hamming between 1946 – 1976.
- September - Interviewed additional professionals who knew Hamming.
- October - Received email from James Werner, nephew of Hamming, and travelled to Seattle, WA to meet he and his wife, the sole heirs of Richard Hamming. Given access to 3500 pages of documents and photographs from Wanda Hamming's personal files that the Werner's had inherited.
- December - Completed the first version of my research results and copyrighted the book. *Richard Wesley Hamming: Man, Mathematician, and Mentor*.

2019 - Six months of editing, obtaining reviews, and revising the book.

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- 2017
 - Started 30 months ago (January 2017) when I was reviewing some filed papers I my home
 - Originally Contacted NPS Head Librarian Eleanor Uhlinger, and discovered the special collection boxes that had been sealed for 18 years. Scanned/photographed over 10,000 pages – the contents of Hamming's NPS desk and Home Office
 - Met with number of NPS Professors including Herschel Loomis, Tri Ha, Charles Robertson, Donald Brutzman, and others.
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3. WHO WAS RICHARD WESLEY HAMMING



Richard Wesley Hamming (b. 1915 - d. 1998) was an American mathematician whose work has a lasting impact on many disciplines including mathematics, computer science, engineering and telecommunications.

He was born in Chicago, IL 1915.

He was a Professor of Computer Science and Mathematics at NPS from 1976 until his death in 1998.

The basic information on his background was covered in the 9 May 2018 lecture at NPS (Birth, family genealogy, education, initial job as a teacher, highlights of Los Alamos, Bell Labs, and NPS).

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Richard Wesley Hamming (1915 - 1998) was an American mathematician whose work has a lasting impact on many disciplines including mathematics, computer science, engineering, and telecommunications..

From modest Midwest origins, Hamming demonstrated some important traits:

- Ambition to not be "As poor as my parents"
- Drive to Understand,
- Dedication to Succeed, and
- Commitment to provide help to others.

During his life, education, and career, he developed additional traits.

- Focused Accumulation of Knowledge,
- Development of Wisdom and Insight,
- Focus on Important Problems, and
- Application of Innovation

3.1 RICHARD WESLEY HAMMING



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3.2 RESEARCH DISCUSSION AND FINDINGS ON HAMMING: THE MAN

Discussion: My research efforts on were able to document Hamming's heritage, family upbringing, environment, social development, role models, education and early academic career.

- He grew up in "interesting times"
- His family and friends were all trying to live the "American Dream"
- Hamming quote - "He did not want to be rich, but he did not want to be as poor as his parents."

Some Major Findings:

- I claim that Hamming was significantly influenced early in life by many **role models**, including his father, mother, brother, maternal grandfather (Casper Lavater Redfield), friend Nicholas Metropolis, future wife Wanda Mae Little, and his doctoral advisor Waldemar J. Trjitzinsky from the University of Illinois.
- **The focused pursuit of education** helped prepare Hamming for the challenges and opportunities he would face in his life, the world-class individuals from whom he would learn, and the big questions on which he would ultimately focus.
- "Luck favors the prepared mind" – Louis Pasteur
- "Success is 90% Preparation and only 10% Opportunity." – Seneca, Roman Philosopher

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Discussion: My research efforts on were able to document Hamming's heritage, family upbringing, environment, education and early academic career.

He grew up in "interesting times"
Crash, Depression, 1932 Chicago
and Library System, University of
and University of Illinois.

His family and friends were all trying
Hamming quote - "He did not want to be

Some Major Findings:

I claim that Hamming was significantly influenced early in life by many **role models**, including his father, mother, brother, maternal grandfather (Casper Lavater Redfield), friend Nicholas Metropolis, future wife Wanda Mae Little, and his doctoral advisor Waldemar J. Trjitzinsky from the University of Illinois.

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GREAT MEN AND HOW
THEY ARE PRODUCED

CASPER LAVATER REDFIELD

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“Luck favors the prepared mind” – Louis Pasteur

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PATERNAL GRANDFATHER

GREAT MEN AND HOW THEY ARE PRODUCED

BY CASPER L. REDFIELD, CHICAGO, 1915

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3.1.1 PHOTOGRAPHS ABOUT RICHARD WESLEY HAMMING (1915 - 1942)



Figure 2-7: Baby photograph of Richard Wesley Hamming, 1915.



Figure 2-24: High School yearbook picture of Hamming, 1933.



Nicholas Constantine Metropolis.



Hamming earned a B.A. in Mathematics, 1933 - 1935



Figure X: Richard Wesley Hamming and Wanda Mae Little.



Hamming earned a M.A. in Mathematics, 1935 - 1937



Figure 2-1: 25-year Hamming when he entered the PhD program at the University of Illinois, 1940.



Hamming earned a Ph.D. in Mathematics, 1939 - 1942



Figure 2-45: Master of Art Degree Graduation picture of Wanda Mae Little, 1942.

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- 1915: Born in Chicago, Illinois
- 1933: Graduated Crane Technical High School
- 1933 -1934: Attended Three Junior Colleges
- 1934-1935: B.A. in Mathematics, University of Chicago
- 1935-1937: M.A. in Mathematics, University of Nebraska
- 1937-1939: PhD in Mathematics, University of Illinois

3.1.2 ROLE MODELS AND MENTORS FOR HAMMING (1915 - 1942)



Father Richard
James Hamming



Mother Mabel Grace
Redfield



Brother Walter
James Hamming



Paternal Grandfather
Casper Lavatar Redfield



Friend Nicholas
Constantine Metropolis.



Doctoral Advisor
Waldemar Trjitzinsky

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THEY ARE PRODUCED

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3.2.1: FROM 1945 – 1946, HAMMING WORKED ON THE MANHATTAN PROJECT AT LOS ALAMOS, NM.



Nicholas Constantine Metropolis.



Photo of Los Alamos Project Main Gate, Los Alamos, NM



Photo of Enrico Fermi (left) and Robert Oppenheimer (right) at Los Alamos, 1945.



Photo of one of the hand-operated calculators used on the Manhattan Project.

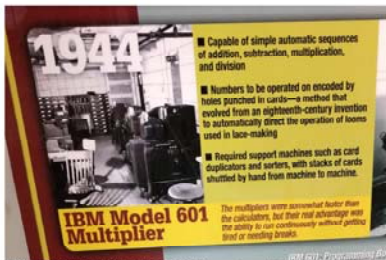


Photo of IBM Model 601 Multiplier Digital Computers used on the Manhattan Project.



Photo of Dr. Hans Bethe, 1945.



Photo of Richard Feynman, 1944.



Photo of the first atomic bomb test, Alamogordo, NM, 16 July 1945.



Photo of the Manhattan Project silver lapel pin, 1946.

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Published on Mar 11, 2012

The IBM 604 Electronic Calculating Punch with Type 521 Card Reader/Punch, 1948. The 604 performed addition, subtraction, multiplication, and division hundreds of times faster than any of IBM's earlier electromechanical machines, and was the first IBM product to use modular vacuum-tube based pluggable units, later used in IBM's NORC and 701 computers. The 604 was programmable via plugboard and could execute a program of up to about 60 steps. Footprint: 53 by 33 inches; contained 1100 vacuum tubes and 125 relays. Power consumption 7.59 Kva. Weight: 1949 pounds. More than 5000 were sold (or, rather, rented at \$645 per month, 1948 dollars, for the 604 and 521).

I filmed this for an exhibition which was held in 2008/9 at the Amsterdam based Science Center NEMO. I asked if the film could be released to the public: that could be done, if a NEMO sign would appear in the video. Hence: here it is.

The voice explaining how it works belongs to Hans Sprengler of the IBM museum in Sindelfingen, Germany: "Haus zur Geschichte der IBM Datenverarbeitung", or the House of the History of IBM Data Processing.

3.2.2: FROM 1946 - 1976: HAMMING WORKED AT AT&T BELL LABS



Photo of AT&T Bell Labs Building in Murray Hill, NJ. Reused with permission of Nokia Corporation.



Figure 3-2 The Bell Labs "Younger Turks". Clockwise from top and then center - Shannon, Tukey, McMillan, Ling, and Hamming. [Source: Nokia Bell Labs.]



Photo of Claude Shannon at Bell Labs (date unknown, circa 1942 - 1955). Reused with permission of Nokia Corporation.



Richard Hamming helping Mrs. Wanda Mammol on a math problem. Reused with permission of Nokia Corporation.



Photo of ACM Turing Award Medal given to Richard Hamming, 1968. Courtesy of the Dudley Knox Library, NPS, Monterey, CA.



Richard Hamming demonstrating Error Correcting Codes to Bernard Holbrook, 1950. Reused with permission of Nokia Corporation.



Richard Hamming at AT&T computer center, 1975. Reused with permission of Nokia Corporation.



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3.2 RESEARCH DISCUSSION & FINDINGS ON HAMMING: THE MATHEMATICIAN



Discussion: My research efforts on “Hamming: The Mathematician” were able to:

- Document his early conceptual challenges and the world-class scientists with whom he would work for on a classified government project to help end World War II – The Manhattan Project at Los Alamos.
- Document some of his work during the 30 years he spent as a Research Mathematician at AT&T Bell Labs, including his early dedication to helping others succeed. Hamming's focus and reputation for excellence resulted in him being recruited to work with many of the world's best and brightest scientists, engineers, and mathematicians. Instead of only doing the work or being in awe of his colleagues, Hamming sought to understand the factors that drove these individuals to success and, by so doing, developed his own special insights and expertise.

Some Major Findings:

- I uncovered who was the previously undisclosed “friend” who called him starting in 1944 about leaving teaching and helping on a special project.
- I claim that Hamming's traits, abilities, and dedication to excellence resulted in his working primarily on very important problems. This placed him in the position of being able to create important results that not only earned him mathematics' highest awards, but it also enabled and enhanced the work of others at Bell Labs, various colleges, and professional organizations (IEEE, AMA, ACM, AAAS, NAE, etc.).
- Besides the Turing Award, Hamming's contemporaries including John Tukey recognized the value of his contributions and Tukey, head of the Statistics Department at Princeton, coined the term “hamming window” in recognition of Hamming's contributions to Tukey's award winning FFT work.

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Discussion: My research efforts on “Hamming: The Mathematician” were able to:

Document his early conceptual challenges starting with the responsibilities that he was given and the world-class scientists with whom he would work for 18 months on a classified government project to help end World War II – The Manhattan Project at Los Alamos.

NOTE FOR 50 MORE YEARS

He next worked for 30 years as a Research Mathematician at AT&T Bell Labs, highlighting his early dedication to helping others succeed. Hamming's focus and reputation for excellence resulted in him being recruited to work with many of the world's best and brightest scientists, engineers, and mathematicians. Instead of only doing the work or being in awe of his colleagues, Hamming sought to understand the factors that drove these individuals to success and, by so doing, developed his own special insights and expertise.

Some Major Findings:

I uncovered who was the previously undisclosed “friend” who called him starting in 1944 about leaving teaching and helping on a special

project. **It was his lifelong friend, Nickolas Metropolis**

I claim that Hamming's traits, abilities, and dedication to excellence resulted in his working on very important problems. This placed him in the position of being able to create important results that not only earned him mathematics' highest awards, but it also enabled and enhanced the work of others at Bell Labs, various Colleges, organizations (IEEE, AMA, ACM, etc.).

"The Purpose of Computing is Insight – Not Numbers"

"If you don't work on Important Problems, it's not likely that you'll do important work"

"Luck favors the prepared mind" – Louis Pasteur, scientist.

"Luck is 90% Preparation and 10% Opportunity" – Seneca, Roman Philosopher?

Beides the Turing Award, Hamming's contemporaries including John Tukey recognized his contributions, and coined the term "hamming window" in recognition of Hammings contributions to Tukey's award-winning FFT work.

"The Purpose of Computing is Insight – Not Numbers"

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1976 - 1998: RICHARD HAMMING WORKED AT THE NAVAL POSTGRADUATE SCHOOL, MONTEREY, CA



Wanda and Richard Hamming, Monterey, CA in 1980. Courtesy of Dudley Knox Library, Naval Postgraduate School, Monterey, CA



Richard Hamming in his office, NPS. Courtesy of Dudley Knox Library, NPS, Monterey, CA

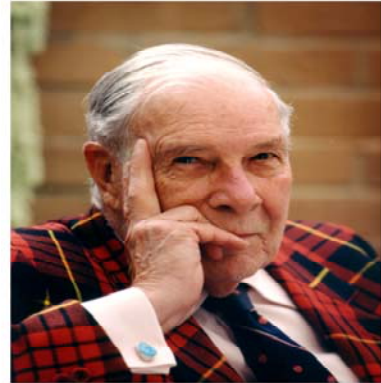


Photo of Richard Hamming in Monterey, CA, 1982. Courtesy of the Dudley Knox Library, NPS, Monterey, CA

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3.3 RESEARCH DISCUSSION & FINDINGS ON HAMMING: THE MENTOR



Discussion: My research efforts on explores Hamming's choice to focus on helping and empowering many others through his professional work, books, articles, teachings, philanthropy, and mentoring. It included my own story about the significant benefits that I received from knowing and being mentored by Hamming as his doctoral student between 1978-1982.

I captured and presented important stories obtained through interviewing over 24 individuals who knew, interacted with, and were helped by Hamming. Their personal stories and written recollections demonstrate Hamming's positive impact, and their stories helped grow the vision I had this for this project. I am indebted to the following individuals for allowing me to use their recollections in my findings:

- Hershel Loomis, an NPS professor, and his wife Shirley were very close friends of Richard and Wanda Hamming since 1982. Each provided their recollections.
- Donald Brutzman, a professor at NPS, discusses the impact on his being a graduate student attending a course taught by Hamming at NPS, during his project remastering Hamming's last course videos, and his thoughts on Hamming's legacy.
- Karen Hamming Werner, Richard Hamming's niece, and her husband James Werner discuss family history and personal interactions with both Richard and Wanda Hamming since the 1960s.
- Ben Schneiderman, a professor at the University of Maryland, was a student attending two class taught by Hamming at the City College of New York (CCNY), interactions with Hamming at conferences.. Ben has mentored many Masters and PhD students.
- Douglas McIlroy, a professor at Dartmouth, worked with Hamming at Bell Labs between 1958 and 1976. Ben has mentored many Masters and PhD students.
- Brian Kernighan, a professor at Princeton, worked with Hamming at Bell Labs between 1967 and 1976 and kept in touch with Wanda and Richard until their passing. Brian has mentored many Masters and PhD students.

Some Major Findings:

- Hamming chose early in life to developed the traits and skills to effectively mentor others. There was no half-way with Hamming – It was "All or Nothing". His published articles, lectures, and books were all aimed at teaching other how to learn. This was his gift to us.

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Discussion: My research efforts on explores Hamming's choice to focus on helping and empowering many others through his professional work, books, articles, teachings, philanthropy, and mentoring.

It included my own story about the significant benefits that I received from knowing and being mentored by Hamming as his doctoral student between 1978-1982.

To the best of my ability, I have captured and presented important stories obtained through interviewing over 24 individuals who knew, interacted with, and were helped by Hamming. Their personal stories and written recollections demonstrate Hamming's positive impact, and their stories helped grow the vision I had this for this project. In particular, i am indebted to the following individuals for allowing me to use their recollections in my findings:

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Some Major Findings:

I claim that Hamming chose early in life to developed the traits and skills to effectively mentor others. There was no half-way with Hamming – It was “All or Nothing”.

WHAT RICHARD WESLEY HAMMING WOULD SAY TO YOU TODAY IF HE WAS HERE TODAY:



- 1) *"If you don't work on important problems, it's not likely that you'll do important work."*
- 2) *"The Purpose of Computing is Insight - not numbers."*
- 3) *"It is better to do the right problem the wrong way than the wrong problem the right way."*
- 4) *"The emotion at the point of technical breakthrough is better than wine, women and song put together."*
- 5) *"Good teachers get apples - great teachers get chocolate!"*

– Richard Wesley Hamming



Photo of Richard Hamming, (date unknown, circa 1990 - 1998, Courtesy of the Dudley Knox Library, NPS, Monterey, CA)

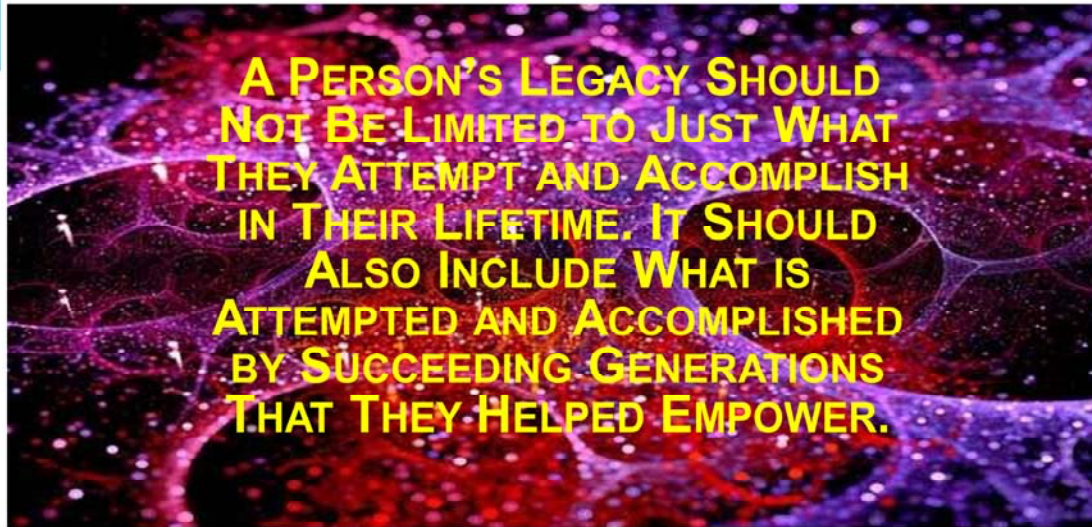


Photo of Wanda Hamming, (date unknown, circa 1998 - 2008), Courtesy of the Monterey Herald, Monterey, CA

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MY MOTIVATION FOR THIS LEGACY PROJECT



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Richard Wesley Hamming received 3 patents, wrote 9 books, authored (or co-authored) about 100 articles, and empowered thousands of students with his classes and lectures. A handful were fortunate to have him as their Masters Thesis Advisor, I am extremely fortunate that he chose to accept me as his Doctoral Student.