America are also good launching pads. Don't be afraid to reach out and request a conversation.

In a nutshell, my advice is to make enough contacts so that when you do apply for a job, you can ask a neutral but knowledgeable party to read over your materials before you submit. And have patience with the online systems: consider them a "necessary evil" to get you where you want to be. Good luck!

Jennifer Pearl

Credits

Author photo is by Kat Song, AAAS.

Early Career Paths at Los Alamos National Laboratory

Mary Frances Dorn, Daniel O'Malley, Harsha Nagarajan, Navamita Ray, and Andrew Sornborger

We represent a selection of early career staff at LANL with backgrounds in mathematics. There are many possible paths to a position at LANL. The lab has very active graduate research and postdoctoral programs, and it is not uncommon for graduate students to become postdocs, who can then be "converted" to staff. Conversion from being a postdoc is not the only route to a position at LANL, nor is it a guarantee, but most of us did postdocs here before becoming staff. Being a postdoc here also gives you an idea of whether you'd like living in northern New Mexico, a

Mary Frances Dorn is a scientist in the Statistical Sciences group at Los Alamos National Laboratory. Her email address is mfdorn@lanl.gov.

Daniel O'Malley is a scientist in the Computational Earth Science group at Los Alamos National Laboratory. His email address is omalled@lanl.gov.

Harsha Nagarajan is a staff scientist in the Applied Mathematics and Plasma Physics group (T-5) at Los Alamos National Laboratory. His email address is harsha@lanl.gov.

Navamita Ray is a scientist in the Applied Computer Science (CCS-7) group at Los Alamos National Laboratory. Her email address is nray@lanl.gov.

Andrew Sornborger is a scientist in the Information Sciences group at Los Alamos National Laboratory. His email address is sornborg@lanl.gov.

rugged, beautiful, and somewhat remote area. It is important to say here that citizenship is not a requirement for many of the positions at the lab. The lab historically and currently welcomes investigators from all over the world.

LANL offers a broad spectrum of mathematical challenges that are largely problem driven. Particularly to those who feel that academic mathematics can be stove-piped, with a focus on deep but not necessarily broad expertise, the LANL environment gives the flexibility to move and grow in many different directions. The lab encourages a team-based approach to problems, which not only enhances the breadth of our approach to solving problems, but also gives team members access to new fields. From the outside (academia), however, it can be difficult to see how fields map between academia and the lab. This is one of the reasons that having interaction with the lab as a graduate student or postdoc can be helpful in understanding if the environment would be a good match for you.

An important advantage of working at the lab is our high visibility both in academia, as well as in industry and the government. Because of its mission-driven projects, LANL, and more broadly the Department of Energy Laboratories, help set research directions that are picked up by researchers in academia. For this reason, many lab staff have worked at LANL for a number of years, then have transferred into academia after having set the agenda for their field of expertise.

Below, we will share some of our experiences, opinions, and reflections in order to give the reader a feel for our own early career experiences.

Mary Frances Dorn: I joined the Statistical Sciences Group at LANL as a staff member straight out of a PhD program in statistics at Texas A&M University. I got into mathematics in college because I enjoyed problem solving, and at LANL I've found an endless supply of interesting, challenging, and consequential problems. These days, I spend most of my time modeling extreme weather events and their impacts on energy infrastructure, improving estimates of uncertainty for material equations of state, and developing statistical methods for nuclear proliferation detection.

I work in a well-established group of statisticians whose collective areas of statistical research include reliability, design of experiments, computer model calibration, Bayesian methods, spatio-temporal modeling, statistical learning, and more. It's a bit like an academic department, but every member of the group is first and foremost engaged in interdisciplinary collaboration and applying statistical methods to real (and often messy) problems. Nobody works in a silo, and I can always find a colleague to brainstorm a problem. The research environment is definitely more collegial than competitive, and my fellow early career staff and I receive lots of informal mentoring from senior group members. There is more than one model for being successful as a statistician at LANL, and I would encourage any students

interested in a career in problem-driven applied statistics research to come spend a summer out here to learn more.

One misconception that people have about the labs is that the research done here stays here. This is far from the case. We publish, participate in and organize conferences, and collaborate with academic researchers around the world on challenging problems inspired by the lab's work, and many of our senior staff are recognized as leaders in the profession. We routinely host academic researchers as part of our seminar series, and we have a cohort of students each summer (many of whom return summer after summer while students, or on a more permanent basis as postdocs or staff scientists). Even though we live in beautiful, remote northern New Mexico, we are very much at the heart of the statistics research community.

Daniel O'Malley: Life as an early career scientist at LANL is generally good. There are plenty of opportunities to advance your career and research at present due to retirements and robust funding levels. Additionally, one does not have to worry about the tenure process. The day-to-day work of an early career scientist like myself is focused on research, writing (papers and proposals), and mentoring (students and postdocs). There is a competitive aspect to the environment, but I find it to be more cooperative and collaborative. It is a great place to do interdisciplinary research, drawing on expertise from scientists across multiple fields and/or integrating theory and experiment. A notable downside that disproportionately impacts early career scientists is the lackluster parental benefits, but this situation has improved recently and will hopefully continue to improve.

For anyone interested in making a career at LANL, I would recommend getting a foot in the door early. Postdoc positions often lead to staff positions, graduate assistantships often lead to postdocs, etc. I consider a postdoc at LANL to be more comparable to a tenure-track faculty position than a university postdoc position. This is because successful postdocs at LANL often have the opportunity to "convert" to a permanent position (akin to getting tenure), and LANL postdoc salaries are competitive with many assistant professor positions.

Harsha Nagarajan: I first heard about the US National Labs, particularly Los Alamos, during my PhD days when I read the popular book of reminiscences by the physicist Richard Feynman, *Surely You're Joking, Mr. Feynman*. Though I wasn't a physicist myself, I always had a fascination for Los Alamos and New Mexico since I had read the book. Later, once I was about to complete my PhD at Texas A&M University, I found LANL at the career fair, where they were particularly looking to hire United States citizens. Hence, I was under an impression that the National Labs were not meant for foreign nationals. However, given my background in operations research, graph algorithms, and control theory, as I was looking for potential postdoctoral

positions, I found an interesting opening (on the LANL jobs website) to work on network science problems with applications to energy infrastructure system problems at LANL. Once I applied, I was pleasantly surprised to hear back from a LANL scientist that I could indeed visit LANL and present my PhD work, after which I did receive an offer from the Center for Nonlinear Studies to pursue my postdoc work. To summarize, if you are a foreign national PhD student looking for potential positions at a national lab, and assuming that your thesis topic is not related to sensitive areas like nuclear security, etc., there is a very high chance that you will find an opening where you can be hired. Particularly, the theoretical (T) division at LANL is very flexible in hiring foreign nationals, provided your research aligns with the ongoing projects.

As an early career scientist, I was always excited to work on problems that are both fundamental in nature and also had direct relevance to real-world applications. In contrast to the folklore that most of the fundamental work happens at academic universities and all the documentation and implementation work happens at the labs, I realized it was actually a fine balance between these two at LANL. To give a better context, my research work here at LANL is focused on development of theory and algorithms towards better and smarter electric grids. As we all know, "Changing a system in the electric grid is like upgrading an airplane while it is flying," thus making it very hard to get your algorithms implemented in real-time grids. However, an advantage of being at the lab is the access to test the developed methodologies on real grid data and the communication access to the system operators who handle the grids on a day-to-day basis. Hence, this makes it easier for a scientist from a lab to demonstrate the importance of science-based methods to operate grids, in contrast to the time-tested ad hoc methods. Further, working at the lab, it will also be surprising to see connections of one's research areas in various unexpected applications. Hence, considering all these aforementioned reasons, working at a national lab as an early career scientist can be a great opportunity to further the frontiers of science.

Navamita Ray: My path to LANL involved joining the lab as a postdoctoral researcher and conversion to a staff position later. While some postdoctoral positions do require citizenship, there are ample postdoctoral and graduate student internship/researcher opportunities for foreign nationals at the lab. The postdoc position I applied to did not require citizenship.

There is a multistage approach to research at LANL that I personally find very appealing. First is the fundamental focus through programmatic research on developing methods that target real applications that have direct impact on actual design policies. It is always motivating to know that your work has been used to achieve some practical goal. Second, the lab also provides excellent opportunities to explore newer and upcoming research areas through its

LDRD Exploratory Research, Directed Research, and Early Career Research funding programs. A wide range of research areas (advanced numerical analysis, quantum computing, machine learning, fluid dynamics, statistics, etc.) in mathematics are pursued at the lab, mostly driven by various applications that the lab is interested in.

The model of work that I have been part of involves collaborations within and between medium-sized teams. I have found such team collaborations extremely beneficial in terms of getting valuable insights from more experienced team members, both for technical and nontechnical questions, with substantial encouragement to pursue my personal goals within project-specific goals. I have found the lab to be very open to collaborations across different research areas and have been able to extend my core expertise to research areas that I have never worked on before by forming collaborations with staff who have very different research backgrounds than mine.

Andrew Sornborger: Compared to my colleagues above, I took a somewhat longer path to LANL. With a PhD in cosmology and subsequent work in quantum computing, then a switch to neuroscience, my career has taken me through a wide range of fields and interests. Over the course of my career, I have had faculty positions in two mathematics departments and an engineering school. I am largely recognized as a mathematician (as opposed to a physicist) only because theoretical neuroscience is typically done by applied mathematicians. I learned about a position at the lab via a lucky encounter at a conference. This relatively quickly (in bureaucratic terms) led to my position. I have been at LANL for two years, but my perspective is less that of an early career scientist and more of a mid-career recruit.

For someone like me, LANL is a dream job. The breadth of interesting projects here is staggering, and the concentration of expertise is probably unique. One of the things that I have benefited from at the lab is the management structure. Here, a manager does not control a pot of money. They are largely responsible for helping connect researchers with funding streams. When I arrived, I expected to largely be doing work in neural computing, one of my specialties. But once my management learned that I also had a background in quantum computing, they connected me with quantum computing researchers here. We quickly developed projects to work on, and, if anything, this aspect of my research has become more dominant than my neural computing work. We now have LDRD and DOE program funding to pursue a number of compelling research projects.

My position has led me to become involved in cross-DOE lab research teams. This type of work is encouraged by the DOE and has helped me and my collaborators broaden our impact. LANL has given me the opportunity to be involved in a number of situations in which I and my collaborators have been able to set a research direction that quickly gained recognition for mission-driven problems.

The lab is an active place. Graduate students arrive en masse during the summer, and I have found that this is one of my most productive times for research. The quality of both graduate students and postdocs here is very high, and this makes it rewarding to work with and supervise research projects. This is also one of the reasons that the lab has such a broad reach in the research life of the country and the world. Past students and postdocs often retain close relationships with the lab, helping cross-fertilize academic and lab research goals.

Mary Frances Dorn

Daniel O'Malley

Harsha Nagarajan

Navamita Ray

Andrew Sornborger

Credits

Author photos are courtesy of the authors.