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Barbara Bertin
Office of the Undergraduate Dean

Dear Barbara,

This is a follow-up to our conversation Wednesday morning, January 6, 1999. We discussed opportunities for UCI Faculty at UC/DC. You suggested there might be a position for two quarters, Winter and Spring 2001. Below is a proposal supporting the value of my presence to UCI in Washington. **Part A** is a seminar proposal: **School Mathematics And National Science Policy**. Also, I would interact with the American Mathematical Society (**AMS**) over research and educational policy issues related to mathematics. Partly this would be for my education; learning how to deal with the undervaluing of research mathematics. Science policy is part of my seminar offerings, so this interaction would inform my seminar presentations. Further, AMS could use my skills with unix programs that simplify communication to large groups of people.

A three-module seminar, sufficient for one quartere, appears below. An alternate module, **The geometry behind Renaissance art**, shows two points.

- Such a seminar could go on indefinitely (i.e. into a second quarter).
- Its historical aspects will suit Humanities and Social Science students.

Each module has substantial math-science behind it. Each would generate several weeks of lectures, and a Smithsonian field trip. I would encourage some relation between seminar activities and research topics of students whose independent field work I would be supervising.

My seminar design matches present AMS mission in DC: To advertise the powerful contribution of mathematics to the success of national technology projects. Reference to the National Security Agency (NSA) and National Science Foundation (NSF) appear in comments on getting outside speakers for the proposed seminar. UC/DC interaction with these organizations would strengthen social and political resources for the UC Washington presence.

Here is a reminder of my schedule of commitments:

- On leave to give talks this spring 1999: Florida, Germany and Israel.

- Organizer for a Mathematical Sciences Research Center Semester at Berkeley, fall 1999 — away most of the quarter.

For a while I have the flexibility to go to Washington upon my return, winter 2000. A 2-quarter window arising earlier than winter 2001 would be great. Still, I am enthusiastic about the period of winter–spring 2001, for myself personally and what I can do for UCI by being in Washington.

A. **School Mathematics And National Science Policy**:

This three-module seminar would be for the first UC/DC quarter. This will include discussion of national education policy: especially toward K-16 mathematics taught in our schools. The seminar material will adjust to the backgrounds of humanities' students. This should allow students to develop interest in one of many different aspects of the topic. Each has a title followed by list of subthemes, including taking advantage of the *Smithsonian Institute.*

A.1. *355/113 —Not the famous PI, but an incredible simulation!*: Training sufficient engineers for massive projects has often been a national policy issue.

- Advantages to practical field work of having a great rational number approximation to PI.
- Early 20th century technology projects, requiring massive machinery, for which such an approximation would be insufficiently accurate.
- Field trips to the American History Museum to see historic changes in machinery dictated by increasingly subtle engineering projects.

A.2. *GROUPING complicated data*: Children get a famous puzzle from cracker jack boxes (see picture below). The goal is to move squares around in a 4×4 grid to achieve specific *target* configurations. Each attempt (even those that don't work) interprets as an element of a *mathematical group.* A novice would think it impossible to keep track of such *attempts.*

- Applying *group theory* shows why the 2nd target below is impossible.
- It also shows exactly which configurations are possible, like how to go to the 1st target below.

Exploiting symmetries in complicated data informs such varied topics as compression of digitized art, tracking the genome, and quantum computing.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	■

$\overset{\text{attempt}}{\Longrightarrow}$

■	15	14	13
12	11	10	9
8	7	6	5
4	3	2	1

$\Uparrow$ Some attempt will take the left to the right $\Uparrow$

$\Downarrow$ No attempt will take the left to the right $\Downarrow$

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	■

$\overset{\text{attempt}}{\Longrightarrow}$

15	14	13	12
11	10	9	8
7	6	5	4
3	2	1	■

Everest Galois died in a duel when he was 21 years old in 1839. His letter to his friend Chevalier, contains the technique behind these observations. The struggle to introduce *group theory* earlier into the school curriculum has engaged organizations like NSF since the middle 60's. Don Lewis (DMS director 1996–1999, or an alternate) would discuss NSF's plans for engaging the scientific community in Data Enhancement and Maintenance. Lance Small (DMS program officer 1996–2000) would discuss such NSF education reform programs as IGERT.

A.3. *Cryptography: Showing crooks where the money is*: Secrecy and public safety have a strange tension, that shows in the problem of keeping sensitive data (like electronic money) safe. The **RSA** method openly publishes everything except a *private key*. It is like putting a sign in the front yard saying: "We have a beautiful diamond necklace under Givenchy bags in the upper story closet. The key is in the bureau 3rd drawer." Why do we trust this method?

- The core mathematics, older than the Bible, behind **RSA**.
- How 3-6th grade math. confounds the belief **RSA** keeps data safe.
- Why noone knows if **RSA**'s assumptions are correct.
- How NSA encourages testing **RSA** and other similar methods, without defying our need for security.

John Dillworth (NSA Program Officer) would inform our seminar of public policy. Secure data problems appear also in our increasing reliance on electronic communications and information storage, more efficient and more accurate file back-ups; more stable software, and more secure data transfers via modem. My team (1993) characterized the mathematical functions that could manipulate data appropriately for encryption design and assuring data integrity. This used *group theory*, like that from the Cracker Jack puzzle. It showed some things were impossible. Yet, it revealed new encoding functions, with better behavior than expected. It used the *classification of finite simple groups*, one research project from the 1970's to which AMS wants to attract attention.

A.4. *Geometry behind Renaissance art*: A Jacopo de' Barbari painting, *Ritrato di Fra' Luca Pacioli and a young man*, from 1494 has considerable renown.

Brother Pacioli has before him an open copy of Euclid's elements. The identify of the well-dressed young man over Pacioli's left shoulder appears nowhere. I discovered who he was on a 1996 trip to Venice. It is Albrecht Dürer, the northern genius of the renaissance who studied with de' Barbari at exactly this time. I contend de' Barbari painted it sans Dürer and gave it to Dürer. Dürer, at 19, painting himself into it as a symbol of a new artistic generation.

The painting appears in recent books with an historical view of modern technology. Example: *The Measure of Reality: Quantification and Western Society, 1250-1600*, by Alfred Crosby, Cambridge University Press, 1997. Even without knowing it is Dürer, one recognizes de' Barbari's painting as a symbol for European rewriting of the world view commencing the age of exploration.

B. **Interaction With AMS In Washington**:

Sam Rankin is Associate Executive Director of the Washington branch of the *American Mathematical Society*. AMS opened a Washington office in Fall of 1992. I chair the AMS committee on Summer Research Conferences and the Von Neumann Symposium. This committee awards large research amounts for two-week summer conference support.

B.1. *AMS agenda in Washington*: The agenda, according to Sam, driving the AMS Washington presence ties research funding to the national perception of Mathematical Research. Information technology and computation are big ticket items that drive recent funding for Mathematics and Science. Large research teams receive this funding. AMS wants to recast the view of funding individual researchers as leveraging funds: small amounts bring great dividends, at risk rates not approaching the support, say, behind bio-technology. AMS wants to increase appreciation of individual mathematics researcher contributions. This includes advertisements of the impact of such reseach in scientific achievements. Examples abound, like how *inverse scattering theory* gave us *Magentic Resonance Imaging*. My seminar would contribute in Washington to mathematical advocacy to a Social Science oriented audience.

B.2. *Statement on the Sloan Funded e-mail technology*: AMS will experiment with e-mail and the web to broadcast its message. The e-mail technology I developed with Sloan Foundation support can help: www.math.uci.edu/˜mfried/#ed has an article from an MAA publication on assessment. This explains an effective tool: **Interactive Questionnaires** (IQs). These are unobtrusive e-mail interactive communication environments, appropriate for enhanced interactions with students in the Washington environment and for collaboration with AMS. Below is an article summary picked up by several newspapers across the country.

B.3. *UC Items article on the e-mail technology*: The goal of the program is to help students succeed in calculus .... It opens electronic communication between students and their instructors.

The grant provided development time for writing programs performing the following functions.

- Gathering information from each student through e-mail questionnaires.
- Automating creation of interaction portfolios on each student through regular E-mail contact.
- Formating weekly comment files for continual reinforcement and course feedback to students.

"These daily e-mail interactions gave me more contact with students in one course than I've had in 20 years of teaching, without increasing the work burden. ... The mathematics department's usual dropout rate for this course is between 25 and 40 percent. Using this method, I started with 56 students (fall quarter) and ended with 55."

Sincerely

Michael D. Fried
Professor of Mathematics

cc: Mathematics Department Chair: Abel Klein
Associate Executive Director of Washington Branch of AMS: Samuel Rankin
Dean of Physical Sciences: Ron Stern
Dean of Graduate Studies and Research: Fred Wan