CISE Directorate of NSF : charter, budgets, goals, organization

Catalog number: 102740243
Gordon Bell NSF-CISE Records
Virtual Bankers Box[1] 1

[1] To view individual document titles within this PDF, set your PDF reader to display bookmarks.

Contents: Bell-NSF-CISE archives in three VBBs (Virtual Banker Boxes) of approx. 750 pages. The boxes contain budgets, goals, organizations, presentations, and correspondence. Box 2 is about NSFs role in creating the National Research and Education Network (NREN) aka the Internet. Box 2 contains a number of interviews by persons creating the history of CISE and the Internet.	MB	Bookmarked Items	Pages
Bell CISE Directorate of NSF. Charter, Budgets, Goals, Org. 1986-1987 VBB1. Contains rationale for a new NSF Division taken from Engineering, Math and Science, and Social Science. Talk to Congress, CS community, including CRA.	3.6	26	100
Bell CISE NREN FCCSET reports, papers, & Aspray, IEEEE, Kleinrock, van Houweling interviews VBB2. This folder is about NSFs role in creating the National Research and Education Network (NREN) aka the Internet and has my interviews with people and organizations writing the history of CISE and the Internet	18.2	16	441
Bell CISE NSF Centers for ASC division VBB3. NSF Supercomputer Centers that were established at this time. The funding and operation was somewhat contentious since the computer science community had no interested in scientific computing in 1986. Thirty years later the condition is about the same even though Computational Science is a CS sub-discipline.	58.9	47	218
	80.7	89	759

Be11 schedu1e Feb 1986-Ju1y 1986 and Be11 a986 and 1987 Ca1endars have been added to VBB1
Increases the fi1e to 207 pages

Computer Science Network

csnet news

Published by CSNET CIC

Fall 1986, No. 11

SPECIAL REPORT:

New Directorate for Computing at NSF

The computing and information science research programs at the National Science Foundation (NSF) have been reorganized and combined into a new directorate for Computer and Information Science and Engineering (CISE). Within NSF, CISE is at the same organizational level as the other major directorates: Mathematical and Physical Sciences, Engineering, Geosciences, Biological and Behavioral Sciences, and Science and Engineering Education.

The new directorate is headed by C. Gordon Bell, formerly of Digital Equipment Corporation (DEC), Carnegie-Mellon University, Encore Computing Corporation, and the Dana Group. (See interview, page 2.)

CISE brings together the Office of Advanced Scientific Computing (OASC) from the Office of the Director, the Division of Computer Research (DCR) from Mathematical and Physical Sciences, and the Division of Information Sciences and Technology (IST) from Biological and Behavioral Sciences. In addition, a new CISE division, the Division of Computer and Information Engineering (CIE), was created to house two programs transferred from Engineering.

The chart on page 4 describes the new structure in detail and lists the staff in charge of each program. The organizational changes will be in place by October 1, 1986. NSF grant applicants may contact the appropriate program director for more information about individual programs.

(cont'd on pg. 2)

C. Gordon Bell, head of the new Computer and Information Science and Engineering Directorate of the National Science Foundation. Mr. Bell's vision for the directorate emphasizes parallel processing as the most important breakthrough in computer technology since the von Neumann architecture.

ICOT Becomes CSNET's First Overseas Member

ICOT, the Institute for New Generation Computer Technology in Tokyo, Japan, became CSNET's first overseas member in July 1986. Shigeyuki Takagi, ICOT's postmaster, submitted the following article, which is based on ICOT's "Outline of the Fifth Generation Computer Project."

Established in 1982, ICOT is the organization responsible for implementing the Fifth Generation Computer Systems (FGCS) project of the Japanese Ministry of International Trade and Industry. The goal of the FGCS project is to develop fifth-generation computers with a wide range of capabilities for use in new applications that are expected to exist by the 1990s. These new computers will incorporate advanced artificial intelligence, hardware, and software technologies.

The research and development program that ICOT has mapped out for the FGCS project spans ten years and is divided into three stages. The initial research and development stage took place between 1982 and 1984, and focused on the basic technologies required to build a fifth-generation computer. The current intermediate stage, which began in 1985 and is scheduled to end in 1988, is expected to

(cont'd on pg. 8)

IN THIS ISSUE

SPECIAL REPORT:

New Directorate for Computing at NSF

Interview with Gordon Bell

On August 7, 1986, Laura Breeden of the CSNET CIC spoke with Gordon Bell, head of the new CISE Directorate at NSF, about his plans for the directorate. Mr. Bell, who assumed his post on June 17, 1986, was Manager of Computer Design at DEC from 1960 to 1966, when he worked on the development of the PDP series of minicomputers. After serving on the faculty of Carnegie-Mellon University from 1966 to 1972, he returned to DEC as Vice President of Engineering, in charge of research and development activities in hardware and software. In 1983 Mr. Bell left DEC to become Chief Technical Officer at Encore Computer Corporation. Most recently, he was with the Dana Group. His professional interests focus on computer architectures and the evolution of the computer and computing.

CIC: First I'd like to ask where you see the directorate going. You've made some big changes in the way computer and computer engineering and information sciences research are organized at NSF. What's behind that?

GB: The biggest theme is parallelism, and the goal here is to get a factor of ten speed-up within five years and a factor of a hundred in ten years. I think the factor of ten may be doable because we have machines that can deliver that now. There is a whole range of multiprocesssors, from Crays to Sequents and Alliants, as well as multicomputers like the hypercube.

I believe that parallelism is the most significant change in computing since the von Neumann architecture. In terms of freeing thinking, the idea of virtual memory was a major accomplishment. Vectors, as very large data types, were also significant. Those occurred at roughly decade intervals, one in the sixties, one in the seventies.

Now I think it's time for parallelism, which is in fact much more significant because it requires a change in thinking. The others were, in a sense, simplifications: by adding vectors you could think bigger thoughts easier, and by adding virtual memory you didn't have to worry about certain programming environments. But they were not fundamental changes in the way people thought about programs. They were mind expanders that took limits away. So parallelism is a major focus, and it is unique at this time.

This focus on parallelism is, however, an operational goal, not a specific research target. Within five years I expect people to be routinely using machines and getting a factor of ten speed-up for production problems. We probably need to expand and change theory, algorithms, the problems themselves, programming languages, programming environments, and measurement analysis tools.

"The biggest theme is parallelism, and the goal here is to get a factor of ten speed-up within five years and a factor of a hundred in ten years."

CIC: It sounds like a departure for NSF from the traditional mode in which the researcher comes to you with a proposal in hand and you review whatever you get. Is NSF going to take an active role in promoting parallelism?

GB: Well [laughs], we still expect them to come in with proposals, but I want them to come with proposals that are exciting. So much of computation is based on performance—all of the analyses of algorithms are performance-oriented. For example, I want to see parallel algorithms now.

We want to understand what the limits of the algorithms are and make sure that people are stretching their minds. I believe researchers need to think more about parallel programming languages rather than sequential ones. We already have thousands of sequential languages.

CIC: You've had a long and successful career in industry and you also taught at Carnegie-Mellon. At NSF you'll be funding primarily academic research. Do you think NSF is going to play a role in encouraging cooperation between industry and academia? Is that kind of cooperation important?

GB: I think it's really important, and I want to do everything we can to make it better. Anything that encourages more cooperation between industry and academic institutions is important.

CIC: I'm sure you wouldn't be at NSF if you didn't think the universities had something to contribute.

GB: Yes, I'm always looking for mechanisms to encourage cooperation. I'll be meeting with people from industry to ask, "What do you need and how can we get more interaction?" NSF's number one focus this year is industrial competitiveness. The two cultures have to get together.

CIC: CSNET is one way that people have been able to do that.

GB: I want CSNET to evolve into a real packet-switching network as quickly as possible. You'll be happy to know that there's a research component within this directorate, and a massive service component. Networking has both, as does the supercomputer section. I guess that if I had to say what the highest priority is right now—and I can't tell you that won't change in a month or so—certainly it is networking.

CIC: You said that networking has two components, research and service. The interesting thing about CSNET is that it pays for itself (or its users pay for it). NSF is supporting research that may influence the development of CSNET, but the users pay for the basic service. Have you done any thinking about how the network will be paid for?

GB: I think ultimately all networks have to be paid for by the users, either explicitly or implicitly. Implicit funding, like telephones, seems more natural.

CIC: And you expect networks to continue to be an area of emphasis for NSF?

GB: Yes, because things are so terrible! And we have such a need! [Laughs]

CIC: Could you elaborate?

GB: Well, I was involved in ARPANET at the beginning, and basically I'd like to see CSNET get up to ARPANET technology, which is now 15 years old. Then we have to go beyond that very rapidly.

CIC: Where would you like NSF to be with regard to networking in three years?

GB: OK, in three years I would like to see a major part of the network running at a megabit. I'd like to see routine, wide numbers of T1 links installed.

CIC: Who would be on this network?

GB: All of the research community. I'd like every researcher to have access. That assumes that the campuses all have local area networks (LANS) that are wired together, and those LANS are then networked through a collection of networks.

"In three years I would like to see a major part of the network running at a megabit."

CIC: How about researchers on the industry side?

GB: I'd certainly like as many as possible of them to have access.

CIC: What's the biggest challenge that you've come up against so far?

GB: Networking is the hardest because it involves questions of funding, technology, and administration. I think it's a hard problem.

CIC: Let me ask one more question about money. There's been a lot of nervousness over Gramm-Rudman. There have already been some cuts or anticipated cuts in budgets, and those have translated into cuts in programs at some of your sponsored sites. What do you think is going to happen in CISE?

GB: The one thing I don't understand here is the budget, in terms of what the numbers are going to be. I guess if I had to have a frustration it would be the ponderousness of the whole process by which the government sets budgets. I think NSF works beautifully, because we have a leader who knows how to lead and how to budget. He's an industrial-strength manager, and it's wonderful. But to ask me "What's the number going to be?"—no one here can tell you that, or would profess to. They can give you all kinds of guesses, and I haven't yet learned who's the best guesser!

CIC: You've done a lot of interesting things in your career and I assume NSF is not going to be the last one. When you leave NSF what do you want to leave behind?

GB: I want to leave a beautifully functioning organization with a 20-year research program and an appetite to do exciting things. I want a coherent and competent community, an organization, and researchers who have in fact built a combined vision of the future and are marching off to implement it. That's exactly what I did at DEC with the VAX* architecture and network structure, and at Encore. If I could do the same thing here, for this community, I would feel good. Parallelism is really an opportunity-component of the vision, along with networks and other parts of CISE. Everybody so far has been very responsive. The community is really very good, and that's why I'm so excited about this job. ■

"The community is really very good, and that's why I'm so excited about this job."

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* VAX is a trademark of Digital Equipment Corp.

csnet news

CSNET is a nonprofit computer network dedicated to the support of computer-related research and development in universities, industry, and government. **CSNET News** is published four times a year by the CSNET Coordination and Information Center, located at BBN Laboratories Incorporated, 10 Moulton Street, Cambridge, MA 02238 (on-line address cic@csnet-sh.arpa). **CSNET News** is distributed free of charge to member organizations and interested individuals.

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csnet hotline

For CSNET help or information, call the CSNET hotline 24 hours a day:

(617) 497-2777

Or send a netmail message to cic@sh.cs.net (cic@csnet-sh.arpa).

USPS address:

CSNET CIC
BBN Laboratories Inc.
10 Moulton Street
Cambridge, MA 02238

NETWORK

July 18, 1986

News of Interest to Employees of the National Science Foundation

C. Gordon Bell Sworn in to Head CISE

C. Gordon Bell was officially sworn in as Assistant Director for the Computer and Information Science and Engineering (CISE) Directorate on June 18, 1986. Mr. Bell has had an extensive career as an innovator in the computer world. He served as Vice President for Engineering for Digital Equipment Corporation and was the firm's chief technical officer from 1972-83. He led the Design Task Force in 1975 for the development of VAX-11, which set the world standard in research laboratories and departments for scientific and engineering calculations. He also was instrumental in the development of the highly successful minicomputers of DEC including the PDP-4, PDP-5, and PDP-8, and in the development of larger computers such as the PDP-6 and DEC System 10.

From 1966-72 he was a member of the faculty of Carnegie-Mellon University, where he conducted the first experiments on multiple processor architecture and, with Professor Allen Newell, did fundamental work related to the taxonomy of computational systems. Among his numerous publications is *Computer Structures,* which he co-authored with Siewiorek and Newell. This work resulted in the ISPS computer description language which is now widely used. He also holds several patents.

Mr. Bell and his wife Gwendolyn were responsible for the establishment of the Computer Museum in Boston that is both a repository for artifacts and archives on the history of computing, and a living museum with exhibits of working computers. Mrs. Bell is Director of the museum.

Mr. Bell is a Fellow of the American Association for the Advancement of Science and the Institute of Electrical and Electronic Engineers. He is also a member of the National Academy of Engineering and the Association for Computing Machinery. Among the honors he has received are the Mellon Award, the McDowell Award, and the Eckert-Mauchy Award for contributions to computer design.

Mr. Bell is located in room 306 and can be reached on 357-7936.

C. Gordon Bell, Assistant Director, CISE, being congratulated by NSF Director, Erich Bloch.

Telephone Use and Abuse

The National Science Foundation anticipates a telephone bill of approximately $1.7 million next year. Almost one-half of the bill will be for long-distance calls.

The telephone is an essential ingredient in our working lives and is a useful tool in accomplishing our jobs expeditiously. Phones provide quick and efficient access to individuals who can respond to questions or help resolve issues, thus reducing the need for time consuming exchanges of correspondence. Because NSF staff rely on long-distance calls to conduct much of their business, we are taking this opportunity to remind you that long-distance calls are charged by distance and duration, and to ask that you try to keep these calls as brief as possible.

Unfortunately, a small number of individuals misuse or abuse the telephone services to which we have access, and their actions have a significant impact on the rest of us. An individual misuse, such as a personal long-distance call, may appear small, but the accumulated cost to the government can be substantial. If you must make a personal long-distance call, use an outside line and report the call to Mary Thomas in the Division of Audit and Oversight (DAO). When the charges are received by DAO you will then be asked to reimburse the Foundation.

Seemingly innocuous calls to determine the weather or the correct time became so costly that this privilege has been taken away, and, in the near future, the telephone system will be modified to block all "900" calls. These calls are typically associated with "party" lines, "dream" lines, sporting events, etc.

Each of us has an obligation to be familiar with the rules and regulations governing the use of the government telephone system(s). If you are unsure of your responsibilities regarding telephone usage, refer to NSF Circular 14, "Long Distance Telephone Calls." If you have any questions, contact Mary Thomas on 357-9457.

A FAREWELL TO GORDON BELL

Y'ALL COME

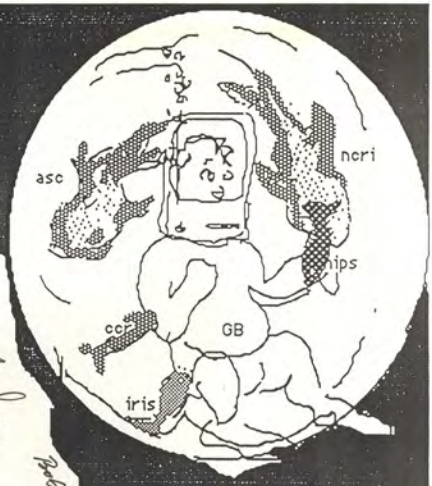
Date: November 10, 1987

Place: Room 1243

Time: 3:30 to 4:30

CISE ECOSYSTEM

THANKS FOR A GREAT START



Bob Corriveau

Deborah Crosby

Barbara H. Palmer

Dallen Fisher

Dave Standt

Jane Carrin

Pamela Williams

Bob Grafton

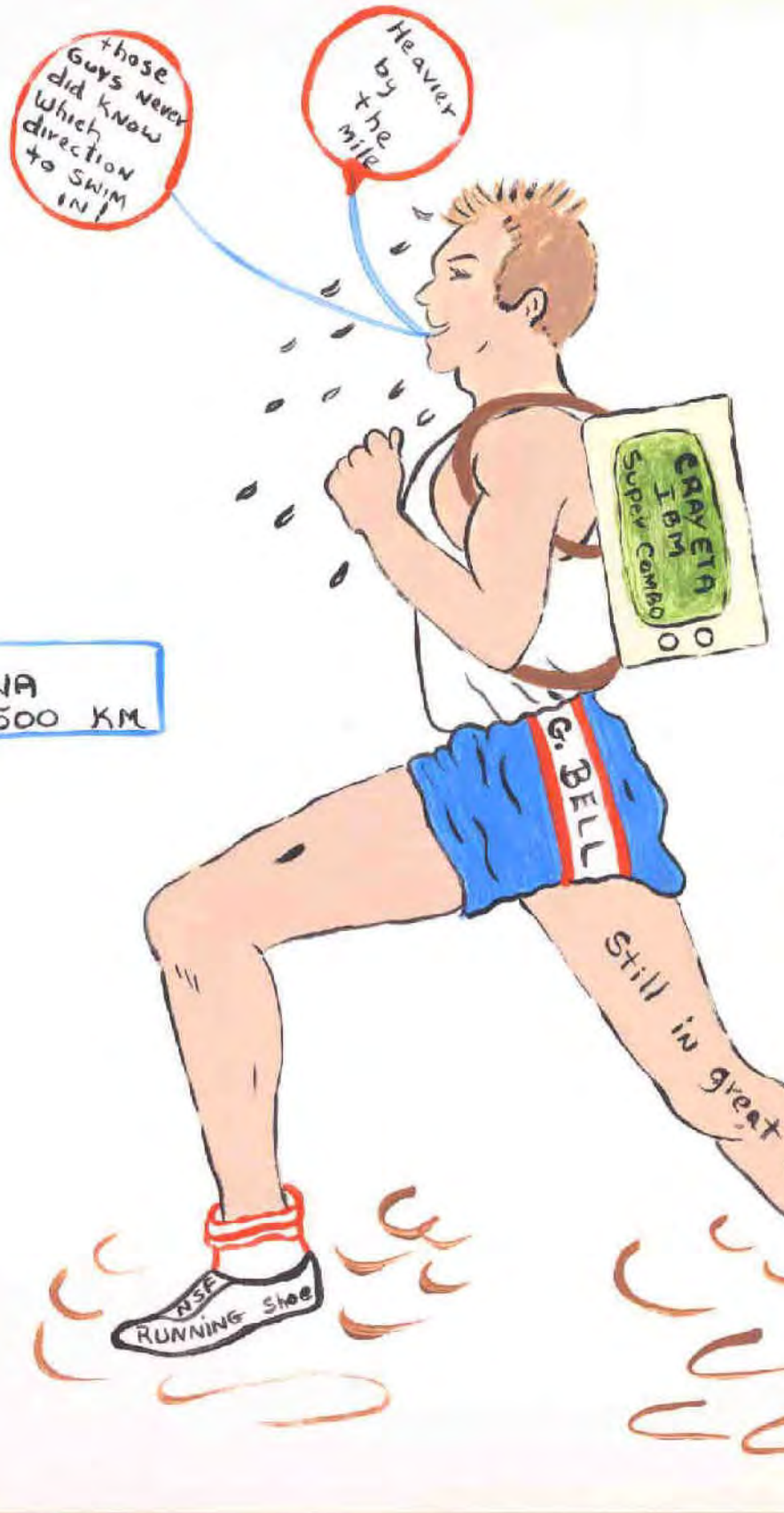
Irene Lombardo

Coral Reid

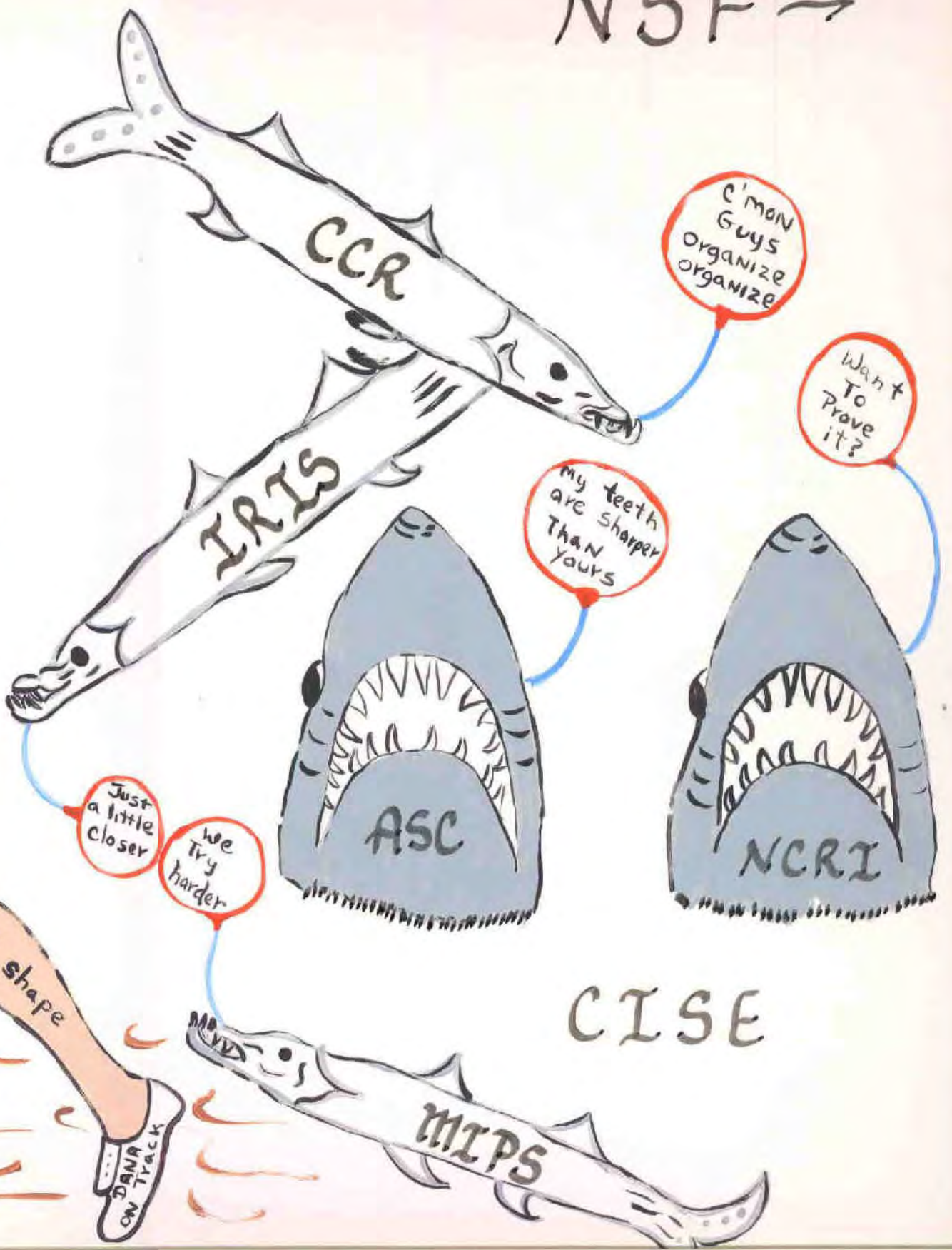
Beverly Baker

Jerry Dean

NSF →



← DANA 4500 KM

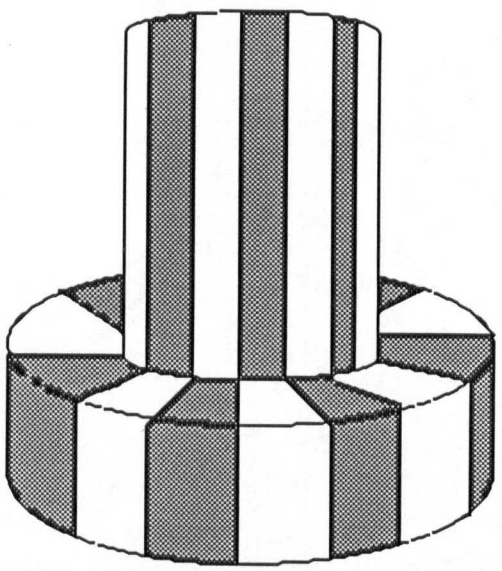


CISE

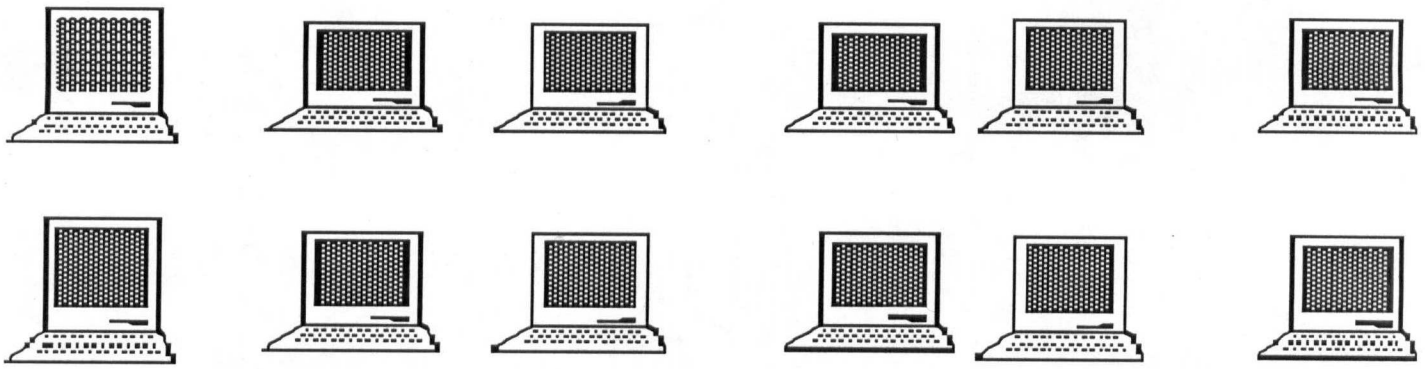
Certificate of Appreciation

Divison of Advanced Scientific Computing

1 CRAY XMP48



2 GENERIC HOT BOX



This Certificate Entitles the Bearer to

ONE COMPUTING HOUR

on

One of the Two Groups of Equipment

Pictured Above

NATIONAL SCIENCE FOUNDATION
Office of Advanced Scientific Computing

MEMORANDUM

DATE: February 28, 1986

REPLY TO ATTN. OF: Irene D. Lombardo, 357-7558, Room 511

SUBJECT: Mailing addresses for Dr. Gordon Bell

TO: Ms. Bertha Salsburg

cc: Dr. Charles Brownstein, Dr. Bernard Chern, Dr. John Connolly, Dr. Kent Curtis, Dr. Sandra Toye, Ms. Maydie Hughes, Ms. Pat Dennis

==========

For urgent matters, Dr. Gordon Bell can be reached at the following addresses and telephone numbers until he is on full-time status at the Foundation.

The Dana Group
550 Del Rey
Sunnyvale, CA 94086
(408) 732-0400

Home in California (evenings or early morning)
(415) 325-2037

Home in Massachusetts (very rarely in Massachusetts)
Page Farm Rd.
Lincoln, MA 01773
(617) 259-9144

Encore Computer Corp.
c/o Mary Jane Forbes (generally knows of Dr. Bell's whereabouts)
257 Cedar Hill St.
Marlboro, MA 01752
(617) 460-0500

If you have additional questions or if I can be of assistance, please contact me.

Gordon Bell Appts Friday
3/14/86

Irene

Mar 17 Change meeting w/ CISE DIV. DIRECTORS TO 11:00 (Per instructions from Dr Connolly)

Mar. 17

2:30 - 3:00

Gordon Bell interview Daniel Oberst from Princeton U. - Networking Applicant

Mar 19

10:30 A M

Gordon Bell interview Ray Masse from Codex. Mansfield, MA. Networking Applicant

Apr 23

10:00 - through lunch

Roger Elliott of British Supercomputing Networking and Richard Harton of the

British Embassy Contact 898-4582

John Connolly, Kent Curtis, Gordon Bell in Room 511

Dr. Brownstein Revised
Room 336
3-13-86

Tentative Schedule for Mr. Gordon Bell

For the Week of March 17- 21, 1986

Date	Time	Appointment
Monday March 17	9:00 A.M. 10:00 A.M. 10:30 A.M. 1:30 ~~PM is open until~~ 3:00 ~~3:30~~ P.M.	Dr. Brownstein & Dr. Adrion Ms. Constance McClindon Meeting with CISE Div. Directors Dr. Toye - Rm 306 Meeting with Dr. Nam Suh
Tuesday March 18	AM is open 2:00 P.M.	 Budget meeting with Mr. Bloch Dr. Toye, Mr. Loweth
Wednesday March 19	A.M.? 2 - 4:00 P.M.	Open S.D.I. meeting with Col. Audley
Thursday March 20	All day	Board Meeting 8~~9~~ - 12 = ~~BBC~~ PPC Prog. & Plans Cmte 12 - 2 = Executive Meeting 4~~2~~ - 9 = ~~BBC~~ PPC Prog. & Plans Committee
Friday March 21	All day	Board Meeting Meeting with Dr. Nam Suh to be arranged

This is a tentative calendar - please call Irene Lombardo for revisions, confirmation of appointments, etc. (357-7558)
March 21

cc:Dr. Adrion, Mr. Bloch, Dr. Brownstein, Dr. Chern, Dr. Clutter, Dr. Connolly, Dr. Curtis, Ms. Salsburg, Dr. Suh, Dr. Toye, (and pertinent support staff)

TENTATIVE AGENDA FOR THE VISIT OF DANIEL OBERST
PRINCETON UNIVERSITY
3/17/86

10:30 - 11:30 A.M.
DENNIS JENNINGS

11:30 - 12:00 NOON
JOHN CONNOLLY

12:00 NOON - 1:30 P.M.
LUNCH

1:30 - 2:30 P.M.
LARRY LEE

2:30 - 3:00 P.M.
GORDON BELL

3:00 P M.
JOHN CONNOLLY

BP's Copy

TENTATIVE AGENDA FOR THE VISIT OF RAY MOORE

CODEX
MANSFIELD, MA

3/19/86

10:00 - 10:30 A.M.
JOHN CONNOLLY

10:30 - 11:00 A.M.
GORDON BELL

11:00 - 11:30 A.M.
DAVE FARBER

11:30 12:00 N
LARRY LEE

12:00 - 1:30 P.M.
LUNCH

1:30 - 2:00 P.M.
RICK ADRION

2:00 P.M.
JOHN CONNOLLY

TENTATIVE AGENDA FOR THE VISIT OF RAY MOORE

CODEX
MANSFIELD, MA

3/19/86

10:00 - 10:30 A.M.
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10:30 - 11:00 A M.
GORDON BELL

11:00 - 11:30 A.M.
DAVE FARBER

11:30 - 12:00 NOON
LARRY LEE

12:00 - 1:30 P M.
LUNCH

1:30 - 2:00 P M.
RICK ADRION

2:00 P M.
JOHN CONNOLLY

Dr. Brownstein Revised
Room 36
3-13-86

Tentative Schedule for Mr. Gordon Bell

For the Week of March 17- 21, 1986

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Tuesday March 18	AM is open 2:00 P.M.	 Budget meeting with Mr. Bloch Dr. Toye, Mr. Loweth
Wednesday March 19	A.M.? 2 - 4:00 P.M.	Open S.D.I. meeting with Col. Audley * Rm 306 Strategic Defense Initiatives
Thursday March 20	All day	Board Meeting 9 - 12 = BBC 12 - 2 = Executive Meeting 2 - 9 = BBC
Friday March 21	All day	Board Meeting Meeting with Dr. Nam Suh to be arranged

This is a tentative calendar - please call Irene Lombardo for revisions, confirmation of appointments, etc. (357-7558)
March 21

cc:Dr. Adrion, Mr. Bloch, Dr. Brownstein, Dr. Chern, Dr. Clutter, Dr. Connolly, Dr. Curtis, Ms. Salsburg, Dr. Suh, Dr. Toye, (and pertinent support staff)

Comp Impr. Sci. & ENG. - CISE

Call Kingsbury

GORDON BELL'S APPOINTMENTS - THURSDAY, MARCH 20-FRIDAY, MARCH 21, 1986:

Thursday, March 20:

National Science Board Meeting

6:30 - Meeting with Mr. Bloch and Dr. Suh - Room 520

Friday, March 21:

9:00 National Science Board Meeting

1:00 - Meeting w/DARPA Representatives, 1400 Wilson Blvd, 7th Floor; Visitor Control Contact is Steve Squires (694-5917) (Attending: Bell, Brownstein, Curtis, Adrion, Audley)

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

April 23:

10:00 a.m. through lunch:

Roger Elliott of British Supercomputing Networking and Richard Horton of the British Embassy. Attending: Mr. Bell, John Connelly, Kent Curtis (Room 511 for now; though subject to be held in Mr. Bell's office)

April 24:

9:00 a.m. → 10:00 old friends. Want to chat drop by a while for a chat

Meeting with Dr. Karl Weiss, Vice Pres. and Mr. Peter Schroeder, Director of Off. of Sponsored Programs at Northeastern University, Boston, MA, re College and Computer Science Research Initiatives at Northeastern University. (CONTACT: Mattie Kendricks (617) 437-4589)

Please Add

GORDON BELL'S APPOINTMENTS

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

April 14:

2:30 p.m.: Meeting with Mr. Bloch, Room 520.

April 15: 9pm Kat Cuts

April 16:

2:00-2:30 p.m.:

(TENTATIVE) Meeting with Mr. Rubin Olsher, Digital Corporation (617-467-5257-Marlboro, Massachusetts). He'd just like to welcome Mr. Bell on board--semi-social visit--no issues involved. (He will possibly be staying at the Mayflower Hotel--will call early part of the week to confirm appointment and to see how Mr. Bell's appointments are coming along.)

April 17:

11:45-12:00 noon:

Math Advisory Panel Meeting - Would like for Mr. Bell to speak to the Panel. Dr. Polking is placing him on agenda. If this is not good, Barbara should call Dr. Polking at 357-9669 as soon as possible so that he can redo the agenda.

2:00-3:00 p.m.:

Meeting re MOSIS--(Attending: Bloch, Bell, Brownstein/ISI staff) - Room 520 - Contact: Keith Uncapher - (213) 822-1511.
(Chuck Brownstein called on 4/3/86 & asked me to calendar.)

April 18:

11:00-11:30 a.m. - Steve Wolf - Networking Candidate. (Call Irene Lombardo, -7558 to confirm.)

MAY, 1986:

May 14 NSB Board Dinner at ?

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

F—, May 21
Mini Retreat for LRP

APR 15 1986

GORDON BELL'S APPOINTMENTS

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

Tuesday, April 15:

10-10:30 a.m.:

Robotics/AI Planning - Bell, Joe Deken, Rick Adrion, Y.T. Chien, Bernie Chern - Room 306

11:00-11:30 a.m.:

Parallelism Meeting - Bell, Bob Minnick/Other Math Staff - Room 306

1:30-2:30 p.m.:

Meeting on CISE Staffing--Toye, Windus, Bell, Brownstein

3:00-3:30 p.m.:

Meeting with Eli Schutzman (referred by John Lehman, per Mr. Bell's request)

9:00 p.m.:

Kent Curtis

Wednesday, April 16:

8:30 - Executive Council Meeting - Room 520

11:30 a.m.: Meeting with Mr. Bloch

2:00-2:30 p.m.:

(TENTATIVE) Meeting with Mr. Rubin Olsher, Digital Corporation (617-467-5257-Marlboro, Massachusetts). He'd just like to welcome Mr. Bell on board--semi-social visit--no issues involved. (He will possibly be staying at the Mayflower Hotel--will call early part of the week to confirm appointment and to see how Mr. Bell's appointments are coming along.)

Thursday, April 17:

11:45-12:00 noon:

Math Advisory Panel Meeting - Room 540 - Would like for Mr. Bell to speak to the Panel. Dr. Polking is placing him on agenda. If this is not good, Barbara should call Dr. Polking at 357-9669 as

soon as possible so that he can redo the agenda.

Friday, April 18:

9:30 - Mtg with Dr. Farber

10:00-10:30 a.m. - Update on Administration Activities with Jeff Fenstermacher, ADM - Room 306

11:00-11:30 a.m. - Steve Wolf - Networking Candidate.

2:00-2:15 p.m.: "Get to Know You" meeting with OASC staff - Room 511

MAY, 1986:

Wednesday, May 14:

7:00 p.m.:

National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

Executive Council Mini Retreat for LRP

REVISED COPY - 4/16/86 - 11:40 a.m.

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

Wednesday, April 16:

8:30 - Executive Council Meeting - Room 520

11:30 a.m.: Meeting with Mr. Bloch

2:00-2:30 p.m.:

(TENTATIVE) Meeting with Mr. Rubin Olsher, Digital Corporation (617-467-5257-Marlboro, Massachusetts). He'd just like to welcome Mr. Bell on board--semi-social visit--no issues involved. (He will possibly be staying at the Mayflower Hotel--will call early part of the week to confirm appointment and to see how Mr. Bell's appointments are coming along.)

3:30-4:30 - Supercomputer Initiatives - Lehman, Larry Lee, Adrion

Thursday, April 17:

11:45-12:00 noon:

Math Advisory Panel Meeting - Room 540 - Would like for Mr. Bell to speak to the Panel. Dr. Polking is placing him on agenda. If this is not good, Barbara should call Dr. Polking at 357-9669 as soon as possible so that he can redo the agenda.

2:00-2:30:

Larry Lee and staff from John Von Neumann Center (they're looking for a new President at the Center) - Room 306.

3:30 - Meeting with Mr. Bloch

Friday, April 18:

9:30 - Mtg with Dr. Farber

10:00-10:30 a.m. - Update on Administration Activities with Jeff Fenstermacher, ADM - Room 306

11:00-11:30 a.m. - Steve Wolf - Networking Candidate.

2:00-2:15 p.m.: "Get to Know You" meeting with OASC staff - Room 511

MAY, 1986:

Friday, May 2:

11:00: - Don Beilman, MCNC

Wednesday, May 14:

7:00 p.m.:

National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

Executive Council Mini Retreat for LRP

REVISED COPY - 4/17/86-as of 11:35 a.m.

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

Thursday, April 17:

11:45-12:00 noon:

Math Advisory Panel Meeting - Room 540 - Would like for Mr. Bell to speak to the Panel. Dr. Polking is placing him on agenda. If this is not good, Barbara should call Dr. Polking at 357-9669 as soon as possible so that he can redo the agenda.

12:00 noon: Meeting with Rich Nicholson, Room 512

2:00-2:30:

Larry Lee and staff from John Von Neumann Center (they're looking for a new President at the Center) - Room 306.

2:45-3:00: "Get to Know You Better" meeting with Math/Computer Science staff

3:00-4:00: Continuation of discussion with Rick and Chuck

4:00 - Meeting with Mr. Bloch

Friday, April 18:

8:30 - Bill Bandy - Room 1108

9:30 - Mtg with Dr. Farber

10:00-10:30 a.m. - Update on Administration Activities with Jeff Fenstermacher, ADM - Room 306

11:00-11:30 a.m. - Steve Wolf - Networking Candidate.

2:00-2:15 p.m.: "Get to Know You" meeting with OASC staff - Room 511

MAY, 1986:

Friday, May 2:

11:00: - Don Beilman, MCNC

Wednesday, May 14:

7:00 p.m.:

National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

Executive Council Mini Retreat for LRP

4/18/86-8:15 a.m.

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

Wednesday, April 30:

8:30-Mr. Bell, meeting with Chuck.

MAY, 1986:

Thursday, May 1:

10:00: Dave Farber re Networking (CHECK OUT WITH MR. BELL!!)

Friday, May 2:

10:00: Bassam Shakhashiri - Courtesy visit in Room 516 (set up in Bassam's office so that Mr. Bell will know where he's located.)

11:00: Don Beilman, MCNC

Monday, May 5:

9:30-10:30: Parallelism Seminar (Room to be announced) Contact: Al Harvey (OASC) - 357-7727

1:30-2:30: Parallelism Meeting with Martin Schultz of Yale - Room 306, Contact Al Harvey (OASC) - 357-7727

Wednesday, May 7:

10:30: Executive Council Meeting

Tuesday, May 13:

8:30: Executive Council Meeting

Wednesday, May 14:

7:00 p.m.:

National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147, CALLED TO ASK IF MR. BELL COULD PRESENT THE DINNER ADDRESS ON MONDAY EVENING, JULY 7. A KICKOFF CONFERENCE RECEPTION WILL BE HELD ON SUNDAY EVENING, JULY 7. DR. WALKER WOULD LIKE TO FIRM UP THE AGENDA ASAP AND WOULD LIKE FOR US TO CALL EITHER HIM OR HIS ASSISTANT, MS. ANN DOOLIN, TO ADVISE OF MR. BELL'S DECISION.

4/30/86-8:00 a.m.

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

Wednesday, April 30:

8:30-Mr. Bell, meeting with Chuck.

2:30-3:00-meeting with representatives from the University of Pennsylvania re Mini Supercomputers.

3:30-4:30-meeting with Mr. Curtis.

MAY, 1986:

Thursday, May 1:

9-4:00-ADVISORY COMMITTEE FOR COMPUTER RESEARCH - Room 1242A

12:30-1:00-Dave Farber

1:30-AMDAHL COMPUTER-UNIVERSITY OF MICHIGAN-OHIO STATE MEETING Bloch, Moore, Bell, Connolly, Lee - Room 533

3:00-Dr. Lehman, DCR (tentative)

Friday, May 2:

9-4:00-Advisory Committee for Computer Research - Room 1242A

10:00: Bassam Shakhashiri - Courtesy visit in Room 516 (set up in Bassam's office so that Mr. Bell will know where he's located.)

1:00-2:00??: Don Beilman, MCNC (MR. BELL: WERE YOU ABLE TO CHANGE BEILMAN FROM 11:00 TO 1:00?

Monday, May 5:

9:30-10:30: Parallelism Seminar (Room to be announced) Contact: Al Harvey (OASC) - 357-7727

1:30-2:30: Parallelism Meeting with Martin Schultz of Yale - Room 306, Contact Al Harvey (OASC) - 357-7727

Wednesday, May 7:

10:30: Executive Council Meeting

Tuesday, May 13:

8:30: Executive Council Meeting

Wednesday, May 14:

7:00 p.m.:
National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147, CALLED TO ASK IF MR. BELL COULD PRESENT THE DINNER ADDRESS ON MONDAY EVENING, JULY 7. A KICKOFF CONFERENCE RECEPTION WILL BE HELD ON SUNDAY EVENING, JULY 7. DR. WALKER WOULD LIKE TO FIRM UP THE AGENDA ASAP AND WOULD LIKE FOR US TO CALL EITHER HIM OR HIS ASSISTANT, MS. ANN DOOLIN, TO ADVISE OF MR. BELL'S DECISION.

5/1/86-8:00 a.m.

GORDON BELL'S APPOINTMENTS - APRIL, 1986:

Wednesday, April 30:

8:30-Mr. Bell, meeting with Chuck.

2:30-3:00-meeting with representatives from the University of Pennsylvania re Mini Supercomputers.

3:30-4:30-meeting with Mr. Curtis.

MAY, 1986:

Thursday, May 1:

9-4:00-ADVISORY COMMITTEE FOR COMPUTER RESEARCH - Room 1242A

12:30-1:00-Dave Farber

1:30-AMDAHL COMPUTER-UNIVERSITY OF MICHIGAN-OHIO STATE MEETING Bloch, Moore, Bell, Connolly, Lee - Room 533

3:00-Dr. Lehman, DCR (tentative)

Friday, May 2:

9:00: Don Beilman, MCNC

10:00: Bassam Shakhashiri - Courtesy visit in Room 516 (set up in Bassam's office so that Mr. Bell will know where he's located.)

9-4:00-Advisory Committee for Computer Research - Room 1242A

Monday, May 5:

9:30-10:30: Parallelism Seminar (Room to be announced) Contact: Al Harvey (OASC) - 357-7727

10:30: Bassam Shakhashiri - Courtest visit in Room 616 (set up in Bassam's office so that Mr. Bell will know where he's located.)

1:30-2:30: Parallelism Meeting with Martin Schultz of Yale - Room 306, Contact Al Harvey (OASC) - 357-7727

Wednesday, May 7:

10:30: Executive Council Meeting

Thursday, May 8:

OBAC Position Paper Due

Tuesday, May 13:

8:30: Executive Council Meeting

Wednesday, May 14:

7:00 p.m.:
National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147, CALLED TO ASK IF MR. BELL COULD PRESENT THE DINNER ADDRESS ON MONDAY EVENING, JULY 7. A KICKOFF CONFERENCE RECEPTION WILL BE HELD ON SUNDAY EVENING, JULY 7. DR. WALKER WOULD LIKE TO FIRM UP THE AGENDA ASAP AND WOULD LIKE FOR US TO CALL EITHER HIM OR HIS ASSISTANT, MS. ANN DOOLIN, TO ADVISE OF MR. BELL'S DECISION.

5/2/86-8:00 a.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Friday, May 2:

9:00: Don Beilman, MCNC

1:00: Meeting with Brownstein, Volceker, Lehman, and Bamford-Room 306

9:00-4:00-ADVISORY COMMITTEE FOR COMPUTER RESEARCH-Room 1242A

Monday, May 5:

9:30-10:30: Parallelism Seminar (Room to be announced) Contact: Al Harvey (OASC) - 357-7727

10:30: Bassam Shakhashiri - Courtest visit in Room 616 (set up in Bassam's office so that Mr. Bell will know where he's located.)

1:30-2:30: Parallelism Meeting with Martin Schultz of Yale - Room 306, Contact Al Harvey (OASC) - 357-7727

Tuesday, May 6:

12:30 p.m.: Lunch with Dr. Amarel, 1400 Wilson Blvd.

Wednesday, May 7:

10:30: Executive Council Meeting

Thursday, May 8:

OBAC Position Paper Due

Tuesday, May 13:

8:30: Executive Council Meeting

Wednesday, May 14:

7:00 p.m.:
National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147, CALLED TO ASK IF MR. BELL COULD PRESENT THE DINNER ADDRESS ON MONDAY EVENING, JULY 7. A KICKOFF CONFERENCE RECEPTION WILL BE HELD ON SUNDAY EVENING, JULY 7. DR. WALKER WOULD LIKE TO FIRM UP THE AGENDA ASAP AND WOULD LIKE FOR US TO CALL EITHER HIM OR HIS ASSISTANT, MS. ANN DOOLIN, TO ADVISE OF MR. BELL'S DECISION.

5/5/86-8:30 a.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Monday, May 5:

9:30-10:30: Parallelism Seminar Room 1242; Contact: Al Harvey (OASC) - 357-7727

10:30: Bassam Shakhashiri - Courtesy visit in Room 516 (set up in Bassam's office so that Mr. Bell will know where he's located.)

1:30-2:30: Parallelism Meeting with Martin Schultz of Yale - Room 306, Contact Al Harvey (OASC) - 357-7727

Tuesday, May 6:

12:30 p.m.: Lunch with Dr. Amarel, 1400 Wilson Blvd.

Wednesday, May 7:

10:30: Executive Council Meeting

12:00-1:45 p.m. - Lunch Roundtable in Mr. Bloch's office for Sir David Phillips, Chairman, UK Advisory Board for the Research Councils.

2:00-3:00 p. m. - Mr. Bell to give talk at the Computer Science & Technology Meeting, National Academy of Sciences

Tuesday, May 13:

8:30: Executive Council Meeting

Wednesday, May 14:

7:00 p.m.:
National Science Board Black Tie Dinner

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147, CALLED TO ASK IF MR. BELL COULD PRESENT THE DINNER ADDRESS ON MONDAY EVENING, JULY 7. A KICKOFF CONFERENCE RECEPTION WILL BE HELD ON SUNDAY EVENING, JULY 7. DR. WALKER WOULD LIKE TO FIRM UP THE AGENDA ASAP AND WOULD LIKE FOR US TO CALL EITHER HIM OR HIS ASSISTANT, MS. ANN DOOLIN, TO ADVISE OF MR. BELL'S DECISION.

5/14/86-8:30 a.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Tuesday, May 6:

9:00 a.m.: Mr. Curtis

12:30 p.m.: Lunch with Dr. Amarel, 1400 Wilson Blvd.

Wednesday, May 7:

10:30: Executive Council Meeting

12:00-1:45 p.m. - Lunch Roundtable in Mr. Bloch's office for Sir David Phillips, Chairman, UK Advisory Board for the Research Councils.

2:00-3:00 p. m. - Mr. Bell to give talk at the Computer Science & Technology Meeting, National Academy of Sciences

Tuesday, May 13:

8:30: Executive Council Meeting

Wednesday, May 14:

7:00 p.m.:
National Science Board Black Tie Dinner

Friday, May 16:

1:00-3:00 p.m.:

Dry Run for CISE Quarterly Review, Room 306

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Tuesday, May 20:

1:00-2:00 p.m.:

Meeting with Col. Audley, SDIO, Room 306 (Set up by Rick Adrion)

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

8:00 a.m.:
Ken Wilson, Member of Advisory Panel for Advanced Scientific Computing at Cornell Theory Center, Room 306

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

5/15/86-8:30 a.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Thursday, May 15:

National Science Board Meeting

Friday, May 16:

National Science Board Meeting

1:00-3:00 p.m.:

Dry Run for CISE Quarterly Review, Room 306

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Tuesday, May 20:

1:00-2:00 p.m.:

Meeting with Col. Audley, SDIO, Room 306 (Set up by Rick Adrion)

2:00-4:00 p.m.:

SDIO/DARPA/NSF Briefing with Bell, Audley, Squires, and other NSF staff - Room 523

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP

Thursday, May 22:

8:00 a.m.:
Ken Wilson, Member of Advisory Panel for Advanced Scientific Computing at Cornell Theory Center, Room 306

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

October 6, 1986:

Information Infrastructure Conference

5/19/86-8:30 a.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Monday, May 19:

1:30-4:30 p.m.:

CISE Quarterly Review with Mr. Bloch - Room 306

Tuesday, May 20:

10:30-11:30-ADP Needs for CISE - Mark Weiser, Head, Comp. Science Dept. Facility - U. of Maryland.

1:00-2:00 p.m.:

Meeting with Col. Audley, SDIO, Room 306 (Set up by Rick Adrion)

2:00-4:00 p.m.:

SDIO/DARPA/NSF Briefing with Bell, Audley, Squires, and other NSF staff - Room 523

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP - National Academy of Science (Main Building on Constitution Ave.) Conference Room 150. RECEPTION TO FOLLOW.

Thursday, May 22:

8:00 a.m.:
Ken Wilson, Member of Advisory Panel for Advanced Scientific Computing at Cornell Theory Center, Room 306

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting Room 540

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

October 6, 1986:

Information Infrastructure Conference (GET MORE DETAILS FROM MR. BELL.)

5/20/86-1:30 p.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Tuesday, May 20:

10:30-11:30-ADP Needs for CISE - Mark Weiser, Head, Comp. Science Dept. Facility - U. of Maryland.

12:00-Steve Wulf, Room 306 (Rick Adrion and Dave Farber also attending)

1:00-2:00 p.m.:

Meeting with Col. Audley, SDIO, Room 306 (Set up by Rick Adrion)

2:00-4:00 p.m.:

SDIO/DARPA/NSF Briefing with Bell, Audley, Squires, and other NSF staff - Room 523

Wednesday, May 21:

1:00-5:00 - Executive Council Mini Retreat for LRP - National Academy of Science (Main Building on Constitution Ave.) Conference Room 150. RECEPTION TO FOLLOW.

7:00 - Dinner with Keith Uncapher at Hyatt Arlington (703-841-9595

Thursday, May 22:

8:00 a.m.:
Ken Wilson, Member of Advisory Panel for Advanced Scientific Computing at Cornell Theory Center, Room 306

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting Room 540

2:00 p.m.:

Keith Uncapher: Briefing/Identify Holes in U.S. Technology and Recommendations/Programmatic Issues for NSF (w/Mr. Bloch).

3:30 p.m.:

CISE Division Directors Meeting

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

October 6, 1986:

Information Infrastructure Conference (GET MORE DETAILS FROM MR. BELL.)

5/22/86-8:30 p.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Thursday, May 22:

8:00 a.m.:
Ken Wilson, Member of Advisory Panel for Advanced Scientific Computing at Cornell Theory Center, Room 306

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

10:00 a.m.
Meeting with Drs. Chern and Voelcker - Room 1108

2:00 p.m.:

Keith Uncapher: Briefing/Identify Holes in U.S. Technology and Recommendations/Programmatic Issues for NSF (w/Mr. Bloch).

3:30 p.m.:

CISE Division Directors Meeting

Friday, 5/23/86:

11:00 a.m.:
Tom Marrill's Visit (WHAT TIME IS HE COMING, MR. BELL?)--Let Brownstein, Adrion, Chern and Curtis know when I find out.)

JUNE, 1986:

MONDAY, JUNE 30:

2:00 p.m.:

Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee)
NOTE: Mtg set up by Larry Lee, OASC.

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

October 6, 1986:

Information Infrastructure Conference (GET MORE DETAILS FROM MR. BELL.)

5/22/86-8:30 p.m.

GORDON BELL'S APPOINTMENTS - MAY, 1986:

MAY, 1986:

Thursday, May 22:

8:00 a.m.:
Ken Wilson, Member of Advisory Panel for Advanced Scientific Computing at Cornell Theory Center, Room 306

9:00 a.m.:
Advanced Scientific Computing Activities Advisory Panel Meeting
Room 540

10:00 a.m.
Meeting with Drs. Chern and Voelcker - Room 1108

2:00 p.m.:

Keith Uncapher: Briefing/Identify Holes in U.S. Technology and Recommendations/Programmatic Issues for NSF (w/Mr. Bloch).

3:30 p.m.:

CISE Division Directors Meeting

Friday, 5/23/86:

Tom Marrill's Visit (WHAT TIME IS HE COMING, MR. BELL?)--Let Brownstein, Adrion, Chern and Curtis know when I find out.)

JULY, 1986:

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

October 6, 1986:

Information Infrastructure Conference (GET MORE DETAILS FROM MR. BELL.)

6/17/86-8:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

TUESDAU, JUNE 17:

R. CHERN NEEDS TO TALK WITH YOU FOR ABOUT 40 MINUTES RE A MEMO OF UNDERSTANDING AND THE NEW DIVISION. WHEN WOULD BE A GOOD TIME???

2:00: Joe Traub to call Mr. Bell to have a discussion by phone His number there is (home) 415-843-6163; (office) 415-642-0143 or 415-642-1024--Barbara: if you need to call, just tell secretary it is important to speak to Joe.

2:30-3:00 p.m.:

Meeting with Mr. Curtis re Negotiations with ICOT (Japan) (A Memo of Understanding is in preparation and Mr. Bloch wants Mr. Bell to sign it.)

3:00 p.m.:

Mr. Bloch's NSB Dry Run - Board Room (All Executive Council members should attend.)

Wednesday, June 18:

8:30 a.m.:

Executive Council Meeting - Room 520

1:00 p.m. ~~or 1:30 p.m.~~:

Dr. Don Beilman and a Dr. Richard Fair from Microelectronics Center in Research Triangle Park, NC would like to meet with Mr. Bell for 1/2 hour. (BARBARA: CALL SANDRA GREENE OF HIS OFFICE 919-248-1810 ON TUESDAY TO CONFIRM THE TIME.) NOTE: DR. BEILMAN HAS A 2:30 FLIGHT BACK TO NC.

2:00:

Connie McLindon

3:00:

Meeting with Dr. Howard Graeyber (interested in a position as a program manager in the CISE Directorate--has experience in the Applied Physical Sciences and SBIR.

MONDAY, JUNE 30:

6/18/86-8:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Wednesday, June 18:

8:30-12:30 p.m.:

Executive Council Meeting - Room 540

1:00 p.m.:

Dr. Don Beilman and a Dr. Richard Fair from Microelectronics Center in Research Triangle Park, NC would like to meet with Mr. Bell for 1/2 hour. (BARBARA: CALL SANDRA GREENE OF HIS OFFICE 919-248-1810 ON TUESDAY TO CONFIRM THE TIME.) NOTE: DR. BEILMAN HAS A 2:30 FLIGHT BACK TO NC.

2:00:

Connie McLindon

3:00:

Marcelle Costello re papers Mr. Bell needs to sign.

Thursday, June 19:

6:00 p.m.: NSB Cocktail Hour - Room 1242A&B

6:45 p.m.: NSB Dinner - Room 1242A&B

MONDAY, JUNE 30:

2:00 p.m.:

Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee) NOTE: Mtg set up by Larry Lee, OASC.

6/19/86-9:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Thursday, June 19:

National Science Board Meeting

6:00 p.m.: NSB Cocktail Hour - Room 1242A&B

6:45 p.m.: NSB Dinner - Room 1242A&B

12:00: Lunch meeting with Ralph Devries, U. of Wyoming re Plans for Supercomputers

Friday, June 20:

National Science Board Meeting

9:00-11:00 a.m.:

SDIO/DARPA/NSF Briefing - Room 219

Monday, June 23:

10:00-10:30 a.m.:

Kent Curtis and Jerry Daen

MONDAY, JUNE 30:

2:00 p.m.:

Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee)
NOTE: Mtg set up by Larry Lee, OASC.

6/19/86-9:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Thursday, June 19:

6:00 p.m.: NSB Cocktail Hour - Room 1242A&B

6:45 p.m.: NSB Dinner - Room 1242A&B

12:00: Lunch meeting with Ralph Devries, U. of Wyoming re Plans for Supercomputers

Monday, June 23:

10:00-10:30 a.m.:

Kent Curtis and Jerry Daen

MONDAY, JUNE 30:

2:00 p.m.:

Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee)
NOTE: Mtg set up by Larry Lee, OASC.

L

6/23/86-9:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Monday, June 23:

2:00-2:30 p.m.:

Kent Curtis/Jerry Daen

Tuesday, June 24:

10:00-10:30:

John Zelenka, ETA Systems, Exec. Director of Gov't Programs re Would like your views on how many supercomputers can best be applied in university research. (Contact @ Sheraton-Tyson's Corner, 488-1234.

Wednesday, June 25:

3:00 p.m.: Workshops on Undergraduate Education in Mathematics, Engineering and the Sciences, Room 516.

6:15: Time Life

5:30-6:30 p.m.:

Reception for Awardees in the VPW Program - Room 1242

Thursday, June 26:

8:00 a.m.:

Meeting with Charles Sporck, Pres. of Semiconductor Co. and Mr. Bloch - Room 520

Friday, June 27:

A.M.:

Visit Math Soft.

Saturday, June 28:

Goldsmith to visit at home with Mr. Bell.

MONDAY, JUNE 30:

2:00 p.m.:

Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee)
NOTE: Mtg set up by Larry Lee, OASC.

Tues.

12:00 JT

L

6/25/86-8:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Wednesday, June 25:

8:30 a.m.:

Executive Council Meeting - Room 520

3:00 p.m.: Workshops on Undergraduate Education in Mathematics, Engineering and the Sciences, Room 516.

6:15: Time Life

5:30-6:30 p.m.:

Reception for Awardees in the VPW Program - Room 1242

Thursday, June 26:

8:00 a.m.:

Meeting with Charles Sporck, Pres. of Semiconductor Co. and Mr. Bloch - Room 520

2:00 p.m.:

Michael Schrag, Washington Post (Contact: 334-7320)

Friday, June 27:

A.M.:

Visit Math Soft.

Saturday, June 28:

Goldsmith to visit at home with Mr. Bell.

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2:00 p.m.:

Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee)
NOTE: Mtg set up by Larry Lee, OASC.

6/25/86-8:30 p.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Wednesday, June 25:

8:30 a.m.:

Executive Council Meeting - Room 520

3:00 p.m.: Workshops on Undergraduate Education in Mathematics, Engineering and the Sciences, Room 516.

4:00 p.m.: Connie McLindon

6:15: Time Life

5:30-6:30 p.m.:

Reception for Awardees in the VPW Program - Room 1242

Thursday, June 26:

8:00 a.m.:

Meeting with Charles Sporck, Pres. of Semiconductor Co. and Mr. Bloch - Room 520

2:00 p.m.:

Michael Schrag, Washington Post (Contact: 334-7320)

3:30 p.m.:

Professor Gerald Estrin, UCLA

Friday, June 27:

A.M.:

Visit Math Soft.

Saturday, June 28:

Goldsmith to visit at home with Mr. Bell.

MONDAY, JUNE 30:

10:00 a.m.:

Meeting with Jack Schwartz, New York University, and Mr. Bloch, Room 520

2:00 p.m.:
Meeting with NCAR representatives re the Future Role of NCAR in Advanced Scientific Computing (Attending: Bell, Connolly, Lee)
NOTE: Mtg set up by Larry Lee, OASC.

Tuesday, July 1:

12:00 noon:

Lunch with Judith Turner, Chronicle of Higher Education
JULY, 1986:

July 2: John von Neumann Center Site Review, Princeton, NJ (Take train up either the night before or the morning of the 2nd.)

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

Thursday, July 17:

11:00a.m.:

Gene Bylinsky, FORTUNE Magazine, interview with Mr. Bell - Room 306. Contact phone nos.: NYC-212-841-2805 (office); Riverside, Connecticut (home): 203-637-0035.

October 6, 1986:

Information Infrastructure Conference (GET MORE DETAILS FROM MR. BELL.)

7/1/86-9:30 a.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

Tuesday, July 1:

9:30 a.m.:

Drs. Kahn and Corf with McLindon

11:00 a.m.:

Gaylord Ellis

12:00 noon:

Lunch with Judith Turner, Chronicle of Higher Education

2:00 p.m.:

MOSIS Engineering Contributions - Frank Huband

JULY, 1986:

July 2: John von Neumann Center Site Review, Princeton, NJ (Take train up either the night before or the morning of the 2nd.)

SUNDAY, MONDAY, TUESDAY, JULY 6, 7, 8, 1986:

ANNUAL SNOWBERG CONFERENCE, SNOWBERG, UTAH

July 6: Kickoff Reception (evening).

July 7: Mr. Bell to present Dinner Address.

Contact: DR. WALKER, PROGRAM CHAIR (FROM LOUISIANA) 318-231-6147.

July 14:

2:00 p.m.:

Meeting with Dr. Akiba and Japanese Researchers

Thursday, July 17:

11:00a.m.:

Gene Bylinsky, FORTUNE Magazine, interview with Mr. Bell - Room

306. Contact phone nos.: NYC-212-841-2805 (office); Riverside, Connecticut (home): 203-637-0035.

Sunday July 27 and Monday July 28:

NCAR/UCAR User Conference - Boulder, Colorado

Monday, July 28:

11:00-12:00:

Visit of Professor William Mitchell, Chairman of the Science and Engineering Research Council - Dr. Connolly also to attend - Room 306 - Contact: Christine Glenday-357-7554. (THIS MEETING REQUESTED BY BLOCH--PROF. MITCHELL IS MEETING WITH SOME OF NSF'S ADs.)

October 6, 1986:

Information Infrastructure Conference (GET MORE DETAILS FROM MR. BELL.)

October 27, 1986:

Education Advisory Board of the National Academy of Engineering (NAE)

1987:

February 26, 1987:

9:00a.m.:

Keynote address to the 1987 Phoenix Conference on Computers and Communications (PCCC-87)--Contact Dr. Oris D. Friesen, (602) 997-3996.

March 19, 1987:

Education Advisory Board of the National Academy of Engineering (NAE)

7/1/86-9:30 a.m.

GORDON BELL'S APPOINTMENTS - JUNE, 1986:

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Why was it necessary to establish a central directorate for computing?
CISE recognizes the pervasiveness of the computer in society today and the unique opportunities for computing at this time.

The information society, which is the largest sector of the economy is based on computing and communication. Just as mechanisms were the basis of the industrial revolution, cinoters are the basis of the information revolution.

Computing is found in virtually every scientific and engineering discipline as a base either as a tool or a component, and it is a science in its own right. In science, the Nobel Laureate, Ken Wilson, and head of the Cornell Theory Center housing one of the NSF supercomputer centers, expains computation as the third paradigm of science. The first being theory, and second, experimentation.

History has shown that government funding of computing research has been the main driving force of the revolution in computing that has become the largest industry today.

Finally, today, we have a new opportunity vis a vis parallelism to come off the technology evolutionary path of the last few decades that provide only x10 of performance per decade.

How Do you see Computing research affecting Competitiveness?
Directly through products. We have history of revolution that has occurred by funding university research -The Army funded Eniac and Edvac at Penn, the first computers that became the basis of modern computers, and the designers went on to create Univac. At MIT, ONR funded Whirlwind, from which came core memories, real time, air defense, air traffic control computers, interactive computing and the first computer aided manufacture. Digital Equipment Corporation came almost directly from the Whirlwind effort and team. Timesharing was first implemented at MIT; this became the basis of all modern computing. Graphics research, initially at the University of utah, became the basis of all workstations and PC's, its how computers are beginning to be truly useful to everyone. ARPA funded communications networks for computing. The artificial intelligence-based expert system at Digital to specify how computers are put together was first prototyped at Carnegie Mellon U. This was the basis of the emerging AI industry. Universities are the main source of ideas and programs in VLSI design.

Only this week, these example of NSF funded projects came across my desk: Don Knuth's program, TEX, is now the basis for modern typesetting of scientific and mathematics manuscripts. Two different parallel processing schemes, are now implemented by 5 companies. A research at Utah has just implemented a text searching scheme that promises to be able to retrieve any text in any size database in virtually 0 time. Kamakahar's algorithm at BTL came out of extension of his thesis work at UC/B.

The supercomputer centers produce results regularly: America's cup, Kodak Material, Corning (1/6 throw away) simulation of the new superconducting materials, search for cold virus serum, molecular modeling and computational chemistry, we even have work to use the computer as a computational telescope.

Computers are critical to CAD,CAM,CAI, CAI, ... in every environment from home, office, laboratory, vehicle, or factory. We especially are focusing on hardware in this budget, note the increase in the MIPS area.

Finally, we still have a + balance of trade in computers, but its fading fast. Japan is breathing down our neck in every phase of R...D, and every area from AI to payroll.

Bottom line: We have no trouble in measuring results, including gestation times. It is quite rapid, and it can and must be even faster.

What are you doing to help the education process?
I mainly believe that the big force that drives the education process comes from the right balance between research and teaching by first rate researchers. Much of research comes from student questions.

Let me give a homely example of the interaction of teaching and research. I took 6 years off from Digital to teach and do research at Carnegie Mellon university from 66-72. I wanted to explain how simple computers were and to have computers design them. We came up with 2 notations, that later became languages to describe, simulate and ultimately now to begin to automatically design computers. The text we wrote is still a classic on computers, and many simulators use the language, and at least one company sells the program. All of this came out of a research direction and drive that was largely pedagogical.

I also believe that the work we are doing indirectly in CAI in some of the leading universities will ultimately filter into all forms of education.

Are you familiar with Rep Sabo's Proposal to have NSF fund the Phase I centers by cutting 15% from the Phase II budgets, and then ultimately go to a free market for all supercomputer service?
The Phase I program was established to buy computer time from various organizations, including three companies and three universities (Colo state, minn, Purdue) who had supers. We had no long term commitment for support and the contract was clear from the beginning that we were not going to continue support when our own phase II, centers became operational. The phase II centers are all now operational, pretty much according to our plan. By cutting our Phase II centers back 15%, would be a disaster; we simply can not maintain the systems at the performance levels we need, that is having the latest, and highest performance computer available on the market. This requires amortizing a computer over 3.5-5 years, the gestation time for a supercomputer. I do not support the concept of a "free market mechanism" for

machine time at this time, whereby anyone can supply cycles. This mechanism didn't work and was the main drive why the government had to step in and form the ASC program in the first place.

I am in the process of reviewing whether we have adequate funds to maintain our existing centers with the latest computers. It looks as if we are going to have to need more funds. I am not requesting more at this time, but believe we want significantly more help from computer suppliers, several of the states, some of the universities that host the computers, and industrial users. I believe the government is paying too much of the freight.

Are you happy with the Program?

Yes. We have 6K people on 2K projects, at 200 sites in all states. We see exciting results almost daily.

One of the great benefits from the program to date is the side effect of causing a number of great universities to acquire their own supercomputer. I don't believe any great university can afford not to have this kind of capability. For example, Berkeley has a small Cray XMP and an IBM 3090/200, Texas, Ohio State, Minnesota have or acquiring Crays. I hope the ETA computer will be successful, and replace the CDC 205's at various universities that have them. Michigan got the second 3090 after the center at Cornell. IBM has installed 40-3090/200's which could supply signficant computing power (each processor of a dual is about equal to a Cray 1). In fact today, I estimate that we have the equivalent of over 110 times the Cray 1 available to the university research community, about 70 of this is in unis, about 40 at the centers (including NCAR) in 4 Cray xmps, 1-Cray 1, 1-3030/400, and 2-CDC 205's that are to be replaced with a machine of 20x a Cray 1.

As an alternative, three companies are building and installing mini-supers, all of which can do many of the tasks supers can do on a cost-effective basis. Many more designs are in the wings.

As the person responsible for getting about 3000 computers of the minicomputer price class into the scientific community in the form of VAX, I think the future will give us lots of options in the way to do computing. Today, supercomputer users generally access supers at the end of a very slow network. This limits their own abilities in a different way, particularly in being able to visualize results. Many things (other centers, superminis, and networks) have changed since the establishment of the centers program, and we must continually evaluate the options for the future.

In all scenarios, I continue to see the need for a few centers which have the latest and fastest computers.

[redacted]

From: [redacted]
To: 'William Aspray'
Cc: 'Peter A. Freeman'; 'Rick Adrion'
Subject: RE: CISE Oral History: 20 Questions
Attachments: FCCSET Research and Development Strategy for High Performance Computing 871120 c.pdf

William,
More.
G

From: Gordon Bell
Sent: Thursday, July 13, 2017 10:23 AM
To: 'Gordon Bell' <[redacted] 'William Aspray' <[redacted]
Cc: 'Peter A. Freeman' <[redacted] 'Rick Adrion' <[redacted]
Subject: RE: CISE Oral History (1-11)

See comments below.
I sent docs on nren.
The other biggie was that the ASC i.e. supers program direction, funding:
use UNIX, stop von Neumann Center because CDC can't deliver, get the directorates to pay. Got Cray to support the centers, also IBM at Cornell
g

From: Gordon Bell
Sent: Thursday, July 13, 2017 8:48 AM
To: 'William Aspray' <[redacted]
Cc: Peter A. Freeman <[redacted] Rick Adrion <[redacted]
Subject: RE: CISE Oral History

Fine.
g

From: William Aspray [mailto:[redacted]
Sent: Thursday, July 13, 2017 8:44 AM
To: Gordon Bell <[redacted]
Cc: Peter A. Freeman <[redacted] Rick Adrion <[redacted]
Subject: CISE Oral History

Gordon,

I will plan to call you at 10:30 am PDT today at [redacted].
In case it is more convenient for you to start earlier, I am prepared and available. Just send me an email telling me when. If I don't hear from you, I will call as originally planned.
Below are the questions I plan to ask in case you want to think about them before the interview.
Thanks for agreeing to this interview.
Bill
***

<u>Gordon Bell/CISE History – Interview Questions</u> [likely to be followed up with other questions based upon comments made by the interviewee] [13 July 2017]

1) Before joining CISE, what experience had you had with NSF more generally (grantee, reviewer, advisory board, etc.)? What about with other federal agencies (DARPA, ONR, etc.)?

   I had an NSF Grant or two at CMU during 1966-72. Had served on various panels including the first one that reviewed centers proposals… vividly recall a Xerox researcher rejecting the Santa Clara U magnetics proposal by various former IBM disk folks because who was the university and that magnetic disks were dead with optical stores. Was on an industry panel that got a bill passed that would allow companies to gift stuff at a tax advantage that had a nice effect.
   Also see attached letter.

2) Who recruited you to CISE? Why did you decide this was a good offer to accept? When did you actually arrive?
   Erich Bloch. I knew Erich and NSF and thought it was an important thing to do.. also I wanted to work for Erich.
   I felt strongly that computing should separate from being distributed appendages in other directorates and to have its own directorate!
   I believe I arrived Jan 86… but need to check the date.

3) Was the fact that you had both high-level academic and high-level industrial experience an asset at NSF? Was the fact that you were distinguished in your technical career an asset in carrying out your NSF work?

   Hopefully, my experience with large organizations, university faculty, and especially the computing industry re. what I felt was needed was useful
   As you see in one of the interviews, I pressed the community for working on parallelism and got pushback from Knuth, Karp and Ken Thompson. Re dictating to community.
   Failed to get computational science adopted by computer science… but did establish the name.
   Kent Curtis had funded Seitz at Cal Tech. I got Darpa to pick this up and this was the path that got Intel et al into building MPPs, etc. for HPC
   Also the connection with Squires et al at Darpa was important

3) Tell me about your relationship prior to and while at NSF with Eric Bloch?
   I had massive respect for Erich and had worked with a committee he and Bob Noyce chaired to set up Semetech and SRC.

   Did your shared engineering background with Bloch stand you in good stead at NSF, where science rather than engineering was pre-eminent?
   Erich definitely establish engineering as an equal part Suh Nam, former MIT ME Dept head was a giant that Erich headed for the Engineering Directorate. He is president now of KEIST. Staff meetings were fun.

4) Although it predated you, what can you tell me about the reasons behind and the process involved in forming CISE?
   The obvious branches were brought over. I had known Kent Curtis, Erich made decision that Bernie Chern would come over from Engineering, John Connolly from ASC, and ?? came over from robotics. Erich made the CISE name. I preferred “Computing” but we didn’t spend a lot of time on the name.

No doubt, Chuck Brownsteing as my exec/adm assistant was perhaps the most important addition since he knew the various people and politics.

The big change I made fairly early on was to extract networking from the centers program. Am not sure about the details, but it was one that had some conflict… will try to find any memos. Then getting Steve Wolff to run it was fortunate. It was obvious that the centers shouldn't be driving the network.

6) Sometimes people believe that NSF funding is a zero-sum game. This might mean there was resistance from other directorates to the creation and growth of CISE. Did you experience this attitude? How did you deal with it?

In fact CISE was really a tree pruning exercise. No new money came in. Yes. Engineering, MPS also lost funding and organization.
Erich really managed this, but the other Directorate manager (e.g. Rich Nichols I believe) managed this. I had strongly believed in an independent Directorate for some time.

a) There was already a computer engineering program in the engineering directorate, which got moved over into CISE over the objection of the Engineering AD. Would you care to talk about this program?
Nam Suh lost some folks, but this was mostly a hardware and devices. Note semiconductor research stayed in engineering
I believe Nam, I, and Erich all believed that CS is substantially an engineering discipline.

b) Was there any effort to bulk up the size of CISE, so that it really looked like a directorate and so that there would be less incentive for some successor of Eric Bloch as NSF Director to turn CISE into a division in another directorate?
No. CISE was well funded.

7) You had had a heart attack not long before you came to NSF. Did this have any bearing on how you carried out your work at NSF, e.g. the division of labor of work in the CISE office?
I had this 3 years earlier and that caused me to leave Digital and I went to start Encore computer and also to do angel investing. The only affect it may have had was to make me a little more remote i.e. not take the decisions as personal when I forced the decisions that had conflict. The main thing was Erich gave me the support for all the changes

8) Chuck Brownstein has had some very favorable comments to make about your management style. Can you talk about your management style and how effective it you perceived it to be?
In a way, I never perceived myself as a manager, but really more as a leader. I assume that the Division heads were able to manage the NSF process that, left alone, just moves money. I felt my job was to force the changes that were necessary e.g. like closing von Neumann center when it was really not needed and CDC had failed. Also see the attached re. the ASC funding as it evolved

What were the greatest management challenges and successes during your time in CISE?
I tended to be at odds with the centers folks and for them to get more external support to validate their need. See attached.
Also wanted them to focus as a single facility vs. fiefdoms that characterize supers centers.

The biggest success by far was writing the response to the Gore Bill that eventually begot the Internet later

on.
I believe this is the only thing that was ever done across agencies: nsf, darpa, doe, nasa, NIH, doc, etc.

NSF really drove this by the funding of the regional net funding and the document and then getting Bob Kahn's organization to take on the management that got Michigan.

9) I understand that you shared Eric Bloch's desire for larger dollar-value grants and grants of longer duration, and that there was some resistant from the program officers for that meant they could not provide support to as wide a portion of the community. Is this correct?
Yes. The centers grants were going when I arrived. I had been a reviewer of the first centers grants. Also, had experience with DARPA vs NSF small grant funding.

How did you handle this situation?
I don't recall whether we did any of these.

10) Rick Adrion has shared a brief document with me from the time that you prepared for a discussion with the NSF Board and Director. This indicates that your five proposed areas of emphasis for CISE were:

Parallelism, applied to parallel processing
Automation, robotics, and intelligent systems
Ultra-large scale integrated systems
Advanced scientific and **engineering** computing [emphasis in original]
Networks and distributed computing

Can you discuss the negotiations that took place as you discussed these programmatic emphases for CISE? Did the programs get modified through this process of negotiation?
Early on, I recall having an advisory panel that reviewed our dircitnn

11) Another document that Rick Adrion has shared with me as an NSF org chart that indicates the 4 proposed organizational structures (divisions) that corresponded to these programmatic initiatives:

Computer research
Information science and technology
Computer and information engineering
Advanced scientific computing

These evolved into CCR, IRIS, MIPS, and ASC. Later, networking split off from ASC. Can you discuss these decisions about organizational structure?
The formation of a network group that was separate from ASC came from the obvious pruning that I believe I determined to be more important than ASC.
This was something that I took away from the very strong supercomputer centers. This stemmed from a long personal belief and support of networking that started at DEC and continued through the ARPANET.

How well did they achieve your programmatic goals? NREN begot Internet as the result.
What were the challenges? Just doing it.

12) Both networking and high-performance computing were important parts of the story of the development of computing at NSF yet somewhat apart from mainstream computer science. Can you talk about their status when you arrived at NSF, your actions in these areas, how these activities changed over time, and how they affected the support of other areas of computer science education and research?

a) In the networking area: what was the relationship between NSF and DARPA?
b) Basically DARPA had gotten out of the networking business, but their budget was being eaten in support of ARPAnet that was consumed with email transmission.

With other agencies? See the agencies and people in the FCCSET documents. This was the seminal group, including network group.

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Charles F. Stebbins
Air Force Systems Command
Daniel F. Weiner, II
Joint Tactical Fusion Program

Computer Networking, Infrastructure and Digital Communications

C. Gordon Bell (Chair)
National Science Foundation

Ronald Bailey
National Aeronautics and Space Administration
Sandra Bates
National Aeronautics and Space Administration
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National Bureau of Standards
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Dennis G. Perry
Defense Advanced Research Projectes Agency
Arnold Pratt
National Institutes of Health
Shirley Radack
National Bureau of Standards
Rudi F. Saenger
Naval Research Laboratory
Daniel VanBelleghem
National Science Foundation
Stephen Wolff
National Science Foundation

What role, if any, did Al Gore play here?
Gore wrote the Gore Bill which I believe was helped by the staff.
The essence of the bill (Public Law 99-383, August 21, 1986) is given in the FCCSET Vol. I report.

Is there anything you wish to say about Steve Wolf's role in this area?
Steve was an important fine based on his experience and administrative capability.

c) In the high-performance computing area, how did NSF activities relate to those of DOE and NASA?

d) tSee the FCCSET structure.
e)
f) Do I understand correctly that you already had an interest in high-performance computing from your time at Carnegie Mellon?
g) This is a long term interest of mine, including the computers that were built at CMU.
h) I wrote a number of papers on the history, progress and alternatives to get to various performance levels e.g. mega, giga, tera, exa

Is there anything you wish to say about John Connelly's role in this area?
John was a great advocate for supercomputing centers, having established temporary contracts prior to the centers.
I tended to focus on the cost, utilization and effectiveness versus starting more centers.

13) What can you tell me about your interactions with Congress? For example, dealing with Rep. Edward Boland in appropriations? Handling the 10% cut that was caused by Gramm-Rudman balanced budget amendment? Other particular incidents or key figures in Congress or the White House that should be mentioned?

I attended some of the congressional hearings, but never had to present, but may have answered a budget question or two. I came away with enormous respect for the bureaucrats as being much brighter and harder working than the politicians.

14) You only stayed at NSF for a year and a half. Why did you decide to leave?
I left to head up engineering at Dana, a startup I had helped found in Silicon Valley. The head of engineering had been fired.
I felt that CISE was up and running with the right structure and division heads and I wasn't essential and I had completed the formation of CISE.
Re me cutting out prematurely, I think my agreement with Erich was for me to start CISE…in any case, I prefer to startup organizations.

Was that enough time to have an impact?
Yes. The org structure, division heads, and charters/plans were exactly where I thought they should be.

Can you give me a snapshot of the state of CISE at the time you left?
Org and charters and plans were all in place.
Job now was to finish building NREN with NSF and the rest of the government agencies. This had been contracted with CNRI.
Big thing that didn't get done was to integrate computational science with computer science. This is yet to happen.

What were the major opportunities and challenges facing CISE at that time?
ASC funding and effectiveness and coupling with industry … also expanding user base versus more capacity for QCD computation.

Do you believe the directions that you set for CISE were continued after your departure?
I think Bill Wulf may have told me, that he just implemented the established plan.

15) More broadly, what were the most memorable or key events at NSF and in CISE, e.g., re-organizations, programs, initiatives, etc.?

Just getting the CISE organization, especially networking, in place that functioned as one with external reviews.

The most significant was the NREN Plan responding to the Gore Bill requesting NSF to come up with a plan and proposal for networking that was done with all the other agencies, followed up with the contract to CNRI (Kahn's organization) that subcontracted the building of out of NREN at U of Michigan and IBM.

The Network plan that responded to the Gore Bill then stimulated/embarrassed the two other FCCSET groups (see the figure) to want to leverage a concrete plan to advance their agendas of Decker for HPC at DOE, and Saul Amarel for CS Research at DARPA. Thus our plan became part of an overall plan attached that Steve Squires and Bill Scherlis really got together. This plan morphed into a book then was updated and republished over the next few years as a shiny blue book from FCCSET. Unfortunately, I don't have copies of those books. In the mid to late 90s? CSTB I believe published a very aggressive proposal for CS funding that had everything in it… but went nowhere.

With ASC, I forced the focus on manufacture supplied UNIX software in an effort to make it easy to migrate apps across systems.

In focusing on parallelism, I was motivated to offer the Gordon Bell Prize for parallelism that the ACM administers at the Supercomputing conference. I believe the prize got the whole thing started. See my keynote
https://www.researchgate.net/publication/316283770_Gordon_Bell_Prize_Three_Decades_Motivating_and_measuring_High_Performance_Computing_progress

Just being downtown, living near Dupont Circle, walking to work in the humid DC and being next to the Whitehouse (where I did a bit of photo bombing) was personally enjoyable. I don't think I would like to be away from the center as NSF now is.

16) I understand that the NRC CSTB had become moribund and that it was revived and supported well by CISE at about the time that you were AD?

I don't recall any interaction with the group.

Later on, I convinced them to look at the HPC systems as a study. I believe Fred Brooks and Ivan Sutherland led this study.

My goal was to try and get focus on parallel programming since it was clear that microprocessor had a dramatic advantage in price-performance

What function, if any, did CSTB play in helping to identify new directions for the field, or legitimizing the creation of new CISE programs?

None that I recall

Was this activity modeled after work that was already being done in the physics community?

No connection that I know of or can recall.

17) Chuck Brownstein was the acting AD both before your arrival and in the interim between your term and that of Bill Wulf. Is there anything you wish to say about Chuck's role as either acting AD or as your deputy?

Chuck was simply critical to help get around and understand the political environment.

Often I would write a memo, Chuck would translate it into NSF Bureaucratise… he also said that my printer needed to be connected to a shredder.

18) Who were the most memorable/influential people with whom you worked/interacted while you were at NSF (NSF and external) who we have not already discussed?

I had good an long lasting interactions with the supercomputer community at DOE that went back to my first visit to Livermore in 1961 or so.

Why were they memorable and/or influential?

Bloch established CISE. It is unclear whether this would have ever occurred without him doing it.

He was supportive a manager and kind of delighted at seeing me in hot water: when I closed von Neumann; had to deal with CDC: had to write a letter to the Pres of Bell Labs when I had been interviewed and said that ATT would only screw up NCR that they had just bought; respond to Cornell that their Nobel Prize winner couldn't spend the money they had been given for running the supercomputer on a crazy research project that we had rejected.

He introduced a 360 evaluation of the organization whereby everyone was peer reviewed. NSF under him was quite open with conflicts exposed.

He was effective at getting a big increase to the budget taken over a few years during the Reagan years.

19) Can you comment on influences from the computer science discipline, industry, the government, or society more generally (if any) that shaped the development of CISE or your programs at the time you were at NSF?

DARPA was in the midst of the Strategic Computing Initiative

20) Any other comments?

I noted that something about the CMU community that felt that NSF and government service was important: me, Bill Wulf, Nico Haberman, Peter Freeman, and Jeannette Wing,

FALL JOINT COMPUTER CONFERENCE TALK-Dallas 11/5/86

Computer Science Community Concerns About The Directorate

F1. Supercomputers are not computing. OASC will eat the CS budget. OASC could, but it hasn't. The OASC program has raised the visability and importance about computing generally. Unfortunately the CS/CE/Eng. community is uninvolved and it should be. Vectors in computing are here to stay, and this community should enter the decade of the 80's and get involved with education and use.

F2. CISE has programs in computing that don't include my area: a. software engineering, and b. theory, and c. x. (x so far has been undefined). NSF's #1 goal is competitiveness. Our programs are attentive to this goal. '88 allocations reflect this. The organization reflects on-going areas of research, not all of the themes, disciplines and areas of research. The priorities are set by the research community. I will express what I think are the needs, and I want you to express what your goals and agenda are.

F3. You have programs with goals. Don't you know basic research is supposed to be undirected. Forgive me as a student of history and a computer scientist who has a real engineering streak. Ironically, the engineers worry that I don't believe in engineering. This is compensation for what could be undisciplined research. Frankly, I would like to compare the output of the two approaches: project/goal vs. community directed... in terms of useful results, papers, students, you name the criteria.

F4. Government Confusion to the research community. The Engineering Directorate has significant programs in computating (e.g. neural science and engineering), I thought all computing came under the CISE directorate. Yes, but that's the nature of engineering. "what's mini is mine and what's yours is negotiable". The Computing Directorate encourages funding from all sources. I assume you don't care whether you get the money from our directorate or wherever. I'm encouraging all directorates and other agencies such as NASA and DOE to discover and fund computing research, especially mathematics who claim computing as a special branch of applied math on a par with statistics.

The goals for the Computer Research Community

• Agenda for research across the board in all the areas. I'll posit the agenda that I have used to justify our position within the NSF funding hierarchy. The response was positive in the '88 budget, which is the first time that as a directorate, the organization change could impact the budget!

•Training of graduate students and faculty, plus providing an infrastructure for research. Want to increase the output rate of PhD's in accordance with the pleas from this community. The CS community has been very responsive: the Gries/Young/Miller/Ritchie CS board report published in the ACM. Hopcroft has a paper in process to record accomplishments. The Traub, Computer Science and Technology Research Board is also working in this area.
• Parallelism- Factor of 10 every 5 years for next decade.
• Provide training in microelectronics to reach undergraduate level. Goal is to be able to build ULSI (>2Mt) chips and large systems with no more work than one does in writing a large program. Only one NSF-sponsored project is of any size. I hope to visit it soon, but based on the CMU experience, this is expensive and takes a long time to develop. I want us to focus on being much mroe elegant, but until the infrastructure is in place, I don't believe we can afford much experimental hardware and systems research.
• IRIS- fundamentally a people-less environment at homes, factories, labs, space, offices. I hope NASA will get interested in this.
• Supercomputers. contentious. Train, revise texts, thinking, raise aspirations above VAX mentality. Don't be blinded by looking at your SUNs.
• Revolution to a completely networked environment. Train to use/be comfortable with remote computing. Have all graduate students use it! Provide a networked environment where people in all disciplines are part of single environment. The goals is to be able to communicate and computer such that transportation for face to face communication and problem solving is unnessesary.

Richard Karp said this all sounded like DARPA. I felt flattered. The goal directed program approach produced the computer through ENIAC, others included whirlind which had as by-products, core memories, graphics, and air defense that ultimately became our air traffic control. The aproach also yielded: interactive computing, timesharing, parts of cad/cam, vlsi cad, graphics, speech analysis/synthesis, packet switching, the development of artificial intelligence and the current wave of parallel computers. Virtually all revolutions in computing came from government funded goal-directed research either directly or as a by-product.

On the other hand, without the constant funding of NSF the people would not be availabe to carry out the projects or provide the intellectual underpinnings and ideas. This continues to be our charter and direction, especially with the limited funding and broad charter we possess.

It is not NSF's goal to become DARPA. We provide a broad range of funding for supporting science and engineering at all universities. The top 20 ranking universities correspond identically to those supported by DARPA and by the NSF Co-ordinated Experimental Research Program. We don't have large centers (other parts of NSF does), nor do we have large goal-directed projects such as the Strategic Computing Initiative.

On the other hand, we want to leverage the DARPA effort (as we are doing with MOSIS, networking). We want to be able to support an incredible variety of efforts. If any become important, they can go on for larger, project breadboard funding. Our ASC is a program that is beginning to stimlate change.

Overall Organization: What are the Divisions and areas?

Division of Computer and Computation Research:
C&C Theory... revision of this is critical to support insight into new paradigms of computation. I don't think this is the case today. It trails, and is essentially a continuation of a sequential, Turing machine model. The analysis of algorithms part doesn't reflect parallelism or cost of communication.
Numeric and Symbolic Computation is a new program and reflects the emphasis on supercomputers and the need to integrate symbolic and numbers
Software Engineering- and a distinct other program in
Software Systems these two programs argue for a strong definition and agenda
Computer Systems Architecture- NSF supports the examination of new and more radical ideas. We haven't been able to support large projects.
CISE Institutional Infrastructure and Instrumentation

IRIS: Information, Robotics and Intelligent Systems
Knowledge and Database
Robotics and Machine Intelligence
Intereactive Systems
Information Impact

MIPS... biggest growth is MIPS. Goal is to be able to design and build systems at a distance. MOSIS+.
Design, Tools and Test
Microelectronic Systems Architecture
Circuits and Signal Processing
Experimental Systems
System Prototyping and Fabrication

Supercomputers
Ken Wilson was one of the major sponsors of the ASC program. ASC got a much higher growth rate than any other part of the NSF budget. It was especially marked by congress. It includes operation of 5 centers and continued support of computer time for several resource centers.

Your peers in other disciplines have made me feel very guilty by calling this phenomenon of non-use and uninvolvement by you and even members of the engineering and scientific community, the VAX mentality. Namely, those of you who grew up to covet your own VAX can now have a workstation with a VAX chip in it or use some other workstation from Apollo, IBM or Sun which has at one to four times the power of the 1978 model VAX-11/780. I think you have to raise your aspirations, the supercomputers at our centers provide anywhere from 50-500 times this power. The problems they solve are totally unlike anything you can dream of putting at a workstation that limits your vision and dreams.

Supercomputing is critical. Notion of vectors is with us for the foreseeable future in our architectures, but more importantly the linear algebra that these machines support has been around for over a century. These machines provide many more operations per second then scalar computers and assures a major change in graphics to include solids and other data-structures that require training. With the introduction of the IBM 3090/400 vector, multi-processor as a qualified entrant (according to Bill Buzbee of Los Alamoto the supercomputer market, we can expect the number of these machines to at least double in the next two years. Most large campuses will likely have their own large scale scientific computers. Furthermore, the supply of cost-effective alternatives in the form of mini-supercomputers requires directional changes too. I know of at least two companies designing personal supercomputers with built in high performance graphics workstations.

At our centers, engineers are using only about 10% of the machine capacity, and computer science projects are essentially non-existent. Your apathy is typical of why disciplines such as chemistry and physics take over the teaching of a discipline. I believe that you and your students have to become involved in this form of computing. Traditionally, you have led. This time you are univolved but must not stay that way. You owe it to your students in computer science, computer engineering, and other scientific and engineering disciplines you train. Don't be blinded by looking into your Suns... there are other important forms of computing.

I am asking our five centers to take on a real leadership role, including:
•supplying services on an equitable basis across disciplines, geographies, traditional and new users
•training, education (making up for the lack of training in CS), and program /database support
•network access and support
•test sites for new machines and software including production-oriented larger scale parallel computers
•evaluation of the best hardware and softare (benchmarks, workloads, etc)
•standardization activities in networking, graphics, and program environments... UNIX
•standards for the routine form of parallel processing found in supersomputers, based on both message-passing and memory sharing.

I believe you can and should play a major role in this revolution in scientific and engineering computing that needs to take place.

Parallelism and Parallel Processing

The principle theme of the directorate is parallelism. The goals is to provide a factor of 10 eavery 5 years for the next decade as measured in actual use. This is independent of technology and the use of vectors. Ken Wilson believes this should be a factor of 100 each 5 years for the next 15 years, which would get a factor of 1,000,000 in 15 years. We both may abe right. We only get a 10 in 5 years, but within 15 years we see very large speedup. My conservatism comes from 2 sources: engineer - I've been involved, historian -we have no parallelism now in actual use. On the other hand, we do have machines which can provide parallelism of 10 and 100 today (which I believe will take 10 years to make commonplace), and one machine which could be easily scaled to

1,000,000 (but with only a factor of 10-50 degradation in clock speed over the fastest machines.

I believe parallel processing is likely to be the most significan advance in computing since the invention of the stored program. Compare it with the machine ideas of virtual memory and memory hierarchies (early 60's concepts, and vectory processing, introduced in 1975 in the Cray 1. This is not to say vectors aren't important, nor are they transient. It took IBM and the Japanese a decade to discover them, and most minicomputer builders have yet to make the discovery. It'll take another 5 years for micro makers. Furthermore, getting an understanind of parallelism will be the true 5th generation. The age of intelligent machines which exploit parallelsim is at least another generation and decade away!

Parallel computers aren't new. Many of the structures have been written about for the lst two generations or decades. What is new is the plethora of computers which can actually explloit and provide paralleism. The unfortunate part is that we have nor real understanding about using them. We have been attending many Annual Conference on Parallel Processing, including the recent second one on Hypercubes. Virutally all of the results reported give no real measures or insight other than the fact that someone has parallelized some algorithm to run on an inapporpriate architecture. The results can be typified by the following kinds of work and papers:

•Case 1. Another packet switching network to connect computers to one another or processors to memories with completely unrealistic assumptions indicating a complete lack of knowledge of how computers are built or how they connect or a misunderstanding of software. The results aren't usually very interesing either.

•Case 2 shows formulas about decomposition, following the traditional approach used in early approaches in the analysis of algorithms. for example, a recent article in the Transactions on Computers looked at an algorithm and completely ignored the communications time among the computers in showing that an algorithm could be run on a multicomputer (in this case a hypercube). Typical communciation times are anywhere from 10-1000 times the access time of variables in local memory.

•Case 3. Lack of Experimental verification. This was especially sick since the university where the work was carried out is one of the few with several parallel computers supported by NSF. The paper should never have been allowed to be published either with or without experimental data. If experimental data had been required, the authors would have violated

•Case 4. misguided attempt to use a coarse grain, multicomputer message passing architecture for a medium-grain problem with lots of communication. Of course, an algorithm can be written and analyzed just as there have been thousands of papers written on how Turing machines can be used. It works, but it produces an incredibly large slow-down over a uniprocessor. Real computing is not an arguement based on religions founded on topology, but rather it is strictly economics based.

In working on parallelism, the goal is to change the way we think about computing from a basically sequential, procedural form so that other paradigms of computing. Rule based systems, decision tables, spread sheets, forms, and relational databases point out other ways to get computers to work for us. The 100X goal will be met, most likely by a completetly different way of utilizing machines in a different and transparent fashion. I don't believe the goal will be accomplished by a compiler that automatically takes dusty deck Fortran programs and recompiles them for new machines, or by training and completely rewriting current software.

We need to galvanize research to this modern end, inlcuding: the underlying theoretical machines (The Turing machine or multiple machines is sequential), mathematics, algorithms, and analysis of algorithms, and the traditional languages and their environments so we can understand and use parallel computers. Mostly we want to train all students about parallelism so they can break us out of the old mold.

It is not the intent of the program to stimulate new computer structures, for now, I think we need to practice birth control of new computers while we understand the plethora of machines we have. Until recently, the top ranking universities resisted obtaining and using parallel ocmputers, which might account for why they are tops. It's easier to concentrate on theories that don't have to be tested.

Why I think parallelism is so important:
1. circuit technology is not improving at as rapid a rate as in the past. Schneck and Rignanti observed that in 1982 it took 4.2 years to double performanc, and this equates to 18% per year, which is significantly less gain than we made in the first 3 decades of computing. CMOS is still improving at a 40% rate, or doubling every two years, until it hits drive and interconnection limits. The new ETA 10 supercomputer, using 20K gate CMOS chips, promises to be eight times as cost-effective as a current Cray XMP, or roughly the same as the next workstation that Bill Joy of Sun is promising us for

scientific computation. The problem with a workstation is that the stretch time is still a minimum of 60 times longer than with a supercomputer.
2. the machines are there... not a reason per se, but they are and will continue to exist and proliferate with or without your involvement just like supercomputers have. Most of the work in hypercubes so far has been performed by people with applications to solve. Machines will or will not exist because they provide signicant improvement in cost and performance.
3. they provide a radical improvement in performance which in turn will create new applications in traditional areas, in ai, or provide better human interfaces through speech and visual i/o, etc.

I believe the direction is clear on how to address parallelism, given the number of computers and approaches. I want us to proceed along three paths:
Path I. Standardize parallel processing primitives in all programming languages to conform to a model based on multi-process, message passing. This is fundamentally the approach used in workstations and remote procedure calls and allows commonality of environment on three quite radically different structures. The goal is to clearly understand the applicabilty of machines for coarse to very coarse grain parallelism algorithms.

Implement these parallel processing primitives on:
•workstation clusters of 20-100 exist in most every environment- Apollo's movie "A Long Ray's Journey into LIght" was created using 100 workstations doing ray tracing in a parallel fashion with almost infinite grain.
•Multicomputers, gets to 100 now, and one can easily build an mC with a 1000 computers- the most common form is the Hypercube.... fortunately Cal Tech is going to a grid with circuit switching. Eventually they may even get to multiprocessors. This machine class will proliferate as all the workstation folks take the hardware out of their stations and lash them together somehow.
•shared memory multiprocessors- Today we have multiprocessors with anywhere from 4 to 30 processors, and one with 128. The SCI program gets us to 500-1000. Cray, ETA, multi's (Alliant, Arete', Butterfly (if you play a little loose with the definition), Encore, Elexi, IBM mainframes, Masscomp, Sequent)
Depending on the hardware, the communication time to computation time ratio is somewhere like 10**6, 10**3, and 100 on the various computers. The need is to understand the communication requirements of the algorithms.

Modify the texts, and teach this model to all students! Abolish all strictly sequential, single thread programs.

Path II. Provide a common set of primitives to use the shared memory multiprocessors to have sharing of data among a collected set of processes. In this medium grain approach, communication of data is necessary and synchronization of the processes can occur every 20-100 or so instructions. Alliant has produced landmark hardware and software, based on the ideas coming out of Illinois to automatically parallelize a single program across 8 processors. The CEDAR project at Illinois has the goal to increase this number to 32 and eventually a 100. The real question here is whether we have to change our programming models from something that is completely transparent to handle 10's or 100's of processors.

Path 3 is a fine grain approach using a single program stream, but executed by a massive number of parallel, processing elements. This structure goes back to the Illiac IV, Goodyear MPP, and DAP. The Connection Machine is the only commercial machine to adhere to this model. IBM is building the GF11 with over 500 processing elements and a peak speed of 11 gigaflops for QCD calculations.

Networking

We have several needs for radically improved networking. The most obvious for NSF is the connection of workstations, and departmental mini and mini-supers to large, central and regional computers. The other is to improve the deplorable state of networking since ARPANET to a high data rate or DS1, formerly T1. Our sites are going to require significantly higher bandwidth because the proliferation of both LANs and CANs/MANs will cause a major congestion. The acronym I think of is gLAN, or Global, LAN. The goal is to get substantially faster links on a substantially faster schedule then would otherwise happen.

We have yet to establish goals: I think we need T1 across our networks within 3 years, but these are hardly interesting or useful to carry the traffic generated on the 80 Mbit CANs they must interconnect.

Part of the problem is the perception that there's no market for communication links, and hence the telephone operating companies won't have the services. They have a

number of 45 Mbit (DS3) links in place, and we could have a packet switched network operating at at least this speed within 5 years, but we must start now.

Telephone companies have a planning model of only two decades, down from 40 years based on a very strong central plan. The plan is that in order to get low cost for everbody, all residents have to be wired with fiber optics. The only way to justify fiber optics is for carrying television into the home, and cable tv is wearing out in 10-15 years. On the other hand, fibers are being installed like crazy for interconnecting switching centers. It's just not available for users... because their market model doesn't see a demand. Could it be because they don't offer the service?

I believe the market does exist based solely on the LAN/CAN needs, but useful services have to exist. One of the most important could be a much advanced form of picturephone service that evolves out of clusters of workstations. Universities should be the place to explore this model of collaborative use by scientists and engineers which are not tied to speccial places. If we can in principle, eliminate the need for travel in order to communicate or problem solve, then such a network will develop and create new organizations and ways of doing research. It's up to us to build and explore such a vision.

CSE (Cover)

NATIONAL SCIENCE FOUNDATION
Computer and Information Science and Engineering
1800 G Street, NW
Washington, DC 20550

January 30, 1987

Dear Colleague:

This letter is being sent to you in order to inform the scientific community of important activities presently taking place at the National Science Foundation. The fiscal 1987 Budget for the National Science Foundation includes funds of several million dollars in support of an initiative known as: "Computational Science and Engineering" (CSE). These funds are being distributed among the various disciplines: Biological, Behavioral and Social Sciences; Computer and Information Science and Engineering; Mathematical and Physical Sciences; Science and Engineering Education; Engineering; and Geosciences. It is anticipated that this new program will stimulate activity at the interface between the sciences and advanced computer technology. The NSF strongly urges investigators to inquire further about the details of the initiative with the various program directors at the Foundation. Enclosed with this letter is a program announcement (NSF 86-91) that describes the goals of the overall NSF/CSE programs.

Many of you may know that there have been a number of organizational changes at NSF. One is the creation of a new Directorate for Computer and Information Science & Engineering (CISE), which combines several preexisting computer activities from other directorates, the Division of Computer Research, the Division of Information Science and Technology, and programs in Computer Engineering, Communications and Signal Processing, and the Office of Advanced Scientific Computing.

CISE supports research in computer science, information systems and processing, robotics, networking and communications, microelectronics, advanced scientific computing and intelligent systems. The overall goal of the effort is to improve the knowledge base, research infrastructure and professional labor force needed to understand and improve the nature, synthesis and use of computing and information processing devices and systems. The current structure of CISE includes 5 divisions:

- Computer & Computation Research
- Advanced Scientific Computing
- Information, Robotics & Intelligent Systems
- Networking & Communications Research & Infrastructure
- Microelectronic Information Processing Systems

FORMATION OF RESEARCH TEAMS

Although many of the efforts described below can be performed by single investigators, and will be, to some extent, supported in that form, this new initiative will emphasize strong inter-disciplinary approaches to the enhanced computing capability and environment of the scientist and engineer. Proposals involving computer scientists, mathematicians, scientists and engineers, and specialists in such areas as computer graphics, might be integrated in such a way as to form an inter-disciplinary group or team, addressing specific problems of importance to one or more scientific or engineering disciplines. For example, such proposals might be strongly coupled with the efforts of innovators of state-of-the-art algorithms and software for application on machines with highly parallel architecture. Such approaches could develop new paths for entire disciplines to follow. They will be coordinated among CISE programs and the NSF scientific and engineering disciplines.

RESEARCH OPPORTUNITIES IN CISE

Proposals with a strong interdisciplinary approach are being encouraged in the following computational areas, although this list is not intended to be complete:

- Software and Algorithm Development
- Application of Advanced Technologies to problem solving
- Visualization, Graphics and Image Processing
- Formation of Novel Computational Strategies
- Network and Communication Systems
- Performance Evaluation of Computer Systems and Software
- Distributed and Parallel Processing and Vectorization

Software and Algorithm Development: It is widely accepted that software lags hardware development. This fact is ...ecially true for supercomputers and other machines of advanced architectures. Within CISE, the Computational Science and ...ineering Initiative will focus on research that addresses the development of novel algorithms and their implementation ...o useful software packages, the creation of friendly working environments, and the automatic production of fast, efficient code for scientists and engineers working on advanced computers. Innovations in languages, user-friendly interfaces, software tools, etc. might address issues related to the speed up of code development and therefore the productivity of researchers. Methods which assist in the portability of code across a variety of advanced machines will also be considered.

Visualization, Graphics and Image Processing: More powerful visualization capability is being demanded to take advantage of the most powerful machines. Substantial insights are already being gained from graphics, which is the only way to understand many scientific phenomena. Among the many research topics in graphics and image processing are: extemporaneous, interactive steering of numerically intensive calculations; dynamic visualization of fields in higher dimensions; high bandwidth graphics, networks and protocols; massive data set handling and standards; vectorization and parallelized algorithms for visualization; workstation-driven remote use of supercomputers; standard graphics-oriented scientific programming environments.

Performance Evaluation: A recent NAS/NRC report on "An Agenda for Improved Evaluation of Supercomputer Performance" remarks on the severe lack of scientific foundation, regarding our ability to evaluate the performance of advanced computers. Investigations into the definition and techniques for performance evaluation of parallel or other computer systems are encouraged either as the principal subjects of proposals, or as components of other research projects in this initiative.

Distributed and Parallel Processing and Vectorization: The direction of advanced scientific computing is clearly headed toward parallelism to achieve increased capacity. Since the complexities of programming in parallel environments with optimally vectorized code place even more challenging demands on software and algorithm development, the Computational Science and Engineering Initiative will emphasize means to provide effective scientific computing in vector and highly parallel environments. For example, the initiative will consider methods for automatically parallelizing existing scientific codes or rewriting them for efficient use on machines of advanced architectures. Also, software tools for increasing productivity of the programming environment on parallel and distributed architectures will be encouraged especially, for vector and multiprocessor computers.

Advanced Technologies: The Science and Engineering Initiative welcomes proposals concerned with areas of technology that have a strong impact on the conduct of future computing. Examples include high capacity and/or high performance mass storage coupled with appropriate file and data base management systems, optical computing, neural networks, non-binary computing, or any such ideas that could influence the nature of advanced scientific computing. The CSE Initiative will cooperate with other programs on the potential application of advanced computing technologies and systems to scientific and engineering problems. Proposals of this type will be coordinated as appropriate both within and outside the Foundation.

Formulation of Novel Computational Strategies: New computer architectures, communications technologies, languages, and other software or hardware advances becoming available offer promise of greatly enhanced speed, flexiblility, or cost-effectiveness in performing scientific and engineering research. However, the hope for significant increases in insight to discipline specific problems may demand a fundamental revision in the strategic approach taken toward solving problems to make effective use of these options. Investigations into alternate ways of formulating and computing important scientific and engineering problems are encouraged.

Network and Communication Systems: Recently increased accessibility of advanced computing resources opens possibilities for new, computationally-based, advances in the understanding - i.e., analysis and especially design/synthesis - of computer networks and communication systems generally. This Initiative will entertain proposals for computational research in such problem areas as: event-based, Monte Carlo, or other simulation methodology applied to very large scale computer networks with attention to realistic detail; protocol design based on computational studies of state-machine models of networks with state spaces so large as to render such studies hitherto impracticable; specialized, interdisciplinary studies of Presentation- and Application-layer protocols; knowledge-based or other expert aids for intelligent dynamic network management; and research using symbolic computation in studies of algebraic coding theory. Proposals in these and other appropriate topical areas will emphasize the innovative computational nature of the proposed investigations, and may include the use of advanced (e.g., highly parallel) architectures in the research.

Sincerely,

Gordon Bell

C. Gordon Bell, Assistant Director
Computer and Information Science and Engineering

FOR FURTHER INFORMATION WRITE OR CALL THE PROGRAM DIRECTOR OF THE PROGRAM MOST RELATED TO YOUR AREA OF INTEREST OR DR. MEL CIMENT, DIVISION OF ADVANCED SCIENTIFIC COMPUTING (202-357-9776).

CISE PLANNING SCHEDULE

1. Now - Begin "Defining the Base", and developing long-range plans, including descriptions of areas of need, opportunity, enhancements, initiatives, etc. Develop issue papers for Gordon Bell. All of these will be due March 17.

2. March 20 - NSB Meeting, Director will discuss PES and planning approach, Gordon Bell will discuss CISE reorganization and planning

3. March 28 - Formal planning call from OBAC for directorate long-range plans

4. March 31 - All material due to AD/CISE

5. April 25 - Final submission, directorate 5-year plans

6. May 5-16 - Director has one-half day review with each directorate (instead of Quarterly Review)

7. May 19-30 - Directorates prepare presentations for June NSB

8. June 19 - 20 - Presentations to NSB (guidance for FY 1986 Budget)

APPROACH TO ORGANIZING CISE RESEARCH

>Leverage and effectively use the small research budget by being a "balance wheel" to DARPA and industry

change to lead

>Focus research into **five**, very broad areas with

- >Relatively clear, long-term goals
- >Measureable output (e.g. by utilizing the research in further research, providing computing, and service)
- >Emphasis on maintaining U.S. leadership in computing
- >Continued, significant economic and competitive impact
- >Support for undergraduate and graduate training
- >Support for basic, front-end, research throughout the entire computer research community at a time when DARPA is becoming more "mission oriented"

new slide

THE FIVE RESEARCH AREAS

new slide

>PARALLELISM, APPLIED TO PARALLEL PROCESSING

>AUTOMATION, ROBOTICS, AND INTELLIGENT SYSTEMS

>ULTRA-LARGE SCALE INTEGRATED SYSTEMS

>ADVANCED SCIENTIFIC *AND ENGINEERING* COMPUTING

>NETWORKS AND DISTRIBUTED COMPUTING

OVERVIEW

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

Three factors set the context for long range planning in CISE.

First, CISE programs comprise research in computing and information processing in the broadest sense, including both science and engineering, thus creating a knowledge base, infrastructure, and a labor force of scientists and engineers who understand the nature, synthesis, management and use of information processing devices and systems. By their very nature, CISE programs are closely coupled to national economic leadership and national security; they create and are affected by very rapid technology changes.

Second, the fields of research represented by CISE are interdisciplinary, reflecting their youth and the demands of the problems attacked. For this reason, NSF has a special leadership role to play which is significantly different from the tradition of passively "serving" more established research communities by responding to demands. This is reflected in the selection of the five major thrusts described below and the mapping of these thrusts into current programs. CISE research programs range from the fundamentals of computational and information theory, through the design and exploration of software and hardware computing and communication systems, to applications in which theory and practice are tested and improved, to analysis of the role of information technology in society and the economy. These problems admit to analysis, using and improving mathematical and logical techniques, benefit from experimentation and simulation, and intermix traditional scientific and engineering principles across many programs.

Third, CISE also has the Foundation-wide responsibility to improve scientific and engineering computing, communications and semiconductor fabrication. CISE research programs contribute to improved computational techniques and machinery; but its largest activity, Advanced Scientific Computing, provides shared use, state-of-the-art computing and communications facilities, training, and ancillary research on software and networking for the benefit of the entire scientific and engineering research enterprise.

PLANS AND PRIORITIES

Five specific thrusts are proposed:

- Parallel Processing;
- Automation, Robotics and Intelligent Systems;
- Advanced Scientific Computing;
- Networking and Distributed Computing; and
- Ultra Large Scale Integrated Systems (ULSIS)

These thrusts are overlapping and are not meant to rule out other important areas of computer and information processing research. They are proposed as themes to identify the resources needed for accelerating progress in each area, to integrate science and engineering where needed, and to create tangible goals by which to measure NSF's effectiveness. Each of these areas is a high priority and would be supported at some level no matter what the

budget picture. Each area is currently supported to some degree, at levels ranging from a few individual projects to major interagency programs.

CISE will increase the research, instrumentation, and infrastructure support base in **parallel processing**; begin a significant instrumentation program to supply parallel machines to computer and information processing researchers; develop standards and industrial cooperative programs; and establish a center for parallel processing research.

In **automation, robotics, and intelligent systems**, CISE plans a enhancement of the base along with the establishment of several interdisciplinary research centers.

The **ULSIS** thrust will be directed at significantly expanding both fabrication facilities and research on the underlying technologies.

Other research activities in CISE in such areas as information impact, database and information systems, software engineering, computer graphics, programming languages and theory, and communications will be protected with a modest base growth.

The service components of CISE will be stabilized, with the five **advanced scientific computing** national centers becoming showplaces for conventional supercomputing. Planned growth includes a major instrumentation program under the computational science and engineering initiative; a supercomputing systems center; enhanced production support for special-purpose processors; and the addition of one new national center.

NSFNET will be substantially upgraded and the supporting **networking and distributed systems** research programs will be expanded.

These initiatives are the core of the new directorate, with first priority continuing NSF's role in maintaining the health of computer and information science and engineering research in the nation's universities. Emphasis on graduate training will continue within all programs. Research activities will dominate service activities, but we expect the technology output of research to enhance service while the users' experience will identify new research problems.

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6/30/86
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IEEE Software

JULY 1987

LISP ON A CRAY

GORDON BELL INTERVIEW

TOOLS

MAKING REUSE A REALITY

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VOLUME 4 NUMBER 4

Parallel, distributed processing lead NSF software research directions

The common theme of parallelism characterizes research across all the divisions of the Computer and Information Science and Engineering Directorate (CISE) at the National Science Foundation, said C. Gordon Bell, assistant director in charge of the directorate, in an interview with *IEEE Software*. Bell said he is acutely aware of the need for research in the software aspects of parallel processing.

Computer-science research programs under Bell have been criticized by some for ignoring software in favor of hardware and industrial programs. In this interview, Bell addresses the NSF's influence on software research and comments on research directions. The interview concentrates on parallel processing, an area critics said Bell deemphasized despite early indications he would stress it. The questions were posed in writing by Editor-in-Chief Ted Lewis, Contributing Editor Ware Myers, and Assistant Editor Galen Gruman.

Bell's directorate spent about $100 million on research in 1987 and hopes to spend $123 million in 1988, a 23-percent increase. Another $20 million is requested for administrative personnel and materials. (The NSF's funds went up about 20 percent in 1987 compared to 1986.) The NSF's research grants often set the tone for other, nondefense research, and the foundation's influence will be greater if Congress approves the 23-percent increase in NSF computing funds that President Reagan recently requested. The full 1988 budget request has survived the first of eight rounds in the congressional budgeting process, Bell said.

Bell's reputation was made at Digital Equipment Corp., where he was long-time vice president of engineering. He led the team that conceived the VAX architecture. More recently he was the chief technical officer at Encore Computer Corp.

Q: *What areas of software research do you think will be the most vital in the next decade? Why?*
A: Methods to design and build large programs and databases in a distributed environment are central. We have the opportunity and need for such programs through the availability of new powerful workstations, supercomputers, and mini-supercomputers. These are dramatically changing the way engineering and science is being carried out. We can now almost simulate most of the physical structures of interest to engineers and manufacturers ranging from manufacturing processes to molecular structures to VLSI chips.

Q: *What software research areas is NSF funding now?*
A: We fund what the [research] community considers to be important research, including object-oriented languages, databases, and human interfaces; semantics; formal methods of design and construction; connectionism; and data and knowledge bases, including concurrency. We aren't funding applications such as particular expert systems, unless they're potentially useful in another area of research being funded, such as VLSI design. Also, programming in the large is a concern — how do you write, evolve and share large programs?

Q: *Do you see major shifts in software research directions taking place?*
A: An article by Fred Brooks in the April 1987 issue of *Computer* presents various areas that are likely to contribute to improvement in software engineering. The gains look meager, so I don't expect dramatic shifts. I don't believe that software engineering is adequately taught in most places because the faculty haven't the experience nor do they appreciate the difficulties of management, training, and quality control in the process. Breakthroughs are hoped for and sought after.

I believe the big gains in software will come about by eliminating the old style of programming, by moving to a new paradigm, rather than magic tools or techniques to make the programming process better. Visicalc and Lotus 1-2-3 are good examples of a dramatic improvement in programming productivity. In essence, programming is eliminated and the work put in the hands of the users.

A similar opportunity exists for scientific and engineering computation in a program like MathCAD that, in essence, eliminates programming; it does not make programming in Fortran or C more productive or error-free.

These breakthroughs are unlikely to come from the software research community, because they aren't involved in real applications. Most likely they will come from people trained in another discipline who understand enough about software to be able to carry out the basic work that ultimately is turned over to the software engineers to maintain and evolve.

Q: *How are distributed computing and artificial intelligence faring as research areas?*
A: Both are of importance. AI is quite diffuse and should be segmented into its components. Many people argue that these areas are best pursued in terms of specific applications and objectives. A recent paper by [John] Hopcroft argued that robotics research is a major area for computer-science research. A research agenda, outlining the major problems and areas, would be useful for all of the computing community. Know anyone who would want to work on this?

Q: *What areas appear to be poised to next capture the imagination and fervor of researchers?*
A: Given the plethora of computers capable of generating vast arrays of numbers, research to use this performance to provide more insight is critical. In scientific computing we have an initiative in visualization — creative use of graphics — aimed at exploring these needs and opportunities. Also, accompanying the power is low-cost half-gigabyte CD PROMs and ROMs that should revolutionize the way we think about databases, books, handbooks, documentation, and computer-aided instruction as objects of computing research.

Some of the new machines are exciting and should be challenges in their own right because of the breakthroughs they provide. For example, the Connection Machine, which has 64K processing elements, carried out in about one hour all of the experiments in image processing that had been done in the last four decades.

Q: *The recent Software Engineering Conference featured a strong division of opinion on mechanized programming. Some said that developing a programming system to write programs (called "process programming" at the conference) can automate much of the mundane tasks, while others warned it will lead students astray and damage the creative*

SOFT NEWS

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Jobs: Unix must grow or die

Joe Schallan, Contributing Editor

"I believe very strongly that Unix has got to become a mainstream operating system by 1990 or it's going to start to die," Apple Computer founder Steve Jobs told an audience of more than 1500 Unix programmers, developers, and users at the Summer Usenix Conference in Phoenix, Ariz.,on June 10.

Jobs is now president and chairman of Next, Inc., which is developing a Unix-based workstation. He warned his listeners that, despite the size of its technical user community, Unix is not in the mainstream and although "some people believe we can go on sitting on the sidelines of what is considered to be the mainstream . . . the world is changing and that's not going to be possible.

"I'm actually on your side now, since our whole new company is based on Unix," Jobs said, and he outlined what he thinks needs to be done in the next few years.

The Apple II operating system has an installed base of more than three million, MS-DOS more than six million, Macintosh more than one million, and OS/2 has a potential base of at least one million, Jobs noted. Unix, he said, has less than 250,000 systems installed.

Jobs said Unix developers should consider the players in the market before deciding how to make Unix a mainstream operating system. Neither IBM, Digital Equipment Corp., Apple, nor Microsoft are served by a successful Unix, he said.

Speaking of IBM, Jobs noted that, "when you're selling MIPS and gigabytes for as much as they are, it's not in your interest to have a lot of software out there that can run on machines from a lot of companies that are willing to sell MIPS and gigabytes at a lot less." DEC must protect a large investment in its proprietary operating systems. Apple, with "the best user interface out there," is not "particularly interested in seeing a community of 1600 very bright people trying to copy that on top of Unix, especially if there are going to be multitasking units all over." Microsoft has received large royalties from MS-DOS and looks forward to large OS/2 royalties. Microsoft's Xenix implementation of Unix is more of a "rearguard than a frontal attack," Jobs maintained.

The players on the other side—AT&T, Sun, Apollo, and universities—have less power in the marketplace, he said.

Comparing the two lists "should make most Unix enthusiasts a little nervous. . . . There's a whole lot of money and a whole lot of energy riding on the side of not having Unix be successful."

But Unix can be successful, Jobs said, citing its advantages:

- It supports multitasking, virtual memory, and networking.
- Its development environment is "much more mature than many of its competitors."
- It is somewhat vendor-independent.
- It is probable that more programmers have been trained to use it than any other operating system.

However, the "bad news" about Unix, he said, are its shortcomings:

- There is more than one version, which "seems to cause everybody quite a bit of confusion."
- It is incomplete, lacking especially graphics and windowing.
- Its user interface "is impossible for mere mortals to use."
- It offers few end-user applications compared to PC operating systems.
- AT&T's $50-per-unit royalty makes Unix too expensive for low-end systems.

To solve these problems, Jobs said, the Unix architecture will have to evolve to include graphics and windowing and an applications toolkit.

Jobs said he believes the graphics will be Postscript-based. "Just as Postscript has become the standard in the printing industry, with IBM and DEC and Wang

Continued on p. 106

Unix	OS/2	Macintosh
Applications	Applications	Applications
Applications toolkit	Microsoft Windows 2.0 (with applications toolkit)	Applications toolkit
Postscript graphics and windowing		Quickdraw graphics and windowing
Unix OS	OS/2	Macintosh OS
TCP/IP networking	LAN manager	Appletalk

In this view of the Unix, OS/2, and Macintosh operating system environments, unimplemented levels are shaded. In his Usenix speech, Steve Jobs cited three points Unix enthusiasts should remember — that all the items in the Macintosh column are available today, that several billion dollars have been committed to unshading the OS/2 column, and that in the Unix column "we have two boxes to go."

Correction

The report " 'Star Wars' Research Feeling Boycott?" (Soft News, March, pp. 94-95) said the Union of Concerned Scientists has about 100,000 member scientists and engineers. The actual number is about 20,000, a spokesman said. The group has about 80,000 financial supporters and nonscientist affiliates.

part of programming. What do you think?
A: Mechanized programming is recreated and renamed every few years. In the beginning, it meant a compiler. The last time it was called automatic programming. A few years ago it was program generators and the programmer's workbench. The better it gets, the more programming you do!

It isn't unreasonable to believe that approaching software engineering from a purely mechanistic viewpoint can help, especially in managing the details of building large programs. Anything that helps and makes people more productive will be useful and will be assimilated. Arguments against change based on creativity are the same ones that were used to inhibit the use of high-level languages for building systems only a decade ago.

Q: *What are good approaches to technology transfer?*
A: Anything that works and gets the revolutions to take place. What I believe doesn't work is having random congressmen decide that a certain machine should be built in their states and forcing an agency to buy a system when no real user would.

Q: *Could you give us an example?*
A: DoE [Energy Dept.] and DARPA [Defense Dept.'s Advanced Research Projects Agency] are two examples. [Bell declined to name the congressmen involved. —Ed.] The NSF has been able to operate under the peer-review system without such interference.

Q: *Before we discuss parallel processing, is there anything of software research — in general and from NSF's perspective — that we've missed?*
A: You've covered just about everything except the opportunities and needs we have based on the mainline evolution of mini-supercomputers and supercomputers. Traditional software research has not played an important part in this, but it's time, it's not too late, to get involved.

[A. Nico] Habermann believes research in designing and documenting reusable software is one of the most fruitful areas of research to pursue vis à vis productivity and competitiveness — and I agree with him. Software is virtually the only engineering endeavor where one starts over each time a new artifact is to be built. I'm convinced that science and engineering computing itself is a good venue for doing first-class computing research.

Q: *What is NSF's role in software research in parallel processing?*
A: We — together with our program advisory committees — have described the need for basic work in parallel processing to exploit both the research challenge and the plethora of parallel-processing machines that are available and emerging. We believe NSF's role is to sponsor a wide range of software research about these machines.

This research includes basic computational models more suited to parallelism, new algorithms, standardized primitives (a small number) for addition to the standard programming languages, new languages based on parallel-computation primitives rather than extensions to sequential languages, and new applications that exploit parallelism.

Three approaches to parallelism are clearly here now: First, vector processing has become primitive in supercomputers and mini-supercomputers. In becoming so, it has created a revolution in scientific applications. Unfortunately, computer science and engineering departments are not part of the revolution in scientific computation that is occurring as a result of the availability of vectors. New texts and curricula are needed.

Second, message-passing models of computation can be used now on workstation clusters, on the various multicomputers such as the Hypercube and VAX clusters, and on the shared-memory multiprocessors (from supercomputers to multiple microprocessors). The Unix pipes mechanism may be acceptable as a programming model, but it has to be an awful lot faster for use in problems where medium-grain parallelism occurs. A remote procedure-call mechanism may be required for control.

Third, microtasking of a single process using shared-memory multiprocessors must also be used independently. On shared-memory multiprocessors, both mechanisms would be provided and used in forms appropriate to the algorithms and applications. Of course, other forms of parallelism will be used because it is relatively easy to build large, useful SIMD [single-instruction, multiple-data] machines.

Furthermore, it looks as if the programming will be quite straightforward because of the single thread of control. For example, a Connection Machine was just introduced with a 256M-byte memory, a 10G-byte disk operating at 40M bytes per second, direct-connected bitmapped memory for display, and the capability of calculating at 10 to 20 GFLOPS — or 10 times the speed of today's largest supercomputer.

Alan Karp of IBM Research has offered a prize of $100 for a real scientific application if someone gets a speedup of 200 by 1995 using MIMD [multiple-instruction, multiple-data]. Measurement is key to achieving such a goal of parallelism. Unfortunately, the target is reached incrementally and not all at once.

To show you my own commitment to parallel processing, I would personally like to offer for the next 10 years, two $1000 annual awards for the best, operational scientific or engineering program with the most speedup (measured against a similar program run sequentially on one processor of the same system), not including vectorization on a vector processor.

The program must have a factor of two more speedup than a previous winning program. Operational is defined as a program used to produce a useful scientific or engineering result. The program should run at near the peak speed of any computer available (including various supercomputers), and be a cost-effective solution — no "toy" examples. One prize is for a program run on a general purpose computer system over $10 million, and the other is for any system. The rules should also comply with Karp's. In fact, let me invite *IEEE Software* to flesh out the rules and run such a contest. [We've taken Bell up on his offer. The details are in the accompanying box. —Ed.]

Q: *What performance do you expect from parallelism in the next decade?*
A: Our goal is obtaining a factor of 100 in the performance of computing, not counting vectors, within the decade and a factor of 10 within five years. I think 10 will be easy because it is inherently there in most applications right now. The hardware will clearly be there if the software can support it or the users can use it.

Many researchers think this goal is aiming too low. They think it should be a factor of 1 million within 15 years. However, I am skeptical that anything more than our goal will be

IEEE Software launches annual Gordon Bell Award

Editor-in-Chief Ted Lewis has announced the First Annual Gordon Bell Award for the most improved speedup for parallel-processing applications. The two $1000 awards will be presented to the person or team that demonstrates the greatest speedup on a multiple-instruction, multiple-data parallel processor.

One award will be for most speedup on a general-purpose (multiapplication) MIMD processor, the other for most speedup on a special-purpose MIMD processor. Speedup can be accomplished by hardware or software improvements, or by a combination of the two.

To qualify for the 1987 awards, candidates must submit documentation of their results by Dec. 1. The winners will be announced in the March 1988 issue. This year's judges are Alan Karp of IBM's Palo Alto Scientific Center, Jack Dongarra of Argonne National Laboratory, and Ken Kennedy of Rice University.

For a complete set of rules, definitions, and submission guidelines, write to the Gordon Bell Award, *IEEE Software*, 10662 Los Vaqueros Cir., Los Alamitos, CA 90720.

too difficult in this time period. Still, a factor of 1 million may be possible through the SIMD approach.

The reasoning behind the NSF goals is that we have parallel machines now and on the near horizon that can actually achieve these levels of performance. Virtually all new computer systems support parallelism in some form (such as vector processing or clusters of computers). However, this quiet revolution demands a major update of computer science, from textbooks and curriculum to applications research.

Q: *Critics complain that hardware and industrial research (high-speed communications, VLSI, industrial robotics, and parallel-processing machines) is dominating NSF parallel-processing spending. They say that the focus should be on the software to use the hardware. How do you answer their concerns?*
A: I generally agree with them, and that's why we are not, in future plans, emphasizing the design of new, parallel computers. Our new efforts will be mainly on two areas: first, using the hardware we have for research and, second, adding educational opportunities, including training students, especially undergraduates, in programming such machines.

Last year I took a survey at the biennial Snowbird Conference of computer-science and computer-engineering chairmen, and found that only 15 percent of the departments had environments for teaching parallel processing. To begin with, all departments should have such machines. I don't understand how people can do meaningful research without machines to test their theories or decent teaching without hands-on instruction.

Q: *How much money is being spent on research on parallel-processing software?*
A: In fiscal year 1986, about 25 percent of the 241 projects and 30 percent of the $16.6 million of support from the Computer and Computation Research Division were devoted to parallel-processing research. At most, 12 of the projects had a hardware flavor. The CISE Institutional Infrastructure program (which used to be called CER [Coordinated Experimental Research]) funds 23 universities, seven of which are working primarily on parallel processing and nine of which have a secondary focus on parallel and distributed processing.

Q: *How does this compare with hardware?*
A: Only a small fraction of the funding is for new hardware research, including research into new architectures. None of our research borders on industrial or product research. It's quite basic.

However, NSF has a primary goal of improving US industrial competitiveness. This means training, experimental research with larger projects (as indicated in the president's recent statement initiating science and technology centers), and emphasizing areas like automated manufacturing.

The NSF Engineering Directorate also funds a significant amount of research in computing, especially the application of computers for robotics, control, engineering design, and neural computing. Its effort is more hardware-oriented than CISE's.

Q: *To take full advantage of these new classes of parallel machines, what modifications of algorithms, languages, compilers, and programming environments may be needed?*
A: The manufacturers provide primitives of all types to handle synchronization and communication. Most provide a Unix development environment for parallel processing. It would be great to get these primitives standardized across languages and machines so that texts could be written and undergraduate training could take off. Ada, for example, has the primitives for multitasking. The research community probably needs experience with what exists now before it starts to design a new language and environment.

Q: *What applications do you see parallel processing being used for?*
A: Scientific and engineering computation of all types can use all the processing power that can be developed for the foreseeable future. Many physical problems grow quadratically or cubically, and hence a factor of 1000 in processing is required to get an order-of-magnitude improvement in problem-solving.

In addition, many applications are inherently parallelizable, including transaction processing, message switching, commercial processing, human-interface management (like voice and video), database management, and robotics. High reliability depends on parallel processing.

Q: *What do you think of claims from Unix creator Ken Thompson that parallel processing is impossible for people to create well, much less debug? ["Parallel Processing's Future Dim, Unix's Bright," Soft News, May, pp. 92-93.]*
A: I believe the results obtained on the multiprocessors and multicomputers belie this. People have to be trained to use the machines — it isn't that hard. Furthermore, training of this kind may encourage better decomposition for sequential programs. The greatest stumbling block in the way of learning parallel programming is the training people already have in thinking sequentially.

Q: *How can parallel processing be harnessed for AI purposes?*
A: It's unclear how much traditional AI applications are speeded up with parallelism. These may not be significantly different from conventional processing, so I expect a wide variation in the degree of useful parallelism. Some researchers believe that inherently parallel paradigms such as connectionism and neural modes of computing are necessary for revolutionary advances in most AI areas.

Preparing for Changing Scientific Computing Environments

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30 September 1986

Introduction

Recently, a hierarchy of scientific computers in three price ranges and computing styles have evolved with relatively the same performance/price and computational ability. The hierarchy includes: the supercomputer and large mainframe used as a regional or central computer costing between $10M-20M; the mini-supercomputer used alternatively as a central, departmental, or group computer costing around $500K; and a workstation/workstation cluster, used as a shared, departmental resource, as a single user system, and access to other machines in the hierarchy costing around $50K.

The comparable computational power of these new scientific computers raises various policy issues for NSF including the management of its Advanced Scientific Computing Program, the role of the five National Centers, and the way computation is supplied to the research community. Ideally, a user will utilize all forms of computation based on economics, networking, power, response time, and interaction (especially graphics) needs. This paper explores these parameters and outlines the policy implications required to provide the most productive environment for the research community.

The data for this analysis are key performance characteristics of a variety of scientific computers:

- number of processors, **#P.c**
- primary memory size in 64-bit Megawords, **M.p**, with virtual memory (shown as **.v**)
- secondary memory size in Megabytes, **M.s**
- speed measured in millions of floating point operations per second using Dongarra's Linpack benchmark for a 100x100 and 300x300 matrices, **Mflp**
- the price of the machine in millions of dollars, **$.M**
- the cost-effectiveness, i.e. performance per unit price for two sized matrices, **flp./$**
- introduction date, **Intr**
- stretch time versus Cray XMP single processor for a single job ()

Table of Computer Characteristics

System	#P.c	M.p	M.s	Mflp	$.M	flp./$	Intr	(Stretch) comments
Supercomputers								
Cray 416	4	16	9.6	108.-480	17	6.4-28.2	86	(1) 27/Pc, 8.5ns clock
Cray 48	4	8	9.6	108.-480	15	7.2-32	84	
ETA 10 (Est.)	8	288.v	9.6	1040.-2K	19.7	52.8-107	6/87	(0.2) 10.5ns, 7ns '88 = x1.5
Cray 2	4	256	9.6	60.-372	18.6	3.2-20	86	
Mainframe								
IBM 3090/400	4	16.v	60	48.-108	9.8	4.9-11	9/86	(2.25) sans software
Mini-supercomputers								
Alliant F8	8	1.v	.4	7.6-14	.75	10.1-18.7	6/86	(3.6) with directives
Convex C1	1	1.v	.4	2.9-14	.4	7.3-35	1/85	(9.3)
SCS-40	1	2	.7	7.3-26	.65	11.2-40	7/86	(3.7) XMP compatible
Workstations								
Sun 3-200	1	1.v	-	.47	.04	12.0	9/86	(57)
Sun 3-200	1	1.v	.28	.47	.06	8.2		(57)
Sun 3-200	1	2.v	2	.47	.12	3.9	9/86	(57)
+3 diskless	4	8.v	2	1.9	.25	7.5		cluster of 4
Sun 87/B Joy	1	2.v	-	1.5	.02	75	87	(18)
Sun 88/B Joy	1	4.v	-	4.0	.03	132	88	(6.75)
Sun 89/B Joy	1	8.v	-	10.0	.04	250	89	(2.7)
Historical References								
Cray 1/S	1	1		12.-66	6	2.-11	75	(2.3)
VAX-11/780	1	.5v	.1	.15	.3	2.	4/78	(180)

Notes:

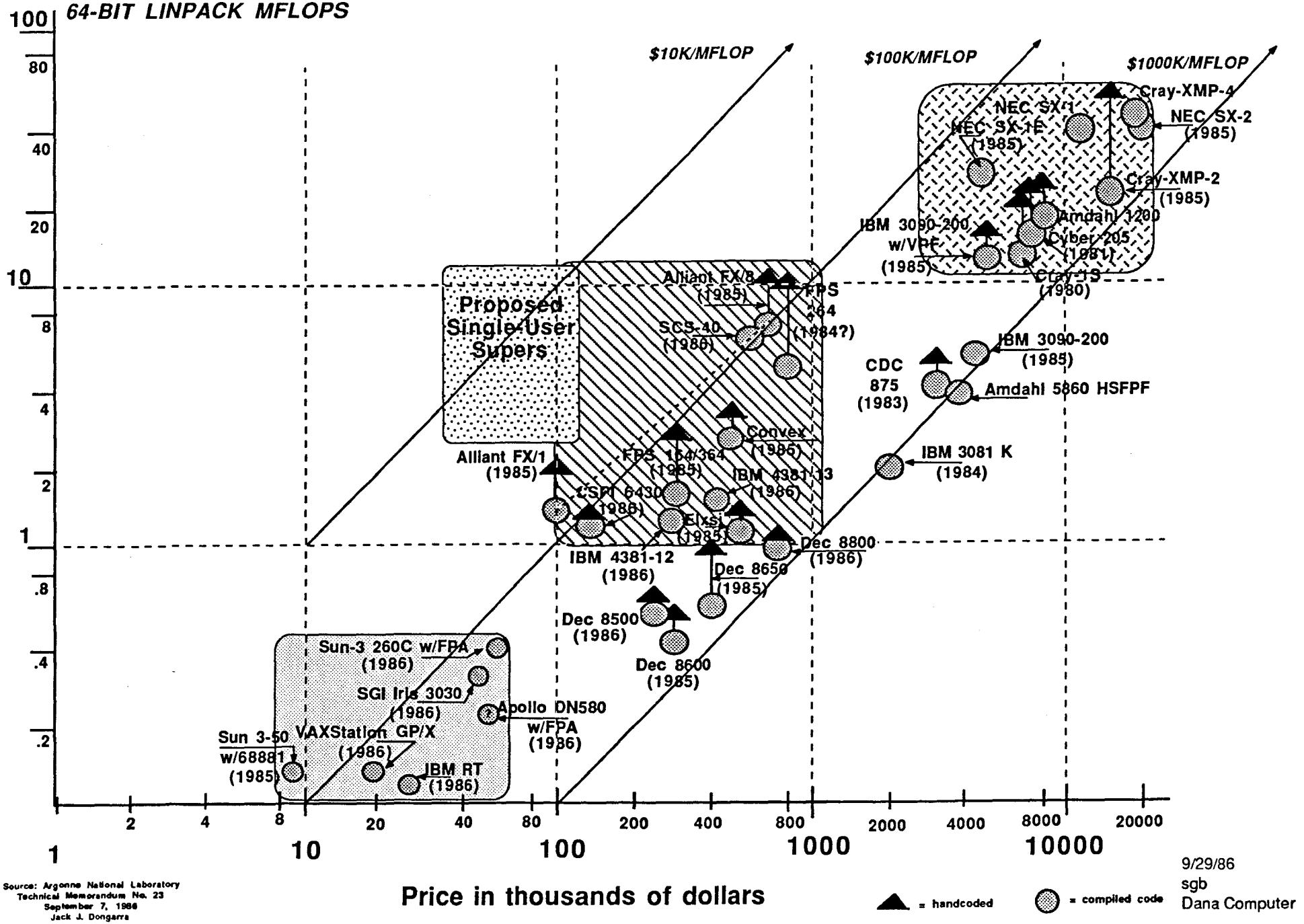
For the Crays and ETA-10, the performance is for 4 and 8 independent job streams. Linpack appears to be a good benchmark in that it correlates well with other scientific and engineering benchmarks, and with the average delivered power. As work is "tuned" for vector processing, the 300x300 matrix is a realistic target for typical applications.

A variety of different secondary memory configurations are given, including none for the 3090 and several Suns.

The fastest uniprocessor is the NEC SX-2 at 43-347 Mflops.

Super-minicomputers, and high-performance PC's are not included because they provide relatively poorer performance, and performance/price. For example, the PC AT/370 is a factor of 818 slower than a Cray and the cost to perform floating point operations is roughly double.

Comparative Linpack Performance



Source: Argonne National Laboratory
Technical Memorandum No. 23
September 7, 1986
Jack J. Dongarra

9/29/86
sgb
Dana Computer

Background

The current surge of interest in supercomputers becomes clear when we look at the evolution from the late 70's when the Cray 1 and VAX 780 were the standards for computation. The 780 entered the scientific and engineering community because it provided relatively the same price performance as a Cray 1, even though the performance differed by a factor of 80 (using Linpack as an indicator). A more reasonable estimate for the difference is more like a factor of 20-40. Those who bought VAXen observed that since the average user only got 1-2 hours of Cray time each week, (50-100 hours per year) they could get the same amount of computing done by letting a VAX grind 20-160 hours per week.

Over time, the Cray evolved; the XMP was speeded up by over a factor of two and built as a multiprocessor, which roughly trebled the performance/price. When the scientific community started utilizing Crays with improved compilers, they began to develop more effective algorithms for vectors that increased the effective power of the machines. The delay in getting a more cost-effective VAX (the 8600 was two years late), and the relatively high price of VAXen exacerbated the difference between the supercomputer, and the super-minicomputer (in essence a lower priced mainframe). The popularity of VAXen for more general computing also allowed the price to remain high, by giving it a market outside the research community. DEC, like IBM when it introduced a complete range of compatible computers, may have become less interested in and attentive to the research community. The Cray/VAX gap may have been a major motivation in the formation of the NSF Advanced Scientifc Computing Program.

In the early 80's Alliant, Convex, and Scientific Computer Systems formed to exploit the performance/price gap between the Cray XMP and VAX by utilizing vector data-types pioneered in the Cray 1. Thus, a new class of mini-supercomputers was formed, all of which have better performance/price than the Cray (almost a factor of 2 in the case of the new SCS-40).

By 1985, ten years after the Cray 1, IBM and Japanese manufacturers building IBM-compatible mainframes had added vectors and multi-processors to their machines.

Observations About the Computers From the Table

Three characteristics are important: the processing power in Megaflops; the cost-effectiveness in flops/$, and the stretch time versus a Cray. There are exceptional computers, when comparing the cost-effectiveness in each class: the (projected) ETA-10 (to be better by a factor of 8!), and the SCS-40 (better by almost a factor of 2). The SCS-40's virtue and principle flaw is Cray compatibility. Other mini-supers have virtual memory. A cluster of SUN workstations could provide up to a factor of 2 better performance/price, depending on the amount of secondary memory. The factor of 5 difference in the speed of the ETA-10 versus a Cray XMP should open up new problem solution domains. The ETA-10 uses large CMOS gate arrays on large, multilayer

printed circuit boards. This kind of fabrication provides a potential breakthrough in cost that is counter to the use of ECL to build supercomputers, large mainframes, and superminicomputers by Cray, DEC, IBM and the Japanese.Both the Cray 2 and ETA-10 have large memories that should open up new problem domains. All of the machines, except the Crays, have virtual memory. Because of the lack of paging, it may be difficult for multiple users with very large problems to effectively utilize the Cray 2. The use of large physical and virtual memories needs to be explored and understood.

While the table shows times for a floating-point intense program, Linpack, it is unclear how the machines perform under comparable workloads or whether they will actually be used in the same fashion. For example, a slower machine is likely to be used more interactively and results of the computation viewed constantly to avoid unnecessary work. Users of large batch machines may have to request more work and output because turn-around is longer. Scalar benchmarks aren't given, and most machines are used a significant amount of time either interactively or in scalar mode, both of which lower the performance and favor the 3090 (which outperforms the Crays in scalar mode), mini-supers, and workstations.

NEC's SX-2, not included in the Table, executes Linpack at about twice the performance of a single processor Cray XMP. The performance/price is unclear.

Many computers exhibit performance/price comparable to today's supercomputers. The Advanced Scientific Computing Program must understand the relative power and work capacity of all forms of computation and begin to develop ways to supply resources appropriate to user need and cost-effectiveness considerations.

Can Users Tolerate the Time Stretch/ Lower Cost Trade-off?

Can a user of a smaller computer, stand the lengthened turn-around time that comes with using a slower computer and stretching the computation time by factors of 4 to 10? At present, only one or two users within our user community are receiving an hour of computer time per day. The mini-supercomputers, supplying the eqivalent of one hour of Cray time in 4-10 hours are competitive because the average turn-around for a one-hour job on a Cray can easily be this long. The typical turn-around for a 15 minute job is 2 hours (or factor of 8 stretch). The Sun Workstation might be used for longer computation provided the user "guides" the computation. The Sun's stretch factor is comparable to that experienced between the Cray and 780 during the late 70's. Alternatively, advances in partitioning programs for parallel processing make the cluster have the best performance/price if a job can be parallelized using a message-passing model of computation.

Based on the performance, and time allocations inherent in supercomputer use, a complete

hierarchy of computers will exist and is justified. Given that an individual user or project is likely to simultaneously access all levels of the hierarchy, a compatible (and most likely standardized) basic environment that can support user communities, who in turn have common applications environments, is essential.

Multiprocessors, Array processors and Multicomputers (e.g. Hypercubes) for Parallel Processing

A number of alternatives exist that may offer significant improvements in performance or performance/price. For example, a 64 computer NCUBE has been used to solve a problem that took twice as long on a single processor XMP. The improvement yielded almost an order of magnitude in cost. Given the decomposition for parallel procesing on the NCUBE, an XMP might be used to gain a 4 times speed-up; in fact, the XMP operating in this mode has computed Linpack at a rate of 713 Mflops which is 26 times the single processor rate. Likewise, array processors such as the FPS X64 have been lashed to minis and mainframes, yielding significant improvements in performance/price. None of these alternatives are explored.

Standardized parallel processing primitives in all programming languages based on a multi-process, message passing model of computation is needed for all structures. Programs used in this fashion will operate compatibly and identically across workstation clusters, multicomputers such as the hypercube, and shared-memory multiprocessors (e.g. Cray and ETA). Given the relatively constant performance/price and similar turn-around times for all of the computing alternatives, parallel processing becomes essential.

The Role of the Super Computer Centers

Historically, centers have existed for a variety of reasons including cost sharing, technology, performance, networking, user needs, local politics, government funding, etc. Clearly when hot ideas emerge and projects need ten to several hundred hours of supercomputer time that can't be supplied locally the centers are essential. The definition of the kinds of work that the centers will support is critical, given that computation can be done very effectively by local university centers, departments, projects, and individuals at workstations.

Our centers are critical to scientific and engineering computing for the research community. Today the centers train users about the parallelism inherent with vector data-types. They have the programs and staff to train the trainers and users rapidly, and to support large programs and datasets inherent in supercomputer use. Centers may be the best place to support certain large programs and databases for a given intellectual community; NCAR is an excellent example as it provides millions of lines of common programs and 17 terabits of common data for its community of atmospheric scientists to environmental engineers. Centers may also support common programs for communities of distributed users at mini-supers, super-minis, and workstations in order to

supply service when the distributed research requires significant computing power.

Large amounts of power (on the order of 1 hour per day) would be supplied to large projects that do not have machines, and to a community of student and casual users who access common programs and data. If the "average" project uses 1 hour per day or 350 hours per year, then a Cray XMP would support 24x4, or about 100 projects! Projects of this size would be, in effect, subsidized at about $100,000 with steady-state costs. It can, alternatively, service 640 users who use at most an hour a week, or 50 hours per year, providing them about a $15,000 subsidy. Finally, several thousand student and casual users who would use no more than 10 hours per year (a year on a PC/370) could be supported at negligible cost. Policy statements are needed which characterize useage across geography, user size, and discipline.

The centers have a lead role in supporting state-of-the-art computers of all types including supercomputers, mini-supercomputers, and larger scale experimental machines. The centers should be the beta test sites of all new systems, especially those which can not be easily purchased or supported by local researchers or departments. The centers must take the lead role in understanding benchmarks, workloads, and cost-effectiveness of all forms of computation.

Standards. The three alternative forms of computation that form the main line of computing all provide roughly the same computational service at comparable costs (not including the cost to the user). We must establish standards that make it equally easy for users to work at any of the places in a compatible fashion. In many cases, a user will use the super or mini-super or existing super-mini for calculations and the workstation to view results. Thus code will be run in a highly distributed fashion across different machines including new, and evolving UNIX-compatible PC's. Similarly, we should work toward establishing and supporting common programs and data across engineering and scientific disciplines so they may compute at any level of the hierarchy.

Conclusions

Computers now exist which allow various styles of computing ranging from regional supercomputers to personal workstations. All of the computers in the hierarchy will continue to exist and flourish because, with the exception of the ETA 10 to be delivered next year, all offer relatively the same cost and effectiveness.

Having the wide range of styles and locations demands attention to:

- •training, education and program support;
- •networks for intercommunication of programs, data, and terminal access;
- •benchmarks, workloads, accounting, and pricing i.e. understanding cost and effectivenss;
- •allocation of time across user communities by size, discipline, and geography;
- •standardized programming environments and graphics enabling effective use;
- •supporting specialized community programs (e.g. NASTRAN) and databases (e.g.NCAR);
- •specialized and alternative computers; and
- •standards, understanding and training for compatible, message-passing parallel processing.

With the center program entering phase II, attention and resources will have to be focused on these demands.

MEMORANDUM

SUBJECT: Advanced Scientific Computing Strategic Opportunities
TO: FILE
FROM: Assistant Director/CISE
DATE: August 31, 1987

I'd like to raise several strategic issues for our support of advanced computing for research which go beyond the budgeting for the NSF Supercomputer Centers. This concern is based on:

o lack of support for distributed minisupercomputer facilities which complement, but do not replace the DASC supercomputer centers

o difficulties and long lead times in the creation and support of a completely compatible distributed computing environment across a range of machines horizontally (supers) and vertically (supers, mainframes, super-minis, mini-supers, and workstations)

o inability to support new, faster and/or more cost-effective computers on an opportunistic basis, (because the centers consume such a large fraction of our resources)

o the inefficiency of central facility versus research discipline-based management

o inability to support a CSE or a "Grand Challenges" program via the research directorates (which is necessary for a true revolution in scientific computing)

o lack of understanding and inability to fund benchmarks dealing with performance and performance/cost issues associated with alternative forms of computing

Background

Last fall, I wrote a memo which was circulated widely within the community (Preparing for Changing Scientific Computing Environment, 30 September 1986). The reactions were bi-modal: "don't rock the boat because at least we have supercomputer time" and "you're right, we need a range of compatible computers for a complete environment, furthermore we need support for

smaller machines". I am now convinced the hypothesis of the Cray XMP/VAX-780 gap was correct, and the genesis of the supercomputer program. However, if the program hadn't been started, then today, more researchers would be using mini-supers and super-minicomputers such as Alliant, Convex, DEC, Elexsi, IBM, etc., which would serve many researchers better than the centers are able to. For those researchers who do not need the maximum capability offered by supercomputers, mini supercomputers distributed into the researchers' own environment and connected via networks to the supercomputer centers would offer significantly more and higher quality computing resources to those researchers. Note that capacity refers to throughput and capability refers to turnaround. Independently, Stuart Rice made similar points in a recent speech:

> "I have in mind a networked system . . . graphics workstations and local supporting intermediate computer and ultimately connects to a supercomputer, with provisions of special devices . . .
>
> 1. Distribution of computer resources distorted by the use of "funny money" . . . cash and credit . . . Workstations come from grants, supers are "free" . . . intermediate machines are indispensible and current funding patterns have to change if . . .
> 2. Dramatic advances in hardware haven't been matched by advances in algorithms and operating systems. . . . parallelism is "chicken and egg"
> 3. The scientific community has become rather inflexible with respect to use of operating systems. . . . don't use particular machine features . . .
> 4. . . . the scientific community has not been as imaginative as it might in thinking about the uses of computation in research."

A Vertically and Horizontally Compatible Computing Environment

Rice's scenario is based on complete horizontal (all the supercomputers) and vertical (supers, mini-supers, and workstation) compatibility. We now have six incompatible centers (including NCAR). Since UNIX is truly becoming an important standard under the forthcoming Federal Information Processing Standard, FIPS P1009, Posix, I believe this situation must change. Unfortunately, NSF at SDSC is supporting the development of "Unix-like" calls for CTSS, thereby creating a continuing support commitment for a proprietary operating system. The ASC Program has been slowly addressing this problem. Until UNIX is in place the existing situation limits the use of the centers' supercomputers for entire communities such as VLSI designers and creating more work for their users who now operate with the standard (workstations and minis).

Mini-supers Are Required to Operate **With** The Supercomputer Centers In Order To Provide The Best Computing Environment

Support for supercomputer centers was provided without providing support for intermediate equipment, thereby depriving users from doing a substantial amount of their computing on a local basis. NSF Program Managers have not funded mini-supers in the same manner as they did minis and superminis because of the availability of "free" supercomputer time and higher cost of mini-supers.

We need all forms of computing: workstations for productive development and visualization; local super-minis, and mini-supers for the shorter calculations or where programs can be run longer to get the same results; and supercoomputers for the exceptional scientific opportunities and "grand challenges" that networked powerful central systems with common programs, data and support provide. To have such an environment requires two components: compatibility and the ability to fund the distributed, small machines.

While I support having the existing centers at the largest, peak power for users whose problems require the maximum computational capabilities, I don't believe they are an "acceptable" way to supply scientific and engineering computation capacity to the larger community. In particular, some of the existing supercomputers in the centers are a poor way to supply computation to certain parts of the engineering community, because most of their small memories, lack of virtual memory, lack of UNIX compatibility (most workstations run UNIX), and network-limited graphics. However, the IBM 3090/600 has both a large physical and virtual memory. Similarly the ETA 10 has large physical and virtual memories and will have a UNIX capability.

Comparing a Supercomputer Centers Approach With Distributed Minisupers

Enclosed is a table which compares the centers approach with distributed mini-supercomputers which are operated directly by the research community. While the table compares the minisuper with the super, it isn't the intent to eliminate the center. Distributed machines would be managed on a group, department, or university-wide basis in precisely the same fashion as the several thousand minicomputers and super-minicomputers are today. The table compared a single Cray XMP (sans networking) center with a collection of mini-supers costing roughly $600K (plus interest, but without discount), assuming that most of the operational costs for the mini-super are borne by the user communities institution. In essence, distributing the mini supercomputer transfers the costs of the large central staff, facilities, materials and supplies, travel, networking, etc. from direct NSF funding to the organization using the distributed center. By distributing,

usually one full-time person and a plethora of students maintain a mini and it is expected that this would continue with the mini super environment. Furthermore, many students are now deprived of the operating experience and training of a supercomputer environment.

The cost to NSF that I've used to operate a Center is $11M, and doesn't include the roughly $1M required for network access (about $1K per user), nor the upgrade. The NSF budget amount request for the centers in FY '88 averaged $9M. The average cooperative agreement request is $9.7M. The amount needed is somewhat more--$10.7M. If you include the network which is needed for an overall integrated environment, it gets to roughly $12M per center. They still must be able to continue at the level of $2M-$4M of outside support. In contrast to supercomputers which are increasing in price, superminis are getting cheaper with the large number of new suppliers and approaches, but mini supers have remained in the $0.5M to $1.5M price range, probably because of the artificially limited market for these devices.

These cases are provided to compare the distributed and the centralized approach. Each assumes that a user base of 1200 is to be supported which is similar to that of a NSF supercomputer center. Also, it is assumed that a minisuper provided 1/24th the capacity of an XMP/48, or each mini would be equal to 1/6th of processor (1/4-1/3) is probably more realisitic. Note both cases favor the distributed approach:

1. 24 superminis, with 50 users each could supply the capacity but not the ultimate capability of the XMP. The NSF cost for 5 years for the computers would be only $6M versus $11M. To provide operational assistance to such a large community (50 users) would probably cost NSF an additional 100K , or raise the NSF cost by another $2.4M. This system provided equivalent capacity of a single center. Certainly, one would not operate 24 superminis in a centers environment!

2. To serve 1200 users, with only 25 users per machine would cost roughly the budgeted FY '88 NSF cost per center. However, each user would have at least twice as much computing capacity, and have no networking limits.

The main environments where supercomputers make sense are the large, centralized, National laboratories which can afford large support staffs, and which need large amounts of computing resources including many shared programs and databases. Also, they require minimal networking.

New Machines In Various Price Ranges

A number of new machines that will provide opportunities for service as super and mini supercomputers are described below.

Thinking Machines has introduced a much faster version of the Connection Machine at a price of about $5M which will be useful for a reasonably large class of problems.

ETA has announced their "Piper" running at 205 speed which is a room cooled computer running Unix.

A large number of conventional and parallel processing computers (multicomputers) exist and are being introduced, all of which offer significant (factors of 2-10) performance and/or performance/price improvements for scientific computing. For example, a new company, Multiflow, based on work NSF funded at Yale on parallel procesisng just introduced a new $400K machine which conputes at 1/4-1/2 a Cray XMP for Linpack, and higher on the average because it automatically parallelizes over 7 operations per instruction.

Several RISC processors, includingMIPS, have introduced computers which have scalar integer performance, characteristic of work done by compilers and operating systems, equal to the Cray XMP.

We can support none of these directly via CISE without trading off some important component of our current activities. The program offers refer computer requests to ASC and have not decided to support mini supers in the same manner that they have supported minicomputers in the past.

Center-based Management versus Research-based Management

There is essentially no management of the program based on research needs. The computational science and engineering initiatives we are able to fund are anemic and completely out of balance with the very large centers budget! A real program would be the basis of Wilson's "Grand Challenges", and until each of the disciplines is given the dream and responsibility, they will not deal with the opportunity.

Also, given that essentially all of ASC funding is going into centers we have no funding to understand scientific computing (e.g. benchmarks), to improve productivity through visualization, or new algorithms or new approaches to computation based on parallelism. This lack of understanding will be the first limit of using the next round of supercomputers which are predicated

on a number of processors.

Bottom Line

Many opportunities exist: The incompatible computing environment at the centers, lack of graphics, novel research results that cold only be accomplished with larger resources, performance levels, new user training and population, growth by engineering users, vendor support *outside of IBM's total commitment,* and industrial involvement I am disappointed with the imbalance in the existing program given we are spending so much and cannot address the entire spectrum of requirements. Above all, we have not provided an important style of user-managed distributed computing for our users, including new machines which could provide much more capacity, capability, and training.

Recommendations

Given the political environment surrounding large centers, I don't believe NSF could withdraw support to any of the centers in order to fund a more balanced computing environment, even though this is what I recommend given that NSF in effect operates a zero sum game. For balance, the funding should be increased to support them at their peak power, along the lines I argued in an earlier memo. At the same time, we need a much stronger CSE Program which is distributed among the research directorates and divisions, along with the computer time. Finally research directorates should encourage users to buy their own smaller, more cost-effective, and in the case of memory, more powerful computers. None of this is happening.

I believe we need both ideas and help in order to have a better balanced program.

GB6

Subject: Alternatives to fund the centers up to their desires and abilities?

To: Director

From: Assistant Director, CISE

Date: 21 August 1987

Based on what I heard at a recent meeting reviewing the centers plans, it is clear that the ASC centers have the ability to absorb an arbitrary amount of funding for the following arguably reasonable things:

- incremental equipment for better balance (e.g. memory, disks, lines)
- upgrades to prevent center obsolescence increased capacity to meet industrial needs and opportunities “batch” and remote visualization equipment for movies
- and lesser priority items including:
- courses
- grand challenges in computational science new technologies and new techniques in parallelism scientists to help in parallelization and visualization interactive visualization at the user level

We cannot possibly meet the requests. The disturbing fact is that NSF is the sole source of support at nearly all of the centers except Illinois, and the degree of support is increasing. Our current approach to funding has literally reduced industrial support. Except for Cornell and Illinois, the centers are really decoupled from industry; they are customers rather than research partners.

I would like to find some other ways to share this incredible funding burden. Here’s my current list of options (ideas):

1. Status quo. NSF funds it all centrally, as we do now in competition with computer science. This is the worst of all possible worlds because the use of the facility is completely decoupled from the supply of the service. By being in CISE, nearly everyone associated with the budget, gets the erroneous conclusion that people working on computer science and engineering research have something to do with the centers. Little or no coupling or use of the centers is made by computer science. The machines aren’t suitable for computing research, nor are adequate funds available for computational science.

   If I make the decision to trade-off, it will not favor the centers, but rather centers will be funded at about the same as overall science.

2. Central facility. NSF funds ASC as an NSF central facility. This allows the Director, who has the purview for all facilities and research to make the trade-offs across the foundation.

3. NSF Directorate use taxation. NSF funds it via some combination of the directorates on a taxed basis. The overall budget is set by AD’s. DASC would present the options, and administer the program.

4. Directorate-based centers. The centers (all or in part) are “given” to the research directorates. NCAR provides an excellent model for say BBS, and MPS. Engineering might also operate a facility. I see great economy, increased quality, and effectiveness coming through specialization of programs, databases, and support. This is partially happening.

5. Co-pay. In order to differentially charge for all the upgrades and incrementally nice facilities a tax would be levied on various allocation awards. Such a tax would be nominal (e.g. 5%) in order to deal with the infinite appetite for new hardware and software. This would allow other agencies who use the computer to also help pay.

6. Manufacturer support. Somehow, I don’t see this changing for a long time. A change would require knowing something about the power and throughput of the machines so that manufacturers could compete to provide lower costs. *BTW:Erich Bloch and I visited Cray Research and succeeded in getting their assistance.*

7. Make the centers larger to share support costs. Manufacturers or service providers could contract with the centers to “run” facilities. This would reduce our costs somewhat on a per machine basis.

8. Fewer physical centers. While we could keep the number of centers constant, greater economy of scale would be created by locating machines in a central facility and running them more like LASL and LLNL where each run 8 Crays to share operators, mass storage and other forms of hardware and software support. With decent networks, multiple centers are even less important.

9. Simply have fewer centers. but with perhaps increasing power.

10. Maintain centers at their current or constant core levels for some specified period. Each center would be totally responsible for upgrades, etc. and their own ultimate fate.

11. Free market mechanism. Provide grant money for users to buy time. This might cost more because I sure we get free rides at places like Berkeley, Michigan, Texas and the increasing number of other institutions who do provide megaflops to their users.

I really question how we are going to fund this program in any fashion which permits the facility to be “traded-off’ as part of a total research program. Only the disciplines can do this. I believe we should do the following:

1. consolidate equipment in fewer equipment-based centers to reduce cost and operate fewer physical centers at a greater economy of scale

2. have 3 or 4 directorate based centers and 2 or 3 general centers

3. use co-pay as a means to look at real need and as a way to fund specialized facilities such as 35mm movie equipment

Can I have your help on this matter?

Subject: Budget Allocation
To: File
Date: 25 October 1986
From: A/D, Computer and Information Science and Engineering Directorate

Divison	86	RQ	AL	%	
CC	33.7	36.9	36	6.8	7% for MPS (15.5% Math)
IRIS	14.84	16.3	16	7.8	7.5% for BBS
MIPS	6.87	12.2	11.5	67	13.5% for Eng.
(Research)			14.6		
ASC	45.1	57.5	53.2	18	
Total	100.56	122.98	116.7	16.1	
(Foundation-wide	)			8.6	

The above table shows the dilema of having the centers constraint in the CISE budget. In effect a slightly dispropotionate share of the 16.1% increase was constrained to the ASC program. Research (nets, EXPRES, and computational science) within ASC may be required to carry a disproportionate share of the cut.

The budget allocation feels acceptable within the constraint. The rationale is as follows:

1. Competitiveness is number one. This is highly correlated with our ability to train engineers who can build complex *physical and software-based* objects. MIPS is probably our most direct way to fund this training and activity because it teaches both very complex software design, but yet attracts people who can also work in the physical world. Competitiveness requires dealing with physical, manufactured goods!

2. We have a responsibility vis a vis competitiveness to attract and train engineers in the use of Advanced Scientific *and Engineering* Computing. This extends to all parts of CISE and within the foundation.

DRAFT 12 /10/86 BROWNSTEIN, BELL

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING (CISE)
AT THE NATIONAL SCIENCE FOUNDATION

INTRODUCTION

The National Science Foundation's new research Directorate, **Computer and Information Science and Engineering** (CISE), combines several pre-existing activities: the Division of Computer Research, Division of Information Science and Technology, programs in Computer Engineering and Communications and Signal Processing, and the Office of Advanced Scientific Computing. This article describes the scientific and institutional context of CISE, and the general direction of its research programs.

CISE supports scientific and engineering research in the broadest sense of the terms. The overall goal of the effort is to improve the knowledge base, research infrastructure, and professional labor force needed to understand and improve the nature, synthesis and use of computing and information processing devices and systems. Information processing is taken to include the creation, representation, processing, storage, retrieval, and transformation of information.

CISE is multi-disciplinary, supporting work in fields such as computational mathematics and theory, software engineering and database research, artificial intelligence, robotics, cognitive systems, economics of information, VLSI design and fabrication, and signal processing and network research. Research is also supported on the design and application of advanced and experimental computers to problems in which the computing or information processing component presents interesting and important intellectual challenges.

In addition to research support, CISE has a major "service" role regarding the use of advanced computation and communications, and rapid prototyping of microelectronic devices for the general scientific community. It supports advanced facilities, national supercomputer centers, electronic networks, and the associated research, software service, and training needed to enable their use.

CISE programs participate fully in NSF's "cross-directorate" programs which target specific needs in improving the nation's research infrastructure. These include the following: Research Experience for Undergraduates (REU), Presidential Young Investigators (PYI), Minority Research Initiation (MRI), Research Opportunities for Women (ROW), Facilitation Awards for Handicapped Scientists and Engineers (FAH), Research and equipment awards in Undergraduate Institutions (URI), Research Opportunity Awards
(ROA) for small college faculty, and the Experimental Program to Stimulate Competitive Research at the State level (EPSCOR).

CISE ORGANIZATION

CISE is one of five research Directorates within NSF. It currently has five Divisions, each of which has several Programs. All support the scientific and engineering research required for advances in the fields they encompass. All work closely to support research which cuts across organizational "boundaries" within the Directorate, NSF, or other Federal agencies. This structure is flexible, and can be expected to change as required to best support and develop the fields involved.

The Division of Computer and Computation Research (formerly the Division of Computer Research) supports research in the fundamentals of numeric and symbolic computation, complexity and algorithm theory, computer system architecture and testing, computer graphics, and software engineering. Directorate-wide programs to support infrastructure and instrumentation are also housed in this Division.

The Division of Information, Robotics and Intelligent Systems (formerly Information Science and Technology) contains programs dealing with robotics, automation and intelligent systems, knowledge resource and database systems, human-system interfaces and interaction, cognitive information processing and the economic and societal aspects of information and information processing systems and industries.

The Division of Microelectronic Information Processing Systems (formerly Computer and Information Engineering) is focused on research on very large scale and ultra large-scale integrated analog and digital systems. This includes work on architecture, hardware (including silicon compilers) and related software, packaging and fabrication, circuit theory and signal processing. Also located in this Division are two Directorate-wide programs. One is devoted to the design, construction and evaluation of experimental systems. The other, in close cooperation with DARPA, it is the focal point for NSF participation in MOSIS, for rapid prototyping services for research and teaching.

The Division of Advanced Scientific Computing (formerly the Office of Advanced Scientific Computing) supports the operation of national supercomputer research centers, providing supercomputer time, programming support services and training to the nation's research community. In addition, it supports research to improve software for supercomputing, and explores alternative computing technologies for advanced applications.

The Division of Networking and Communications is responsible for a substantial electronic networking service and research activity, providing remote access to the supercomputer centers, linking members of the research community, and exploring innovative network services which support the research enterprise. NSF's new effort in flexible multi-media document transmission, EXPRES, experimenting with the proposal submission and review process, is located here.

ROLE OF CISE IN RESEARCH SUPPORT

In the fields supported by CISE, NSF has historically funded individual investigators and small research groups in response to unsolicited proposals. Except for the Coordinated Experimental Research (CER) awards of the Division of Computer Research, which were specifically designed to improve the nation's academic research infrastructure in computer science, and support for research instrumentation, most awards have supported "project" rather than "programmatic" scale research endeavors. This mode of support has at times been seen as a "balance" to the larger scale but more targeted funding styles of mission-oriented agencies, especially DARPA. Actually, it reflected a conscious emphasis on fundamentals and the development of firm theoretical foundations and a broad training ground for emerging fields.

Today, the fields represented in CISE are maturing, and adding to their traditional focus on internal development a broader concern for experimental research as a way to test theory and motivate innovation. Coinciding with the improving capability of computing machinery, and explicitly recognizing the importance of support for engineering research through CISE fields, this course of evolution promises a significant increase in larger scale experimental and systems oriented research.

Apart from the Division of Advanced Scientific Computing, CISE research programs are not concerned directly with the application of computers in disciplines and fields supported outside of CISE programs, except where the computer research is a significant part of the resulting work or system. There are many examples of such research. Computer-aided design (CAD), speech understanding and synthesis, on-line retrieval systems, VLSI design tools, robotics, and expert systems for medical diagnosis and geological exploration are but a few of the areas in which CISE fields pioneered major innovations. As these areas developed, other disciplines assimilated the underlying knowledge and expanded upon it, frequently raising new fundamental issues. In such

cases, CISE programs are enthusiastic partners in reviewing proposals and supporting cross-disciplinary research.

Similarly, CISE programs are not particularly concerned with supporting the implementation of systems which imbed computer and information technology (such as cars, health care systems, or research instruments). CISE has an active program which supports research on the economic and societal effects of such innovations, but does not support their implementation. CISE is, however, concerned with providing the fundamental knowledge and developing the skilled personnel required to understand and implement complex systems involving computers and information technology. As such, CISE programs may support research with other programs of NSF, other Federal agencies and with industry.

NSF and other federal funding agencies have a long history of cooperation in research funding in computer related fields at academic institutions, and NSF believes that it is important to maintain a diversity of support opportunities. DARPA, in particular, has played a major role in establishing computer science as a discipline through its broad scale support for major academic departments, its research funding, its development of time-sharing, graphics, artificial intelligence, ARPANET and MOSIS. These activities benefit the field as a whole, and provide economies of scale which leverage federal dollars. Further development of these critical activities, on a cooperative basis, is needed to maintain the vitality of the overall field. As DARPA assumes a greater responsibility for applied research and prototype development, NSF must attend to more broad scale support of fundamental research for the field.

CISE will continue to cooperate in joint research support at the program level with other agencies as well. The Office of Naval Research, Army Research Office, Air Force Office of Scientific Research, National Library of Medicine, Department of Energy, NASA and the National Bureau of Standards are illustrative of the diversity of cooperating partners in research support. Over time, perhaps with the assistance of the newly formed Computer Research Board of the NAS/NAE, NSF will begin to work closely with other "mission" oriented agencies to explore additional avenues of coordination and cooperation at both policy and research support levels.

ROLE OF CISE IN COMPUTER AND COMMUNICATION SERVICES FOR RESEARCH

Unlike the other research Directorates of the NSF, a substantial portion of the current CISE budget is devoted to programs which serve all the disciplines of the scientific and engineering research community. The Division of Advanced Scientific Computing is responsible for supplying very high capability computing resources, supporting the development and maintenance of specialized software, and providing training for researchers in the use of the resources. These services are today supplied through five National Supercomputer Research Centers.
The Division of Networking and Communications is developing electronic networking capabilities to link researchers remotely to the centers, and to link researchers to each other.

CISE support for such activities is at the "leading edge" of computer and information technology, and both of these new Divisions house research programs which fund a full range of activity from basic to applied. Support responsibilities for other computational services, disciplinary data resources, computer-base instrumentation, and similar services, remain distributed in the various disciplinary programs of the NSF.

EXPECTED DIRECTIONS OF RESEARCH AND SERVICE SUPPORT

Each of the CISE Divisions supports research based on peer review of unsolicited research proposals emanating from the research community, managed locally through separate research

programs. Analysis of emerging research directions in the CISE programs, and of the field in general, points to several important themes in the years ahead. These are: parallel processing; information, robotics, and intelligent systems; ultra large-scale integrated systems; and networking and advanced computing.

These areas, in addition to their intrinsic interest within the computing research community, may have significant implications for future industrial competitiveness and national security. Increased support, within the context of the generic programs of the Directorate, is expected for work related to these areas. Additionally, these areas suggest significant objectives by which the eventual progress of the programs might be measured.

PARALLEL PROCESSING, A DIRECTORATE-WIDE THEME

The concept of parallel processing has existed for some time. However, twenty-five years of conjectures about parallel processing have remained unvalidated, by comparison to other computing innovations, because of the lack of parallel computers for experimentation. But 1985 marked the introduction of a number of commercial machines exhibiting a high degree of parallelism. These range from distributed processing networks of workstations, to multiprocessor supercomputers and mini-computers and mini-supercomputers with four to tens of processors, to a computer with 64 thousand processing elements which can perform several billion operations per second.

The paucity of theory and accompanying experimental evidence preceding the introduction of many new parallel processing machines by manufacturers shows how advances in technology affect contemporary computer science and engineering research. Although
the conceptual underpinings of nearly all of the new machines can all be traced back to basic research, their availability creates both the demand and opportunity for new research.

Our ability to take full advantage of the emerging new classes of parallel machines will require major modification of many computer science and engineering theories at the levels of basic chip components, hardware and operating system design, languages and programming environments, algorithms, and the general approach to designing applications software. If this effort is successful, applications can exploit at least two order-of-magnitude performance increase through parallelism in the next decade.

This performance improvement would be independent of the anticipated hardware technology gain of a factor of 2-4 during the next five years. The overall effect can be truly revolutionary.

The availability of parallel machines in this decade may be the most significant advance in computer systems since virtual memory (c. 1962, applied in the mid-1970's), vector processing, (c. 1960's) and distributed computing (c. early 1970's and applied in the early 1980's). To begin to exploit the opportunity, every computer science and engineering department will need one or more machines capable of parallel execution.

Many of these machines can be purchased as conventional, operational machines since they are relatively inexpensive. Others, such as the Connection Machine, may require a common-use facility, such as an existing supercomputer site, a university lab, or be located at a DOE, NASA, SRC, or other such facility.

Because the potential of parallel processing is so significant, incentives for start-up companies engaged in parallel processing should be developed, similar to the tax laws which allows large, profitable companies to make equipment grants to universities.

While parts of computer science have long dealt with parallelism, a more focused approach should provide the impetus to progress, so that most basic mathematical theories, machines and operating systems, languages, algorithms and applications are inherently parallel within a decade. The goal of this emphasis is to stimulate a speedup in computation by a factor of 10 within five years, and a

factor of 100 in a decade for a wide range of applications, and much greater improvements for specialized applications.

RAPID TURNAROUND MICROELECTRONIC FABRICATION: MOSIS "+"

In order to have an effective program in computing research, NSF researchers in all disciplines must have a facility to build
specialized computer systems in an experimental fashion.
While much of the early use would be within computer science and
engineering in order to build experimental systems, the major use ultimately should be in electrical engineering by engineers and scientists who need to build specialized systems.

The MOSIS (MOS Implementation service) facility was established by DARPA in 1981 for fast turnaround fabrication of VLSI chips. Designs submitted in digital form over a computer network using standard design rules and protocols are fabricated, packaged, and returned to designers (researcher and student) for testing and use.

MOSIS "+" is the name we give DARPA's MOS Implementation Service extended for whole systems. This initially requires CISE (and NSF's Engineering Directorate) to operate a joint program with DARPA, aimed at interconnecting and packaging chips into systems, and exploiting non-traditional properties of chips so they may act as transducers to be directly coupled to other systems. This critical infrastructure effort includes significant research in communications and networking, automatic manufacture, and testing of complete, complex, packaged systems. In addition, libraries of chips, systems, and tools to fabricate these systems would be available for the community.

Until chips reach density levels of between 100 and 1,000 million transistors or the equivalent of 10-100 million bytes/chip (where 1 byte is equal to 8 bits of information), silicon is likely to continue to be the basic technology for information processing. Many of today's systems will reside on a single chip in the near and far future simply because chips will provide equivalent memory and processing power to today's multiple chip systems. In addition, radically new information processing systems will exist as multiple chip systems and provide vastly increased memory and processing capability. While there are opportunities to transform information directly from the physical world into the chip, these are in the realm of the device physics. The challenge of CISE research is to create tools to allow engineers and scientists in all disciplines to design and to combine these chips into larger special purpose systems.

An example of such a system is Carver Mead's artificial retina, which employs and utilizes the analog, digital and photo-electric properties of a silicon chip. In addition to any value such a device might have in bio-engineering or performing pattern recognition with motion detection, a different form of experimental science is created. With this technology, a "working model" is built that can be tested against a natural retina for experimental validation. A new theory of the operation of the retina is emerging, based on this work.

It is vital for all of engineering, science, and industry to have a facility which can handle the complexity of systems which ULSI will permit. The use will be for building everything from conventional information processing systems to supercomputers tailored to a particular task, to doing behavioral science by building working models that simulate and emulate natural human components and behaviors based on computational neural science and engineering concepts. Also, with the right interfaces to the physical world, such systems will be the basis for scientific instrumentation for a wide variety of applications.

To be maximally effective, the design interface to the user to exploit such technology must be made easy to use.
The long range goal of this activity is to generate the knowledge to implement a complete ULSI design and production system, so that with roughly the same human effort as we think of as

necessary for designing, developing, compiling, testing and running a substantial computer program, end users can obtain the specially tailored systems they require.

INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS

Automated information processing systems can be regarded as extensions of computer technology, that is, as computers with various transducers to deal with particular environments. In their specific applications, such devices will come to assist and augment human mental and manual work and play, just as tools, machines and conventional computers do today. Conceptually, these systems range from simple electronic signal comparators, i.e., feedback devices, to the (mostly imagined) complex "intelligent" or at least "flexible" robot. The knowledge base needed to realize the benefits of such technology is currently crude.

Significant progress has occurred in the development of expert systems, with techniques emerging as the basis for encoding and retrieving limited areas of expert knowledge. The challenge for working toward robot autonomy is to codify and represent the complex "everyday" knowledge required for touch, vision, planning, execution, and interaction with the real world and with other intelligent beings. Research in kinematics, dynamics and actuator design and engineering has resulted in useful prototypes for manufacturing, including grippers, arms, walkers and sensors. An advanced robotics system will encompass all of these devices linked to knowledge bases to exhibit intelligent, or at least competent behavior. The research required to develop the knowledge base to build and use such systems is inherently interdisciplinary, and the end use, such as assisting a biochemist or building an electronic or mechanical assembly, will be determined by an application environment.

To achieve intelligence or to react in a flexible way to unanticipated situations, a robot must be able to encapsulate knowledge of the problem domain (environment) and combine it with human-like skills in reasoning, judgment, and decision making as well as the powers of search and inference. Complex cognitive processes (such as perception, vision, reasoning and learning, and understanding natural language) have been modelled for programming in computers only in the most primitive way. New methods for automating these tasks must be developed and then combined with the various actuator and control systems to create the flexible intelligent, robotic systems that can communicate with and supplement humans.

The goal for expanded activity in this broad area is to have created the knowledge to employ robots as human assistants capable of working and helping in the laboratory, office, factory, and home capable of doing a significant fraction of manual and mental activities found in these environments with little or no supervision or explicit programming. Progress toward such a goal is vital for the overall economic health of the nation. It appears that by the year 2000, mere competence in the international marketplace for manufactured goods and services will require nothing less.

SUPERCOMPUTING

Today, NSF's Advanced Scientific Computing program is a major force in providing supercomputer resources to research scientists and engineers. Currently available supercomputers provide well-defined benchmarks for various dimensions of performance and cost. The overall effectiveness of these large systems can, however, be improved, through research on algorithms, applications software, and methods of access and data display.

Understanding the state of the art of supercomputers (especially the performance of competitive alternatives) and doing adequate research on hardware and software is critical to keep American supercomputers viable for the long-term. Initiatives in this area include the adoption of standard operating systems such as UNIX to facilitate access and resource sharing, and research on the use of advanced graphics technology and user environments.

Several alternatives are emerging for supercomputing, and these should also be understood and exploited. For example, a compelling case can be made for using individual idle workstations to form a distributed supercomputer. Many computer science and other departments have a large number of workstations, which when combined, could provide more power than some supercomputers if the applications programs can be made parallel for distributed processing.

A less radical approach is the emergence of mini-supercomputers which supply significant computational power on a more cost-effective basis than a conventional supercomputer. For some purposes it would appear that providing users with mini-supercomputers would be both a more cost-effective and powerful solution, albeit with some increase in turn-around time. A major task of the program is to encourage researchers, in and out of computer science, to experiment with and use the wide range of computational power becoming available.

NETWORKING

NSF has been actively developing a networking facility, NSFnet. While NSFnet now supports supercomputer users at dumb terminals, tomorrow's network will support a sophisticated distributed processing environment so that graphics and computational power of workstations can be exploited on a distributed basis.

NSFnet will also provide the capability for new efforts aimed at scientific communications issues which could have major impacts on research productivity. An initial research activity is the EXPRES program, which explores the creation, transportation, and use of compound documents across heterogenous machine environments. It requires research on a range of topics in network engineering, human interface design, workstations and standards, and system implementation.

NSFnet's next phase will target significantly higher data-rates, (T1 speeds of 1.5 Mbits/sec) and the capability for new forms of communication combining data, voice and video. In order to properly understand the research needs, it is vital to be able to understand and influence the availability of communications transport links during the next two decades. Unfortunately, unless the links are available, the network nodes and services can not exist. And unless the nodes are available, a market for the links will not occur. In fact, the state of the art in networking has remained relatively static (c. 1970 ARPAnet using 55 Kbit links). In contrast, much of CSnet and NSFnet uses 9.6 Kbit links. NSFnet should be designed to operate with 1 Mbit links within three years, and to operate with high speed fiber optic networks within a decade.

Thus, the goal is to have, by 2000, adequate communications capabilities so that, in principle, people involved in the information and knowledge industries and those acting as surrogates to communicate with computers (e.g., for airline reservations, financial information) can work from any location with the same ease that has evolved for face-to-face interaction.
The situation is further complicated by the emergence of high speed Local Area Networks (LANs) operating on most campuses. These LANs provide a new range of capability including teleconferencing, co-operative problem solving and conferencing, and even parallel processing. A "global" LAN (GLAN) will be required to link the campuses. Given that information is the raw material for scientists and engineers, it is fitting that we use our own research environment as the principal laboratory.

Interaction With Industry for Industrial Competitiveness

Advancing science and engineering in order to enhance industrial competitiveness is a significant theme for NSF. NSF has been active in encouraging industrial support through its Small Business Research grants, state-of-the-art computer equipment grants for research, joint industry-university research programs, and the joint funding of research with companies and industrial consortia. These programs are all vital to industrial health.

As scientific and engineering results are produced requiring full-scale development into working technology and products, we anticipate and encourage the constant flow of people and technology

into the industrial sector to both established companies and start-up companies via venture capital funds.

Conclusions

Primary objectives of the National Science Foundation are the advancement of knowledge and the maintenance of a vibrant infrastructure for science and engineering research and education. Successfully pursued, the fruits of this activity significantly affect national economic competitiveness and human progress. Applications of research supported by the Directorate for Computer and Information Science and Engineering are at the heart of the enterprise. With responsibility for both research and operations, CISE plays a critical role within and beyond the National Science Foundation.

MIT: Steve Lerman, Jerry Salzman, howard???, jay wet., richard fateman, john ousterout, cornell: hopcroft; eric hahn ccmail mtn view 800 448 2400, pa phone

Rashid, Birnbaum, Morris, john hennesey, john ousterhout, Patterson,

Adams, Duane		DARPA	
* Albus, Jim		NBS/robotics	
* Amarel, Saul		Darpa	? in Washington,
* Baker, Henry	818-999-0278	retired	former prof. &Symbolics fdr, MITAILab
#Barstow, Dave	203-431-5501	Slumberger	9/17 no
* Bejczy, Antal	818-354-4568	Jet Propulsn Lab	
?Binford, Tom	415-723-2797	Stanford	I didn't call back
#Bledsoe, Woody	512-343-0978	MCC>U.T	65, going back to do 20 yrs of research
Bobrow, Dan		PARC	too senior and west coastized
* Borgman, Christine		UCLA	
* Brachman, Ron		BTL	WB?
* Brady, Jay M.		Oxfd.U.	
Brown, john seely		PARC	too involved
Buchanan, Bruce	415-723-4878	Stanford	supplied names
* Chandrasekaran, R.		OSU	Rich, wife prof in perf eval and dp
* Charniak, Gene		Brown U	
* Chowning, John		Stanford	
* Clancey, Bill	415-723-1997	Stanford	BB#3, mixed re tenure, not-M
#Davis, Randy	617-253-5879	MIT/Sloan	9/25, not now, things going too well
# Dodd, George		GM	
* Duda, Dick	415-327-2274	Syntelligence	
* Ehrich, Roger		UPI	
N Ernst, Les		Stanford,	not appropriate
#Feldman, Jerry		ICSI	
* Fikes, Rich	415-965-5500	Intellicorp	
* Firschein, Oscar	415-859-4839	SRI	
* Freeman, Herb		Rutgers	
Friedland, Peter		Stanford	
* Genesereth, Mike	415-723-0324	Stanford	BB#2.9, not-M
* Georgeff, Michael	415-859-4839	SRI	
#Gerhardt, Les	518-266-6400	RPI robotics	12/86, new lab, family business
* Ginzburg, Matt	415-723-1239	Stanford	BB#4, RA with Genesereth, Not-M
* Goldstein, Ira	415-857-1501	HP labs	tried but was out of coutry
* Grossberg, Steven		Boston U.	
* Grossman, Dave	914-945-2452	IBM/Yktn Hts	
* Grosz, Barbara		Harvard	
* Hart, Peter	415-327-2274	Syntelligence	
#Hartmanis, Juris	607-255-9208	Cornell	family
* Hayes-Roth, Rick		Teknow.	wife works at Stanford
#Hopcroft, John	607-255-7416	Cornell	research commitment
* Horn, Berthold	617-253-5863	MIT	
Hunt, Earl	206-543-2640	Wash.	AN Cognit. Sci.
* Jarvis, John F.	201-949-2392	BTL	
* Joshi, Arvind	215-898-8540	U Penn	WB+
* Kanade, Takeo	412-268-3016	CMU	
* Kant, Elaine		Schlumberger-Doll	
* Kling, Bob		UC-Irvine	
#Kuipers,		UT	WB
* Labonte, Toby		CDC	WB young

* Lesk, Mike		Bellcore	WB, not in core of Ai
Lessor, Vic	413-545-0111	UMass	
Lewis, Phil	518-387-6458	GE Res.	
* Lowrance, John	415-859-4839	SRI	
* Mahnany, Steve		BTL	JH, Aho's group, theory
McDermott, John		CMU	too many irons in fire to bother
* Miller, Stu		GE	
#Minker, Jack		UMd.	WB, 9/16 not interested, ala Kent
#Moran, Tom		PARC	AN 9/86 going to UK for a year
* Morgan, M. Granger	CMU		
* Newell, Allen		CMU	
* Nilsson, Nils		Stanford	
* Nitzan, David		SRI/Robtcs	
* Noll, Roger Gordon		Stanford	
?Norman, Don			AN supposedly visiting in OCT.
* O'Dell, Gary		RPI	
Ohlander, Ron			
* Paul, Lou		Penn	
* Paulidis, Theo		Suny-Stony Brook	
* Pearl, Judea	213-825-3243	UCLA	
* Polit, Steve		DEC/Hudson	WB
* Raibert, Marc H.	412-268-3800	CMU	
* Reddy, Raj		CMU	
* (Rich, Charles		MIT	(Husband and
Sidney, Candace)		BBN	wife)
* Sirbu, Marvin		CMU	
* Rich, Elaine		MCC	An, but WB didn't suggest?
* Rosen, Charles		Mach.Intel	Retired
* Rosenfeld, Azriel		U.MD	
* Rosenschein, Stan	415-859-4839	SRI	
* Rossol, Lothar	313-641-4140	GMF Robotics	
#Saccerdoti, Earl	415-424-0500	Teknowledge	BB#1, can't leave due to children, D
Schmacher, Randal	202-767-2884	NRL AI lab	unhappy
#Schwartz, Jack	212-460-7209	NYU	Summer 86
Selfridge, Oliver	617-890-8460	GTE	said he would look, but didn't follow up
* Selman, Allen		Iowa>NEstern	JH theory, gets thing done
?Senders, John	416-596-1252		applied, behaviorial sc.
* Shimano, Bruce S.	408-747-0111	Adept Techngy	
* Simmonds, Bob		UT	WB... says he is interested
* Stefik, Mark		PARC	research going very well
* Szolovitz,Pete		MIT/LCS	
* Tannenbaum, Marty	415-496-4699	Schlumberger	BB#2, problem at work,
* Taylor, Russ	914-945-1796	IBM/Yrktn Hts	
* Ullman, Jeff		Stanford	
* Volz, Richard		U.MI	
* Wagner, Roger		CDC	WB
* Waller, Don		Bellcore	WB
>Waltz, David	617-876-1111	TMC/Brandies	
* Weber, Bonnie		U. Penn	WB
* Wesley, Mike		?	Farber
* Will, Peter	203-431-5000	Schlumberger	
* Winston, Pat	617-253-6754		
617-253-6218			
617-253-6249			

University

On list	Unlikely	GB/EB no	Said No
Duane Adams, CMU and former	DARPA,		
Bob Ashenhurst			
*Jim Brown, UofT (Kent feels fine)			
Fred Brooks (jturner)			
Tom Cheetham			
Corbato			
Ed Cranch			
Al Despains, UCB Kent unenthusiastic			
	Mike Dertouzous		
	Ed Feigenbaum		
Dominque Ferrara, UCB (Kent neutral)			
Bill Gear (Kent thinks interesting)			
Gene Golub (Kent entrant)			
Susan Graham, Berkekely			
David Gries kent unenthusiastic ... can't separate personal obj.			
Juris Hartmanis coming in for interview			
Michael Harrison			
Nico Habermann			
Tony Hearn, Rand Kent no			
J Hopcroft			
Ky Hwang (joke by Jturner)			
Angel Jordan			
Karp?? did I ask him Kent entrant			
	Ken Kennedy		
	Ed McCluskey		
Bill McKeeman			
Raymond Miller Georgia Tech. Can't think above his objectives			
*Jack Minker (Kent, new entry)			
Joel Moses kent thinks JC replace.			
	Allen Newell		
Nils Nilsson, Stanford			
	Raj Reddy		
	Jack Schwartz is now at Darpa		
	Chuck Seitz		
	Joe Traub		
Andy van Dam? no?			
Pat Winston			
Anita Jones is to be preferred/Bill Wulf			

On list	Unlikely	GB/EB no	No
Industry			
		Les Belotti, MCC,IBM, EB unenthusiastic	
	John Seely Brown, Xerox		
	Dave Evans		
	Sam Fuller		
			Sandy Fraser, BTL
IBM Hirsch Cohen Kent unenthusiastic			
IBM Zurich Lab Director			
		Frank Kuo, SRI would like it	
	Jack McCredie, DEC, former Educom Pres.		
	Bob Metcalfe		
George Paul, IBM Research			
			Bob Richie, Xerox Parc
	Herb Shorr		
	Sutherland		
	Bill Strecker		
		Steve Teicher, DEC	
		*Schemel Winograd, IBM, EB said no.	
	Irving Wylansky-Berger		
National Labs/-crats			
Chuck Brownstein			
			Peter Denning, NASA, will eventually
Al McLauglin (lincoln lab)			
		Dave Nelson, DOE	
		Burton Smith (jturner).	
		Jack Worlton, (jturner wants to be considered)	

G BELL 10/27/87

Subject: My Conclusions from DARPA's Strategic Computing Program Review 9/15-17 /87 And the Direction of Scientific & Eng. Computers
To: File
Date: 9/17/87
From: Gordon Bell

0. The "main line" of computing development is the Cray (super), Crayette (minisuper under $1M), and an emerging personal super (under $100K). It contains as many vector processors as possible, and runs at the highest speed possible which meets the price constraints.

There appears to be NO Economy of scale. In fact a diseconomy of scale in performance/price may favor higher volume products. All classes have successors to be competitive with the YMP and Cray 3. For example, the current estimates (using the Linpack 100x100, which is the average of the speed at which the supers run) show the YMP at 20 Flops/s/$ versus a projected 100 for the lowest priced vector multiprocessors in Jan '88.

1. The future of the uniprocessor using RISC and an attached vector processor makes for a very bright picture for scientific and engineering computation in workstations and simple computers.

time	clock (mhz)	Mips	Mflops	Mflops peak with vector unit
90	50	50	10	100
92	100	100	20	200

This will push everybody and be a good component for multicomputers.

2. By using relatively simple, commodity-like micros, one gets a factor of 10 in price performance over the 'main line" by arranging these in a multiccomputer such as a hypercube and its successors which have improved switching among the computers. Hypercubes exist with 32-1024 computers and several hundered are in use. Programs have to be rewritten to utilize the multicomputer message passing system.

3. Two, relatively simple and sure paths exist to building a system that could deliver on the order of 1 teraflop by 1994. These are:

a. Hypercube of 4K 800 Gflops peak
b. Connection Machine >teraflop with several million proc. elem.

4. The Cray 4 is to be available in 92, operating at 125 Gflops, using 64 processors. In order to get this amount of power on a single program, it has to be reprogrammed along the same lines as with the Hypercube.

5. Intel is building a single systolic processing chip that's capable of operating at a 24 megaflop rate. Such a chip would be an ideal complement to a PC in the '91 timeframe.

Some conclusions for us:

Diseconomy of scale continues to exist and favor small machines. We have no way to support these unless the prices are at workstation levels.

The highly specialized computers offer the best performance/price and operate at supercomputer speeds, but cost more than a workstation. We don't have a way to support them, nor do we have the right combination of computer scientists and scientists and engineers working on them to tackle the problem in any general way.

If we want peak speed out of any computer, programs will have to be redone to operate in parallel. One model using message passing, will work equally well on multicomptuers as on Crays. The shared memory, multi-tasking model won't work on the multicomputers. Again, no signs of signficant support, training, etc. from the computer science community.

For the ultimate performance, SIMD machines such as the Connection Machine can be built (IBM is also building the TF 1 for teraflop) ... and such machines are pretty easy to program. However, the programs are different than what exists today. We aren't pursuing this within CISE or withing NSF in places like GEO, nor are the two agencies, DoE and NASA who yell loudest for the mostest. BBS has ordered a Connection Machine and should be commended for their forward thinking.

The computer science community has several options:

1. continue to ignore the challenge of scientific/engineering computing
2. learn about these forms of parallelism, write texts, and train
3. work on automatic programming systems to analyze programs and rewrite them for the above computational models.

The good news is we're getting the machine. The bad is that only a few applications can be converted in any reasonable time frame to run on them.

A Cross-NSF Initiative (to be extended cross-agency) in Design and Manufacturing aimed at basic understanding and training for competitiveness.

The objective is to automatically design, build, and test any electronic, mechanical, and electro-mechanical system (of parts) by fully understanding the:

- **phenomenon and materials of the parts**
- **process for building the parts**
- **part collection as a system in all forms**
- **design system for the parts and system**
- **design system for combining parts in a fully automated fashion (virtual asmbly)**
- **an automated factory to build the system**

GOALS

•Understanding and evolution of all processes and resulting parts
•Radical new processes/parts
•Complete information controlled, distributed factory
•Electronic and other standards for parts/processes, systems of parts, and remote fabrication (e.g. like MOSIS)
•Cause a revolution and revitalization in our ability to design and build small, electro-mechanical things (basis of the econonmy, defense)
•Form small factories at universities to train and reform factory design and operation

1. Establish a parts/process "centers" program between university and industry including factories at universites for unique "MOSIS-like" facility for many processes:

- **Mechanical**
  - **milling, stamping/bending, casting, molding, ... laser sintering**
- **Electronic chips**
  - **CMOS, bipolar, GaAs, ... electo-optical**
- **Electronic interconnect**
  - **PWB, wirewrap, multiwire,... wafer**
- **Micro-electromechanical based on silicon**
- **Electromechanical**
  - **POC, POC components (e.g. disks), all kinds of robots, etc.**

Covers:

- **•process for fabricating a part via remote specificatio**
- **•basic science of phenomenon/part,**
- **•and new representations for design of systems of parts.**

2. Encourage the invention of new processes, parts and systems.

3. Establish full scale cad/cam systems for the design and fabrication of new and traditional parts including the representation and cataloging of all traditional parts for automated design (including analysis and simulation) and automated fabrication.

Michael Schrage,

re: your 11/21 article: "Major political battle looms over government's role in innovation"

I share your concern, and even hope that things will be different when the Republicans allocate R&D funds to NIST (and ARPA), but I doubt. I don't share your belief that the Commerce Department's ATP spending will help establish new technology and new industries in the U.S... it might help Japan, but I question whether this work is even that creative or useful. All it does is fund the marginal, make-work, social welfare, research industry we've created! A recent survey of grantees revealed them to be universally ungrateful, believed the effort was marginally worth the gain, and had little respect for the government program monitors who behaved as investors (not a bad idea).

The Republicans kind of want to minimize spending and give it to military contracting companies ... who support them to retain power; the frightening thing is that they may try to get back to the Reagan years of military spending, less taxes, and greater annual deficits. The Democrats just kind of want to have a bigger budget and give it to ... friends who support them and buy more friends to retain or gain power. A third group, the bureaucrats and their grantees, are able to permeate or align with anything resembling political ideology (an oxymoron) in order to retain power and get more money, respectively. Neither party nor the crats have an understanding about how to develop technology and turn it into industry. Risk averse researchers is the last group capable of understanding the creation of companies, products, or industries They are busily writing proposals to maintain and expanding our dependent, research industry.

Most research or advanced technology money goes down the drain for various reasons. For example, LCD research is mostly for marginal industrial programs that companies haven't the discipline to stop or that the companies are in no position to commercialize or make into an industry. Big bucks to Xerox for panels follows the tradition of their recent computer research (marginal programs that have no channel for internal or external productization or use).

I'm terrified if Dr. Prabhakar had $1.4 billion (more than 1/2 of NSF's budget) to spend. While I don't know anything about her besides being at Cal Tech, DARPA, and that you say is bright. These aren't necessarily qualifications for someone who has to manage a program that's supposed to get us technology that will effect or establish industries. Has she ever built anything (product, product prototype, technology demonstration, or a

theory) that anyone else has converted into something useful that someone actually buys and uses, and that has helped the economy or paid us (taxpayers) back? Has she ever funded research or whatever that anyone else has converted into something useful that someone actually buys and uses, and that has helped the economy or paid us back? Just what is her (at ARPA) and the ATP's record so far? What's her funding versus payback record?

For the last decade, I've worked with and personally funded startup ventures that I think are competent and will make a difference. I've learned that it's really tricky and I doubt if the government or random bureaucrats or political appointees passing through the Washington offices can figure this out. ATP's word, "risky", might better be defined as "the team doesn't know what the hell its doing, but in the hands or eyes of anyone competent, the project is provably poor".

While the intentions of The Department of Commerce's Advanced Technology Program for Information Technology are laudable, the results based on a sampling of the four winners in the Bay area are certain to be nil. I ask Dave Fisher who spends ATP computing money to look at these proposals and contracts, but didn't get a response. I wanted to review the program and contracts before commenting on ATP's selections. The goal was to see if I could understand just how it was that we (taxpayers) get our money back. Three of the four programs that I'm a bit familiar with cover the gamut of sure losers: large company Xerox ($1.8m)'s work in programming is pretty well characterized above; startup Cubicon ($2m) could not get funding and has the unanimous non-support of everyone who reviewed it; decade old research company, Kestrel ($19.5m) is a decade old DARPA program that went astray, but at least ARPA gets them off their book. I didn't know the fourth, Reasoning Systems. It's pretty easy to predict nil output for the other grantees including AT&T and Unisys based on their historical records.

I challenge you to write non-trivial, plausible stories for each of these proposals as to how these projects are going to be paid back!

While the Department of Commerce gives anecdotal evidence that it helps manufacturing, the funding of computer science, computer engineering, and software engineering is unlikely to be at all useful or pay back the funding. These Bay area grants are a great example of how not to fund advanced technology that will turn into products with revenue that produces profit that pays tax to fund more research.

BOTTOM LINE

Based on my 30+ year recollection of funding 50+ research efforts in computer systems, only two things help: funding universities and buying advanced products. Funding companies whether startups (that make them government dependent) or large companies (that allow them to continue marginal work) doesn't work!

Can the program be saved? Yes, but only if it is opened up to universities where the ideas are and who need larger than NSF grants to carry out larger scale, and more developed research.

Regards,
Gordon Bell
cc:
Duane Adams
Erich Bloch
Dave Fisher, please forward to Dr. Prabhakar
Mary Good
Cornellius Pings
Bob White
Bill Wulf

The federal government has played a most significant role in computer system development, including minicomputers, workstations, RISC architecture, computer networks and over the last decade, parallel computers. It is important to understand the funding the mechanisms that form or detract from healthy computer structures and lasting industries. The following heuristics, based on my 30 year recollection of about 50 computer hardware systems activities are offered to policy makers and funders:

1. Demand side works i.e., "we need this product/technology in order to accomplish x"; supply side doesn't work based on a "Field of Dreams", build it and they will come.

2. Direct funding of university research resulting in technology and product prototypes that is carried over to startup a company is the most effective -- provided the right person & team are backed with an avenue for technology transfer.

a. One researcher, Forest Baskett, executive VP at SGI should be encouraged to return to Stanford because he was very successful (SGI, SUN, MIPS).

b. Transfer of technology, except trained people, to large companies for new or existing projects has not been effective. No really successful transfers are known.

c. Government labs rarely produce products or create companies unless by accident.

3. A demanding and tolerant customer or user who "buys" or demands products works best to influence and evolve products (e.g., CDC, Cray, DEC, IBM, SGI, SUN, TMC).

a. DOE's labs have been effective buyers and influencers as significant users, i.e., the "Fernbach policy" at Livermore and Los Alamos that created the supercomputing industry.

b. Universities influenced timesharing, graphics, workstations, AI workstations, etc. through purchase, co-development, use, and product evolution.

c. Although a major successful funder in the past, (D)ARPA, has been less successful in the last decade of parallel processing, partially because of the scale, difficulty, and lack of a driving need from its computer science university contractors -- hence are unlikely to be helpful as users in the trek to the teraflop.

4. Direct funding of large scale projects to a sole source vendor is risky in outcome, training, and technology transfer. Did BBN or ARPAnet help or defer the establishment of comptuer networking and a network industry? What about Internet? After a dearth of no output after email, it was the University of Illinois and CERN's work on the Web and Mosaic that gave us hope that the information highway could be usefu..

5. HPCC funded product development, targeted purchases, and other subsidies to establish "State Computer Companies" in a vibrant and overcrowded market is

wasteful, likely to be wrong , likely to impede computer development, (e.g. by having to feed an overpopulated industry) that by its nature is likely to do the right thing. It is also likely to have a deleterious effect on a healthy industry e.g. supercomputing.□

6. "University-Company collaboration is a new area of government R&D. So far it hasn't worked nor is it likely to unless the company co-invests and receives no subsidy. This form of funding appears to be a way to help a company keep and fund marginal people and projects. In many cases, even if a project were to succeed, the company has no avenue to a market or is it likely to fund costly market development.

7. CRADAs or co-operative research and development agreement are very closely allied to direct product development and are also likely to be ineffective.□

8. Direct funding of software apps or the porting of apps to one platform, e.g., EMI analysis is a way to subsize a marginal company. If government funds apps porting, it must be cross-platform for comparative benchmarking, understanding, and training.

9. Too many marginal machine efforts are funded! Encourage the use of computers, but discourage new designs from those who have not used, need, or built a computer.

Summary
A number of heuristics are given regarding effective funding of computer systems research and development. Given the nature of computer sytems, projects are relatively large scale costing several to tens of millions of dollars depending on whether the project builds on a design and existing computer system and infrastructure or is built from scratch in a university or a company.

Only two funding methods have been found to be effective: university research that is transferred via a startup company and the purchase of systems by knowledgeable, early adopter users to validate them and assist in their development and evolution. Given the extensive ARPA funding to companies and the projected use of this type of funding by the Department of Commerce ATP, it is critical to understand if the poor results presented herein will be a future predictor.

Subject: DOE/NSF Supercomputers, Engineering, and Science Working Group
To: DASC Division Director
CC: CISE Division Directors
From: Assistant Director, CISE
Date: 23 April 1987

The attached charter describes a working group set up under a DOE/NSF Overview Committee. The list of members of our working group from DOE is attached.

I have met with the co-chairman of our working group, Dave Nelson. We've decided to start with a first meeting which would explore the opportunities for collaboration in scientific and engineering computation and networking. This first meeting would concentrate more on facilities (including the network) and software sharing rather than research (a next meeting), but would include the activities in benchmarking and visualization. It would include the technical directors from each of the centers, including NCAR, and someone representing NSFnet. Each of our Divisions should be represented as appropriate.

Would you, or someone from DASC, please work with the appropriate DOE designee, when appointed, to set up and run this first meeting?

22 December 1986

Karen A. Frenkel
Association for Computing Machinery
11 West 42nd Street
New York, New York 10036

Dear Ms. Frenkel:

Please forgive me for commenting on your reporting of my talk. I should have waited for the publication before commenting on it. I can hardly wait to see what you say, given that you had trouble copying it and that I was trying to communicate a fairly complex message to the computing research community. For example, the definition of "VAX mentality" is non-trivial.

Enclosed is a paper, sans references, which describes the activities of the new NSF Directorate. The authors are the five members of my staff. I would expect it could benefit by editing. If it isn't in your domain, could you please route it to the appropriate section? I hope there's a way to get it published because the Directorate would like to have direct communication about our organization and direction with the community. I have encouraged Saul Amarel, Director of DAPRA's Information Sciences Techniques Office, to write a similar article.

Sincerely,

Gordon Bell
Assistant Director

Dr. William Graham
Scientific Advisor to the President
Old Executive Office Building

Dear Bill:... this has to be on 1 page.

It was good to meet with you today and discuss the computing environment, including our proposed National "Superhighway" Network.

Enclosed is the paper I described on the (re)-emergence of a "range" of scientific computers. The supercomputer users at our centers, including those who have their own minisupers (e.g. Alliant, Convex), were immediately alarmed because they thought the paper raised concerns about the viability of supercomputers (and the NSF national supercomputer centers). The paper speaks to the opening point you raised about whether we need an expensive, high speed network just to support what maybe a passing phase of computing.

The network study though commissioned to address supercomputer access, includes a general network for the entire research establishment. The supercomputer network study is due from OSTP this August, followed by the general case next year. Our panel addressed both issues together, and believe the main use of the network will be for the exchange of scientific and engineering data, not just tieing graphics workstations to supercomputers. Use will include research collabortation, sharing common data from equipment such as satellites, remote control and data acquisition at special facilities, shared design data, and manufacturing information to build and test chips and electronic subassemblies (eventually electromechanical subassemblies), etc. I personally believe that the main use of the network will be to support "collaboration technology" in various forms including face to face teleconferencing, including use for conferences and education. Just as no one was able to predict the use of ARPAnet for electronic mail and bulletin boards, I believe the same will be true of this new neetwork when we start to achieve the next level of performance in the 1 -50 Megabit per second per link range.

Hope this gives you some idea of what we are proposing for the National Super Network and glimpse of its potential. While we haven't taken the network public, people at communications and computer companies believe it is both a ciritical utility and a necessary, large scale techno-social experiment. Furthermore, they are quite willing to participate intellectually and financially.

Sincerely,

Gordon Bell

21 December 1986

Professor Peter Lykos
Department of Chemistry
Illinois Institute of Technology
IIT Center
Chicago, Illinois 60616

Dear Peter,

Thanks for the letter of 17 November requesting slides on computing. Enclosed are several which I use both to discuss the Advanced Scientific Computation (supercomputers) program, and paralellism. I would appreciate it if you would redraw any of the hand-drawn ones. The two key slides on parallelism are the taxonomies on the computer structures and the forms of use which show the corresponding computer structures the use supports or requires.

Sincerely,

Gordon Bell
Assistant Director

DRAFT..... John, and Chuck please coment before I send.....
21 December 1986

Dr. Kenneth H. Keller, President
University Of Minesota
202 Morrill Hall
100 Church Street S. E.
Minneapolis, Minnesota 55455

Dear Dr. Keller:

I enjoyed your very thoughtful letter of 11 December. However, I find substantial disagreement with your assessment of NSF's actions regarding advanced scientific computing. I believe we are acting in the best interest of our users, and the public generally. Our policy has been quite clear.

In order to get the program moving rapidly in the beginning and to provide time, we bought time at various facilities including Bell Labs, Boeing, ... Minnesota in the period 9/84 till the present. We may continue to buy time or even computers when special situations arise.

For the planned second phase of the program, we held a competition and established five national centers which we agreed to support on a long term basis. The University of Minnesota participated in the competition and its proposal was declined.

Today, the NSF centers are all delivering at their full rated capacity. It is NSF's intent to fund the five centers such that they can all have the leading edge computers manufactured by our domestic industry. I believe these centers must play a leading role in providing advanced scientific and engineering capabilities, including proper network access for graphical workstations, large shared programs and databases, and doing the work needed for understanding the economics and providing the best environment for the community. Furthermore, a computational science and engineering technology program must be put in place to address the leading edge problems in this domain. The University of Minnesota should have an advantage in participating in this program.

Although the government cannot respond favorabley for every request for financing computing facilities, the NSF program may have encouraged supercomputer facilities at other universities. For example, Michigan just installed a 3090/400 with vectors (roughly 1/2 the power of a Cray 48/416), and Ohio State just ordered a Cray XMP. Other state universities are following. IBM has installed 40 3090/200's that can be easily upgraded to provide more scientific power than we currently have installed. All the manufacturers see a very bright market for supercomputers in universities. This situation, and a longer range view is described in the two attached pages-- a census and Advanced Scientific Computing: Past ... Future.

I do agree that new machines like the Cray 2 should be available for new problems. I would also put the Connection Machine in this category because it allows new ways to solve problems. We have begun to think about a market mechanism whereby users buy the time directly when they need critical resources. For now, we have allocated 1000 hours of Cray 2 time at NASA Ames, and currently have significant resources ($ 1.5 Million) available for resource needs.

I regret that we can not fund all centers, but hope we can move to something that is much more akin to a real market mechanism whereby users are free to use whatever machine they want based on price and service. When the centers become saturated, this argument will be easy to make, and we will consider it.

As a former industrial user who purchased supercomputer time from the Minnesota center, it was great to have low cost supercomputer time. This also provides a very effective and necessary communication channel with the industrial community. Let me urge you to strengthen the interface to include your academic programs. Illinois is starting to do this now. Given the increased use of supercomputers in industry, I think you will continue to have a large market for supercomputer time for the foreseeable future.

Sincerely,

Gordon Bell
Assistant Director

Enclosures

CC:
Erich Bloch
John Connolly

21 December 1986

Dr. Peter A. Gilman
National Center for Atmospheric Research
P. O. Box 3000
Boulder, Colorado 80307-3000

Dear Peter:

Thanks for your thoughtful and direct letter of 4 December. Let me just comment on your points.

1. Regarding the "penetration" of new use: we simply don't know what's happening. At the University of Illinois where I visited, I counted only 5%-10% of the faculty of engineering (including physics) which had used any time. The computer science faculty was hardly involved, for example. Illinois has very good networking to support local users. It is hard to make the argument that even 5% of the engineering and scientific community are involved. In order to increase this number (and I think it needs increasing to say 20%), much work along the lines I mention in my paper has to be done... especially compatiblity and networking whereby users can migrate work up and down the hierarchy in a compatible fashion.

2. I presented one facet of cost and performance. It didn't include operations costs, user costs, or attempt to say what they got. The 1000 scientists using the NCAR computers have a total salary more like $100 Million and NCAR costs about $15 Million to run. Yes, user time is the most important part because it is the (output) numerator in performance/cost. My own feeling is that a "distributed" system of mini-supers will evolve, especially when the centers saturate, and will be very productive because it puts the control nearer the user, and gets rid of the networking bottlenecks.

I disagree that working scientist make cost-effective trade-offs every day... they adapt (very rapidly) to a particular economic enviornment. We give them "free" supercomputer time and they are able to buy workstations out of grant money. They compute where-ever they can given the local economics, especially supporting free time. If we were able to give them money to buy their own mini-supers, for example, we would get completely different results as they become computer operators for example. I would love to get to some scheme like you have at NCAR where a community of scientists and engineers are the ones who allocate money across personnel, programs, databases, networking,

computers, etc. and we don't do it from Washington. (Note that it was that allocation mechanism that allocated only minimal hardware until the XMP. Today NSF is committed to a non-market based approach where we provide "free" supercomputer time using a panel allocation approach. The nice part of this is that the program has encouraged a number of universities to get their own supercomputers. I attach a page which is my attempt to understand what the picture for computer time is likely to be in the next three years. At every opportunity, I am asking universities to buy their own supercomputer. The NSF centers will focus on always having the latest system where the most power can be obtained. If the centers accomplish nothing else, being a "foil" for university centers to upgrade to supercomputing is worthwhile.

3. Regarding supercomputer use.
a. I would like to see what the distribution of use is. How many of your users get more than an hour of day, even in times of intense use. I really do want to characterize use in some fashion. I have repeatedly asked for this, and have seen nothing. We have a group at Illinois of 5-10 users who have used about 3000 hours this year when we are starting up.

b. My statement about large users was rejected by one of the panel members. He stated that 10 hours per year may be just fine for certain applications (presumeably if there's a program or database they run).

c. I think standards are necessary so users can migrate work over the hierarchy and within machine of the same class. This is how you get the most cost-effective systems ... by not being locked in to a particular manufacturer. Compatiblity is how you also get new use and users (by discovering intractable problems on lower level machines)! I envision more departmental and group machines which generate large models and problems for very large machines. This is needed when the difference between mini-supers and supers increases (which it might if Cray builds a 64 processor Cray 3).

4. I don't think mini-supers are cost-effective necessarily when you put the 16 of them in a room and call them an XMP, even if they cost the same and give you more Megaflops. This is due to the problem of allocating work across the seperate machines, something that a single, multiprocessor computer solves automatically. (That's why I like multiprocessors.) /VAX Clusters were what we used at DEC to provide more power than the largest machine we could build. Clusters are needed for all systems! I believe that cost-effectiveness is favoring the smaller machines now because of networking, graphics interfacing, memory costs, and CMOS. For example, ETA's uniprocessor should be about the most cost-effective computer (I think it will be better than their ETA 10, even though it is only 1/2 the speed).

5. It was not my intent to make networking worse by making it a seperate division. In running the networking research, development, and operations within Digital, I found that as long as communications and networking were part of any organization dealing with nodes, the networking was weak. Once, I

asked the networking person (on an organizational par with all the managers responsible for computing nodes (workstations... minis), we were able to put a powerful network in place (today, DEC's engineering network has more hosts than any other network, to my knowledge).

I too am deeply concerned about the networking, and will not support an extravagent funding of EXPRES unles it is going to be deployed. I am now chairing a Federal Co-ordinating (FCCSET) Committee on networking. We have just agreed to have a special part of the report deal with the Supercomputer access problem as the first priority. While I want this considered as part of the general networking problem, I do not intend to lose the focus on supercomputing, which today is non-existent to minimal.

Sincerely,

Gordon Bell
Assistant Director

Enclosures

CC:
J. Connolly
P. Rotar

21 December 1986

Professor Kai Hwang
Professor of Electrical Engineering and Computer Science
Director of USC Computer Research Institute
University of Southern California
110 University Park
Los Angeles, California 90089-0781

Dear Professor Hwang:

Thanks for sending me your vitae regarding the position of Chief Scientist of the Computer and Information Science and Engineering Directorate. Unfortunately, I have decided not to fill the position at this time and for the indefinite future. Our critical need right now is for Division Director of Information, Robotics, and Intelligent Systems.

I would like to encourage you to spend some time working at NSF in one of the programs in one of the existing divisions (this could be in any of the three research divisions, although with your excellent hardwre background, it would most likely be working with Bernie Chern, or perhaps. Can we can get together either when you next visit Washington, or when I'm at USC?

I am enjoying your fine book on Computer Architecture you sent.

Sincerely,

Gordon Bell
Assistant Director

21 December 1986

Mr. Steve Emmerich
Alliant Computer Systems
42 Nagog Park
Acton, Massachusetts 01720

Dear Steve:

Thanks for the information about Alliant installations. Please convey my congratulations on building what looks like a fine computer and on becoming a public company!

Thanks for the invitation to visit Alliant and give a talk. I want to do this, and will schedule it with you for when I visit Boston after the first of the year. I also look forward to meeting your fellow workers and exchanging views about computing and the market... especially since many of the folks I know involved in the NSF "centers" program believe our charter is to provide "free and unlimited" computing to all worthy scientists. I am more interested in seeing that the scientific and engineering community has a great environment, and a key part of this environment is the mini-supers.

Along these lines, Michael Rossman, a scientist working on cold virus synthesis at Purdue has been using the Purdue CDC 205. NSF is withdrawing financial support of this computer center, and Rossman will probaly get his own machine. It would be great if you could get someone in the computer science department at Purdue involved regarding a comparison with the 205, conversion cost, etc. It is critical to get this understanding into the community rapidly, and this takes demonstrations with visible users and then writing up the results.

Can I urge you to talk to him immediately and get the CS department involved? One of my goals is to get the CS departments involved in scientific and engineering computing.

Happy Holidays to you and Eve.

Sincerely,

Gordon Bell
Assistant Director

22 December 1986

Dr. Leland H. Williams, President and Director
Triangles Universities Computation Center
P. O. Box 12076
Research Triangle Park, North Carolina 27709

Dear Leland:

Thanks for your lettter of 18 November and comments on my October paper.

A graphics panel on visualization is in progress with the aim of sponsoring work both on advancing the art relative to supercomputer use and on standardization. In the next two years, we have programs oriented to this activity. A meeting is scheduled in Pittsburgh in January with representatives of the centers to address the whole issue of standards, including Unix, which facilitate the migration of programs and data across the various machine in the hierarchy. The goal is to be able to move across machines within a class (CDC, Cray, IBM), and among the classes (supers, mini-super, workstations).

The whole question of the existence of a hierarchy is another matter. Several people have pointed out a concern that my performance metric is just aimed at through-put, and doesn't take into account the availability of peak power or indeed the effects of getting fast turn-around for very small jobs, giving added insight which can reduce computational needs. This argument can be made either for or against large or small machines. We simply need to have some of the smaller machines around to get a better understanding of the question of performance, capacity and cost in order to know much more than we do today. Several people have made arguments that the centers program was designed to eliminate the mini-supers and experimental parallel processors by giving free time, and allowing researchers to write off workstations in their grants.

I am enclosing a letter by Christopher Sims, of the PAC which goes beyond the paper and posits some of the questions the program should be addressing. For now, I am trying to clearly delineate the operational budget for the centers and all the research and development aimed at systems, and improved use by the research community who use the centers.

Thanks again for your concern.

Sincerely,

Gordon Bell
Assistant Director

22 December 1986

Dr. Christopher A. Sims
Federal Reserve Bank of Minneapolis
250 Marquette Avenue
Minneapolis, Minnesota 55480

Dear Dr. Sims:

Thank you for your thoughtful and stimulating letter of 16 December. I think it provides an excellent starting point for a number of policies questions regarding the centers.

I didn't mean to give such a one-sided impression that "a flop is a flop", although I clearly did. The question of turn-around versus throughput is fairly complicated involving the way centers are run, and the amount of spare capacity. I can argue both sides: smaller machines are tighter run under user control where they watch their results develop, and hence need less cycles, futhermore there is more likely to be idle capacity available to improve turn-around; larger machines are run very efficiently and at capacity, thereby increasing turn-around... or scheduling can encourage many very short, interactive runs which can improve user efficiency. I simply don't have the slightest idea of what turn-around is at a large center versus job size. I asked several people, and they indicate that a 15 minute job requires takes about 2 hours on a heavily loaded machine for example. Users then break work up into smaller pieces to get better turn-around.

The issue of the user population (small versus large) is an important one. I have continued to asked about characterizing users, for example, a taxonomy: large project with constant use over a 6-24 month period, large project bursts of duration x, large project debugging, new user with debugging, and small users. While the supercomputer community has not been supportive of having anyone who uses less than 10 hours a year, this might be a very good use, especially since it maximizes effectiveness for the user who would otherwise spend more time getting his work done and who might have to own a machine.

I agree that the program appears to have opened up new avenues of computation that would have otherwise been "machine limited". Providing the largest computers must be a key role of the centers in the future. I want to see them being used as soon as possible for parallel processing! We all have different perceptions of why super-minis came into existence. My experience from the VAX 780 perspective was that virtually no one got enough Cray 1

cycles, and thus it was easy to make the case to have your own VAX. This was especially true in the beginning at the National Laboratories.

Stuart Rice of Chicago just made the point that the supercomputer program may have in fact, reduced the growth in computing resources by providing "free" supercomputer cycles and allowing researchers to buy workstations on the grants. This doesn't encourage, and may actually prevent, researchers from having their own mini-supercomputers. One of the most important side-effects of the program has been to stimulate other universities to buy supercomputers. IBM has 40 3090/200's installed in universities, and if these all get upgraded with vector facility, a net of 40 Cray 1's will be added to scientific computing.

Several months ago, a local reporter was starting a story on how the program was inhibiting the use of new parallel processing machines... but I think I was able to discourage him from writing the story because it won't help anyone. In an attempt to understand the availability of computing in universities, I have started to make a survey of computers in universities, and a copy is enclosed. It begins to show the effect of the centers in the formation of other centers. I think this will really increase as our centers get nearer saturation.

Your last section of Implications for NSF policy is the one we need to study most carefully in preparation for when the centers reach saturation.

IIIA. Getting marginal resources based on other needs or markets isn't being addressed at all except by Illinois. I generally disagree that we should be funding centers of less than national scale, but rather these could be for special needs (the mini-supers for a particular research project or at a smaller university or for parallelism research). Such grants would stimulate certain work or build an infrastructure.

IIIB. Absolutely. Supercomputer time is one part of a total resources grant question, and should be considered with the research.

IIIC. We are working the network issue harder all the time. A new Federal Committee has just been established which I chair to focus on networking across agencies for research, especially NSF, DARPA and DOE.

IIID. Absolutely. I am just getting the community to believe this is important in order for them to migrate work up and down the hierarchy and across machines of a given class (eg. CDC, Cray, IBM). This gives one the most flexibility and it also makes the industry most competitive. The only downside is that it ultimately gives the Japanese a target!

IIIE. I want to keep track... but how?

Sincerely,

Gordon Bell
Assistant Director

Enclosure
CC:
Mel Ciment
John Connolly

22 December 1986

Professor Fred P. Brooks, Jr.
Department of Computer Science
The University of North Carolina at Chapel Hill
New West Hall 035A
Chapel Hill, North Carolina 27514

Dear Fred:

I enjoyed your letter of November 17. So far, I have only asked the Advanced Scientific Computing program for a reaction. I would like to give it to the OASC Program Advisory Committee, but will wait until after you are confirmed to the National Science Board.

Generally, I find the program very difficult to administer on an objective basis. But things should get worse when the centers reach saturation. If they don't saturate, then we would have committed a crime of over production... but I don't think that will happen.

I want to get the PAC involved in order to move to something resembling a market mechanism. A copy of a letter by one of the board members is enclosed which starts to raise some of the policy issues. Stuart Rice, a former NSB member, gave a presentation at an IBM Scientific Seminar, and concluded what I stated in my memo:

> "I have in mind a networked system ... graphics workstations and local supporting intermediate computer and ultimately connects to a supercomputer, with provisions for special devices ....
> 1. Distribution of computer resources distorted by the use of funny money ... cash and credit ... Workstations come from grants, supers are free ... intermediate machines are indespensible and current funding patterns will have to change if ...
> 2. Dramatic advances in hardware haven't been matched by advances in algorithms and operating systems ... parallelism is "chichen and egg"
> 3. The scientific community has become rather inflexible with respect to the use of operating systems. ... don't use particular machine features...
> 4. ... the scientific community has not been as imaginative as it might in thinking about the uses of computation in research."

Right now, I have moved to seperate the centers from the "technologies" program, so we can firewall a budget to address visualization, standards, computational communities, new algorithms, etc. Also, I am requesting a total budget of something like $7 Million in "88 to address this and the computer science work that should go on. Computer Science departments have to get involved in this kind of computing and come into the 80's.

The policy I see for the centers, until we get a market mechanism, is to guarantee support for the five centers such that they will run the latest and best supercomputers, and to try and galvanize them to be avante garde with respect to supercomputing, including having mini-supers around simply so they know what they do and can recommend their use when appropriate. All the support and research issues would be seperate from operations. In this way, resources and R and D for Computational Science and Engineering would not co-mingle.

One of the most positive aspects of the centers in that they have stimulated supercomputer centers in other universities. A census of what I see of supercomputers today is also enclosed.

Hope to have something more definitive on whether and how we are going to become market coupled in the next few months. For now, we will continue to meander through "free space" until the demand increases.

Happy Holidays.

Sincerely,

Gordon Bell
Assistant Director

Enclosures

22 December 1986

Ms. Sheryl Handler
Thinking Machines Incorporated
245 First Street
Cambridge, Massachusetts 02142

Dear Sheryl:

I am writing regarding the marketing of the Connection Machine. Overall, TMC seems to have taken an approach of selling >$ 1 Million machines... which is fine. The problem is that it, and especially the new version, should be quite useful in the smaller versions (say at $100K). Your business strategy could parallel Cray Research, ie. always having the highest performance machine, or it could be to be an OEM who would supply boards to manufacturers who would incorporate them with smaller machines. This "hybrid" approach seems best to me: make and sell the large Connection Machines; sell boards to other companies who would incorporate them into their workstations or super-minis in order to have much higher performance. Recently, a VC asked me to look at a business plan for a company who would sell the next version of the ICL DAP on an OEM basis... so others are thinking this way. They believe the DAP is just fine because you apparently gave a talk that said that most problems are solved by the grid topology.

Anyone the bottom line of the letter is to suggest you contact DEC post haste and get them to incorporate a small machine in their current machines. It would be a very synergystic relationship, and by having lower cost machines, the computer science and applications communities could start to understand and exploit the potential of what I hope will be an interesting and important machine.

Happy Holidays and sincerely,

Gordon Bell
Assistant Director

CC: Sam Fuller, Danny Hillis, John Mucci, Jack Smith

Dr. William Graham
Scientific Advisor to the President
Old Executive Office Building

Dear Bill:... this has to be on 1 page.

It was good to meet with you today and discuss the computing environment, including our proposed National "Superhighway" Network.

Enclosed is the paper I described on the (re)-emergence of a "range" of scientific computers. The supercomputer users at our centers, including those who have their own minisupers (e.g. Alliant, Convex), were immediately alarmed because they thought the paper raised concerns about the viability of supercomputers (and the NSF national supercomputer centers). The paper speaks to the opening point you raised about whether we need an expensive, high speed network just to support what maybe a passing phase of computing.

The network study though commissioned to address supercomputer access, includes a general network for the entire research establishment. The supercomputer network study is due from OSTP this August, followed by the general case next year. Our panel addressed both issues together, and believe the main use of the network will be for the exchange of scientific and engineering data, not just tieing graphics workstations to supercomputers. Use will include research collabortation, sharing common data from equipment such as satellites, remote control and data acquisition at special facilities, shared design data, and manufacturing information to build and test chips and electronic subassemblies (eventually electromechanical subassemblies), etc. I personally believe that the main use of the network will be to support "collaboration technology" in various forms including face to face teleconferencing, including use for conferences and education. Just as no one was able to predict the use of ARPAnet for electronic mail and bulletin boards, I believe the same will be true of this new neetwork when we start to achieve the next level of performance in the 1 -50 Megabit per second per link range.

Hope this gives you some idea of what we are proposing for the National Super Network and glimpse of its potential. While we haven't taken the network public, people at communications and computer companies believe it is both a ciritical utility and a necessary, large scale techno-social experiment. Furthermore, they are quite willing to participate intellectually and financially.

Sincerely,

Gordon Bell

Dr. William Graham

Dear Bill:

Enclosed are a copy of our first NSF network news. I am delighted with the progress the community is making in building this major network. The centerfold gives some idea of the scope of the activity. Darpa, DOE, NASA, etc. all have similar activities. The network should not be looked at as supercomputer access, but rather an information super-highway system for scientific and engineering information interchange of all forms.

We would like your sponsorship of the up-coming FCCSET Sub-committee Networking Report soon to be submitted to you for your submission to congress. I believe your sponsorship could help the whole networking activity progress much faster. Sponsorship may not imply a large (or any) additional federal expenditure or any energy on your part. This interest could be the basis of both Federal co-ordination and also stimulating the the supply of high bandwidth fiber for high speed networking experiments. It might require a bill to allow vendors to provide free, unused fiber for this large scale technical and social experiment.

As an entirely seperate matter, enclosed is a report on Alvey, UK's recent research program in Information Technology, together with comments on large, related European programs. The bottom line is:

- the UK believes its future is based on Information Technology and they have a co-ordinated plan to "manage" it
- industry and academe are working together in a co-ordinated fashion
- they believe their future is Europe and are working with them
- information technology is being acquired, developed, and transfered
- they are moving from basic technology to signficant applications across their government including the office and factory

We are not doing as well as the Europeans.

I would like to discuss with you how our FCCSET on computing effort could be signficantly strengthened and improved. Since Information Technology is the largest segment of the economy, and the basis of any major improvements in productivity and competitiveness, an effective FCCSET on Information Technology could be the most important issue in your office. Furthermore, IT is at the core of many programs such as the Space Station and SDI.

Sincerely,

Gordon Bell

AArdent Computer 880 West Maude, Sunnyvale, CA 94086

Phone: 408-732-0400 Fax: 408-732-2806

August 9, 1989

Robert S Cutler
Program Evaluation Staff
Natural Science Foundation
Washington D.C. 20550

Dear Bob,

Re: CER Program Evaluation Study

Why not use study to compare the CER schools with the next best 20 non-CER as a central group? Ideally, you also compare these with the big "haves" (MIT, CMU, Stanford, Berkeley).

It would be useful to correlate "rank" with funding. Here rank would be arrived at many different ways: peers, all the output, input, $, etc.

It's unclear whether CER funding is an independent or dependent variable i.e. do people get it as a reword for, maintenance of, or path to excellence.

I hope you really isolate all "input" resources, computers, i.e., $, people, space, etc. specifically:

- NSF
- Other Federal
- State (beyond university)
- Consortia (eg. SRC, MCC)
- Corporation (U.S.)-separate dollar vs. in kind.
- Corporations (Foreign)
- University Operating funds.

This would let you test the "leverage" model when comparing the various groups.

An average faculty is a finite resource that can generate outputs which would be measured:

- MS graduates as an important source of manpower. Does CER help stimulate them? Do they go on to PhD?

- The BS undergraudates load should also be looked at.

- In addition to the simple publication and patent measures, it's necessary to know how many product proto-types were produced that went on to become products or start-up companies. For example, lab at Stanford produced Silicon Graphics, MIPS Co, and Sun Micropsystems. MIT produced LISP Machines (dead), Symbols (dying) and Thinking Machines (?). Berkeley created many products/co's.

- It is also useful to measure the graduates in terms of who are major technical contributors, leaders, etc. I would get the universities to get these lists for you - they clearly know them.

This could be a great study if you compare the three strategies for funding because it looks at the formative period of computer science and engineering as it reaches steady state.

Sincerely,

Gordon Bell

P.S. I enjoyed your study regarding Japanese technology transfer techniques. I think it needs wider distribution. Any way to publish it for the lessons for a wider audience such as Spectrum or a business magazine?

cc: Eric Bloch
Charles Brownstein
Bill Wulf

Gordon Bell
450 Old Oak Court
Los Altos, California 94022-2634

Phone and Fax
415 949 2735

30 August 1992

Dr. Nico Haberman
Assistant Director for Computer and Information Science and Engineering
National Science Foundation
Washington, DC 20550

Dear Nico,

I was talking with Rick Weingarten in regard to HPCC, and he encouraged me to write down my thoughts for the CRA board meeting. Since NSF is the key agency to implement most of HPCC, if one assumes the Grand Challenges are an important component, I felt you might also find the recommendations useful. As I look at parallel machines, organizations, and applications, training and application software are the limits in order to get the market started. Again, these comes back to NSF. Also, I have serious reservations about an independent software market for massively parallel computers because the variation in the systems is large and the porting difficulties are much greater than with traditional supercomputers. I have serious reservations about the efficacy of the machines as I look at their architecture and implementation in detail. Ironically, Chuck Seitz, the multicomputer inventor agrees with me, as the machine have become too coarse grain.

As you see in the recommendation, I favor a highly distributed computing approach that places smaller machines with individual research teams, but it's worthwhile to consider NSF centers, DOE centers (which will probably get rejected based on cost and coupling ability), local university centers, and non-massively parallel approaches.

Please feel free to copy and distribute the material as you see fit.

Sincerely,

Gordon Bell

Subject: Resignation, Effective November 1
To: Director
CC: Assistant Director, DPM
Executive Officer, CISE
From: Assistant Director, CISE
Date: October 26, 1987

I have taken a position as head of engineering at the Dana Group in Sunnyvale, California, effective November 1.

I will be at NSF as a consultant on the following dates during the next 3 months:

October 27
November 10-13
December 8-10
January 11-14

I am happy to consult with NSF for as long as it is useful to you on various matters, especially the National Research Network, and to formulate a cross-NSF initiative on competitveness through design, manufacturing, and mastery of existing and novel industrial processes for computers and small electronic and electro-mechanical products. Such a program would have as a by-product, a focus on competitiveness and needs to be in close co-operation with DMCE of Engineering.

The efforts which need to be initiated include: a computer science research agenda (we have an outline now), a revised curriculum, and computers in CS education. I think we have momentum in these programs: a MOSIS undergraduate program, a MIPS research agenda, and the above program on electro-mechanical MOSIS, etc.

I have turned over the chairmanship of the FCCSET Committee on Networking (which is part of the larger FCCSET Committee on Computing) to Charles Brownstein, and volunteered to remain as an advisor to the larger committee. Chuck has a long-standing interest and belief in networking, and would be ideal to continue to build the network. My replacement or Chuck should probably be the representative to the larger committee. As you know, I believe the FCCSET committee has great promise, and is only limited by the imagination and competence of the OSTP.

July = 100 May 1/2? (2-3)
June 75 March 1/4 - 1/2
April 1/2

Updated: 2/12/86

GORDON'S CALENDAR

2/1

Boston/Sunnyvale/Washington

2/3

<>1986

MONDAY 2/17	TUESDAY 2/18	WEDNESDAY 2/19	THURSDAY 2/20	FRIDAY 2/21	SAT 2/22-SUN 2/23
S			ISSCC Panel------)	(----------)	
			8am. Anaheim	U of Colo/Boulder	

<>1986

MONDAY 2/24	TUESDAY 2/25	WEDNESDAY 2/26	THURSDAY 2/27	FRIDAY 2/28	SAT 3/1-SUN 3/2
Advisory Co.--Chern	(----------)			NSF Curtis panel	(S)
9: - 5:00 Washington DC					

<>1986

MONDAY 3/3	TUESDAY 3/4	WEDNESDAY 3/5	THURSDAY 3/6	FRIDAY 3/7	SAT 3/8-SUN 3/9
S					

6:30 Hyde's

<>1986

MONDAY 3/10	TUESDAY 3/11	WEDNESDAY 3/12	THURSDAY 3/13	FRIDAY 3/14	SAT 3/15-SUN 3/16
~~Shalichar~~					Denver
Gunter/Garbrison					
Silicon Compilers			X		

<>1986

MONDAY 3/17	TUESDAY 3/18	WEDNESDAY 3/19	THURSDAY 3/20	FRIDAY 3/21	SAT 3/22-SUN 3/23
← NSF				NSB	Start SKI →

<>1986

MONDAY 3/24	TUESDAY 3/25	WEDNESDAY 3/26	THURSDAY 3/27	FRIDAY 3/28	SAT 3/29-SUN 3/30
X	1/2 Schlumberger talk >3:00			1/2 Colo	
SKI----------					?

<>1986

MONDAY 3/31	TUESDAY 4/1	WEDNESDAY 4/2	THURSDAY 4/3	FRIDAY 4/4	SAT 4/5-SUN 4/6
		(1-3) Palladin			

Jim Bell Dinner 8:5-6435

9:15-12

6:15-10:00

Updated: 1/16/86

GORDON'S CALENDAR

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT-SUN
<>1986					
4/7 Jim Bell dinner	4/8 12:00 Sign	4/9	4/10	4/11	4/12-4/13 SAT: Tecknowledge
<>1986					
4/14	4/15 1st Q report mtg. C. McLinden	4/16 NSF given,	4/17 1:00 E Bolton on MOSIS	4/18 draft 5 yr plan	4/19-4/20
<>1986					
4/21 Sic	4/22	4/23	4/24 6- T² Evening	4/25 Plan (5 year) done	4/26-4/27 to Bos.
<>1986					
4/28 Soldiers: 15A Flat Park W/SF 79	4/29 10:00-3:00 Kurzweil - BOD Watergate Interview	4/30 Discuss Presentation outlines + assignments	5/1	5/2 CS Advisory Committee	5/3-5/4
<>1986					
5/5	5/6 Gwen to Palo Alto	5/7 2-3pm CS+TBird NRC	5/8	5/9 Michals party	5/10-5/11 Gwen leave Mas Day
<>1986					
5/12	5/13 travel Wozniak	5/14 travel Visit ETA NSF Dinner	5/15 NSB Bud Mtg	5/16 Final dry run	5/17-5/18 given to Weatr
<>1986					
5/19 Sic 9 AM Direct. Review	5/20	5/21 7:00 Depart Arlington 703-841-9595 NSF (Mini Retreat)	5/22 DACS Mtg 2:00 Keith Uncapher	5/23 NSF	5/24-5/25 4pm T² KV KV
<>1986					
5/26 HOLIDAY KV -> SF	5/27 Dana	5/28	5/29 lunch at Dana	5/30	5/31-6/1
<>1986					
6/2 NSF site visits: Parc, Schlumberger, SRI, Stanford Berkeley	6/3	6/4	6/5 Dana	6/6 Sand 6:15 T²	6/7-6/8 T²
<>1986					
6/9 Dana	6/10	6/11	6/12 Talk at LLNL NSF	6/13 Lv for Bos IRI: Supercomputer Lecture	6/14-6/15 TCM./TCM. travel
<>1986					
6/16	6/17	6/18	6/19 NSB Mtg.	6/20	6/21-6/22
<>1986					
6/23 Sic	6/24 nsf	6/25	6/26	6/27 visit Blum Goldstein, Stalk off Gordon Inst.	6/28-6/29
<>1986					
6/30	7/1 Reporter: JoTuman Kahn	7/2 visit JPRC X	7/3	7/4 HOLIDAY (10 pm)	7/5-7/6
<>1986					

Reporter from IDC

37.5K @ 7

July 1986					
Mon 28 NCAR/SCIB KC-AL--GB--OUT	Tues 29 W/SCIB?/SEI (Pitts Exec. Council	Wed 30	Thur 31	Fri August 1 9:30-Lorron 2:00 BU	Sat/Sun 2/3
August 1986					
Mon 4- KC/CB both ~~KC/CB-Leave all wk~~	Tues 5 11:00-Scient. Proc Honeywell Reps-540	Wed 6 NTAG 9:00-Osher, DEC	Thur 7 12-Francis 1-IBM-~~Save Award~~ Dig Soul Award dinner	Fri 8 B	Sat/Sun 9/10 B
Mon 11 CB out wk ~~CB Leave all wk~~ Davo + SDC sales	Tues 12	Wed 13	Thur 14 NSB	Fri 15 NSB	Sat/Sun 16/17 B
Mon 18	Tue 19	Wed 20	Thur 21 SCIB (9am)	Fri 22	Sat/Sun 23/24
Mon 25	Tues 26	Wed 27	Thur 28	Fri 29	Sat/Sun 30/31
September 1986					
Mon 1 ~~Schaffer Panel NY,~~	Tues 2 ~~GB On 9/9~~	Wed 3 Laguidy visit	Thur 4	Fri 5	Sat/Sun 6/7
Mon 8 Shaffer	Tues 9 Panel NYC	Wed 10	Thur 11	Fri 12 B	Sat/Sun 13 B
Mon 15 CSTRB	Tues 16 ~~In Washington~~	Wed 17	Thur 18	Fri 19	Sat/Sun 20 B
Mon 22 B KAIB	Tues 23	Wed 24 +	Thur 25	Fri 26	Sat/Sun 27/28 Surrealist Ball, TCM
Mon 29 SCIB	Tues 30	Wed October 1	Thur 2	Fri 3	Sat/Sun 4/5
October 1986					
Mon 6 Info Infra. Keynote Frank Kao, SRI	Tues 7 ~~SCDA (Rye NY)~~	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26

· Board Pkg.

Gordon Bell's Calendar - 8/4/86

July 1986					
Mon 28 NCAR/SCIB KC-AL--GB--OUT	Tues 29 W/SCIB?/SEI (Pitts Exec. Council	Wed 30	Thur 31	Fri August 1 9:30-Lorron	Sat/Sun 2/3
August 1986					
Mon 4 KC/CB out wk 8:30-Rick Adrion 9:00-Erich Bloch 9:30-David Main, Karl Weiss-North- eastern Univ. 11:00-John Connolly ~~2 Cand. for Larry~~ ~~Lee's job William~~ ~~Crossman, NYU~~ cancelled 3-Cand. for Lee's job-Mel Ciment- Math Division	Tues 5 9-John Woods/RPI w/Chern 10-Bartolone et al CRAY Research 10:30 Tony Lauch 11-Scient. Proc.- Honeywell Reps 540 1:30-Derald Morgan N. Mexico Univer.- Parallel Computing 2:30 Physics Today S.Amarel dinner	Wed 6; 9-2:30, Olsher & Digital Group 4-Connolly/Eric Thompson-Lehigh	Thur 7 10-Howard Resnikoff ~~12-Francis, IBM~~ ~~1-IBM~~	Fri 8 ~~2:00~~ 3:00 212-705-7882 Maureen Quinn IEEE	Sat/Sun 9/10
Mon 11 CB out wk	Tues 12	Wed 13	Thur 14 NSB - 540	Fri 15 NSB - 540	Sat/Sun 16/17
Mon 18	Tue 19	Wed 20	Thur 21	Fri 22 SCIB	Sat/Sun 23/24
Mon 25	Tues 26	Wed 27	Thur 28	Fri 29	Sat/Sun 30/31
September 1986					
Mon 1 HOLIDAY-LABOR DAY	Tues 2	Wed 3	Thur 4	Fri 5	Sat/Sun 6/7
Mon 8 Shaffer Panel, NY--	Tues 9 GB talk	Wed 10 2-5-CISE Qtly Rev. w/Director-540	Thur 11 3-5: CIA	Fri 12	Sat/Sun 13
Mon 15 CSTRB----------	Tues 16 in Washington----	Wed 17	Thur 18	Fri 19	Sat/Sun 20
Mon 22 KAIB	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28 Surrealist Ball TCM

Gordon Bell's Calendar - 8/11/86

Call Cozzolino

August 1986

Mon 11 CB out wk 11-12-Negroponte, Minsky, Papert, MIT (617-253-5960) 12-Lunch w/Suzuki of IBM 2-Interview with Joanne Simmons 4-Steve Wolff & Dave Marsten	Tues 12 9-Toye, Griffin, Adrion, and Daen at Thayer, Lunch	Wed 13 8-Exec. Council 3-3:30-Paul Rotar, NCAR, Interview 2-3-Keith Uncapher MOSIS, 1,000 univ. & ARPANET 4:00 Computer	Thur 14 NSB - 540 Dinner:NSB	Fri 15 NSB - 540	Sat/Sun 16/17
Mon 18 9-Interview with Dr. Hahn	Tue 19 9-Col. Audley at DARPA	Wed 20--2:00-3:00- Courtesy call by Gene Amdahl, Chair & Peter Appleton Jones-ELXSI Comput Co.	Thur 21 9 SCIB	Fri 22 SCIB	Sat/Sun 23/24
Mon 25	Tues 26	Wed 27	Thur 28	Fri 29	Sat/Sun 30/31

September 1986

Mon 1 HOLIDAY-LABOR DAY	Tues 2	Wed 3 11:00 → Tibor Szakovo	Thur 4	Fri 5	Sat/Sun 6/7
Mon 8 Shaffer Panel, NY--	Tues 9 GB talk	Wed 10 2:00-3:00 CISE Qtrly Rev. w/Director-540 11:00 Bill Joy, Sun	Thur 11 working Lunch 12-3-4-Dave Frances Nat'l Centers & IBM products 3-5-CIA	Fri 12	Sat/Sun 13
Mon 15 CSTRB----------	Tues 16 in Washington----	Wed 17	Thur 18	Fri 19	Sat/Sun 20
Mon 22 KAIB	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28 Surrealist Ball TCM
Mon 29 SCIB	Tues 30	Wed October 1	Thur 2	Fri 3	Sat/Sun 4/5

Please Note changes

Barbara Fine on Bill Joy on 8/10

Gordon Bell's Calendar - 8/15/86

August 1986

Mon 18-7-To Wash.	Tue 19	Wed 20	Thur 21	Fri 22 SCIB	Sat/Sun 23/24
9-Interview with Dr. Hahn 10-Interview with Odessa Dyson 2-Discuss. mtg of upcoming Q'trly Rev.-Room 306 (Devey attend. for Chern)	4-To California	No Exec. Cl Mtg Call Hewlett > Oct 10 ·Talk ·Open it HP = $, H ≠ $, Collectanis rare.	9 SCIB —	Lawrence Exp. 1:30-Ed SUN 106 Arques	7:15a-To Washington

1:30 Comm

Lion PAO

Mon 25	Tues 26	Wed 27	Thur 28	Fri 29	Sat/Sun 30/31
		8:30-Exec. Cl 2-3-Mr. Valenka Scient. Comp. Sys.		2:59-To Boston	

September 1986

Mon 1	Tues 2	Wed 3	Thur 4	Fri 5	Sat/Sun 6/7
HOLIDAY-LABOR DAY	7-To Washington ~~3-5~~-OMB/CISE Annual Mtg-Rm 425	8:30-Exec. Cl			

9:30 Liz Gallese, Lincoln

Mon 8	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13
Shaffer Panel, NY--	GB talk	8:00-Exec. Cl 2-5-Qtrly Review w/Director-540 11:30 Bill Joy, Sun	12-2-Dave Frances Nat'l Centers & IBM products 3-5-CIA	Gwen to Washington	

Mon 15-1:15-6:30p-	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20
CSTRB---------- Dinner also	in Washington----	8:30-Exec. Cl		9-EBNEK DARPA 11-SDInet Briefing	

Mon 22	Tues 23	Wed 24	Thur 25 Gwen (NY)	Fri 26	Sat/Sun 27/28
8:30-Exec. Cl KAIB					~~Surrealist Ball~~

Mon 29	Tues 30	Wed October 1	Thur 2	Fri 3	Sat/Sun 4/5
SCIB	8:30-Exec. Cl				

remove these lines which screw up format all the time

Gordon Bell's Calendar - 8/25/86

August 1986

Mon 25	Tues 26	Wed 27	Thur 28	Fri 29	Sat/Sun 30/31
10-Larry McCray, NAS--Fund. the CSB (Chuck attending)		~~8:30~~ 9:00-Exec. Cl 2-3-Mr. ~~Valenka~~ Scient. Comp. Sys.	4: E. Block 4:30 Trunnell	Curtis-out 2:59-To Boston	

September 1986

Mon 1-Kent out wk HOLIDAY-LABOR DAY	Tues 2 7-To Washington 2-4-OMB/CISE Annual Mtg-Rm 425 2:00 Dir. Dirs. Mtg-306 12:15 Dr. Krim	Wed 3 8:30-Exec. Cl 1-Tibor Szekeres, re ISDN Products 3-5-OMB/CISE/OBAC Annual Mtg-Bell & Div Dirs-425 Dinner: John Payne	Thur 4 10-George Lindahood, NBS, re: Computer Architecture	Fri 5	Sat/Sun 6/7 Gwen: Wash.
Mon 8 Shaffer Panel, NY--	Tues 9 GB talk	Wed 10 8:00-Exec. Cl 11:30-SUN Micro-systems Group 2-5-Qtrly Review the Director	Thur 11 10:15 Dr. Elgar 12-2-Dave Frances Nat'l Centers & IBM products 3-5-CIA	Fri 12 Doe mtg? Gwen to Washington	Sat/Sun 13 Boston
Mon 15-1:15-6:30p-CSTRB---------- Dinner also	Tues 16 in Washington----	Wed 17 8:30-Exec. Cl	Thur 18	Fri 19 9-EBNEK DARPA 11-SDInet Briefing	Sat/Sun 20 Boston
Mon 22 8:30-Exec. Cl KAIB	Tues 23	Wed 24	Thur 25 2:30-4:30-NASA/NSF mtg-600 Indepen. Ave, SW; Edelson & McConnell re Infor Systems	Fri 26	Sat/Sun 27/28 Surrealist Ball Gwen: Wash.
Mon 29 SCIB ← Colef	Tues 30 8:30-Exec. Cl	Wed October 1	Thur 2	Fri 3	Sat/Sun 4/5

331 9444

New front page 9/25

GB
Will have complete updated calendar printed by COB today

Gordon Bell's Calendar - 9/15/86

September 1986

Mon 15-1:15-6:30	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20
CSTRB----------	in Washington----	8:30-Exec.Cl		9:45-Mr.Bloch/	Boston
Dinner also			2:00-IBM group	EXPRES-Connie,	
			RP3	Thaler	
				11-SDInet Briefing	
				Jefrsn.Aud,14&Ind.	
				4th wing ent.,Ag.so	
		2:00-Steve Wolff		2-Cornel Ctr Group	
		3:00-Briefing for		Mtg-(Connolly &	
	Dinner/Metcalfes	Mr.Bloch by P.House		Harvey)	
		"Allocation"/Rm.540			

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		9:30-Dr. Connolly		California	California
	In at 9 a.m.	10:00-Bernie Chern	10:00-Mr. Bowright/		
	2:00-Exec. Cl.	10:30-Stan Joseph/	Int'l.Prog.		
	3:30-Mr. Bloch	Bob Paluch/Frank	2:30-4:30-NASA/NSF		
		Marshall--CONVEX	mtg-600 Indepen.		
		11:45-Lunch/WH Con/	Ave,SW;Edelson &		
		w/CONVEX	McConnell re Infor		
		2:15-K.Curtis*	Systems		
		2:45-J.Connolly*			
		3:15-C.McLinden/Al			
		Thaler			
		4:00-B.Chern*			
		*Perf.Reviews			

Mon 29	Tues 30	Wed October 1	Thur 2	Fri 3	Sat/Sun 4/5
SCIB	~~8:30-Exec.Cl~~	~~Washington~~		8:30-12:00-EBNEK &	
2 p.m.San Jose	~~10:30-Briefing for~~			INTEL (DARPA)	
	~~Mr.Bloch by P.House~~		1:00-CISE Sr.Staff		
	~~"Health of Science"~~		Mtg (Div.Dirs/CB/		
	~~Rm.540~~		JDaen		
	California				

October 1986

Mon 6	Tues 7 W-I	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
	Cornell S/C	Cornell	Cornell		Boston
		Directors Meeting			

Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
HOL-COLUMBUS DAY					Boston

Gordon Bell's Calendar - 9/15/86

September 1986

Mon 15-1:15-6:30	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20
CSTRB----------	in Washington----	8:30-Exec.Cl		9:45-Mr.Bloch/	Boston
Dinner also			2:00-IBM group	EXPRES-Connie,	
			RP3	Thaler	
				11-SDInet Briefing	
				Jefrsn.Aud,14&Ind.	
				4th wing ent.,Ag.so	
					Moody, Sun. at 5
		2:00-Steve Wolff			
				2-Cornel Ctr Group	
		3:00-Briefing for		Mtg-(Connolly &	
	Dinner/Metcalfes	Mr.Bloch by P.House		Harvey)	
		"Allocation"/Rm.540			

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		9:30-Dr. Connolly		California	California
	In at 9 a.m.	10:00-Bernie Chern	10:00-Dr. Bowright/		
	2:00-Exec. Cl.	10:30-Stan Joseph/	Int'l.Prog.		
	3:30-Mr. Bloch	Bob Paluch/Frank	2:30-4:30-NASA/NSF		
		Marshall--CONVEX	mtg-600 Indepen.		
		11:45-Lunch/WH Con/	Ave,SW;Edelson &		
		w/CONVEX	McConnell re Infor		
		2:15-K.Curtis*	Systems		
		2:45-J.Connolly*			
		3:15-C.McLinden/Al			
		Thaler			
		4:00-B.Chern*			
		*Perf.Reviews			

Mon 29	Tues 30	Wed October 1	Thur 2	Fri 3	Sat/Sun 4/5
SCIB	California	To Washington		8:00-Exec Cl	
2 p.m.San Jose				8:30-12:00-EBNEK &	
			1:00-CISE Sr.Staff	INTEL (DARPA)	
			Mtg(Div.Dirs/Chuck/	12-1-Mr.Bloch/ADs	
			Jerry)	(Lunch provided)	
				3:00-4:00-NSF Staff	
				Mixer/Rm.1242	

October 1986

Mon 6	Tues 7 W-I	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
	Cornell S/C	Cornell	Cornell	To Boston	Boston
	Directors Meeting				
4-Rick Adrion					
5- plans interv					

Mon 13	Tues 14	Wed 15	Thur 16 ENIAC	Fri 17	Sat/Sun 18/19
HOL-COLUMBUS DAY					Boston

Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26
8-10 Mass Council			HOLD/Boston	Bellcore	D.C
Parallelism,				Morristown, N.J.	
Marriott			HP Opening		

Gordon Bell's Calendar - October 6, 1986

October 1986

Mon 6	Tues 7 W-I	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
	Cornell S/C	Cornell	Cornell	To Boston	Boston
	Directors Meeting				9:30 Photog Boston Bus.
3:30-Rick Adrion					
5-Phone interview					

Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
HOL-COLUMBUS DAY	2:30-Jack Dongarra/ Argonne Nat'l.Lab w/Connolly&Harvey		2-2:30-Bob Borchers (Laurence Livermore Lab./California) (FTS 543-6096)		Boston Liz Gallese 18 10:30

Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26
8-10 Mass Council Parallelism,			HOLD/Boston	Bellcore Morristown, N.J.	D.C
3:15-Health of Science Briefing for Bloch & Sr.Stf.					

Mon 27	Tues 28	Wed 29	Thur 30	Fri 31	Sat/Sun Nov 1/2, NAE
10-4-NAE EAB Rm. 180, 2101 Conn.	11:00-Robert White/ VP&Eng./Control Data/Minnesota,Lois Rice/Sr.VP,Govt. Affairs&J.O'Connell (789-6517)	U.Wash./Digital Conf.	Seattle	SCIB Lv for Calif.	11/1-Teknowledge Adv Bd-Palo Alto (tent.
1:00-Health of Science Briefing/ Bloch & Sr. Staff					

November 1986

Mon 3	Tues 4	Wed 5	Thur 6	Fri 7	Sat/Sun 8/9
California	To Dallas	Computer Conf. Dallas-Keynote	Washington		

Mon 10	Tues 11	Wed 12	Thur 13 NSB - 540	Fri 14 NSB - 540	Sat/Sun 15/16
	HOL-VETERANS DAY 9-12-NAE Tel Comm. Bd. To NY	U.Rochester/NY To DC			Washington

Mon 17	Tues 18	Wed 19	Thur 20	Fri 21	Sat/Sun 22/23
			9:00-OASC Adv.Com. 2:00-MIT-Boston w/ Clutter/Shakashiri Contact:J.Wiesner	U.Mass	Boston

Gordon Bell's Calendar - 10/13/86

Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
HOL-COLUMBUS DAY	2:00-Jack Dongarra/ Argonne Nat'l.Lab w/Connolly&Harvey 4-5-Welcome new NSF prof.staff/ Rosslyn Westpark/ 1900 N.Ft.Meyer Dr.	11:00-Dr. Hans Conrad Schmidt,Inst for Comtemp.German Studies (332-9312)	1:30-2-Bob Borchers (Laurence Livermore Lab./California) (FTS 543-6096) 2-2:45-EHR Cmte. Panel Session/Rm543 (NSB)		

Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26
8-10 Mass Council Parallelism, 3:15-Health of Science Briefing for Bloch & Sr.Stf.				Bellcore Morristown, N.J.	D.C

Mon 27	Tues 28	Wed 29	Thur 30	Fri 31	Sat/Sun Nov 1/2, NAE
10-4-NAE EAB Rm. 180, 2101 Conn. 1:00-Health of Science Briefing/ Bloch & Sr. Staff	11:00-Robert White/ VP&Eng./Control Data/Minnesota,Lois Rice/Sr.VP,Govt. Affairs&J.O'Connell (789-6517)	U.Wash./Digital Conf.	Seattle	SCIB Lv for Calif.	11/1-Teknowledge Adv Bd-Palo Alto (tent.

November 1986

Mon 3	Tues 4	Wed 5	Thur 6	Fri 7	Sat/Sun 8/9
California	To Dallas	Computer Conf. Dallas-Keynote	Washington 4-Larry Smarr,Dir. Ill.Suprcmptr Ctr (217/244-0072)	9:30-10:30-DARPA/ Dr.Duncan,Dr.Fields Chuck 2:30-Ann Lewin,Ntl. Lrng.Ctr.(800 3rd NE,Adm.Bldg. (675-4133)	

Mon 10	Tues 11	Wed 12	Thur 13 NSB - 540	Fri 14 NSB - 540	Sat/Sun 15/16
	HOL-VETERANS DAY 9-12-NAE Tel Comm. Bd. To NY	U.Rochester/NY To DC			Washington

Gordon Bell's Calendar - 10/27/86

October

Mon 27	Tues 28	Wed 29	Thur 30	Fri 31	Sat/Sun **Nov** 1/2, NAE
		9:30-Exec. Cl.	U.Wash./Digital	California	11/1-Teknowledge Adv
10-4-NAE EAB		11:30-ICOT Group	Conf.		Bd-Palo Alto
Rm.180,2101 Conn.	11:00-Robert White/	1:30-Mel Ciment			
12-Lunch-Bloch/IBMs	VP & Eng./Control	1:45-Bill Hogan/			
Davis (to confirm)	Data/Minnesota,Lois	Honeywell			
1:30-Health of	Rice/Sr.VP,Govt.	3:00-Mr. Bloch			
Science Briefing/	Affairs&J.O'Connell	(5:25p to Seattle	(10:30p to SF via		
Bloch & Sr. Staff	(789-6517)	via NWAir;Ar.9:32p)	PSA;ar.12:14a)		
(Rm.540)					
4:00-Joe Traub	Les Gerhardt				

November 1986

Mon 3	Tues 4	Wed 5	Thur 6	Fri 7	Sat/Sun 8/9
California		Computer Conf.	(8:40a to DC via		Washington
		Dallas-Keynote	Am.;Ar.1:00p)	10:00-CISE Sr.Staff	
2:00-SCIB (Kleiner	(3:25p to Dallas		Paul Rotar		
Perkins)	via Amer.;Ar.8:30p)		3:00-Bob Gillespie	2:30-Ann Lewin,Ntl.	
			(Gillespie&Folkner)	Lrng.Ctr.(800 3rd	
				NE,Adm.Bldg.	
			4-Larry Smarr,Dir.	(675-4133)	
			Ill.Suprcmptr Ctr		
			(217/244-0072)		

Mon 10	Tues 11	Wed 12	Thur 13 NSB - 540	Fri 14 NSB - 540	Sat/Sun 15/16
	HOL-VETERANS DAY	U.Rochester/NY			Boston
	9-12-NAE Tel Comm.				
11-12-DARPA/Dr.Dun-	Bd.(Rm.351,NAS,2100				MIT Meeting
can,Dr.Fields,Chuck	Pa.)				
				(5:50p to Boston	
	(5:45p to NY via	(4:40p to DC via		via NW;Ar. 7:10p)	
	USAir;ar.6:47p)	USAIR;ar.5:40p)			

Mon 17	Tues 18	Wed 19	Thur 20	Fri 21	Sat/Sun 22/23
9:30-Emerson Hosp./	(7:30a to DC via		9:00-OASC Adv.Com.	U.Mass.	Boston
Outpatient-Tread-	EA; Ar. 8:59a)	10-11-Eng Adv.Comm.			
mill/nucl.camera/	11-12-Bloch w/Dr.		(12:17p to Boston		
+physical ckup by	Nichlsn./Comptl.		via EA; Ar. 1:30p)	(Tent./dnr.mtg.w/	(Sun 23-3:45p to
Dr. Winchell (NOTE:	Sc.&Engin.Program	3:00-Bloch/Research		J.Smith,S.Fuller,	Ill. via TWA; Ar.
Nothing by mouth		ADs (Rm.520)		B.Strecker,R.Olsen-	7:47p)
after midnight				Digital)	
10/16, only sips			2:00-MIT-Boston w/		
of water)			Clutter/Shakarshiri		

Gordon Bell's Calendar - 11/10/86

November 1986

Mon 10	Tues 11	Wed 12	Thur 13 NSB - 540	Fri 14 NSB - 540	Sat/Sun 15/16
9:30-Bill Bickford/ Gould	HOL-VETERANS DAY 9-12-NAE Tel Comm. Bd.(Rm.351,NAS,2100 Pa.) (5:45p to Rochester USAIR #306;ar.6:47p (Will be picked up at airport by Prof. Sidney Shapiro)	U.Rochester/NY (6:50p to DC via UNITED #1422; ar. Dulle 7:53p)	9:00-S.Toye/Rm/425 10:25-Dr. Haaler, U/Utah--courtesy 10:30-David Caswell U.Cal./San Diego (479-2609) 11:30-Fred Brooks, NSB	1:00-Dean Leonard Silverman,USC/LA 2:00-Bensoussan, INRI,Bloch(Rm.520) 5:50p to Boston via NW;Ar.7:10p_	Boston 10:00-MIT/ 545 Technology Sq. Rm. 105 (253-2145) (Knock on door if locked)
Mon 17	**Tues 18**	**Wed 19**	**Thur 20**	**Fri 21**	**Sat/Sun 22/23**
9:30-Emerson Hosp./ Outpatient-Tread-mill/nucl.camera/ +physical ckup by Dr. Winchell (NOTE: Nothing by mouth after midnight 16, only sips of water)	(7:30a to DC via EA; Ar. 8:59a) 11-12-Bloch w/Dr. Nichlsn./Comptl. Sc.&Engin.Program-ADs	8:30-Ex.Cl. 10-11-Eng Adv.Comm. 11-12-Keith Uncaph-er/USC 2:00-3:00-ASC Ctr. Dirs./Bloch (Rm520) 3:00-Bloch/Research ADs (Rm.520)	9:00-OASC Adv.Com. (12:17p to Boston via EA; Ar. 1:30p) 2:00-MIT-Boston w/ Clutter/Shakarshiri Contact:J.Wiesner	10:00-U.Mass. (Driver will pick you up at home)	Boston (Sun 23-3:45p to Ill. via TWA; Ar. 7:47p)
Mon/24	**Tues 25**	**Wed 26**	**Thur 27**	**Fri 28**	**Sat/Sun 29/30**
U.Ill. (SCIB)	(4:40p to Denver via Britt + TWA; Ar. 8:00p)		HOL-THANKSGIVING		(2:53p to DC via EA; Ar. 9:12p)

December 1986

Mon 1	Tues 2	Wed 3	Thur 4	Fri 5	Sat/Sun 6/7
	(Minnesota???)		(CCR AdvCom 9-5:30) 9:00-CCR Adv.Comm./ "Drctrt Status/ Plans"-Rm.540 11:00-Geoffrey Fox/ Caltec,Connly,Hrvy,	(CCR Adv.Comm/9-3) (5:50p to Boston via NW #292;Ar. 7:10p)	Boston

Gordon Bell's Calendar - 11/17/86

12-1 Joe

November 1986

Mon 17	Tues 18	Wed 19	Thur 20	Fri 21	Sat/Sun 22/23
9:30-Emerson Hosp./ Outpatient-Tread-mill/nucl.camera/ +physical ckup by Dr. Winchell (NOTE: Nothing by mouth after midnight 16, only sips of water)	(7:30a to DC via EA; Ar. 8:59a) 10:45-11:45-Bloch/ Nichlsn./Comptl. Sc.&Engin.Program-ADs 1:30-Bernie Chern 3rd mtg Comst	8:30-Ex.Cl. 540 10-11-Eng/Adv.Comm. 11-12-Keith Uncapher/USC 2:00-3:00-Larry Lee 3:00-Bloch/Research ADs (Rm.520) 7:30-Dnr./ASC Adv Grp/HOGATES,9th & Main SW (Connolly)	(7:29a to Boston via EA #1622; Ar. 8:43a) 9:00-MIT-Boston w/ Bloch/Clutter/ Shak'shiri (Contact Wieshner)	10:00-U.Mass. (Driver will pick you up at home at 8 a.m.)	Boston (Sun 23-3:45p to Ill. via TWA; Ar. 7:47p)

Mon 24	Tues 25	Wed 26	Thur 27	Fri 28	Sat/Sun 29/30
U.Ill. (SCIB)	(4:40p to Denver via Britt + TWA; Ar. 8:00p)		HOL-THANKSGIVING		(2:53p to DC via EA; Ar. 9:12p)

December 1986

Mon 1	Tues 2	Wed 3	Thur 4	Fri 5	Sat/Sun 6/7
	(Minnesota???)	9-4:30 EEO Training 4-7-ASCME Open Hs. 1825 K,NW,Suite218	(CCR AdvCom 9-5:30) 9:00-CCR Adv.Comm./ "Drctrt Status/ Plans"-Rm.540 11:00-Geoffrey Fox/ Caltec,Connly,Hrvy.	(CCR Adv.Comm/9-3) (5:50p to Boston via NW #292;Ar. 7:10p)	Boston

December 1986

Mon 8	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
3:00-Jack Smith/ Digital+Sam Fuller/ Bill Strecker/Jim Cudmore	(8:20a to SanFran. via TWA177;Ar.1:30p	-Monterey Keynote-	3:30-CISE Incen	SCIB Awd Cere. 1242A&B	(7:10a to DC via United 122;Ar Chic 1:10p;Lv.Chic 2:30 via UN 616;Ar DC 5:04p)

Mon 15	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20/21
		9:00-Prof.Azriel Rosenfeld,U/Md. (454-4526)	ACM Wash. Chap. Dinner Mtg Gwen/DC -------->	<-----------	Gwen/DC

December 1986

Mon 8	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
3:00-Jack Smith/ Digital+Sam Fuller/ Bill Strecker/Jim Cudmore	(8:20a to SanFran. via TWA177;Ar.1:30p	-Monterey Keynote-	3:30-CISE Incen	SCIB Awd Cere. 1242A&B	(7:10a to DC via United 122;Ar Chic 1:10p;Lv.Chic 2:30 via UN 616;Ar DC 5:04p)
Mon 15	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20/21
	← CSTB	9:00-Prof.Azriel Rosenfeld,U/Md. (454-4526)	ACM Wash. Chap. Dinner Mtg Gwen/DC -------->	<---------------->	Gwen/DC
Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		To Kirxville	HOL-CHRISTMAS		To Bayman
Mon 29	Tues 30	Wed 31	Thur **Jan 1**	Fri 2	Sat/Sun 3/4
<----------VACATION---------->			HOL-NEW YEAR'S		To Washington

January 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
			IRIS 1st Adv.Comm. Mtg. ---------->	IRIS 1st Adv.Comm. Mtg.	Washington
Mon 12	Tues 13	Wed 14	Thur 15 NSB	Fri 16 NSB	Sat/Sun 17/18
	(Gwen/NY)				Boston
Mon 19 HOL-MARTIN LUTHER KING'S BIRTHDAY Boston	Tue 20 NAS Bd. -------->	Wed 21 NAS Bd.	Thur 22 9-10-USR Group DC Conv. Ctr	Fri 23	Sat/Sun 24/25

January 1987

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat/Sun 31/Feb 1
NSF Ex Cl Retreat (Airlee House)---------->	NSF Ex Cl Retreat	1-4-Qtrly.Review/ Mr. Bloch	IBM/Hawthorne/ Thaler		
(KA1B)					

HIN
TWA 122
5:50-6:39

NY 318
4:00 - 5:10
1:00 - Trial
NY 305
9:00
10:23

Agenda

1:00 K - Prime Rib

Gordon Bell's Calendar - 12/1/86

December 1986

Mon 1	Tues 2	Wed 3	Thur 4	Fri 5	Sat/Sun 6/7
8:30-Connolly's office (Fosdick, Klingenstein, Schnabel) 2-Int./Y.Zakstein/ (CCR) 3-4-FCCSET Cmte.on Computers-Rm.5002, NEOB-Amaral/Decker/ Huray	8:30-Exec.Cl. 2-Int./Prof.Ting--(Dep.Div.Dir./CCR) 3:30-Bloch/Connie--re EXPRES--Rm.520	9-11-Bloch's ofc.--Bob Price/Lloyd Thorndyke--Control Data 2-Min.Resrch.Ctrs of Exclence-Rm.540 "CISE Priorities" 3-Wladawsky/IBM 4-Dr.Kenneth Keller Pres./U.Minn. 4-7-ASCME Open Hs. 1825 K,NW.,Suite218	(CCR AdvCom 9-5:30) 9:00-CCR Adv.Comm./ "Drctrt Status/ Plans"-Rm.540 ~~11:00-Geoffrey Fox/~~ ~~Caltec,Connly,Hrvy.~~	(CCR Adv.Comm/9-3) 11-Geoffrey Fox/Caltec Rm 642 (5:50p to Boston via NW #292;Ar. 7:10p) 642	

7:00 Newark

Mon 8 8:00 Lone	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
3:30-5:30-JackSmith Digital+Sam Fuller/ Bill Strecker/Jim Cudmore/R.Olsher-- Sheraton-Lexington 5:30-Dinner w/same	(8:20a to SanFran. via TWA177;Ar.1:30p	8:30-Exec. Cl. -Monterey Keynote-	3:30-CISE Incen Awd Cere. 1242A&B	SCAB	(7:10a to DC S United 122;Ar 1:10p;Lv.Chic via UN 616;Ar 5:04p)

Mon 15	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20/21
11-DARPA-Duncan/ Fields (1400 Wilson Blvd.,Arlington 3:30-Int./Dr.Lefko-vitz (D.Div.DirCCR) 5:30-Dinner/George O'Leary,President, Floating Point Sys	(CSTB Infrastrctr. Subgrp-NAS Bd. Rm)	8:30-Exec. Cl. (CSTB Articulation Subgrp-NAS,Rm.250) 11-Prof.Azriel Rosenfeld,U/Md. (454-4526)	ACM Wash.Chap. Dinner Mtg. Gwen/DC--------->	---------->	Gwen/DC

Ann Lewis @ 10 ~~ICAT~~

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		To Kirxville	HOL-CHRISTMAS		To Bayman

December 1986

Mon 29	Tues 30	Wed 31	Thur Jan 1	Fri 2	Sat/Sun 3/4
			HOL-NEW YEAR'S		To Washington
<----------VACATION---------->					

Gordon Bell's Calendar - 12/8/86

December 1986

Mon 8	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
8:00-Lorron	(8:20a to SanFran.	(8:30-Exec. Cl.)	(3:30-CISE Incen		(7:10a to DC Sun/14
3:30-5:30-JackSmith	via TWA177;Ar.1:30p		Awd Cere. 1242A&B)		United 122;Ar Chic
Digital+Sam Fuller/		-Monterey Keynote-			1:10p;Lv.Chic 2:30
Bill Strecker/Jim					via UN 616;Ar DC
Cudmore/R.Olsher--					5:04p)
Sheraton-Lexington					
5:30-Dinner w/same					

Mon 15	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20/21
	(CSTB Infrastrctr.	8:30-Exec. Cl.	9:00-EEO Trng.		10-(Sat.) Ann Lewin
11-DARPA-Duncan/	Subgrp-NAS Bd. Rm)	(CSTB Articulation			
Fields (1400 Wilson		Subgrp-NAS,Rm.250)			
Blvd.,Arlington)		11-Prof.Azriel			
		Rosenfeld,U/Md.	2-Larry Lee/Alison		
3:30-Int./Dr.Lefko-		(454-4526)	Brown/Ken Wilson/		
vitz (D.Div.DirCCR)			Connolly		
		1-3-House Staff			
		Committee briefing-	Gwen/DC---------->		
		w/Connolly/Wolff	6-ACM Wash.Chap.		
5:30-Dinner/George			Dinner Mtg.(HldyInn		
O'Leary,President,			/Roslyn-1850 N.Ft.		
Floating Point Sys			MyerDr./RoslynMetro		

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		To Kirxville	HOL-CHRISTMAS		To Bayman

Mon 29	Tues 30	Wed 31	Thur Jan 1	Fri 2	Sat/Sun 3/4
			HOL-NEW YEAR'S		To Washington
<----------VACATION---------->					

January 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
			IRIS 1st Adv.Comm.	IRIS 1st Adv.Comm.	
			Mtg. ---------->	Mtg.	
					Washington

Bob

Systems Bayfd
VLSI "
Net. Mtg.

2 OLPA ops HS

1:30

Gordon Bell's Calendar - 12/15/86

December 1986

Mon 15	Tues 16	Wed 17	Thur 18	Fri 19	Sat/Sun 20/21
11-DARPA-Duncan/ Fields (1400 Wilson Blvd.,Arlington) 2:30-Lynn Conway, Asso.Dn./Eng./UMich 3:30-Int./Dr.Lefkovitz (D.Div.DirCCR) 5:30-Dinner/George O'Leary,President, Floating Point Sys	(CSTB Infrastrctr. Subgrp-NAS Bd. Rm) 9-Sid Karin/San Diego Supcomp Ctr 1-IRIS Christmas Party 3-5-DASC Christmas Party	8:30-Exec. Cl. (CSTB Articulation Subgrp-NAS,Rm.250) 11-Prof.Azriel Rosenfeld,U/Md. (454-4526) (12-3?? 335 pmk 506) 1-3-House Staff Committee briefing- w/Connolly/Wolff/ Chuck/Ciment Rm.543	9:00-EED Trng. 11-Dr. Mike Levine/ Dr. Raskies 2-Larry Lee/Alison Brown/Ken Wilson/ Connolly/Rotar 3??-5-Bloch Christmas Party Gwen/DC----------> 6-ACM Wash.Chap. Dinner Mtg.(HldyInn /Roslyn-1850 N.Ft. MyerDr./RoslynMetro	9-Jim Burrows,Dir. Comp.Inst.Bur.Stds w/Wolff 11-Dr.Nicholas Declaris, U/Md. 2-Ed Sussenguth/IBM w/Wolff/Farber (1-5-NSFEA party - GAU 9-1 543 Ec. Comp.	10-(Sat.) Ann Lewin
Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		To Kirxville	HOL-CHRISTMAS		To Bayman
Mon 29	Tues 30	Wed 31	Thur Jan 1	Fri 2	Sat/Sun 3/4
			HOL-NEW YEAR'S		To Washington
<----------VACATION----------				---------->	

January 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
	1:30 Net Mtg. at NSF		IRIS 1st Adv.Comm. Mtg. (9-5:30)---------->	IRIS 1st Adv.Comm. (9-3)	Mtg. ~~Washington~~ Bos
Mon 12	Tues 13	Wed 14	Thur 15	Fri 16	Sat/Sun 17/18
	Pittsburgh Ctr Mtg (Gwen/NY)	Pittsburgh	11-Cecelia Shen, Geo.Lewicki(MOSIS ISI)	10-Ray Wood/Olsher	Boston

466-8811

Gordon Bell's Calendar - 12/22/86

December 1987

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
1:30-Nat'l.Bureau of Standards		To Kirxville	HOL-CHRISTMAS		To Bayman

Mon 29	Tues 30	Wed 31	Thur Jan 1	Fri 2	Sat/Sun 3/4
	VACATION		HOL-NEW YEAR'S		To Washington

January 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
10:00 Dry Run. 1:45/5:40 - News	Return PCCsat Mtg at pm 643 1:30. 10:5~~0~~, 523 = Cong. Staff Budget Review	8:30 Exec. Cl 11-Bert Colvin,Dir. Acad.Affrs.,Francis Sullivan,Ctr.Applid Math/Ntl.Bur.Stds. 2:15 Walsh GW	(IRIS 1st Adv.Comm. Mtg.) 7:30A - To Minneapolis/CRAY Research,w/Bloch ret. 5:34p Ar DC 8:30 p	9-IRIS Adv.Comm./ Remarks	Boston (OK) 1:00-Bob Young/Mitch Kabor (Gensyn Corp) (Bob/H-617/2127; O-617/864-3331)

Mon 12	Tues 13	Wed 14	Thur 15	Fri 16	Sat/Sun 17/18
1:30-3:30-Connolly Wilbur 6 p.m. P to Pittsburgh Ar: 6:51	Pittsburgh Ctr Mtg (Gen/NUY)	Pittsburgh 5:49p) To D.C. Ar. 6:00 p.m Return	10-RayWood/R.Olsher 11-Cecelia Shen, Geo.Lewicki(MOSIS ISI) 12-2-Lunch mtg,NSF ADs/Bloch/Dr.Graham Science Advisor to President 2:30-Dr.Jno Baras, U/Md.	9-12-Cong.Staff Briefing/Rm.540 2-Bill Grossman, E. David, Connally	Boston (OK)

January 1987

Mon 19	Tue 20	Wed 21	Thur 22	Fri 23	Sat/Sun 24/25
HOL-MARTIN LUTHER KING'S BIRTHDAY Boston	NAS Bd. Rev. Tech Seminar (Eng.Direct.)	NAS Bd.	9-10-USR Group DC Conv. Ctr		Washington (Bell)

- Systems →
- VLSI →
- Net Mtg →

Gordon Bell's Calendar - 12/22/86

December 1987

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
		To Kirxville	HOL-CHRISTMAS		To Bayman

Mon 29	Tues 30	Wed 31	Thur Jan 1	Fri 2	Sat/Sun 3/4
			HOL-NEW YEAR'S		To Washington
<----------VACATION---------->					

January 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
		11-Bert Colvin,Dir. Acad.Affrs.,Francis Sullivan,Ctr.Applid Math/Ntl.Bur.Stds.	(IRIS 1st Adv.Comm. Mtg.) Minneapolis/CRAY Research,w/Bloch	9-IRIS Adv.Comm./ Remarks EA:	Boston 1:00-Bob Young/Mitch Kabor (Gensyn Corp) (Bob/H-617/2127; O-617/864-3331)

Mon 12	Tues 13	Wed 14	Thur 15	Fri 16	Sat/Sun 17/18
EA64	Pittsburgh Ctr Mtg	Pittsburgh	10-RayWood/R.Olsher 11-Cecelia Shen, Geo.Lewicki(MOSIS ISI) 12-2-Lunch mtg,NSF ADs/Bloch/Dr.Graham Science Advisor to President 2:30-Dr.Jno Baras, U/Md.	9-12-Cong.Staff Briefing/Rm.540	
1:30-3:30-Connolly	(Gwen/NY)				Boston

January 1987

Mon 19	Tue 20	Wed 21	Thur 22	Fri 23	Sat/Sun 24/25
HOL-MARTIN LUTHER KING'S BIRTHDAY	NAS Bd. ---------->	---> NAS Bd.	9-10-USR Group DC Conv. Ctr		Washington
Boston					

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat/Sun 31/Feb 1
NSF Ex Cl Retreat (Airlee House)---------->	NSF Ex Cl Retreat	1-4-Qtrly.Review/ Mr. Bloch/Rm.543	IBM/Hawthorne/ Thaler		(California???
(KA1B)				lv. for Calif	

TALKS/PANELS/CONFERENCES

Conf. Date:	Due Date:	Contact/Organ.:	Tel.:	Where:	Conference/Subject:
9/8-9(me)		Shaffer		NYC	
9/11		Bill Petrie	351-2338	Washingtn	CIA on Technology
10/6		Kuo	415-326-2600	Washington	Infor. Infra.
10/20		Bricklin	617-497-5716	Boston	Parallel Processing
10/29-30		Golde	206-543-0070	Seattle	
11/5-7		Kowalczyk	914-945-2718	Dallas	FJCC
11/21/86		Knowles	617-655-8000	U. of Mass.	PRIME
11/24-25		Everhart	217-333-1000	U. of Ill.	
12/10		Grothjahn	404-542-3265	Monterey	Comp. Centers Direct.
12/18		Dundzila	202/639-3528	Washington	ACM Dinner Mtg
1/22/87		Reilly	408-986-8840	Washington	USR/Group
2/18/87		Bergstrom	703-883-6000	Williamsburg	MITRE
2/26/87		Friesen	602-997-3996	Phoenix	ICCCD
3/9/87					NASA Symposium
3/16/87				Calif?	Optical Computing Conf. (not invited)
3/24/87		Losleben		California	VLSI
6/29-7/87				Manchester UK	Alvey Annual Conf

INVITATIONS TO VISIT

Date:	Organization:	Person/Title:	Subject:
	U. of Ill.	Tom Everhardt, Provost	
	U. of Georgia	?	
7/3/86	Princeton	William G. Bowen, Pres.	
7/11/86	Ohio State	Jack Hollander	
7/14/86	U. of Alabama	Warren J. Jones, Hd	
?phone	Cornell	Ken Wilson	

WOULD LIKE TO VISIT

BBN
Boeing
BTL
Columbia
Convex (Dallas)
Cornell (centers,csd)
CMU (Kung, SEI, Neural)
Cray/ETA
Dartmouth (603/646-2609)
Digital Productions
(213-642-0055, DMThorpe)
GM Research (George Dodd)
Al Erisman- 865-3500-2
IBM Yorktown
Illinois (Center,Kuch)
Midwestern universities: Iowa,Kansas,Nebraska (big 8)
MIT (arvind, ai lab, negroponte)
NYU
Ovishinsky Dartmouth
SRC (Rignanti)

BOOKS AND PAPERS

Science: CISE charter
Working CS Taxonomies
High Technology Structures
Computer Structures III
Computer Evolution
Suns vs. Supercomputer
Hyper Hypes
Letter to Centers Directors and Panel
Infrastructure Talk Paper

DO

Cholestrol
Dentist in Washington. Eye Mel Krinn 296-3373 2141 K #205
Dermatologist: Merv Elgart 676-4058 (referred by Smith, NSF) 2150 Penn. Ave.
Winchell: Physical

*NATIONAL SCIENCE BOARD MEETING-AFTER JUNE, 1987:

August 20-21, 1987
September 17-18, 1987
October 15-16, 1987
November 19-20, 1987

*NOTE: There are no scheduled Board meetings in April, July and December

TALKS/PANELS/CONFERENCES

Conf. Date:	Due Date:	Contact/Organ.:	Tel.:	Where:	Conference/Subject:
10/29-30				New Orleans	Alliant talk SW Louisiana Talk

INVITATIONS TO VISIT

Date:	Organization:	Person/Title:	Subject:
	U. of Lowell	Bye/Bloch	
	U. of Georgia	?	
7/3/86	Princeton	William G. Bowen, Pres.	
7/11/86	Ohio State	Jack Hollander	
7/14/86	U. of Alabama	Warren J. Jones, Hd	

COMMITMENTS

Dana; Gensym; Kendall Square; Lorron; MIPSCO; Unison; Weitek

WOULD LIKE TO VISIT

BBN
Boeing
Columbia
CMU (Kung, SEI, Neural)
Dartmouth (603/646-2609)
Digital Productions
  (213-642-0055, DMThorpe)
GM Research (George Dodd)
Midwestern universities: Iowa,Kansas,Nebraska (Big 8)
MIT (arvind, ai lab
NYU
Ovishinsky Dartmouth
SRC (Rignanti)

BOOKS AND PAPERS

Science: CISE charter	Suns vs. Supercomputer
Working CS Taxonomies	Infrastructure Talk Paper
High Technology Structures	NASA Paper
Computer Structures III	Why Gov't. Doesn't Work
Computer Evolution	Semitech Position

DO

Cholestrol
Dentists in Washington: Dr. Jeffrey Balter, 730 24th St., NW #1, 337-7266
Dr. Edwin Zimmet, 2033 K St., NW, 296-5142
Eye Mel Krinn 296-3373 2141 K #205
Dermatologist: Merv Elgart 676-4058 (referred by Smith, NSF) 2150 Penn. Ave.
Winchell: Physical

*NATIONAL SCIENCE BOARD MEETING-AFTER JUNE, 1987:

August 20-21, 1987
September 17-18, 1987
October 15-16, 1987
November 19-20, 1987
January 21-22, 1988
February 18-19, 1988
March 17-18, 1988
May 18, 19, & 20, 1988 (Annual Dinner May 18)
June 16-17, 1988
August 18-19, 1988
October 20-21, 1988
November 17-18, 1988

*NOTE: There are no scheduled Board meetings in April, July, September and December

TEKNOWLEDGE BOARD MEETINGS:

November 21, 1987
February 13,1988
June 18, 1988
September 17, 1988

Gordon Bell's Calendar - 1/12/87

January 1987

Mon 12	Tues 13	Wed 14	Thur 15	Fri 16	Sat/Sun 17/18
9:30-Connolly,Chuck Ciment,Jerry	Pittsburgh Ctr Mtg	Pittsburgh	9-Siam/Interview 10-RayWood/R.Olsher 11-Cecelia Shen, Geo.Lewicki(MOSIS ISI)	9-12-Cong.Staff Briefing/Rm.540 12-Bruce McCormack	
11-1-Connolly,Wolff	(Gwen/NY)				Boston
			12-2-Lunch mtg,NSF ADs/Bloch/Dr.Graham	2-Bill Grossman,E. David,Dr.Connolly	1/- Bill Northfield, Ron Massa
(6-To Pitts. via USAir #121;Ar. 6:51p)		(5:10p-to DC via USAir #26, Ar.6p)	Science Advisor to President 2:30-Dr.Jno Baras, U/Md. 3:30-Dan Sullivan, LaVinga--BBN		
(1 nite,Vista Int'l Hotel)	(1 nite Univ.Club) 412/621-1890				

Mon 19	Tue 20	Wed 21	Thur 22	Fri 23	Sat/Sun 24/25
HOL-MARTIN LUTHER KING'S BIRTHDAY	CSTB-(NAS-Rm. 150) 2:15-Open Session 5:30-Reception 6:30-Dinner	~~8:30 Exec. Cl.~~ 1/- John McCarthy// Stanford	9-10-USR Group DC Conv. Ctr	10:15-Dental appt./ Dr.Jeffrey Balter, 730 24th St.,NW,#1 (337-7266)	Washington
Boston					

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat/Sun 31/Feb 1
NSF Ex Cl Retreat (Airlee House)----------)	NSF Ex Cl Retreat	8:30-Wes Meador/ Tenoe/Ultra Corp--Connolly/Ciment/ Rotar	IBM/Hawthorne/ Thaler		Sat.-Teknowledge Adv. Bd.
(KA1B)		9:30-Network FCCSet Meeting		(5-To Calif via UN #623, Ar.9:08p)	

February 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
(-----Visualization--------)	Stanford	Stanford Forum Talk	(7:05a to DC via UN #122; Ar. 4:04p)		

Gordon Bell's Calendar - 1/19/87

January 1987

Mon 19	Tue 20	Wed 21	Thur 22	Fri 23	Sat/Sun 24/25
HOL-MARTIN LUTHER KING'S BIRTHDAY Boston	(6:40a-To DC via EA #189,Ar.7:59a) 8:30-Eng Rtrt/540 11:30-C.Herz/Rm.501 1:15-Decker/DOE--NAE 150 2:15-CSTB-(Open Session/Rm.150) 5:30-Reception 6:30-Dinner	8:00 9:30-Forest Baskett 10:30-Connolly/Rotar 11-John McCarthy/ Stanford U. 11:30-I.Wladawsky/ lunch 1-Dr.ForestBaskett/ Silicon Graphics 2-Bud Skiba/Stellar (Con'ly's office) 3:30 Raj Reddy	8:45-Convention Ctr Spkrs. Lounge--to be escorted to: 9-10 USR Group DC Conv. Ctr. 2:30-David Rogers/ Sequent 3:30- Convene Mtg. Lunch w/ Bill Cole, Ed Hayes, Experts	10:15-Dental appt./ Dr.Jeffrey Balter, 730 24th St.,NW,#1 (337-7266)	Washington

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat/Sun 31/Feb
NSF Ex Cl Retreat---------> (8-Meet bus at 1800 G/trans. to Airlee House/ retreat)	1:30-Lv. Airlee Hs.	8:30-Wes Meador/ Tenoe/Ultra Corp--Connolly/Ciment/ Rotar 9:30-Network FCCSet Meeting-1242 11:00 — CISE QR (virtual) (4:49-To NY via NYA #716)	IBM/Hawthorne/ Thaler 5:30P (Ret. to DC) Arr 6:40P	11-Int/CER-Jay Mack Adams (5-To Calif via UN #623, Ar.9:08p)	Sat.-Teknowled Adv. Bd. Metcalf dinner

February 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
	Stanford Talk (8:30-11-Ex. Cl. Mtg./Bd.Rm.--Chuck)	Stanford Forum TALK BANG	1-Weitch		(Sun/8-To DC v UN #122;Ar.4:4

Mon 9	Tues 10	Wed 11	Thur 12	Fri 13	Sat/Sun 14/15
9-12-CISE Qtrly. Review/Bloch-Rm.543 (Visualization in scientific computation-Rm. 540)	(Visualization in scientific computation-Rm. 540) 10-12-Bloch's office/ NSF Supercomp Dirs 1:30- Ernest Kuh, Eugene Wong/ Berkeley		(MIPS Adv. Comm.) 9:30-MIPS Adv. Com/ Drctrt Status/Plans	(MIPS Adv. Comm.)	Boston

CO 9:58 Dem

2/2

Gordon Bell's Calendar - 1/26/87

January 1987

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat/Sun 31/Feb 1
NSF Ex Cl Retreat---------)			IBM/Hawthorne/		
(8-Meet bus at		8:30-Wes Meador/	Thaler		Sat.-Teknowledge
1800 G/trans. to		Tenoe/Ultra Corp--			Adv. Bd.
Airlee House/	1:30-Lv. Airlee Hs.	Connolly/Ciment/			
retreat)(Cancld)		Rotar		1:30-Dr. Lehman	
(SNOW/agency clsd)		9:30-Network FCCSet			
		Meeting-1242		3-4-Ex.Cl/Stratgc	
				Plng	Sun.-Metcalf Dinner
		(4:59-To NY via NYA	(5:30-to DC via		
		#716;ar 6:30p)	Piedmont #4015;ar	(2-To Calif via	
		(Ramada Inn/Elmsfd)	6:40p)	UN #617, ar 6:02p)	

February 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
	Stanford	Stanford Forum			
	Talk		1-Welch		(7:05a Sun-To DC via
					UN #122;Ar.4:40p)
	(8:30-11-Ex. Cl.				
	Mtg./Adm. Issues)			4	
				2	
	3-5 Wexler				
				7	

Mon 9	Tues 10	Wed 11	Thur 12	Fri 13	Sat/Sun 14/15
10	(Visualization in	8:30-12-Ex Cl/	(MIPS Adv. Comm.)	(MIPS Adv. Comm.)	Boston
9-12-CISE Qtrly.	scientific computa-	(Adm.& Personnel)	9:30-MIPS Adv. Com/		
Review/Bloch-Rm.543	tion-Rm. 540)		Drctrt Status/Plans		
	10:30-12-NSF Supcom				(Laura home)
(Visualization in	Ctr.Dirs/Blochs ofc				
scientific computa-					
tion-Rm. 540)	1:30-Ernest Kuhl,				
	Eugene Wong/Berkly-				
	CISE Drct update)				

Mon 16	Tues 17	Wed 18	Thur 19	Fri 20	Sat/Sun 21/22
HOL-WASHINGTON'S	San Diego Net Conf.	----------)		San Francisco	
BIRTHDAY				9-Austel	
			(1:30-to SanFran		(8 Sun.-to DC via
Boston		(8:30-Ex Cl./Chuck)	viaPSA#161;ar.2:55p		NW #340; ar. 5:46p)
(5:35p-To SanDiego			(SiC bd)		
via TWA#853;ar9:46)		(NSB mtg----------)			
(Holiday Inn/1335					
N.Harbor Dr.,Cnfir					
#64417948)					

Call Barbara x9419

Gordon Bell's Calendar - 2/9/87

FEBRUARY 1987

Mon 9	Tues 10	Wed 11	Thur 12	Fri 13	Sat/Sun 14/15
9-12-CISE Qtrly. Review/Bloch-Rm.543 1:30-3-Centers Task Grp/Nichlsn,McLndn) (5th) 3-5-Chair panel (Visualization in scientific computation-Rm.540)	(Visualization in scientific computation-Rm. 540) 10:30-12-NSF Supcom Ctr.Dirs/Blochs ofc 1:30-Ernest Kuhl, Eugene Wong/Berkly-CISE Drct update) 3-LarryLee/Pete Stegel (Cornell) 4:30-Visualization panel members	1-5-Ex. Cl (Adm. Issues) → Md. T	(MIPS Adv. Comm.--------> 10:45- Clifford Bennett, Todd Gluyen (NEW NSF auditors) 11-Jim Rothnic/ Kendall Sq.Resrch 1:30-2:30-McLindon, Bill Cole, Ed Hayes (Expres)	8:30-MIPS Adv. Com/ Drctrt Status/Plans 10-Centers Task Group - Rm.512	Boston (Laura home)
Mon 16	**Tues 17**	**Wed 18**	**Thur 19**	**Fri 20**	**Sat/Sun 21/22**
HOL-WASHINGTON'S BIRTHDAY Boston (5:35p-To SanDiego via TWA#853;ar9:46) (Holiday Inn/1335 N.Harbor Dr.,Cnfir #64417948)	San Diego Net Conf.	(8:30-Ex Cl./Chuck)	(1:30-to SanFran viaPSA#161;ar.2:55p (SiC bd)	San Francisco 9:00 Austin	(8 Sun.-to DC via NW #340; ar. 5:46p)
Mon 23	**Tues 24**	**Wed 25**	**Thur 26**	**Fri 27**	**Sat/Sun 28/Mar 1**
	8:30-Exec Cl 1-Max Mathews	(12:40-to Phoenix via TWA75;ar5:02p)	Conf. on Computers & Comm.- Phoenix (12:51-to Denver viaUN368;ar2:23p)	Skiing-------->	(3-Sun.3/1-to DC via UN234;arChic 6:19;lvChi via UN #626;ar DC 9:50p

MARCH 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
5-Roger Shank, Yale AI	8:30-Exec. Cl 2-Hs.Appro.Sbcom./ Rm. H143/Capital	10-4-Hs.Appro.Sbcom Rm.H143/Capital 12-2-Nils Salverson Rm.540(flyertocome)	9:45-Dentist(1 hr.)		
Mon 9	**Tues 10**	**Wed 11**	**Thur 12**	**Fri 13**	**Sat/Sun 14/15**
NASA Symposium-Crystal Gateway Marriott/Arlington	10- Dr. Stubbard, DD/Elec. Eng (NSF)	8:30 Exec. Cl. 6-Martins Grosswind U/MD CS anniv.	(California) 8-Laura's Recital (10-Sen App.Subcom hrng.on HUD Independent Agencies/ '88 budget request Rm.SC-124---------->) (9-5-FCCSet Govt'l policy grp/Rm.540---------->)		

12/13 ACM Dinner Mtg.
1/22 usr group

12/10
2/26/87 Monterey Comp. Centers Direct.
Phoenix ICCCD
3/16-18 optical computing (not yet invited)
3/23-26 VLSI Stanford (not yet invited) — ??

Letter INVITATIONS TO VISIT ~~List~~

Date:	Organization:	Person/Title:	Subject:
?	U. of Ill.	Tom Everhardt, Provost	
?	U. of Georgia	?	
7/3/86	Princeton	William G. Bowen, Pres.	general, CS
		~~General~~	
7/11/86	Ohio State	Jack Hollander	
7/14/86	U. of Alabama, ~~Birmingham~~	Warren J. Jones, Hd CS Dept.	
?phone	Cornell	Ken Wilson	Centers, CS Dept

WOULD LIKE TO VISIT

- Arvind, others at MIT
- B.T.L. Columbia Cornell — CMU (Kung)
- IBM ~~Co~~
- ~~Midwestern schools~~ — Kansas, ~~U~~ Iowa, Nebraska, Midwestern Univs.
- NYU
- Ovishinsky
- SRC (Rignante)
- ~~MIT~~ Illinois

Books / Papers — CISE

Science Article / Issue for Sven — High Technology: Guest Editorial

Working CS Taxonomies

High Tech Marketing, Computer Structures, Computer Evolution

Do

Dentist ?

Dermatologist: Marv Elgart 676-4058 2150 Penn

Eye: Mel Krinn 296-5373 2141 K #205

8:30 - x Datamation

Gordon Bell's Calendar - 2/23/87

FEBRUARY 1987

Mon 23	Tues 24	Wed 25	Thur 26	Fri 27	Sat/Sun 28/Mar 1
8-Ctrs Task Grp/512	4:30 Call Kuck	9:30-Ctrs.Task Grp/ Rm. 512	(8:30-Ex.Cl/Chuck) Conf. on Computers & Comm.- Phoenix		(3-Sun.3/1-to DC via UN234;arChic 6:19;lvChi via UN #626;ar DC 9:50p
1:30-2:30-Paul Taylor/NAS	11-Max Mathews 1-Exec. Cl.	(12:40-to Phoenix via TWA75;ar5:02p)	(12:51-to Denver viaUN368;ar2:23p)	Skiing----------)	
€ Chuck in L.a. - Kansas ——→)					

MARCH 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
10-LeeHollar,U.Utah	8:30-Ex.Cl.				
	2-Hs.Appro.Sbcom./ Rm. H143/Capital	10-4-Hs.Appro.Sbcom Rm.H143/Capital	9:45-Dentist(1 hr.)	10-Tom Buckholtz/ Pacific G&E	
5:00-Roger Shank/ Yale AI		12-2-Nils Salverson Rm.540(flyertocome)		10:30-Harold Cohen 11:30-PeterFreeman/ U.Cal/Irvine	

Mon 9	Tues 10	Wed 11	Thur 12	Fri 13	Sat/Sun 14/15
8:30-NASA Symposm- Crystal Gateway Marriott/Arlington (Speak/9:40a)	10-Dr.Stubberud,DD Elec.Eng/Dr.Huband	8:30-Ex.Cl.	(8-To Calif.via Cont.#453;ar12:28p)	(7:20a-To Bostn via UN #100;ar 5:17p)	
		6-U.Md.ComputerSci 20anniv.observance/ Martins'Crosswinds	(10-Sen App.Subcom hrng.on HUD Inde- pendent Agencies/ '88 budget request Rm.SC-124----------)) (9-5-FCCSet Govt'l policy grp/Rm.540----------)) 8-Laura's Recital		

Mon 16	Tues 17	Wed 18	Thur 19	Fri 20	Sat/Sun 21/22
(7:30-To DC via EA #143;ar 8:50a)		10-11-Dentist 3-Ex. Cl.	Ed. Adv. Board	FCCSet-Rm.628	

Mon 23	Tues 24	Wed 25	Thur 26	Fri 27	Sat/Sun 28/29
--Stanford Confer.	--on Advanced Res.	--in VLSI--------- (8:30-Ex. Cl.)		SiC	

3rd April 10

– 3:30 3/10th FCCSet

675-4480

Gordon Bell's Calendar - 3/2/87

MARCH 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
9:45-Dr.Frageau/ Cliff Bennett/Todd Givens(courtesy)	8:30-Ex.Cl.	10-4-Hs.Appro.Sbcom Rm.H143/Capital	9:45-Dentist(1 hr.)	8:30-Exec. Cl.(EEO)	
10-LeeHollar,U.Utah	10:30 CMU- 2-Hs.Appro.Sbcom./ Rm. H143/Capital		12:30 SanAmal	10:30-Harold Cohen	
11-Robt.Schmitz/new DD/DAS(courtesy)		12-2-Nils Salverson Rm.540(flyertocome)	2-Irvin Wdladsky/ H.Walsh/J.Daley/ Cnly--CornellUpdate	11:30-PeterFreeman/ U.Cal/Irvine	
1-Curtis/Hedges-re: Arcadia				12:30 Zary Segall 1-Tom Buckholtz/ Pacific GE	
2-Ray Bye/Rm. 527				2-ETA DARPA 5:30-6:30	7:30-623

Mon 9	Tues 10	Wed 11	Thur 12	Fri 13	Sat/Sun 14/15
8:30-NASA Symposm- Crystal Gateway Marriott/Arlington (Speak/9:40a)	8:30-Exec. Cl. 10:30-Research ADs/ w/Bloch 10-Dr.Stubberud,DD Elec.Eng/Dr.Huband	1-3-Smarr/Wilhelm (U.Ill.) 3:30 John Angus/ Case Western Res.U.	(8-To Calif.via Cont.#453;ar12:28p) (10-Sen App.Subcom hrng.on HUD Inde-	(7:20a-To Bostn via UN #100;ar 5:17p)	
2:30-Int/AlSusskind (Lehigh U--MIPS)	1:30-Olsher/G. Wynters,Software dev mgr/Digital 3-Dr, Stubberud, DD Elec. Eng/Dr. Huband 3:30 OSTP	6-U.Md.ComputerSci 20anniv.observance/ Martins'Crosswinds	pendent Agencies/ '88 budget request Rm.SC-124----------)) (9-5-FCCSet Govt'l policy grp/Rm.540----------)) 8-Laura's Recital		

Mon 16	Tues 17	Wed 18	Thur 19	Fri 20	Sat/Sun 21/22
(7:30-To DC via EA #143;ar 8:50a)		10-11-Dentist 12:00 Brindley 2-Dr.Edelson/NASA 3-Ex.Cl. NAE 6:00	Ed. Adv. Board	FCCSet-Rm.628	

Mon 23	Tues 24	Wed 25	Thur 26	Fri 27	Sat/Sun 28/29
--Stanford Confer.	--on Advanced Res.	--in VLSI--------- (8:30-Ex. Cl.)		SiC	

Saul FCCSet
~~3/27~~ April 10 at 10 → 4/13 — Datapoint

3/10 FCCSet at 3:30 Hunag

Tickets { 3/~~16~~ — ~~Boston~~ —
get ~~Calif.~~ Tickets —

New front page
225-8410

Gordon Bell's Calendar - 3/2/87

MARCH 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
9:45-Dr.Frageau/ Cliff Bennett/Todd Givens(courtesy) 10-LeeHollar,U.Utah 11-Robt.Schmitz/new DD/DAS(courtesy) 11:15-Bernie Chern 1-Curtis/Hedges-re: Arcadia 2-Ray Bye/Rm. 527 4-Paul Rotar	8:30-Ex.Cl. 10:30-CMU/Rm. 642 2-Hs.Appro.Sbcom./ Rm. H143/Capital	10-4-Hs.Appro.Sbcom Rm.H143/Capital 12-2-Nils Salverson Rm.540(flyertocome)	9:45-Dentist 11:30-Dr.Chitsaz 12:30-Lunch/Saul Amarel (here) 2-Irvin Wdladsky/ H.Walsh/J.Daley/ Cnly--CornellUpdate (2-SRC Briefing/ Rm.1243--Dr.Berger) 4:30-Leandro Rodri-quez	8:30-Exec. Cl.(EEO) 10:30-Harold Cohen 11:30-PeterFreeman/ U.Cal/Irvine 12-Zary Segall 1-Dr.Buckholtz/ Pacific GE 2-4-DARPA (5:30-To Boston via EA #650)	(7:30-To DC via EA #623)
Mon 9	**Tues 10**	**Wed 11**	**Thur 12**	**Fri 13**	**Sat/Sun 14/15**
8:30-NASA Symposm- Crystal Gateway Marriott/Arlington (Speak/9:40a) 2:30-Int/AlSusskind (Lehigh U--MIPS) 3:30-John Schoen/ ISTI	8:30-Exec. Cl. 10:30-Research ADs/ w/Bloch 1:30-Olsher/G. Wynters,Software dev mgr/Digital 3-Dr.Stubberud,DD Elec.Eng/Dr.Huband- Semiconductor Research Corp	1-3-Smarr/Wilhelm/ U.Ill. 3:30-John Angus/ Case Western U. 6-U.Md.ComputerSci 20anniv.observance/ Martins'Crosswinds	(8-To Calif.via Cont.#453;ar12:28p) (10-Sen App.Subcom hrng.on HUD Inde- pendent Agencies/ '88 budget request Rm.SC-124----------)) (9-5-FCCSet Govt'l policy grp/Rm.540----------)) 8-Laura's Recital	(7:20a-To Bostn via UN #100;ar 5:17p)	
Mon 16	**Tues 17**	**Wed 18**	**Thur 19**	**Fri 20**	**Sat/Sun 21/22**
(7:30-To ~~DC~~ via EA #143;ar 8:50a)	3:30 — →	10-11-Dentist 12-Brindley/lunch 2-Dr.Edelson/NASA 3-Ex.Cl. 6-NewEngsReception 2101 Constitution	Ed. Adv. Board	FCCSet-Rm.628 621-4; 135 6:40 Calif -908	
Mon 23	**Tues 24**	**Wed 25**	**Thur 26**	**Fri 27**	**Sat/Sun 28/29**
--Stanford Confer.	--on Advanced Res. Keynoter.	--in VLSI--------- (8:30-Ex. Cl.)		SiC	Laura arrives

1117-2-3:10

Odessa note 4/24, 25, 26 flights

7:45 Breakfast

Gordon Bell's Calendar - 3/16/87

Dr. Fred Brooks

MARCH 1987

Mon 16	Tues 17	Wed 18 (NSB)	Thur 19 (NSB)	Fri 20 (NSB)	Sat/Sun 21/22
8:30-Prof.Dertouzos KenSmith,JimBruce- MIT/Bldg.10,Rm.340	(7:30-to DC via EA #143;a 8:50a)	10:30-Bill Brindley 11-Exec. Cl. 12-Dr.Edelson/NASA 5:00 Berkeley 6-NewEngsReception 2101 Constitution	10-3:30-Ed Adv Bd Rm180/NAS,2101 Constitution Ave. 5:15 Bill Conner et al Harrington 6-NSB reception/ 7-dinner - Rm. 1242	FCCSet-Rm.628 (4-To SF via UN#621 ar. 9:08p)	Dinner MCW
Mon 23	Tues 24	Wed 25	Thur 26	Fri 27	Sat/Sun 28/29
--Stanford Confer.	--on Advanced Res.	--in VLSI--------- (8:30-Ex. Cl.)		SiC	Laura arrives (2-SUN-to LA via UN #117;ar.3:10)
Mon 30	Tues 31	Wed APR 1	Thur 2	Fri 3	Sat/Sun 4/5
Network workshop/ Lake Arrowhead,Cal.----------)	(8:30-Exec. Cl.)	(7:30-To DC via UN #100;ar 5:04) 6-Dinner/Worlton		9:30-10:30/Dr. John Fairclough,Science Minister/Gr.Britain (4:30-To Boston via EA #994;ar. 5:56)	

APRIL 1987

Mon 6	Tues 7	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
(7:30-To DC via EA #143;ar 8:50a) 12-Lunch/B.Brindley	8:30-Exec. Cl.	10-Dick Marston Dave Farber-NRC	FCCSET,Rm.628----------)	7:30-To Minnesota/ CRAY Research/Bloch (Ar.8:30a/Lv.5:30p, Ar.DC W/Nat 8:30p) (FCCSET,Rm.1242)	
Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
Dallas/Datapoint		12-P.Petrie/Fortune Mag,NY,Time-Life Bldg,50&6 Ave.		9:15-Dentist	
Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26
	1:30-3-LSU Lecture/ Dan Marin	Bob Chinn/Rotary		EA 630/5:30 to Bos	5:29-AA517. to Nashville

See May 1

Gordon Bell's Calendar - 3/30/87

MARCH 1987

Mon 30	Tues 31	Wed APR 1	Thur 2	Fri 3	Sat/Sun 4/5
Network workshop/ Lake Arrowhead,Cal. (Conference Center 714/337-2478)	(8:30-Exec. Cl.) (Holiday Inn, Los Angeles Intl. Arpt)	(7:30-To DC via UN #100;ar 5:04) 6-Dinner/Worlton, Cnly,Ciment,Rotar/ Dominiques,1900 Pa.	8:30-Bernie Chern 9:30-Dr.Sanat Basu 1:30-3:30-FCCSET/ NBS,Technology Bldg Rm.B154,Gaithers-burg (975-2821)	8:30-REU Panel/523 8:45-9:30-Dr. John Fairclough,Science Minister/Gr.Britain -Rm.511 (9-12-FCCSET sub-committee/1300 N 17th,Arl.,Va.Rm.950 1-Bloch's office/ Wolff-Netwrk update (4:30-To Boston via EA #994;ar. 5:56)	

Mel Ciment

APRIL 1987

Mon 6	Tues 7	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
(7:30-To DC via EA #143;ar 8:50a) 12-Lunch/B.Brindley 2-Roger Shank/Yale	12-Lunch/DaveNelson JnoCavallini/DOE 3-John Alden,Texas Instruments	8:30-Exec. Cl. 10-DickMarsten/Dave Farber 12-1:30-Ken Wilson, Larry Lee,Connolly, Moore/Cornell SC Program	9-12-FCCSET/NSF--Room 628	7:30-To Minnesota/ CRAY Research/Bloch (Ar.8:30a/Lv.5:30p, Ar.DC W/Nat 8:30p)	
Mon 13	**Tues 14**	**Wed 15**	**Thur 16**	**Fri 17**	**Sat/Sun 18/19**
		12-P.Petrie/Fortune Mag,NY,Time-Life Bldg,50&6 Ave.		9:15-Dentist	
Mon 20	**Tues 21**	**Wed 22**	**Thur 23**	**Fri 24**	**Sat/Sun 25/26**
	1:30-3-LSU Lecture/ Dan Marin	Bob Chinn/Rotary		(5:30-To Boston via EA #630; ar.6:55p)	(5:29p Sun.-To Nashville via Am #517;ar.6:58p)
Mon 27	**Tues 28**	**Wed 29**	**Thur 30**	**Fri MAY 1**	**Sat/Sun 2/3**
Nashville (1:20p-To DC via AM #946; ar. 3:59p)	X	(-------CCR Advisory Committee Meeting------)	9:15--CCR Adv.Comm. 10-12-Div.Dirs./ Bloch-Rm.540	9-12 FCCSet Comput	TCM Party/Boston

1300 FCCSet

Gordon Bell's Calendar - 4/6/87

APRIL 1987

Mon 6	Tues 7	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
(7:30-To DC via EA #143;ar 8:50a) 12-Lunch/B.Brindley 2-Roger Shank/Yale	12-Lunch/DaveNelson JnoCavallini/DOE 3-John Alden,Texas Instruments	8:30-Exec. Cl. 10-DickMarsten/Dave Farber 12-1:30-Ken Wilson, Larry Lee,Connolly, Moore/Cornell SC Program 2:30-DASC 3:00-Rubin Olsher 4-Dr.Sidney Singer/ Keyworth Co.	9-12-FCCSET/NSF--Room 628 1-IBM Sheraton Grand/ Capitol Hill	7:30-To Minnesota/ CRAY Research/Bloch (Ar.8:30a/Lv.5:30p, Ar.DC W/Nat 8:30p) (6:55a-Meet Lionel at 1800 R,NW. for transp. to airport) (9p-To Boston, ar. 10:13)	Boston (furniture)

Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
Boston	(7:30-To DC via EA #143;ar 8:50a) 11:30-Lunch/Bill Brindley	(8-To NY via Metro-liner;ar 10:55a) 12-P.Petrie/Fortune Mag,NY,Time-Life Bldg,50&6 Ave. (4-To DC via Metro-liner;ar 6:59p)	MOSIS Exhibit/520	9:15-Dentist ~~Lv 5:30~~	~~Boston~~ Washington ~~Lv 5:30~~

Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26
Lv 5:30	8:30-Exec. Cl. 1:30-3-LSU Lecture/ Dan Marin Lv. 5:40	Bob Chinn/Rotary		(5:30-To Boston via EA #630; ar.6:55p)	~~(50th Anniversary)~~ MIT Party. (5:29p Sun.-To Nashville via Am #517;ar.6:58p)

Mon 27	Tues 28	Wed 29	Thur 30	Fri MAY 1	Sat/Sun 2/3
Nashville (1:20p-To DC via AM #946; ar. 3:59p)	(Dallas??) 8:30-Exec. Cl. 4-Dr.Holzrichter/ LawrenceLivermore Lab(micromachining)	(-------CCR Advisory Committee Meeting------) 9:15--CCR Adv.Comm. 10-12-Div.Dirs./ Bloch-Rm.540 1-FCCSET/NSF--Room 540-A	9-12-FCCSET/DARPA	EA 5:30	BOS Dick Shoup.

Mon 4	Tues 5	Wed 6	Thur 7	Fri 8	Sat/Sun 9/10
3-DEC mtg.	EA 143 7:30 11:45-Lunch/Dr. Craig Fields/DARPA	Exec Cl			TCM Party/Boston

Gordon Bell's Calendar - 4/13/87

APRIL 1987

Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
Boston	(7:30-To DC via EA #143;ar 8:50a) 9:45-B.Chern 10-Connolly/Rotar 11-S.Toye/Chuck 11:30-Lunch/Bill Brindly 2-3-Clutter/Niclsn/Kingsbury--S&T Proposals--Rm.518	(8-To NY via Metro-liner;ar 10:55a) 12-P.Petrie/Fortune Mag,NY,Time-Life Bldg,50&6 Ave. (5-To DC via Metro-liner;ar 7:55p)	MOSIS Exhibit/520 12-1:30-Irvin Wlad-awski	9:15-Dentist	Washington

Mon 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26
(5:30p-To La. via NW#857,ar.9:17p)	8:30-Exec. Cl. 1:30-3-LSU Lecture/Dan Marin (5:40p-To DC via NW#283,ar.9:59p)	2-3:30-GaynWinters/Rubin Olsher,et al, Digital demo.	(Hold 10-12--NSF/DOE)	11-Paul Messina/J.Fox/Caltec 2:00 Dir Dir. (5:30-To Boston via EA #630;ar 6:55p)	MIT Party (5:29p Sun.-To Nashville via Am #517;ar.6:58p) Opryland Hotel 8:30

Mon 27	Tues 28	Wed 29	Thur 30	Fri MAY 1	Sat/Sun 2/3
Nashville (1:20p-To DC via AM #946; ar. 3:59p) Dinner/Kai Hwang	~~(Dallas??)~~ 8:30-Exec. Cl. 3:00 Silyle 4-Dr.Holzrichter/LawrenceLivermore Lab(micromachining)	(-------CCR Advisory Committee Meeting------) 10:30-Al Thaler/EXPRES Briefing 1:30-3:30 Alliant Presentation-Rm511	9:15--CCR Adv.Comm. 10-12-Div.Dirs./Bloch-Rm.540 1-FCCSET/NSF--Room 540-A 1-2:30 John Fisher, Multiflow Computers - 3K 3:30-4:30 Lukasi K/ Technology Synerve	9-12-FCCSET/DARPA 2-Zygielbaum (NASA/JPL) w/ Chuck (5:30-To Boston via EA#630;ar.7:02p)	Boston Dick Shoup

MAY 1987

Mon 4 Boston	Tues 5	Wed 6	Thur 7	Fri 8	Sat/Sun 9/10
~~8~~-DEC mtg. 3:30	~~(7:30a To DC via EA #823;ar.7:~~03) 7:30 PM	Exec Cl 11:45-Lunch/Dr. Craig Fields/DARPA	FCCSet Dry run-to Jim Decker 2-Leiserwitz, U/Minn., Stan Reiter, N.Western, Larry Rosenberg	300 Co 7:00 9-12-BaskingRidge, NJ--AT&T--295 N. N.Maple Ave./Dick Snowden,SandyFraser etal (Bell Labs in afternoon) Co. 5:30	TCM Party/Boston

Saul - What about Darpa, August mtg.?

~~June 18 Open TCM All~~ ✓ +

- ~~Shoffler party 6/22/23~~ +

- Alliant 10 29-30 +

Oct

Gordon Bell's Calendar - 4/27/87

Mon 27	Tues 28	Wed 29	Thur 30	Fri MAY 1	Sat/Sun 2/3
Nashville		(-------CCR Advisory Committee Meeting------)			Boston
	9:00-Exec. Cl.		9:15--CCR Adv.Comm.	9-12-FCCSET/DARPA	
(1:20p-To DC via AM #946; ar. 3:59p)		10:30-Al Thaler/ EXPRES Briefing	10-12-Div.Dirs./ Bloch-Rm.540		
	2-Dr.Holzrichter/			2-Ann Galick/IBM, Wolff,Bloch-520	
Dinner/Kai Hwang	LawrenceLivermore	1:30-3:00-Alliant	1-FCCSET/NSF--	3:30-Zygielbaum,Art	
	Lab(micromachining)	presentation/Ron	Room 643	Villasenor/NASA,	Dick Shoup
	3-Si Lyle/Chuck/YT	Gruner--Rm. 511	1-2:30-John Fisher/ Multi-Flow Comp.	Chuck	
				(5:30-To Boston via EA#630;ar.7:02p)	

MAY 1987

Mon 4 Boston	Tues 5	Wed 6	Thur 7	Fri 8	Sat/Sun 9/10
3:30-DEC mtg.		8:30-Exec Cl		(7-To NJ via Co300)	
		10-DickFairley/Wang Institute		9-12-Basking Ridge, NJ--AT&T--295 N.	TCM Party/Boston
			2-Leo Hurwitz/U.	N.Maple Ave./Dick	
		11:45-Lunch/Dr.	Minn.,Stan Reiter,	Snowden,SandyFraser	
		Craig Fields/DARPA	Northwestern,Larry	et al	
			Rosenberg	(Bell Labs in	
	(7:30p-To DC)	2-4--DDs, New OMB		afternoon)	
		Exminer,JackFellows			
			3:30-4-Judson		
			Sheridan/U.Minn.	(5:30-To Boston	
				via Con)	

Mon 11	Tues 12	Wed 13	Thur 14 (DASC AdvC)	Fri 15 (DASC AdvC)	Sat/Sun 16/17
9-Kurzweil/411	(7:30a-To DC)	8:30-Exec. Cl.	8:30-DASC/Netwrking		California
Waverly Oaks Rd.			Adv.Comm.Mtg.	11-DASC Adv.Com.	
Waltham, MA	11:30-Albert Lum-	2-5-CISE Qtrly		(Bloch)	Techknowledge
	broso,Jean-Claude	Review--540	11-Press Conference	12-Lunch/Joe Traub,	Bd/Sat
6:30 Dinner/ Waggener Group press interview- Computer Museum (?)	Charpentier,et al		IBM/NSF/Cornell--re supercomputers	Pamela McCormick- (Maison-Blanc)	
	Run through with Graham				
			2-Thomas Lidjenmark, Magdalene Ehrstrom/ STU/Sweden	(4-To San Fran. via UA #621;ar9:05)	

Mon 18 (CSTB)	Tues 19 (CSTB)	Wed 20 (NSB Annual Meeting)	Thur 21 (NSB AnMtg)	Fri 22 (NSB)	Sat/Sun 23/24
California	California	(8:30-Exec. Cl.)	(Advncd Technlgy Ventures Annual Mtg /UnivClub,1W.54,NY)	WHSC 8-12	Kirksville, Mo.
		(7:24-To DC via EA #334;ar. 4:30p)	9-11-CISE Adv.Comm. Chairs	(4:35-To St.Louis via TWA #199;lv 6:30 via Greenhill Aviation #28;Ar Kirksville 7:30p)	
			1:30-Rm 543- Minority Institution Seminar 8-10		

Gordon Bell's Calendar - 5/11/87

MAY 1987

Mon 11	Tues 12	Wed 13	Thur 14 (DASC AdvC)	Fri 15 (DASC AdvC)	Sat/Sun 16/17
9-Kurzweil/411 Waverly Oaks Rd. Waltham, MA	(7:30a-To DC) 11:30-Albert Lumbroso,Jean-Claude Charpentier,et al	8:30-Exec. Cl. 10:15-11:15-Rsrch ADs--re Nat'l.Labs/Bloch's office/520 11-Peter Freeman	8:30-DASC/Netwrking Adv.Comm.Mtg. 11-Press Conference IBM/NSF/Cornell--re supercomputers	11-DASC Adv.Com. (Bloch) 12-Lunch/Joe Traub, Pamela McCormick-(Maison-Blanc)	California 8:45-5-- Techknowledge Bd/Sat 1810 Embarcadero Dr
(Run through with Graham)					
6:30--Dinner--Waggener Group press interview/Computer Museum		2-5-CISE Qtrly Review--540	2-Thomas Liljemark, Magdalene Ehrstrom/STU-Sweden 3-Dr.Terry Walker/Dir.Adv.Cmp.Studies SW La.Univ;J. Tibideau/Rep Hayes' office,Bob O'Neal/Hs.Science Comm.Stf +Chuck--re grants for computing	(4-To San Fran. via UA #621;ar9:05)	

Mon 18 (CSTB)	Tues 19 (CSTB)	Wed 20 (NSB Annual Meeting)	Thur 21 (NSB AnMtg)	Fri 22 (NSB)	Sat/Sun 23/24
California	California	(8:30-Exec. Cl.) (7:24-To DC via EA #334;ar. 4:30p)	(Advncd Technlgy Ventures Annual Mtg /UnivClub,1W.54,NY) 9-11-CISE Adv.Comm. Chairs 1:30-Seminar for Faculty of Minority Institutions/State Plaza Hotel	WHSC (4:35-To St.Louis via TWA #199;lv 6:30 via Greenhill Aviation #28;Ar Kirksville 7:30p)	Kirksville, Mo.

MAY 1987

Mon 25	Tues 26	Wed 27	Thur 28	Fri 29	Sat/Sun 30/31
HOL.-MEMORIAL DAY (7a-To Dallas via Greenhill #25;ar St. Louis 8a;9:45a to Dallas via TWA #525;ar 11:26a)	Dallas (5:09p-To DC via Delta #310;ar 8:45)	8:30-Exec. Cl.	(HOLD/8:30-12-Dave Kuck, U/Ill.) 1:30-Seminar for Faculty of Minority Institutions/Rm543	CSTRB Boston	Boston Laura's Wedding

JUNE 1987

Mon 1	Tues 2	Wed 3	Thur 4	Fri 5	Sat/Sun 6/7
Boston	10:00 Bill Hogan Boston	Boston	Pittsburgh USAir 1-CMU/Computer Architectural Conf.	Boston	Boston

EA 7:30 997

JUNE 1987

Mon 8	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
Bloch/EXPRES event	10-Ben Wah(Tent.)			9:00 Netsf Supers.	Howard's wedding
	(-------Networking Supercomputers Conf----------)				
	Geo.Mason Univ.				
		8:30-Talk		Boston	

Mon 15	Tues 16	Wed 17	Thur 18 (NSB)	Fri 19 (NSB)	Sat/Sun 20/21
		← ~~EO~~ Mitch 9:30 Kapor →			
			3:30 874		
			TCM AI Opening by Lords		5:30 67

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26	Sat/Sun 27/28
(---Shaffer seminar/J. Marriott,DC---)		← Sun Mtg →			
(Adv. Scientific Computing)					
(Panelist 6/23)					

Mon 29	Tues 30	Wed JULY 1	Thur 2	Fri 3	Sat/Sun 4/5
	Night-Lv.Vacation				

JULY 1987

Mon 6	Tues 7	Wed 8	Thur 9	Fri 10	Sat/Sun 11/12
HOLIDAY					

JULY 1987

Mon 13	Tues 14	Wed 15	Thur 16	Fri 17	Sat/Sun 18/19
Alvey Annual Conf.	Manchester UK-----	----------)	Ret. to DC	Systems Conf/Bnquet	

Mon. 20	Tues 21	Wed 22	Thur 23	Fri 24	Sat/Sun 25/26

Gordon Bell's Calendar - 6/8/87

JUNE 1987

Mon 8	Tues 9 8:30 Bloch	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
(7:30a-To DC via EA #997; ar 8:50a)	10-Ben Wah(Tent.)	8:30 Exec. Cl.		(Kai Wang here)	To Boston
	<-------Networking Supercomputers Conf---------->			9-Nets & Supers	Howard's wedding
	10:30 Schumacher Geo.Mason Univ.		10-11:30-R.Olsher	1 Dupont Circle	
9:30-12-Bloch/	11-Rich Belzer/			Suite 710/Higher	
EXPRES event-540	Larry Lee	8:30-Talk	11:30-Brown Bag	Educ.& Technology	
	12:30-FCCSET mtg w/		lunch--Bloch/Nclsn-	Committee/Nat'l.	
2-K.Curtis/PE	Tom Rona,Graham's	2-Marvin Franklin/	re CSE initiative-	Assn.State U's &	
	Deputy--NEOB	01 Systems	520	Land Grant Colleges	
3-Mtg.w/Bloch/520	2:30-B.Chern/PE		1:30 Peter Freeman		
4-Peter Hochburg	3-Mel Ciment/CSE		3:00 Supercomputer Chuck	5:30 To Boston/ EA # 6:30, ar. 6:45	
	briefing				

Mon 15	Tues 16	Wed 17	Thur 18 (NSB)	Fri 19 (NSB)	Sat/Sun 20/21
7:30 ToDC, EA #997, ar. 8:55		8:30 Dick Shaffer		To Washington	
	11:30 Lunch/Bob Corell -AD/GEO	9:30-Mitch Kapor	10:30-Jose Mandez		
		12-Lunch-Bill Smith/ NAS-2101 Constitution RM213			
1:30 4-DryRun/ NSB budget presentation		2-FCCSET (NBS)	3:30-To Boston via		Sun. 5:30 to DCvia
		Technology Bldg.	EA #874;ar4:43		EA #67;ar 7:00p
		Rm. B157			
			TCM AI Opening		

Mon 22	Tues 23	Wed 24	Thur 25	Fri 26 8: Davidow 9:15 TeKnowledge	Sat/Sun 27/28 EA 72 x334
<---Shaffer seminar/J. Marriott,DC---->					
(Adv. Scientific Computing)		<---------SUN Mtg---------->			
(Panelist 6/23)		San Francisco/Hyatt	Rickey's Palo Alto	1:00 Apple	
	4:00 UA		4 Regis 1800 Embarcadero		

Mon 29	Tues 30	Wed JULY 1	Thur 2	Fri 3	Sat/Sun 4/5
	Night-Lv.Vacation			Holiday	
10-Burrows/Network Study briefing to Cong. staff/Rayburn HOB					

JULY 1987

Mon 6	Tues 7	Wed 8	Thur 9	Fri 10	Sat/Sun11/12
~~HOLIDAY~~		9-12-FCCSET,Rm.1243			

old

Gordon Bell's Calendar - 6/8/87

JUNE 1987

Mon 8	Tues 9	Wed 10	Thur 11	Fri 12	Sat/Sun 13/14
(7:30a-To DC via EA #997; ar 8:50a) 9:30-12-Bloch/EXPRES event 1:30-Software demo/Helen Kelly/543 2-K.Curtis/PE 3-Mtg.w/Bloch/520 4-Peter Hirshburg	10-Ben Wah(Tent.) 10:30-Schumacher 11-Rich Belzer/Larry Lee 12:30-FCCSET mtg w/Tom Rona,Graham's Deputy--NEOB 2:30-B.Chern/PE 3-Mel Ciment/CSE briefing	8:30-Exec. Cl. <--Netwking Supercomp Conf/GeoMason U.----------> 8:30-Talk 2-Marvin Franklin/01 Systems 3-Paul Rotar	10-11:30-R.Olsher 11:30-Brown Bag lunch--Bloch/Nclsn-re CSE initiative-520 3-Ciment,Chuck, Rotar,Curtis 4-Alan Leshner, Chuck	(Kai Wang here) 9-Nets & Supers 1 Dupont Circle Suite 710/Higher Educ.& Technology Committee/Nat'l. Assn.State U's & Land Grant Colleges 11-"Cost of Excellence" briefing Rm. 540 (5:30-ToBoston via EA #639, ar. 6:43)	Boston Howard's wedding
Mon 15	**Tues 16**	**Wed 17** 8:00	**Thur 18 (NSB)**	**Fri 19 (NSB)**	**Sat/Sun 20/21**
(7:30-To DC via EA #997; ar 8:55) 1:30-4-Dry Run/NSB Budget presentation /Bloch's	11:30-Lunch/Bob Corell, AD/GEO 2:00-3:00 Spao (540)	~~8:30~~-Exec. Cl. 9:30-Mitch Kapor 12-Lunch/Bill Smith NAS,2101 Constitution Ave.,Rm.213 2-FCCSET (NBS) Technology Bldg. Rm. B127	9-Ben Friedlander SAXPY 10-Daniel Cohen 10:30-Jose Mandez 11-Jim Goodman/U.Wisc.&Bell Labs 12-Peter Freeman 1:30-Peter Freeman Hedges,Curtis,Chuck (3:30-To Boston via EA #874 ar 4:43) TCM AI Opening Dinner-M/M Coit	8:00 Mitch	(Sun. 5:30 to DCvia EA #67;ar 7:00p)
Mon 22	**Tues 23**	**Wed 24**	**Thur 25**	**Fri 26**	**Sat/Sun 27/28**
<---Shaffer seminar/J. Marriott,DC----> (Adv. Scientific Computing) (Panelist 6/23)	10:30 Loose (540)	<---------SUN Mtg----------> San Francisco/Hyatt Rickey's Palo Alto	>4 Regis 1800 Embarcadero	8:00 Davidow 9:15 Tek 1:00 Apple -	
Mon 29	**Tues 30**	**Wed JULY 1**	**Thur 2**	**Fri 3**	**Sat/Sun 4/5**
10-Burrows/Network Study briefing to Cong. staff/Rayburn HOB 12:30 Shumacher Lunch.	~~Night-Lv.Vacation~~	(4-To Paris/Lv.W/N via Cont.#318;ar Nwk 5:10;lv 7:40 via Cont.#56)	(8:50-ArParis/Orly)	HOLIDAY	

TeknBD 11/21; 2/13 6/18 9/17

Gordon Bell's Calendar - 7/20/87

JULY 1987

Mon. 20	Tues 21	Wed 22 (No Exec Cl)	Thur 23	Fri 24	Sat/Sun 25/26
	<----------Chuck out this week----------				
	2-Greg Gibbons		9:30-Ciment/Jerry 3:30-Tom Rona/OSTP Room 5005 (6:30-To Boston via EA #854, ar 7:55p)	1-BBN Visit/Boston	

Mon 27	Tues 28	Wed 29(No Exec Cl)	Thur 30	Fri 31	Sat/Sun AUG 1/2
(6:30a-To DC via EA #195;ar 8:00a) 9:00 SC/BR/CB re Cornell+Pgh 2:30-Dean Lee Rudee U.Cal/SanDiego 10:00 SW re Report	9-Peter Freeman	<--------Odessa out 10-Geo. White, Architect/Capitol-Telecommunications Advisory Panel (Capitol/SB15) (5:35p-To San Fran viaEA 325;ar9:12p)	<----------MIPS Panel----------> Palo Alto Gwen arrives		Steve Blank Script

AUGUST 1987

Mon 3	Tues 4	Wed 5	Thur 6	Fri 7	Sat/Sun 8/9
	<----------Odessa out this week----------				
			8:30-Exec. Cl.		
<----------ISAT (DARPA) Conference/Monterey, CA----------					
		4:00 Gwen leaves	1-Research ADs/ Linking Research & Teaching (Bloch's office/no substitutes)		Techknowledge Bd. (Sat.)

Mon 10	Tues 11	Wed 12	Thur 13	Fri 14	Sat/Sun 15/16
(10-KAI Board, MA)		8:30-Exec.Cl.		(7:00a-To Boston via UN#122;ar.4:36)	BOSTON
					Film @ TCM

Mon 17	Tues 18	Wed 19	Thur 20 (NSB)	Fri 21 (NSB)	Sat/Sun 22/23
(7:30-To DC via EA#997;ar 9:00a)		8:30-Exec. Cl. 10:00 CASE DD's 3:30 - AT Theater		10-FCCSET briefing for Pat Windus/ Senate Comm.on S&T to Boston	

Steve

cheddol

Steve

12-2:30 free

Gordon Bell's Calendar - 8/17/87

AUGUST 1987

Mon 17	Tues 18	Wed 19	Thur 20 (NSB)	Fri 21 (NSB)	Sat/Sun 22/23
(7:30-To DC via EA#997;ar 9:00a)		8:30-Exec. Cl.		8:30 Burrows/Radnor Wolff (FCCSET)	
[illegible]		10:30-CISE DD's		10-FCCSET briefing for Pat Windus/ Senate Comm.on S&T -306	
		3:30-4:30 E Bloch/L.Smarr	[illegible] 3:30 FCCSET-NEOB-Rm 5005	12-2-FCCSET-306	
5:30-Rubin Olsher			6:15-NSB Dinner/ 12th flr.dining rm.	(4:30p-To Boston via EA #914;ar5:55)	

Mon 24	Tues 25	Wed 26	Thur 27	Fri 28	Sat/Sun 29/30
	(7:30a-To DC via EA #997;ar 9:00a)	8:30-Exec. Cl.	10-Dentist/337-7266 (cleaning,filling)		Gwen DC??
	10-Bloch/Attitude Survey	10-Architect of the Capitol Adv.Panel meeting-Rm.SB-15			
	10:30 Bloch/EXPRES update--w/Thaler, Wolff				
	11:30-Richard Burk, informal interview (Al Harvey's job)		(4:30-To Boston via EA #914; ar 5:55p)		
	2-Joe Bemrath (Digital)				

Mon 31	Tues SEPT 1	Wed 2	Thur 3	Fri 4	Sat/Sun 5/6
(7:30a-To DC via EA #175; ar 9:02a)	10:30-12-Internet Adv.Bd.briefing/ Bint Cerf	1:30-3:30-CISE DD's /Jack Fellows, OMB		9:30-U.Lowell, MA Cumnock Hall/Bill Hogan	Gordon Institute
			(4:30-To Boston via EA #966; ar 6:01p)		

SEPTEMBER 1987

Mon 7 (HOLIDAY)	Tues 8	Wed 9	Thur 10	Fri 11	Sat/Sun 12/13
	Bob Elder (1-NSF/DOE collab.-Moore's office)	Argonne (Ill.) Talk	10-CISE DD's/PD's/ Leshner/Harris-543		
	(8:50p-To Chicago via UN#361;ar10:15) (Jack Dongarra will pick up)(HolidayInn /Conf.#63190104)	(4:30p-To DC via UN #620; ar 7:08p)	Gwen arrives DC	Gwen DC	

Mon 14	Tues 15	Wed 16	Thur 17	Fri 18	Sat/Sun 19/20
9-12-CISE Quarterly Review to Dir./523				1:30-Silicon Comp. Board (NJ office)	
	Gwen--France		6-Kent Curtis dinner/Monroe House 2017 Eye St., NW		Gwen to S/D

to SF

Let's put our heads together & make a week's schedule

Gordon Bell's Calendar - 8/24/87

AUGUST 1987

Mon 24	Tues 25	Wed 26	Thur 27	Fri 28	Sat/Sun 29/30
	(7:30a-To DC via EA #997;ar 9:00a) 10-Bloch/Attitude Survey 10:30-Bloch/EXPRES update--w/Thaler, Wolff 3:00-Richard Burk, informal interview (Al Harvey's job) 12-Lunch/Teicher, Bloch-Maison Blanc 4-Joe Dempster	8:30-ADs/Bloch re Stability of support for PYIs 10-Architect of the Capitol Advis. Panel Mtg.--SB-15) 2-Dr. Robert Perry, new Sci.Advisor to AD/SEE (courtesy)	10-Dentist/337-7266 (cleaning,filling) (4:30-To Boston via EA #914; ar 5:55p)	1:00 KSR	Weekend

Mon 31	Tues SEPT 1	Wed 2	Thur 3	Fri 4	Sat/Sun 5/6
(7:30a-To DC via EA #175; ar 9:02a)	10:30-12-Internet Adv.Bd.briefing/ Bint Cerf (Bert Sutherland 12:30	8:30 Exec Cl. 11:30-Mel Ciment 1:30-3:30-CISE DD's/Jack Fellows, OMB	11:30-Ed McClusky (Lunch) 2-Chern (re: QR) (4:30-To Boston via EA #966; ar 6:01p)	9:30-U.Lowell, MA Cumnock Hall/Bill Hogan	Gordon Institute

SEPTEMBER 1987

Mon 7 (HOLIDAY)	Tues 8	Wed 9	Thur 10	Fri 11	Sat/Sun 12/13
	Bob Elder (1-NSF/DOE collab.-Moore's office) (8:50p-To Chicago via UN#361;ar10:15) (Jack Dongarra will pick up)(HolidayInn /Conf.#63190104)	Argonne (Ill.) Talk (4:30p-To DC via UN #620; ar 7:08p)	10-CISE DD's/PD's/ Leshner/Harris-543 12-Dentist/Zimmet 2033 K (Take Penicillin 1 hr. ahead) (Gwen arrives DC)	8:30-3:30-Comp. Res. Working Group Rm. 540 Gwen DC 4-5-Reception/ New Program Staff/ 1575 Eye	

Mon 14	Tues 15	Wed 16	Thur 17	Fri 18	Sat/Sun 19/20
9-12-CISE Quarterly Review to Dir./523	Gwen--France		6-Kent Curtis dinner/Monroe House 2017 Eye St., NW	(9-12-FCCSET sbcom/ Wolff to attend) 1:30-Silicon Comp. Board (NJ office) To San Francisco	Gwen to S/D

SEPTEMBER 1987

Mon 21 (CSTB)	Tues 22 (CSTB)	Wed 23	Thur 24	Fri 25	Sat/Sun 26/27
		SSA - Roberts, Xerox, X California Gwen to SF dinner SSA			

Gordon Bell's Calendar - 9/14/87

SEPTEMBER 1987

Mon 14	Tues 15	Wed 16 (8:30-Ex Cl)	Thur 17	Fri 18	Sat/Sun 19/20
9-12-CISE Quarterly Review to Dir./523	<--DARPA mtg--> 9-DARPA IST mtg/ Hldy.Inn/Gaithers-burg, Md.		8:30-Cliff Jacobs	(9-12-FCCSET sbcom/ Wolff to attend)	
			10:30-Larry Lee	1:30-Silicon Comp. Board (NJ office)	
2-Stan Joseph/ Convex	Gwen--France		11:30-Lunch/Lee Hollaar	(8a-To Newark via CO #302,ar 9:02a;lv	Gwen to S/D
			1-3-Dentist	5:45p via UN#179,ar	
			3-Peter Freeman	Denver 7:50p;lv.9p	
			6-Kent Curtis	UN#165,ar.SF 10:25p	Calif
			dinner/Monroe House 2017 Eye St., NW		

Mon 21 (CSTB)	Tues 22 (CSTB)	Wed 23	Thur 24	Fri 25	Sat/Sun 26/27
		SSA-Roberts,Xerox, X			(8:30a Sun.,to DC UN #50; ar Dulles 4:18p)
<--California-->					
		Gwen to SF			<---Chuck/Travel--
		Dinner--SSA			

Mon 28	Tues 29	Wed 30	Thur OCT 1	Fri 2	Sat/Sun 3/4
<--------California??-------->	9:30-Wilmer,Cutler & Pickering/DEC deposition/2445 M St.,NW,8th Flr.	8:30-Exec. Cl.	2-5-Exec. Cl. mini retreat	8-10-Dentist	Boston 1-Sun.-Glenn Rifkin
<--Chuck on travel/Germany-->					

OCTOBER 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
Boston	Steve Teicher visit	8:30-Exec. Cl.		Boston	9-Breakfast/Joe Hanson/~~Algonquin Club~~ East India Row
2-Bill Kehol		1-Rosa Owens/Lib. of Congress		Departure	
			4-5-Reception/New Prog Staff,1575 I		
		3-4:30-Research ADs/CIA--Moore/520	to Boston		

Mon 12 (Holiday)	Tues 13	Wed 14	Thur 15 (NSB)	Fri 16 (NSB)	Sat/Sun 17/18
Boston	to DC	8:30-Exec. Cl.			
KSR Mtg. 10:30					Gwen in DC/banquet
	p.m.-Jack Dixon, NSF talk			to ~~California~~	(Lv. Sun. nite)

Gordon Bell's Calendar - 9/28/87

SEPTEMBER 1987

Mon 28	Tues 29	Wed 30	Thur OCT 1	Fri 2	Sat/Sun 3/4
<--------California---------->		8:30-Exec. Cl.	Steve Teicher here 10–1130	8-10-Dentist	Boston
			3-6	2:00 Saul	1-Sun.-Glenn Rifkin
		(SES Reviews)	~~12-5~~ Exec. Cl. mini retreat		
<----------Chuck on travel/Germany---------->					

OCTOBER 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
6:30		~~8:30~~-Exec. Cl.	8-Bloch's-Ciment, Rotar,Brandt,Chuck re Centers program	Boston 9:30-DEC deposition Weing'ten,Schurgin, Gagnebin & Hayes, 10 P.O.Sq.,5th flr. (542-2290)	9-Breakfast/Joe ~~Hanson/Algonquin Club~~ East
2-Bill Kehol		KSR 11:30 Pincus — 1-Rosa Owens/Lib. of Congress	12- Dentist		Indian Row 1:00 Pincus House 212-878-0677 Jeff Harris
3:30-Dr.Joel Yudkin	2:00 Hunag	3-4:30-Research ADs/CIA--Moore/520	4-5-Reception/New Prog Staff,1575 I		Warbergs'
			(4:30-To Boston via EA #144;ar 6:01)		

Mon 12 (Holiday)	Tues 13	Wed 14	Thur 15 (NSB)	Fri 16 (NSB)	Sat/Sun 17/18
Boston	(7:30a-To DC via EA #175;ar 8:59)	~~8:30~~-Exec. Cl.			Gwen in DC/banquet
	<--------NAE Annual Mtg------>				
10:30 KSR				(5:35p-To SF via EA#325;ar KC 7:10	
	p.m.-Jack Dixon, NSF talk		6-NSB dinner	lv 7:42,EA325;ar SF 9:16p)	

OCTOBER 1987

Mon 19	Tues 20	Wed 21	Thur 22	Fri 23	Sat/Sun 24/25
		8:30-~~Exec. Cl.~~ Merrill Pickard	Dana Bed.	Tekna 11:30 ~~(Silicon Comp.Bd.)~~	(8a Sun.-To DC via UN #188;ar Chic 2:03
<----------California---------->					lv.2:30,UN 616;ar
2-5-Exec. Cl. Mini Retreat		Steve Crist 2 P.A. Sq 425		Ranny Cohen	DC 5:08p)

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat 31/Sun NOV 1
		(8:30-Exec. Cl.) (To NY/metroliner) 1:30-3-IEEE talk/NY	New Orleans/ Alliant		Kansas City
		(5:45-To NewOrleans via EA547;arAtlanta 8:10,lv9:25 EA475; ar NewOrleans 9:41p	(4:30p-ToLafayette Royal #675;ar 5:10)	(6:45p-To KC via Cont'l 2595;ar Houston 7:45;lv 8:25 Cont'l 892; ar.KC 10:23p)(Pick up Avis rental car)	(7:42p Sun-To SF via EA #325; ar 9:16p)
5:30 NAS The Infinite Voyage DEC Party.		Royal Sonesta			

(415) 856-8600 Russ Hall

Gordon Bell's Calendar - 10/5/87

OCTOBER 1987

Mon 5	Tues 6	Wed 7	Thur 8	Fri 9	Sat/Sun 10/11
(6:30a-To DC via EA #195;ar 8:00a)		(Hartmanis here) 10-Exec. Cl.	9:00 Sussman 12:30-2-Dentist	Boston	9-Breakfast/Joe Hanson/E.India Row 10:30-Jeff Harris/ Warburg Pincus 212/878-0677
	3:30--FCCSET-NEOB				
3:30-Dr.Joel Yudkin		2-Henriette Avrams etal/Lib.ofCongress 3-4:30-Research ADs/CIA--Moore/520	4-5-Reception/New Prog Staff,1575 I (4:30-To Boston via EA #144;ar 6:01)		

Mon 12 (Holiday)	Tues 13	Wed 14	Thur 15 (NSB)	Fri 16 (NSB)	Sat/Sun 17/18
Boston	(7:30a-To DC via EA #175;ar 8:59)	8:30-Exec. Cl. 11-Dentist		8pm Lafayette Train (9-2-FCCSETsubcmte/BDM,Arlington) 5:35p-To SF via EA#325;ar KC 7:10 lv 7:42,EA325;ar SF 9:16p)	Gwen in DC/banquet
10:30-KSR	<--------NAE Annual Mtg------>				
	p.m.-Jack Dixon, N&F talk 500 - Dr. Moore	(4p-To SF via UN 621; Ar. Chicago 459, lv. 6p, UN #203; ar. SF 827)	6-NSB Dinner		

Mon 19	Tues 20	Wed 21	Thur 22	Fri 23	Sat/Sun 24/25
(9-Bloch/Ciment/Chuck/Rotar/Brandt)		(8:30-Exec. Cl.) Merrill Pickard	DANA Bd.	11:30-Tekna 9:00 L Rohl	(8a Sun.-To DC via UN #188;ar Chic 2:03 lv.2:30,UN 616;ar DC 5:08p)
<----------California---------->					
	3:30 - Exec. Cl. Mini Retreat	Steve Coit 2 P.A. Sq. 425		Danny Cohen	

Mon 26	Tues 27	Wed 28	Thur 29	Fri 30	Sat 31/Sun NOV 1
9:30 Dentist 10:30-11:30 ETA Systems		(8:30-Exec. Cl.) (To NY/metroliner) 1:30-3-IEEE talk/NY (5:45-To NewOrleans via EA547;arAtlanta 8:10,lv9:25 EA475; ar NewOrleans 9:41p (Take cab to Royal Sonesta Hotel,300 Bourbon St.)	New Orleans/ Alliant (4:30p-ToLafayette Royal #675;ar 5:10)	(6:45p-To KC via Cont'l 2595;ar Houston 7:45;lv 8:25 Cont'l 892; ar.KC 10:23p) (Pick up Avis rental car)	Kansas City (7:42p Sun-To SF via EA #325; ar 9:16p)
5:30-DEC party/NAS The Infinite Voyage	6:30 - China Regency (Doers dinner)				

NOVEMBER 1987

Mon 2	Tues 3	Wed 4	Thur 5	Fri 6	Sat/Sun 7/8
				(9:10a-To Boston via TWA #754;ar 5:25p)	Games--weekend museum
<----------California---------->					
(2-5-Exec. Cl. Mini Retreat)		11pm - Danny Cohen			Boston

Japan Times.-

Gordon's Calendar

November
11/24/87

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4 9:30-10:30 Sieworiek Update & define projects 11:00 Spectrum article 2-4 Exec Staff	5 1:00 i/o guy interview 2-4 EMC 4:15 Sieworiek - Wrap up plans for the future	6 Games Party Eve. TCM 9 am TWA 754 to Boston arrive 5:25	7 Boston Games at TCM
8 Boston	9 Boston 10 KAI BOD	10 7:30 EA175 ar 8:59 8 Exec Council 11 Wolff, Electonix, intrvw 1:30 Art Kaszinski 1:30 Judith Turner 3:30 Farewell party	11 HOLIDAY 8 DENTIST	12 IRIS ADV. Comm CISE overview ?	13 IRIS ADV. Comm 8:30 DASC Adv. Comm. 5:30 Dulles to SF UA 57 arrive 8:02	14 11 Dixit, Diagnos Intervw
15	16 12 Ron Melanson, lunch	17 2-4 EMC	18 11 Danny Cohen, ISI 10 Mips and Prisma 2-4 Exec Comm	19 12 Phil Kaufman 2-4 EMC	20 1:00 Staff mtg.	21 Teknowledge TAB
22	23 10:00 System Adm. Arch. 2:00 Computerworld 4:00 Staff planning mtg.	24 10: 00 Staff mtg. 12:00 Arch. Mtg. 220 ~~2:30~~ UA 178 Denver Arrive 5:45	25 2-4 Exec Staff	26 Thanksgiving Holiday	27	28
29 12:02 to San Jose UN 987 arrive 1:30 6:30 SBlank, Fresco	30 4:00 Staff planning mtg.					

note