An Interview with William R. Pulleyblank

Many of us have no idea as to how is the research environment in a private laboratory like the IBM T.J. Watson Research Center. Could you start by telling us about this research environment, in particular the one in the Department of Mathematical Sciences?

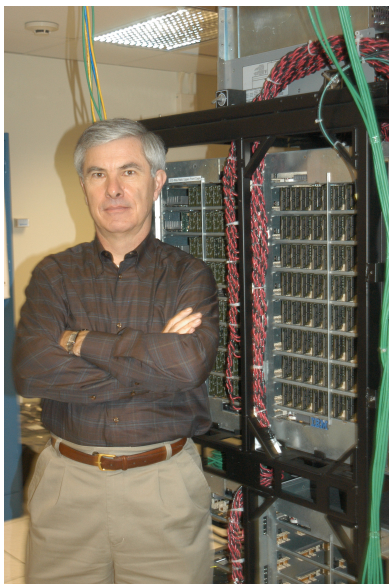
There is probably as much difference between different industrial research laboratories as there is between different universities. IBM Research has consistently had a mission that combined carrying out a top level scientific research agenda with the desire to make the results relevant to the corporation. In some ways, the Mathematical Sciences Department operates like a university department. We write and referee papers, edit journals and present papers at conferences. Some department members teach courses and supervise graduate students at nearby universities, for example, Columbia, NYU, Yale and MIT. However, there are significant differences. Many of the problems we work on come from IBM customers and other units within IBM. Often we are able to apply our work directly to real world problems. In addition, we always have the possibility of seeing the results that our research realized in the form of products. We do get pretty excited when this happens.

I recently heard a biographer of T. J. Watson (the father) emphasizing the importance of Research in the early days of the IBM company. Do you also think that research has played a vital role in the long success of the company?

Absolutely. When Lou Gerstner, our previous Chairman, formulated the principles that he wanted to guide the company, the first was "at our core, we are a technology company". He was a strong supporter of Research, as is our present chairman, Sam Palmisano. There is a feeling here that the things we do really have a chance to have an impact on the company and on our customers. It is very energizing.

In particular, how do you envision the Department of Mathematical Sciences thirty years from now? Will research staff there continue to do basic research and prove theorems?

I hope so. The model of combining serious mathematics with doing things that have the potential to positively affect the company has been remarkably successful, and robust. Examples range from devices like the Trackpoint, to software systems like OSL, to inventing new algorithms for digital half-toning. At the same time, there has been a remarkable collection of papers and books written by department members. The legacy of current and former department members like Shmuel Winograd, Mike Shub, Roy Adler, Alan Hoffman, Ellis Johnson, Ralph Gomory and Herman Goldstine sets quite an example!



William R. Pulleyblank

Now, let us focus on your career. In 1990 you moved from the University of Waterloo in Canada to the Watson Research Center. Would you like to comment on those times? What was the driving force that made you move?

In 1987, I was awarded an NSERC Industrial Research Chair in Optimization and Computer Applications, in part funded by CP Rail. This gave me a chance to expand the applied part of my research program, and also started me thinking about what I would do for the next 25 years of my career. In the spring of 1989, Ellis Johnson called and supposed that I would not move, but wanted suggestions for a possible successor to himself as Manager of the Optimization Center. It got me thinking about alternatives and I came here for a visit. I soon realized that IBM Research would be an excellent place to work on applied problems. Also, earlier in my career I had worked for IBM as a systems engineer. I had always had a high regard for the company, and the Watson Research Center had always seemed to me to be an exciting place.

So, after a lot of discussion with my wife, Diane, we decided to give it a shot and here we are.

How did your research program change as result of moving to the industry?

It evolved. I have always been an interactive mathematician, enjoying working with co-authors. Here I had the chance to work with people like John Tomlin, John Forrest and Ellis Johnson. I became very interested in computational questions. I was granted my first patent ever, jointly with John Tomlin and Alan Hoffman — an application of the Koenig edge coloring theorem to make certain matrix computations much more efficient.

A few years later you were chairing the Department of Mathematical Sciences in the Watson Research Center. How do you describe the leadership skills required for this job in comparison to those needed for a similar academic position?

The scope of a department Director's job is in some ways similar in scale to that of a dean. Tom Brzustowski when he was Provost at the University of Waterloo, described the faculty at the university as "800 small businessmen sharing a library and a parking lot". Today, he would probably add a computer network to the list. IBM is a much more hierarchical organization. When someone becomes a manager, it is not assumed that it is a temporary, three to five year, assignment. A department Director has a responsibility to generate funding for the department as well as to make sure that the careers of department members are progressing satisfactorily. In addition, it is important to understand and be able to present all the work done in a department. This has really encouraged me to broaden my outlook. For example, I am sure that I know much more Computational Biology now than I ever would have learned in a university mathematics department.

Do you think that an academic training can position one better for the industry than the other way around? I mean, do you think that someone with a career in the industry would have had a more difficult time chairing an academic department?

I believe that some of the skills needed for success in an industrial research position can be learned on the job. However, I think that the only way to understand what it takes to carry out a serious research agenda is to do it oneself. I think it is feasible for a person who has worked in an industrial research lab like IBM to be quite successful in a university environment — there are several examples I can think of who have made this switch. However, I have not seen many people who have not got a research background being very successful running a research department in industry or at a university.

How did you find time to write a book during those years? Has it payed off?

Ron Graham once, when asked a similar question, said that his secret is that every day contains 24 hours! You can do a lot of things if you decide to do so. In the case of our best seller Combinatorial Optimization (number 158,831 on the Amazon best seller list!), the big thing was the co-authors. Bill Cook and I launched it one night at Oberwolfach. We began by getting a group of luminaries to contribute comments for the back of the dustcover. Our plan was to write the index next, because then, we thought, it would be simple to write the book — just see what page we were on, check in the index, and see what had to go there. Later Bill Cunningham and Lex Schrijver joined the project. It was really interesting working through this material, that we all really loved, trying to combine our different pedagogic approaches.

I enjoyed doing it — I learned a lot and am very satisfied with the end result. However, I still earn more from my day job than from my book royalties.

Could you also tell us a bit about the Deep Computing project which you are currently coordinating? Has it been a rewarding experience for you? How will it impact IBM's future development policies?

The Deep Computing Institute at IBM Research was formed following our second chess match with Gary Kasparov in 1997 (which IBM's Deep Blue won 3.5 to 2.5!). The challenge was to see what we could do to take the ideas and apply them to a much broader set of problems. The idea of combing large amounts of computation and data to solve business and scientific decision problems is very broad, and the challenge has been to make it concrete. The breadth of topics — from simulation to optimization to data mining to advanced computation has been extremely interesting and has, I believe, led to some interesting research. For example, one of the projects I am currently leading is to construct BlueGene — the largest supercomputer in the world (by a large margin).

Let us now backtrack to the old days in Waterloo. It always impressed me in Waterloo the existence of a School of Mathematics, consisting of different departments. Did you see it as positive too?

The University of Waterloo has always been a very successful and innovative institution. In the sixties, the university decided to focus on mathematics, engineering, and an emerging discipline — computer science. It pioneered coop education in Canada. The idea of creating a Faculty of Mathematics, including pure and applied mathematics, statistics, computer science and

"Combinatorics and Optimization" had very positive consequences. There were stresses and conflicts that had to be resolved, but it seemed easier because of the common background of so many of the faculty members. And, it was really fun being bigger than Engineering!

How exciting was to do combinatorics in Waterloo? Who had a greater impact on you? Do you miss those times?

It was wonderful. I spent two and a half years at Waterloo as a PhD student and nine years there as a faculty member. I had the great fortune to be part of an extraordinary group of researchers in C&O. Jack Edmonds was a huge influence and we were all inspired by being able to work around Bill Tutte. I really enjoyed the time I spent as Managing Editor of Journal of Combinatorial Theory–B with Bill, Adrian Bondy and U.S.R. Murty. One of the exciting things was the set of visitors continually passing through. I also really enjoyed working with some of the young pups — we had quite a few Bruces at Waterloo — ranging from PhD students to Full Professors. They were an amazing bunch of colleagues. Somehow the group of students, postdocs and faculty members formed an amazingly homogeneous group of researchers. The thing that mattered most was the mathematics — everything else existed to support that.

We talked about mathematics in Canada and I don't want to miss this opportunity to ask you to compare the pre-college mathematical education in Canada to the one in the United States.

Clearly there is a huge variety within both countries. I do think that the Canadian system has been more strongly influenced by the British, or European model, and we expect students to take significant responsibility for their own programs and activities. The American system has huge diversity — ranging from top tier research schools to nurturing educational environments. Top schools in both countries are very competitive with each other.

Also, do you think graduate programs in US are stronger than in Canada, especially when it comes to applied mathematics and connection to the industry?

I like the practice of including external examiners on PhD committees in Canada. I believe that it raises the standard of the doctoral program and ensures a high quality of result. I think that the NSERC funding programs have been remarkably effective in supporting a broad base of graduate research. However the much larger size of the United States educational enterprise does result in a huge variety of opportunities.

Both systems work — top graduates from both systems carry out excellent research programs and have great careers.

It is time to end this interview with your future projects. What do you have in hands for the next years?

The big thing right now is building BlueGene — a single computer with about as much power as the total of the world's 500 largest machines today. This includes hardware, software and finding ways to construct applications that can exploit this machine. We should be able to solve some pretty big optimization problems very quickly!

How and when would you like to end your career...?

I don't think of my career ending as much as changing focus. There are still many things that I have not had time to do yet — understand quantum mechanics, the proof of Fermat's Last Theorem, and how the human cell translates DNA into proteins. I'd also like to finish some of the novels that I have started. And, I've still got a long way to go before Eric Clapton will consider me a rival on blues guitar.

Interview by Luís Nunes Vicente (Univ. of Coimbra)

W. R. Pulleyblank chaired the Department of Mathematical Sciences of the IBM T. J. Watson Research Center from 1994 to 2000. He is currently directing the Deep Computing Institute of this Center.

He held faculty positions in the University of Calgary (1974-1981) and in the University of Waterloo (1982-1991), before moving to IBM Corporation in 1991.

Bill Pulleyblank is one of the authors of the book Combinatorial Optimization, John Wiley and Sons, 1998, and the author of more than seventy research papers in this field. He has served on an extensive number of external and editorial boards.