Interview with Philippe Tondeur

On July 31, 2002, Philippe Tondeur finished his three-year tenure as director of the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF). He plans to return to the University of Illinois at Urbana-Champaign, where he is a professor of mathematics.

During Tondeur's time in the DMS, the NSF established the mathematical sciences as a priority area. The division's budget for the current fiscal year, fiscal 2002, is $151 million, a 25 percent increase over the previous year. The fiscal year 2003 budget request would add another $30 million, and NSF director Rita Colwell has pledged to bring the DMS budget to around $500 million over the next several years.

What follows is an edited version of an interview with Tondeur conducted by *Notices* senior writer and deputy editor Allyn Jackson on May 17, 2002. At the time of the interview, Tondeur's successor had not been named.

—Allyn Jackson

Notices: *What kind of changes do you foresee in the mathematical sciences community as a result of the increased funding?*

Tondeur: This fantastic, historically unprecedented situation has created for the mathematical sciences community in the U.S. a situation where they can play a much bigger role in the science enterprise. They now have a chance to be funded on a level comparable to the experimental sciences. Young people will see the mathematical sciences as a more attractive career in the future. The major effect will be the pipeline effect for the mathematical sciences.

It's like a huge playing field opening to the mathematical sciences community, because the resources are there. I hope that mathematical scientists will embrace these opportunities. The opportunities are of many kinds: they are in internal developments in math and statistics, but also in connections of math and statistics to the sciences, and drawing young people into the mathematical sciences. The goal is not only to educate people exclusively dedicated to the mathematical sciences but also to have people who are advocates who work outside and with the mathematical sciences.

An analogy I would use is this: In the past sixty or seventy years, molecular biology made biology into a chemistry-based science. Now genomics makes biology into an information-based science, and mathematics and statistics especially will play a huge role. The analogy would be that the mathematical sciences will play a similarly increased role in many sciences.

Notices: *Are there changes within mathematics that change the subject, in the way genomics changed biology?*

Tondeur: Mathematics is not just a self-contained body. Mathematics is profoundly affected by other sciences. The role of mathematics in information sciences creates a dynamic that in turn will affect mathematics. When I say information, data management is the key: data analysis, feature extraction of data, management of massive data sets. The mathematical sciences will fundamentally contribute to this.

Notices: *But the "gods" of the field of mathematics are not doing data management.*

Tondeur: They do, some do. There is a Stanford group, for instance, which uses topology for feature extraction of data. They think of data as simplicial complexes and compute homology. Lots of good classical mathematical ideas will play a role, and this will in turn affect mathematics. The role of combinatorics is immense. Arithmetic geometry, which is a whole platform for doing algebra and number theory using geometric ideas, is immensely important for the future. Another example is string theory, which is a mix of geometrical and physical ideas. These are powerful ideas that will transcend the field itself. I have faith that all these things will play a big role in the information world—not in a way that I could tell you today, but there is good

historical precedent. We want to support the best thinking on all these agendas. It's not really directed; we want to fund whatever is most compelling from an intellectual point of view.

Notices: *How has your vision of mathematics funding changed since you arrived at the NSF?*

Tondeur: It's more of a reinforcement than a change. I think the health of the discipline depends on the interaction with the science enterprise. I was chair of the mathematics department at Illinois, and it was true on our campus, and it's true nationally.

Notices: *But when you first came to the NSF, did you have an idea of what could be done to improve support for mathematics, and did that perception change?*

Tondeur: I had ambitious dreams, and they turned out to be the right ones. The astounding thing is how much persistent advocacy can affect the world. I hoped for it, I had the experience of it in a smaller context at Illinois, and it happened in this national context. And many funding agencies around the world are looking at what happens in the U.S., and some will change their funding tactics as a result. So I think it will have a worldwide impact.

Notices: *NSF director Rita Colwell is a big supporter of mathematics, due in large part to your efforts.*

Tondeur: But it's her own choice. That's what directors do; they decide to do things or not do them.

Notices: *But how did that come about? Did she just one day say, "Yes, math is important"?*

Tondeur: Well, that's what directors do; they develop a philosophy of things they can and wish to do. The ambition of the discipline has to resonate with the director's agenda. The three aspects of the mathematical sciences priority area are internal fundamental advances in the mathematical sciences, the impact on other sciences, and taking responsibility for the next generation. All these are important in the director's view.

All the players do things based on their convictions. I cannot believe in doing science without the next generation being sufficiently attended to. We currently do not draw enough talent into the profession, but on the positive side, we are making progress in doing so. It is the responsibility of research mathematicians to show their students this glorious adventure that the mathematical sciences are. One mode of support has been the increased attention to the Research Experiences for Undergraduates (REU) activities. That is a very effective tool. We do many more REUs than before, and we still don't do enough. I think many people don't do mathematics because they leave the discipline without knowing the fantastic things they could do. There is nothing wrong with the young people. The talent is there. We don't use it; we don't develop it.

Philippe Tondeur

Notices: *Concerning the mathematical sciences priority area, can you tell me how the support was built for that? You were a big influence, but there were other players too. Can you tell me who the other players were, or what the significant events were along the way?*

Tondeur: It's not a sequence of discrete events; it's more like a flow. General William Odom[1] is a key person. He collaborated with my predecessor, Donald J. Lewis, on the assessment report.[2] The report was prepared by an international group, who created a powerful science policy document that I took as my job description, as a vehicle that I could drive. Many people write reports, but most reports are not read or are not used. That was one that has been read and used. From a science policy point of view, that report is probably the key element. General Odom was a coach to the community in some sense during the preparation of that report and during my time at the NSF for how to operate in the political sphere. I can call him up anytime and get his advice.

Notices: *Why is he such a big supporter of mathematics?*

Tondeur: He was the key person who developed the central role of the mathematical sciences at the National Security Agency. They currently hire every year thirty mathematics Ph.D.'s, and ten master's and ten bachelor's in the mathematical sciences.

Notices: *What other components of this flow of support were important?*

Tondeur: Rita Colwell was and will continue to be important.

Notices: *What about people outside the NSF? Who was influential?*

Tondeur: There were lots of visits of the mathematical sciences community leadership to the different funding agencies. There is representation by

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[1]See "Sustaining the Momentum," by William E. Odom, page 885.

[2]Report of the Senior Assessment Panel of the International Assessment of the U.S. Mathematical Sciences, *National Science Foundation, 1998. Information about the report is contained in the article "Reports assess U.S. standing in mathematics", by Allyn Jackson,* Notices, *August 1998, pages 880–2.*

the society leadership in different combinations—AMS and SIAM [Society of Industrial and Applied Mathematics]—both on Capitol Hill and in the funding agencies, and everything helps.

Notices: *What is needed to sustain the momentum that's built up for the mathematical sciences priority area?*

Tondeur: To some extent, delivery by the community, delivery on all the science agendas. First and foremost, good mathematical results. The human resource agenda is important. You have a very supportive Congress right now, and you want to feed the Congress success stories. A congressional visit with young persons who talk about their work is very effective. Presentations on Capitol Hill by the societies, like the one organized by the Coalition for National Science Funding[3] are very important. The most powerful arguments politically are the interactivity of math with the sciences and the attention to the pipeline.

Notices: *You mentioned that the leadership of the math community visited the NSF. I have heard in the past that the other sciences did that more. Is that still true?*

Tondeur: Oh, yes, incredibly more. Mathematics has only awakened recently to this. Just as an example, the math community has one or two professionals in Washington, whereas the physics community has a whole house full of people. I'm not saying mathematicians should do exactly what others are doing, but certainly their representation in the government is very small. To give some kudos, Sam Rankin [director of the AMS Washington Office] is probably the only full-time person in the math community playing this role. SIAM represents hugely important mathematical science activities, and they have just a part-time person in Washington.

Notices: *An emphasis of the AMS Washington Office has been to work with other scientific organizations in Washington to raise the budget for science overall. How does that balance with the need to argue for your own discipline? Is it dangerous for mathematics to go it alone and argue only for mathematics?*

Tondeur: We are not only arguing for mathematics, we are not going it alone, we are acting through this agency. But if you don't advocate your discipline, who will? You have to balance this within the framework of greater support for the sciences, but certainly we have to advocate our discipline. And all disciplines do it, don't worry! They do it—and it's ugly sometimes. We don't do ugly things. We do very nice things. But you do have to advocate. That's what we are here for.

Notices: *When you look at the fiscal 2003 budget request for MPS [the NSF's Mathematical and Physical Sciences Directorate], mathematics is way up and the other disciplines are flat or down.*

Tondeur: But you have to look at the end result, what is finally appropriated by Congress. Our budget is a mix of the agency advocating through the White House and the administration to Congress, and Congress debating and fixing and changing it. I am totally convinced that in the end all disciplines will have positive increases. But how does an agency express its priority through the budget? The budget request numbers say, "This is more important than this, for us, this year." In the end all will have increases, and math will have a higher increase.

Notices: *Suppose you could start with the $151 million the DMS has today and you could draw the budget any way you wanted without regard to traditions of how things have been divided up in the past. How would you draw the budget? How would you balance between the different things the DMS funds—institutes, VIGRE grants, and so on?*

Tondeur: We think that 10 percent of our budget for math institutes is a good percentage. It was 10 percent a few years back. In the much bigger budget, we will still spend 10 percent on the institutes, but there will be six instead of three[4]. We spent 10 percent of our budget on VIGRE this year; I think it's responsible to spend 10 percent on the pipeline issue. Note that this investment is in addition to many human resource investments in other forms. So the institutes, 10 percent; 10 percent for VIGRE; and the rest is a mix of agendas. We spend $3 million annually on postdoctoral fellowships. This year we awarded twenty CAREER grants, which are each $300,000 total over five years; I think it's a good investment, it's a pipeline investment. We have about thirty REU sites and spend about $1.5 million annually on those. We spend some money on professional society program support and programs at the National Academy of Sciences. And the rest is PI [principal investigator]-initiated grants, which include activities like Focused Research Groups, special solicitations like mathematical biology, SCREMS [Scientific Computing Research Equipment in the Mathematical Sciences], etc. That is how it adds up. Support for PI grants is the bulk of our investments. The growth in the PI grants has been better in this period than ever. It's not something we've neglected.

Notices: *When you say the growth in PI grants has been better, do you mean in terms of the number of grants?*

Tondeur: No—size.

[3] *See "AMS participates in CNSF exhibition",* Notices, *August 2002, page 826.*

[4] *See "New NSF Institutes Announced," page 945.*

Notices: *There is a push for increasing size and duration of grants. But many mathematicians feel not enough people are getting grants.*

Tondeur: Both statements are true, but I basically respond to the directives of the agency. The National Science Board [the policymaking body of the NSF] has a clear directive that increasing grant size and duration is a big priority.

Notices: *But do you think the number of grants will go up, with the coming increases?*

Tondeur: Oh, absolutely. But it's not yet visible. The big growth is in grant size and activities like CAREER grants, institutes, VIGRE, and Focused Research Groups. These grants are massive and very well funded compared to classical funding. Grant size and duration are big priorities for the agency. To some extent, if we get these resources and we don't show a big increase in grant size and duration, we haven't done what we were supposed to do.

Notices: *Someone told me it's hard to increase the size of PI grants in mathematics, because salary is the biggest part of those grants, and there is a feeling that one shouldn't just enrich the individuals. Is there this feeling at the NSF?*

Tondeur: No. Most people ask for two months' salary support, and they get between one and two; that's the pattern. Very few people get two, but the number is increasing and will continue to increase. But you shouldn't underestimate the significant component of graduate student and postdoc support in PI grants. Big dollars go to postdoc and student support. We don't think mainly in terms of salary, but in terms of total support. We want to give them bigger grants and leave it to the researchers' initiative to make judicious use of them. I must say, grants asking for student and postdoc support show interest in the pipeline.

Notices: *You are saying most people don't get two months of summer support.*

Tondeur: That's right, but it's not a dogma. The practice arose over time out of budgetary constraints, and the situation will improve with increasing budgets. I would like leaders in the field to apply for five-year grants; it's not really necessary to review their work every three years. And we can do it if there is a step-up in the budget. I would like this fall and next fall for lots of people to apply for five-year grants, that would be really desirable. Not all of them, though, because then there would be a problem!

Notices: *What about in other NSF divisions? Do they usually give two months, or is it variable?*

Tondeur: It's variable. The mathematical sciences have been restrictive as a response to huge budget pressure. And I would be happy to pay two months, but going from one to two on a big scale costs an extra $100 million. The money is not there yet. I am not against it, but our goal is to talk about total support, which includes PI salary support, but also graduate student and postdoc support. Our goal is to talk about PI support and to fund what they consider important to do their work. I hope many will consider the pipeline issues among the most important. And many do.

Notices: *What do you consider your best achievement at the NSF?*

Tondeur: I think the biggest achievement is to give hope to the community that we can change the support climate, that federal support can improve. But the other side of the equation is that, for this to continue to happen, the community should not think of itself as being an island. The improvement in support happens because the community is not isolated—it's reaching out and doing wonderful things. The funding is in a sense a response to that activity, and we should encourage the community to do more.

Notices: *Was there something that you tried to do at the NSF that you could not?*

Tondeur: Well, it's never enough. More would be even better. But I know that my successor has a good platform for success and can add further improvements. I have high hopes that this will happen.

Notices: *Do you have any advice for your successor?*

Tondeur: Be true to thyself, and do things based on your convictions. Do things that make sense for the community, and pay attention to the pipeline. Work with people, lots of people—you need support in the community. Play to your strengths—you have to use whatever skills you have. You need them all.

Notices: *Any advice to the math community about what it needs to do?*

Tondeur: I think it's a wonderful profession. Do good work; be responsible for the next generation. The mathematical sciences are a glorious enterprise and are destined to play an ever-bigger role. But be responsible to the other sciences, and be responsible to the next generation.

It's an honor to have been able to play this role and a privilege to have an opportunity to repay the NSF for everything it does for the community. I want to thank all the people who have cooperated in these efforts; without them the efforts would not have borne fruit. It is impossible to even begin to name them, because there are so many of them, but all these things are part of a collective enterprise. The science enterprise is a glorious adventure that started in earnest three centuries ago and I hope will be a driving force of society in the future.