Interview with D. J. Lewis

In July 1999 D. J. Lewis will complete a four-year stint as director of the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF). He will return to his home institution of the University of Michigan in Ann Arbor. Lewis will be succeeded by Philippe Tondeur of the University of Illinois at Urbana-Champaign (see "Philippe Tondeur Appointed DMS Director", *Notices*, April 1999, page 475; see also the correction in the "For Your Information" section of this issue of the *Notices*.). The following is an edited version of an interview with Lewis conducted in January 1999 by *Notices* senior writer and deputy editor Allyn Jackson.

Notices: *At the time you came to the NSF, the DMS was funding two mathematics institutes: the Institute for Mathematics and its Applications at the University of Minnesota, and the Mathematical Sciences Research Institute in Berkeley. One of the major undertakings during your time as DMS director was the recompetition of these institutes. Since the final funding decisions have not yet been made, you probably cannot discuss specifics, but can you tell me about the general philosophy you followed in figuring out what kinds of mathematics institutes the DMS should fund?*[1]

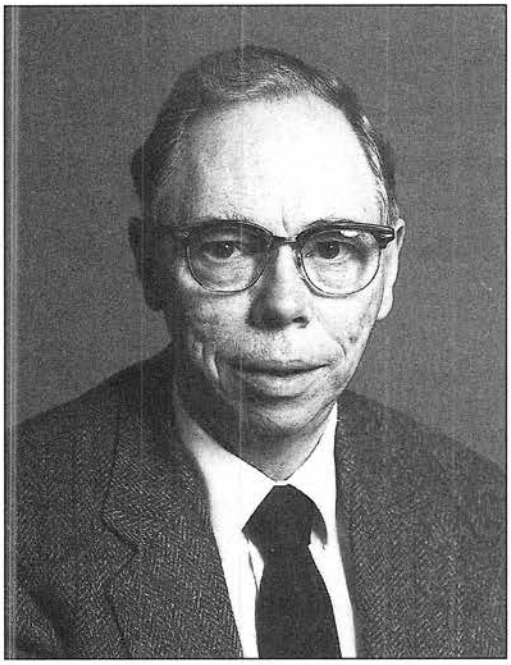
Lewis: We really were sitting back and seeing what the community would define as the activities they'd like. If anything, we were disappointed that they were copying too much of what we had in place. We were forced by the NSF director's office to put in more education requirements than I liked. I was really looking forward to some proposals for straight think tanks, and I still think we need that.

Everything I had heard had led me to believe that mathematicians felt they needed an Oberwolfach-type conference center.[2] We didn't see any proposals like that. I feel right now that the current institutes are running too many conferences, overburdening their facilities, and creating too much noise and distraction. I like the Isaac Newton Institute [in Cambridge, England]. They have thematic programs, but they don't run a lot of conferences. They don't worry about postdocs. They're under less pressure than what the NSF puts on its institutes for outreach. I think the NSF is asking the institutes to do too much. It's not just the institutes; they've done the same thing with the NSF Science and Technology Centers. I think different facilities have different roles to play. Every institute shouldn't have to play all the roles.

I think we need more institutes, but then you run into the question, Is it better to spend $2 million and have another institute or to fund another twenty-five or so researchers each year? It's a question of trying to keep the discipline alive and thriving. There's no doubt the really big ideas in mathematics come from maybe 5 percent of the people, but you need a broad base to nourish that 5 percent and to work out all the details as they move on to more adventuresome things. Look at, say, mathematicians at Group III universities. It's a rarity when they get funding. How do you keep them in the system? If you don't, they will turn out stu-

[1] *The "Reference" section of the May issue of the* Notices *carried a listing of some of the major mathematics institutes in the world, four of which are in the United States: Center for Discrete Mathematics and Theoretical Computer Science (DIMACS), Institute for Advanced Study (IAS), Institute for Mathematics and its Applications (IMA), and Mathematical Sciences Research Institute (MSRI). All four receive substantial NSF funding. DIMACS is supported through the NSF-wide program of Science and Technology Centers, and the School of Mathematics at the IAS has received substantial NSF grants for support of mathematical research. However, the recompetition for the DMS-funded institutes pertained only to IMA and MSRI. The reason is that these two institutes were established in the first DMS competition for mathematics institutes, which took place in the 1980s. The decisions on recompetition may have been made by the time this article reaches Notices readers.*

[2] *The Mathematics Research Institute at Oberwolfach, located in the Black Forest in Germany, is a center for mathematics conferences.*



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dents working on problems they learned about when *they* were thesis students. We've got to find a way to incorporate the larger community.

Institutes and conference centers can and do serve this purpose. The western European mathematical community is about the same size as that in the U.S., yet they have at least seven institutes and three conference centers, and Germany has about half a dozen *Sonderforschungsbereiche*, which are a cross between NSF Science and Technology Centers and its focused research groups. The Canadian mathematical community is about one-tenth the size of that in the U.S., and they have two research institutes. By these numbers the case can be made that the U.S. needs many more institutes than it currently has.

Notices: *During your time at the NSF, two "benchmarking" reports came out: one from the NSF and one from the National Academy of Sciences [NAS].*[4] *These reports attempted to evaluate the international standing of U.S. mathematics. What was the effect of these reports?*

Lewis: I don't think the National Academy report has had much effect, partly because they only took a snapshot of here and now and didn't do any projections. In fact, the NAS committee was forbidden by the Academy to say anything much about the future. Both reports were basically responses to GPRA [Government Performance and Results Act]. Congress seems to be very much insisting on quantitative measures, and GPRA could have a devastating effect on science.

OSTP [Office of Science and Technology Policy] and some members of Congress have seen the NSF report, and a few have responded favorably. And it's had a definite impact on [Robert] Eisenstein [NSF assistant director for Mathematical and Physical Sciences]. The little bit of favoritism that's been given to mathematics in the last two years I think is somewhat attributable to the report. But we didn't get as much as we should have gotten, just because the budget was so flat and so targeted. In some sense it was viewed as a very dramatic report inside the NSF, but there haven't been a lot of funds coming in to respond to it. There is evidence that it might well have some effect on the fiscal year 2001 budget if the budget isn't too politicized. We'll have to wait and see.

Notices: *Parts of that report were surprisingly bold in what they said.*

Lewis: The panel was pretty bold. This is because they were outside the system. We couldn't have anybody on the panel who was supported by the DMS. This was OMB's [Office of Management and Budget's] requirement. I think the report had an impact because the panel didn't have anything to gain from it. We had people who had been very involved in these kinds of assessments in their own countries. One trouble with the NAS report was that the panel consisted of leaders in American mathematics, and if they criticized too much, they were criticizing themselves. The NSF panel had nothing to lose by criticizing. On the whole, I think they made some pretty constructive recommendations. Also, we had some U.S. scientists who weren't mathematicians, and they were awfully tough. They felt that mathematics had gotten too self-centered, and yet they particularly saw the need for mathematics.

Notices: *You have had three changes of bosses in your time at the NSF: William Harris was assistant director for MPS when you came to the NSF, then John Hunt was acting assistant director for a while, and now Robert Eisenstein is assistant director. And you have had another change in the top NSF position, from Neal Lane to Rita Colwell. How much do those changes affect what goes on at DMS?*

Lewis: They set the overall guidelines, and they set the budgets. It's a very hierarchical arrangement. I have to make my pitch for budgets to Eisenstein. He either buys them or he doesn't, and he forwards them upstairs. So I don't get a chance to make my case to Colwell at all. I thought that all three assistant directors I had were very supportive of mathematics. Math, in the four years I've been there, has been in one sense better treated than any of the other divisions in MPS. The percentage increases have been good, but the problem is our base is so small [the DMS budget for the current fiscal year is $100.9 million]. They didn't have a lot of money to give. In the first two years, DMS got one-tenth of the entire increase that the Foundation got, which is pretty good. On the other hand, it was peanuts—about $9 million.

[As DMS director] you have to be aggressive without being obnoxious. In the five or six years before I arrived all increases were for the so-called strategic initiatives. It was a question of whether you could play in the game. Judy Sunley and Fred Wan were division directors then, and they did reasonably well in capturing funds—of course, not

[4] *See the article "Reports Assess U.S. Standing in Mathematics",* Notices, *August 1998, pages 880–82.*

as well as CISE [Computer and Information Sciences and Engineering] did via the High Performance Computing initiative. Some of the divisions, like Physics, didn't play at all. So they were actually flat for three or four years. Literally flat. They wanted to just continue doing the same old thing. They refused to play and got no increase.

The basic thing when you're running something like this is to increase your budget. Legally, with initiatives, strings are attached, but usually three to five years later people will forget what the strings were, and you can reallocate. If you sit back and wait for ideal conditions, your budget is not going to grow as fast.

Notices: *I've heard people criticize NSF, saying, "They're going in too much for applications, like the KDI [Knowledge and Distributed Intelligence] initiative and the material science project with ARPA [Advanced Research Projects Agency]." They are saying that the DMS is putting too much money toward those kinds of things rather than into core research.*

Lewis: The ARPA thing cost DMS about $80,000 in total. I pulled a deal for the NSF contribution to come from OMA [Office of Multidisciplinary Activities] and got about three and a half dollars from ARPA to every OMA dollar. And KDI—that was the only new money coming in last year. It was a Foundation-wide activity. I was given the job of writing the prospectus and the solicitation, primarily because John Hunt and Neal Lane saw that mathematics would be one of the biggest players in KDI. You're only going to grow the budget if you start serving other people.

If you start reaching out to the other sciences, you can make a fantastic case for the support of the core base of mathematics, which is that you've got to keep developing it so that you have the mathematics to use.

Notices: *How did the financial contribution from DMS to KDI work?*

Lewis: That was taxed. It was put in a central pot, and it was run as a central activity. Mathematicians could go after the money that was in the central pot. It had to be multidisciplinary, so it had to be a mathematician with somebody from another discipline.

Notices: *Does it look like mathematicians have recouped what the DMS contributed?*

Lewis: Yes, about twice as much on grants where a mathematician was the PI. But there were also many proposals that were funded that had a mathematician on the team of researchers. Mathematicians did very well, especially when compared with other divisions in MPS. I expect this year, in fiscal 1999, they will do even better. KDI was the direction the Foundation was going. You either played with it or you didn't play. I think it provided a fantastic opportunity for mathematicians. Unfortunately, in fiscal 2000 KDI will not exist, and the funding will be directed to biocomplexity. Mathematicians will be able to be involved here, but the spin will be quite different.

Notices: *Are there certain DMS programs that stand out as having a lot of very good, unfunded proposals?*

Lewis: Algebra and Number Theory is perhaps under the greatest strain. And one that should be under the same strain really is Geometry/Topology. But quite frankly, over the last three years that program made too many very small grants, and so the strain is hidden. Recent review panels in Analysis and Applied Math found it was especially distressing to see how many excellent proposals cannot be funded. So perhaps the strain is being felt rather universally. From my perspective, the math community is much too quiet and acquiescent. I think with some of these programs, the mathematicians ought to send a delegation in to talk to the assistant director.

Notices: *Do they do that in other disciplines?*

Lewis: To some extent, but NSF is a small player in a lot of the disciplines. NSF may provide 25 percent of the funding for chemistry. For mathematics, it's over 60 percent and going onto 70 percent because the DOD [Department of Defense] agencies are pulling out of math. The rumor is that the Air Force [Office of Scientific Research] is taking a 30 percent cut, and ONR [Office of Naval Research] is basically out of mathematical funding. It puts a lot more pressure on NSF. I made the case to Eisenstein, but I don't think anybody from the math community has gone and talked to him about this loss of funding and how it should be made up.

Notices: *Currently what is the percentage of DMS proposals that get funded?*

Lewis: I think about 35 percent, which is about standard at the NSF. But the problem is, we get that by giving very small grants. We're under terrific

pressure to increase the size of our grants. If we did what the [National Science] Board wants us to do, we would fund 800 people instead of 1,400. It's a question of whether DMS did the right thing when they pulled so many people down to one month of summer support. This took some of the pressure off the Foundation to put more money in mathematics. Suppose we funded only 800 people. How much noise would it create? Would there be a march on Washington? I often think that's the way to go. See whether mathematicians would stand up for themselves or whether they'd just meekly accept. In chemistry, people get declined, and in two months they turn around with another proposal. Mathematicians—they get declined twice, and they fold. I think mathematicians have such a personal investment in their problems that if you turn down their proposals, they take it as if you're judging them as mathematicians. They're not as flexible and often don't seem to be able to move to another class of problems. We fund proposals, not individuals.

Notices: *One of the things you started at the NSF was VIGRE [Vertically Integrated Grants for Research and Education]. What has the reaction been from the math community?*

Lewis: A lot of proposals, and some very good ones. It's causing a real cultural change in departments. They're having to look at the undergraduate program. They are expected to do discovery learning and REUs [Research Experiences for Undergraduates], or send the kids out for internships. And they have to have a goal of getting their Ph.D.s done in five years. Mathematicians are beginning to recognize that we do not have enough domestic students entering mathematics. To reverse this, more attention will need to be given to undergraduates. VIGRE asks that this be done. Many mathematics departments are running graduate programs strictly in order to have a cheap way to do their teaching. At some of the very well-established departments, you would be shocked at how much teaching they expect those kids to do. That's probably the reason it takes so long to get their degrees. With VIGRE we hope to provide fellowship funds so the teaching is reduced and they complete their degrees more quickly. With an increased number of postdoctoral opportunities, it should be possible to provide a broader education so those who will go into research will have more time and opportunity to develop.

A goal of VIGRE is to try to get the funding of mathematics graduate students on a par with the rest of the sciences. It's ridiculous—every physics student is totally funded after the first year. Our goal is to get $40 million for VIGRE. Right now it is somewhere between $13 million and $15 million. Forty million is about the amount that the NSF's Chemistry Division puts into graduate students and postdocs. But remember, they're putting in only 25 percent of the total amount of support for chemistry graduate students. So our $40 million is a pretty low target. But we've got to grow it; we can't take it out of the research grants, so it is best to have a realistic goal. The response within NSF is very positive, and I believe that if Philippe Tondeur keeps this as a goal, it will be attained.

Notices: *One person I talked to who had applied for a VIGRE and didn't get it said that it seemed to him that the VIGRE grants were going to the same fancy places that get all the grants.*

Lewis: We have made eleven awards to date. Three of the awards went to departments that are not considered to be in the top twenty-five departments, maybe not in the top fifty. But those departments understood the goals of VIGRE and made quite a compelling case for funding. It is true that the elite places are going to have a better chance because they have better programs and better students. If you're going to invest money in students, you want to invest in students that can really achieve. It's not an equal opportunity program. Put it this way: There are some very big name departments that got turned down. We're expecting them all to come back this year and learn how to write the proposals. We will be making something like eight to ten more awards this summer. An imaginative program seeking to achieve the goals of VIGRE will get funded.

Notices: *After your time at the NSF, do you have any advice for the math community about what they should be doing to try to improve the funding for mathematics?*

Lewis: I don't think that up to this date they've made a very good case for why they should be funded. The bottom line is, What are you doing for the citizens of the country?

Notices: *When you say "make the case," what do you mean concretely? Do groups of mathematicians have to descend on Capitol Hill?*

Lewis: They've got to do some demonstrations of what mathematics has accomplished for the good of society. One of the things mathematicians have done is education. For example, if mathematicians took seriously the job of training elementary and middle school teachers, they could make some claim that they really improve things. Also, science is getting so complicated, it can be done only with the help of mathematics. Is the math community willing to step up and participate?

If so, they will have nonmathematicians making the case for greater funding of mathematics. It is always best to have outsiders make your case for you. Once upon a time I thought going to Capitol Hill would be effective. I don't think it will get very far if mathematicians go to Capitol Hill without the support of others. These days information technology and biology and medicine are the themes that echo well with the president and Congress.

If you start reaching out to the other sciences, you can make a fantastic case for the support of the core base of mathematics, which is that you've got to keep developing it so that you have the mathematics to use. Furthermore, there will certainly be problems that arise in science for which the necessary mathematics has yet to be developed. There has to be a very substantial, core mathematics group to advance the subject all the time. The big thing is for them to be open to problems arising in science.

Early on when I came to the Foundation, I was talking to Neal Lane about the importance of mathematicians being part of the scientific research program. His response was, "I agree with you, and I'm prepared to put money into it if you can guarantee me you can deliver the mathematicians." If I could deliver the mathematicians, I could double the budget. I could farm out part of the increase to core mathematics, but I would have to have some people doing multidisciplinary things.

One thing I've done is to change very strongly the direction of things funded by Applied Math and Computational Math. Too much of applied math in this country has been applied analysis working on toy problems. Now these programs fund problems only where you really can document that somebody in another discipline is interested in what you're doing and can use it. Otherwise, you have to come in and compete in Analysis or another program. The old-time applied mathematicians are very, very unhappy [with this change]. But it's exactly because of this change that we've increased the amount of joint funding with other NSF divisions. The other divisions have more money than we do, so quite often when we co-fund, we put in less than a third.

If you go back one hundred fifty years, there was just science. Later it fragmented into math and chemistry and physics and so forth. What we're seeing now is that you've got to bring all these pieces back together. You can't do the kind of science that you want to do today without having the mathematician and the chemist, or the physicist, or the biologist working together—and maybe all four. Basically, science can't move now without the mathematicians' participation.