Argonne NATIONAL LABORATORY

The Remarkable Career of

Margaret Butler:

From "Computer" to Senior Computer Scientist

presented by

Lois Curfman McInnes

Mathematics and Computer Science Division

Argonne National Laboratory

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U.S. DEPARTMENT OF ENERGY

Margaret Butler: One Woman's Life in Science

by Holly Stump

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Margaret Butler

Holly Stump

46 years in Computing, 1945-1991

Margaret (Kampschaefer) Butler was a pioneer in technology, a ground-breaking woman who graduated with a B.S in Mathematics and Statistics in 1944, and followed a fascinating career path in the public sector starting in the earliest days of computers and nuclear energy. One of the early female "computers," she worked on the first atomic submarine. She also spent time overseas after WW II as an employee of the U.S. military. At Argonne National Laboratory, where she spent many years, Margaret worked with the AVIDAC, ORACLE, GEORGE, UNIVAC, and more, in the formative days of computing. Her experience spanned a technical management track in public service, as Director of the National Energy Software Center, which does R&D for a spectrum of Atomic Energy Commission issues. Margaret was the first woman Fellow at the American Nuclear Society, and is an Honorary Lifetime Member. Margaret draws on decades of success as well as setbacks, to provide a perspective on computer technology and women technologists. This is a story, for all scientists, that deserves to be told… and a celebration of her life, which passed on March 8, 2013…

http://www.semiwiki.com/forum/content/2128-margaret-butler-one-woman%92s-life-science.html

The formative years: 1924-1945

In Evansville with the family pet

Margaret (left) and roommate at Indiana University

- Margaret Kampschaefer: born March 27, 1924, in Evansville, Indiana
- BS in Mathematics and Statistics, Indiana University, 1944
- Graduate work at U.S. Department of Agriculture Graduate School, University of Minnesota, and University of Chicago

Margaret's early career was thrilling

1945: Statistician with the Bureau of Labor Statistics in Washington, DC.

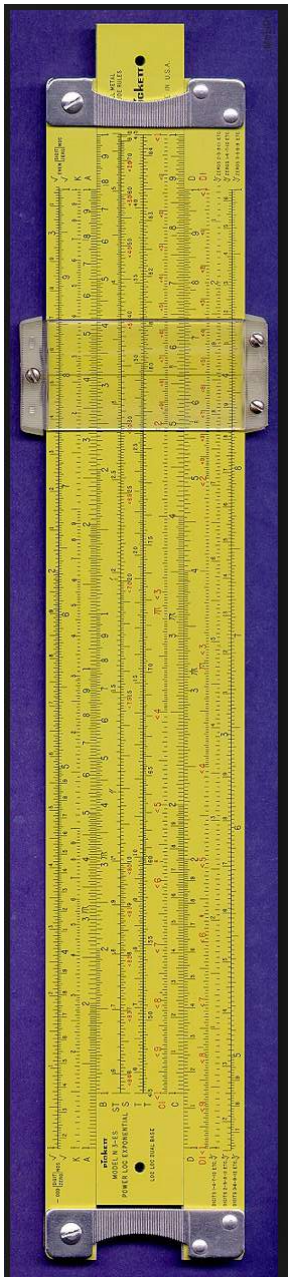
1946-1948: U.S. Air Force Statistician in Europe

Margaret believed in taking calculated career risks and recommended it to others. She believed that work, adventure, and trying out new opportunities help in exploring each person's own traits, capabilities, preferences, and values.

Margaret began her career at Argonne as a "Computer"

- **1948-1949: Junior Mathematician in the Naval Reactors Division**
  - helped to designing a prototype for the Navy's nuclear submarine reactor

- **Early work as a "Computer"**
  - an individual who performed computations required to solve mathematical physics and engineering problems using
    - slide rules
    - tables of integrals and special functions
    - electromechanical calculators
  - historical info:
    - http://topsecretrosies.com
    - http://www.cnn.com/2011/TECH/innovation/02/08/women.rosies.math/



Career excitement at Argonne in 1951

- 1949-1951: Bureau of Labor Statistics, St. Paul, MN
- 1951: Assistant Mathematician in the Reactor Engineering Division
- 1951: Married Jim Butler, a mathematician at Argonne
- Argonne had obtained Atomic Energy Commission funding for construction of a digital computer, or "electronic brain," in the parlance of the day, to put at its disposal "the most modern means of scientific computation."

Margaret and Jim Butler at Argonne Distinguished Service Awards Ceremony, 1986

AVIDAC: Argonne's Version of the Institute's Digital Arithmetic Computer: 1949-1953

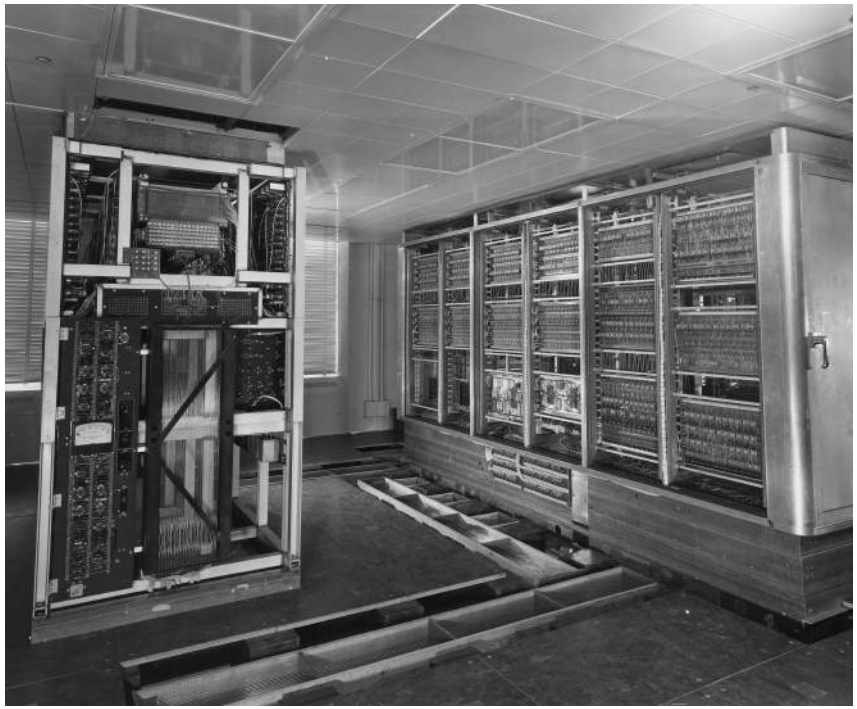
"Moll" Flanders, Project Director
Jeffrey Chu, Chief Engineer

- **AVIDAC: based on prototype at the Institute for Advanced Study in Princeton**
- **Margaret wrote AVIDAC's interpretive floating-point arithmetic system**
  - Memory access time: 15 microsec
  - Addition: 10 microsec
  - Multiplication: 1 millisec
- **AVIDAC press: @ 100,000 times as fast as a trained "Computer" using a desk calculator**

Early work on computer architecture

Margaret helped assemble the ORACLE computer with ORNL Engineer Rudolph Klein. In 1953, ORACLE was the world's fastest computer, multiplying 12-digit numbers in .0005 seconds. Designed at Argonne, it was constructed at Oak Ridge.

Quote from Margaret: “It was the best of times!”



Arithmetic unit (right) and memory unit (left) for GEORGE

- **Margaret was a member of the logical design team for GEORGE, the second ANL computer**
- **She wrote mathematical subroutines, system software, reactor applications, & utilities for**
  - AVIDAC (1949-1953)
  - ORACLE (1950-1953)
  - GEORGE (1955-1956)
  - UNIVAC (1954-1958) – at NYU
  - IBM 704 (1957)
- **1957-1959: Margaret led the Reactor Computing Group**

Margaret learned, then taught, computer architecture and programming before there were courses available in any schools on the subjects, as university computer science courses had not yet arrived.

Margaret headed the Applications Programming Section of Argonne's Applied Mathematics Division: 1959-1965

She developed programming teams for

- reactor physics
- chemistry
- biology
- high-energy physics
- management applications

Back Row:

- **Robert L. Logan**, Lead of AMD Systems Section
- **Wayne R. Cowell**, Lead of Digital Computing Center
- **David Jacobsohn**, Lead of AMD Engineering Section

Front Row:

- **Richard King**, Applied Mathematician
- **Margaret Butler**, Lead of AMD Applications Programming Section
- **J. Wallace Givens**, Director of Applied Mathematics Division (AMD)

Computational Science and Software: 1960-1972

- **Margaret performed research on benchmarking, performance measurement, and image processing**
  - CDC3600 (1963)
    - When the CDC3600 was delivered, a subroutine library accompanied the machine, but there was no documentation.
  - IBM360 (1964-1967)
  - CHLOE (1963-1970)
  - ALICE (1970)
- **Margaret founded the Argonne Code Center**
- **First female Fellow of the American Nuclear Society, 1972**

Argonne National Laboratory and the Emergence of Computer and Computational Science, 1946-1992

Charles Nelson Yood, Penn State University, Department of History, 2005

- https://etda.libraries.psu.edu/paper/6740/2028

Acknowledgments:

"… **At Argonne, I met many interesting, supportive, and friendly people. I would especially like to thank Margaret Butler**, a founding member of the Applied Mathematics Division (AMD) in 1957. She willingly submitted to three long interviews, many emails and phone conversations, and donated to me personal materials related to computing. Margaret was also instrumental in putting me into contact with current and retired members of the AMD, including **Joe Cook, William Cody, Wayne Cowell, Paul Messina, and Bill Miller**, and she also read and commented on my first two chapters. In addition, I would like to thank the aforementioned members of the AMD for agreeing to be interviewed at length and for donating their personal papers to me as well. **Gail Pieper** was particularly helpful for sharing her office at Argonne with me and for providing encouragement and support during my visits to Argonne. Her knowledge of the history of the AMD, and especially its personnel, was invaluable … "

Abstract

This dissertation uses the Applied Mathematics Division (AMD) of Argonne National Laboratory (ANL) as a window to explore the emergence of computer and computational science as independent scientific disciplines. The evolution of the computing activities at Argonne reflects broader issues concerning technology, identity, professionalization, and the social organization of science.

While Argonne's development of digital computer technology is a significant part of this story, I focus on the AMD's efforts to integrate computers – and their attendant personnel – into the scientific process. In particular, the pursuit of "computational science" required that applied mathematicians be incorporated in all stages of science and engineering practice -- from problem formulation to the definition of what constituted a solution. Arguments for such a collaborative structure drew on Cold War rhetoric, debates within the mathematical profession, and issues surrounding the increasing quantification of the sciences. Simultaneously, applied mathematicians sought to define a new research agenda that balanced their duties to provide mathematical expertise to other scientists with their desires to conduct their own research.

Despite the intentions of AMD directors, the interdisciplinary collaboration that computers were supposed to foster failed to materialize as envisioned. The emergence of an independent computer science, technological innovations, and the development of computer expertise by other scientists effectively limited the extent of collaboration. Beginning in the mid-1970s, though, the development of supercomputers, together with a new federal emphasis on high-speed computer networks created new opportunities for mathematicians, computer scientists, and scientists to work together. Impetus for collaboration was fueled by a number of different national concerns, including the Japanese Fifth Generation program, the need to support the domestic supercomputing industry, and pressures to make supercomputers readily accessible to American scientists. The federal government responded by creating the High Performance Computing program in the late 1980s, followed by the Grand Challenge Program of the 1990s in an effort to foster computational science – considered a third methodology, alongside theory and experiment, for doing science . Along with enabling computational scientists to tackle problems with broad implications for science, economics, and national security, another result was a significant reorientation of computer science research.

Margaret was an influential role model and mentor

- President of Chicago Chapter of the Association for Women in Science, 1982
- Paved the way for Argonne's
  - WIST Program, established in 1990
    - https://blogs.anl.gov/wist/
  - Science Careers in Search of Women Conference
    - https://blogs.anl.gov/wist/activities/science-careers-in-search-of-women-scsw/
    - Established in 1988

MCS research leaders: Pushing into the future with cutting-edge mathematics, computer science and computational science

Nicola Ferrier
Computer Scientist

Computer vision to control robots, machinery, and devices, with applications in medical systems, manufacturing, and scientific discovery (MAUI, Waggle)

http://www.mcs.anl.gov/person/nicola-ferrier

Elizabeth Marland Glass
Bioinformatics Engineer

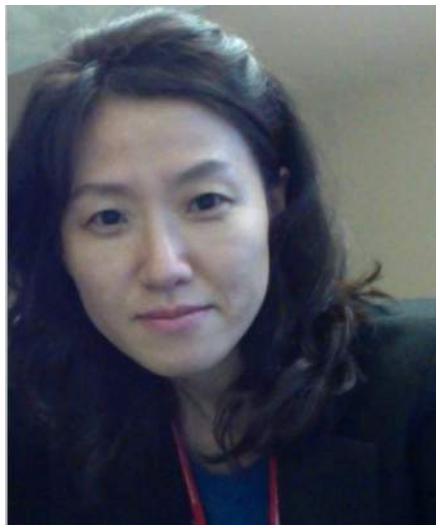
Metagenomics, bioinformatics, comparative and evolutionary analysis of metabolic processes, high-throughput analysis of genomes (KBase, MG-RAST)

http://www.mcs.anl.gov/person/elizabeth-marland-glass

Kate Keahey
Computer Scientist

Virtualization, resource management, cloud computing (Nimbus: Clouds for Science and the Ocean Observatory Initiative)

http://www.mcs.anl.gov/person/kate-keahey



Misun Min
Computational Scientist

high-order numerical algorithms for efficient and accurate modeling in accelerator physics, nano-technology-based applications, and lattice Boltzmann fluid simulations (NekCEM, NekLBM)

http://www.mcs.anl.gov/person/misun-min

Technical Women in MCS

June 2015

Julie Bessac
Postdoc

Zichao (Wendy) Di
Postdoc

Nicola Ferrier
Computer Scientist

Elizabeth Marland Glass
Computational Biologist

Rinku Gupta
Principal Software Development Specialist

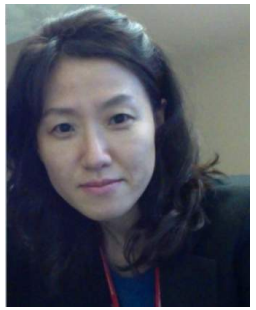
Katherine Heisey
Special Term Appt

Charlotte Haley
Postdoc

Kate Keahey
Computer Scientist

Amanda Lund
Predoc

Lois Curfman McInnes
Senior Computational Scientist



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Janet Jaseckas
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Margaret Kaczmarski
User Experience Administrator

Janet Knowles

Janet Knowles
Principal Software Development Specialist

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Postdoc

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Web Developer Associate

Technical Women in Nuclear Engineering

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(Page 1 of 2)

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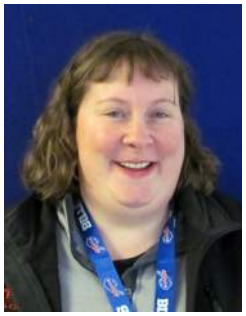

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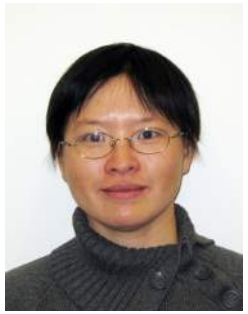
Laural Briggs
Nuclear Engineer

Acacia Joann Brunett
Nuclear Engineer

Tatiana Burtseva
Principal Materials Science Engineer

Jodi Canaday
Forensics Technical Data Specialist



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Nuclear Engineering Associate

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Donna Ferguson
Quality Assurance Coordinator

Sunaree Hamilton
Senior Program Leader

Laura Jamison
Postdoc

Cari Launiere
Postdoc

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Technical Women in Nuclear Engineering

June 2015
(Page 2 of 2)

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Nuclear Engineer

Emily Shemon
Nuclear Engineer

Christine Snyder
Scientific Associate Sr.

Jennifer Steeb
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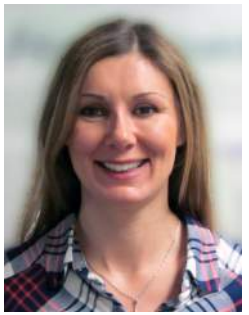

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Yifen Tsai
Analytical Chemist

Magdalena Tylka
Chemical Engineer

Mary Anne Yates
Senior Technical Advisor,
Senior Chemist

Bei Ye
Materials Scientist

Amanda Youker
Chemist

Xuan Zhang
Postdoc

Margaret founded and directed the National Energy Software Center: 1972-1991

Software exchange and information center for DOE and the Nuclear Regulatory Commission

Focus: problems of program interchange and portabililty

Current snapshot of MCS mathematical software

- **1991: Margaret retired**
- **1993-2006: Margaret worked as a Special Term Appointee**
  - Focus: intellectual property rights, copyright law issues affecting software sharing and technology transfer
- **Ongoing issues in mathematical software**
  - How to make software readily available for application usage, customization, and extension
  - How to design software for performance portability in an era of disruptive architectural changes
  - How to exploit capabilities of emerging extreme-scale architectures for new frontiers of scientific discovery

PIPS

Orio

PETSc

MOAB

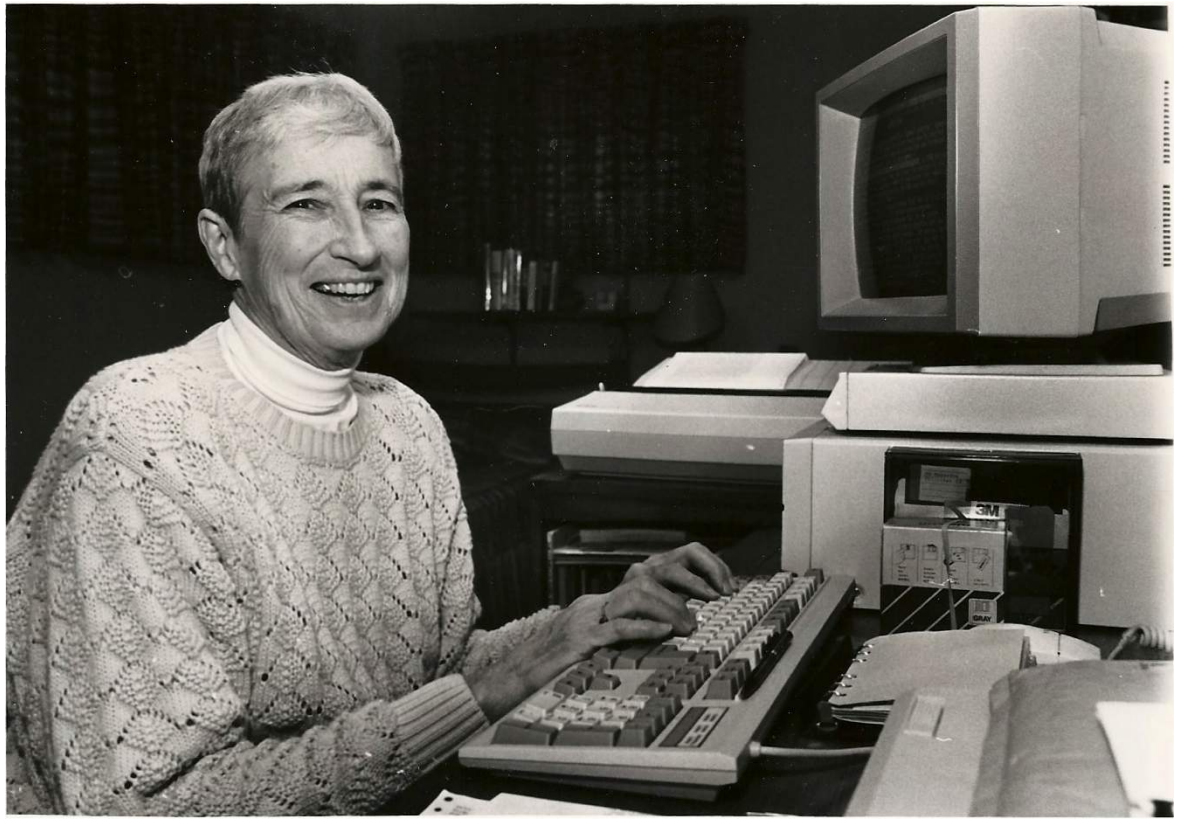
ScalaGAUSS

NEKCEM

NEK5000

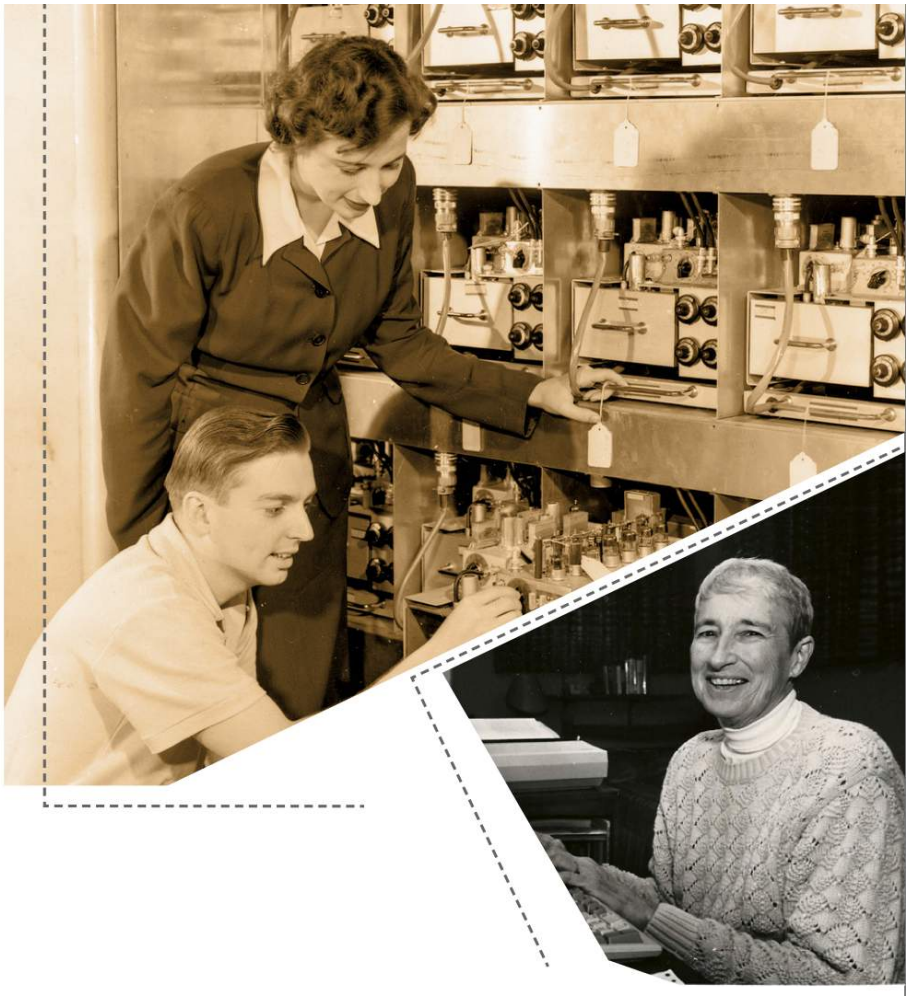
Onward and Upward!

Margaret's motto conveys her passion for computational science – and has inspired countless researchers in the quest for advances in architectures, modeling, algorithms, and software.



Margaret Butler: 1924 − 2013

The Margaret Butler Fellowship in Computational Science



Created in memory of Margaret Butler, a new fellowship at the Argonne Leadership Computing Facility (ALCF) offers computational scientists an opportunity to work at the forefront of high performance computing.

The new fellowship includes a highly competitive salary, moving expenses, and a professional travel allowance. Candidates must have received a recent PhD prior to the beginning of the appointment.

Ying Li – ALCF's first Margaret Butler Fellow

- University of Southern California, 2014
  - Ph.D., Materials Science
  - M.S., Computer Science
- Focus: Simulations studying hydrogen production and storage for fuel cells and batteries using Mira, the ALCF's IBM Blue Gene/Q supercomputer
- More info:
  - https://www.alcf.anl.gov/articles/qa-ying-li-alcfs-first-margaret-butler-fellow

Special thanks to …

- **Jay Butler**
- **Cheryl Stein**


- **Holly Stump**
  - ***Margaret Butler, One Woman's Life in Science,***
    - *by Margaret Butler and Holly Stump, 2013*
    - **http://www.semiwiki.com/forum/content/2128-margaret-butler-one-woman%92s-life-science.html**

- **And also to:**
  - Judy Beumer
  - Catherine Eyberger
  - Paul Messina
  - Jorge Moré
  - Marianne Schiffer
  - Marion Thurnauer