Originally Processed With FOIA(s):
2005-0336-F

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Record Group/Collection: George H.W. Bush Presidential Records
Collection/Office of Origin: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files

OA/ID Number: 62041
Folder ID Number: 62041-003

Folder Title:
Physical Science: General [3 of 8] [1991]

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	0	0	0	0

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124747
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: CRAWLEY, GERARD M.: THE AMERICAN PHYSICAL SOCIETY

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 11/01/91

SUBJECT: A LETTER REQUESTING DR. BROMLEY'S ASSISTANCE IN AVERTING THE PROPOSED DOE BUDGET CUTS IN THE NUCLEAR PHYSICS PROGRAM.

****

DIRECTORATE ASSIGNED: STAFF ASSIGNED:

ACTION REQUIRED: STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

****

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:

REMARKS:

OSTP RECEIVED: 11/12/91 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

4747

The American Physical Society

DIVISION OF NUCLEAR PHYSICS

GERARD M. CRAWLEY, *Chairman*
Physics Astronomy Department
Michigan State University
East Lansing, MI 48824-1116
Phone: (517) 353-8662
Fax: (517) 355-6661
Bitnet: "crawley@msupa"

WICK C. HAXTON, *Vice-Chairman*
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VIRGINIA R. BROWN, *Secretary-Treasurer*
Lawrence Livermore National Laboratory
P.O. Box 808, L-297
Livermore, CA 94550
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Fax: (415) 423-8086
Bitnet: "7304%mfe.mfenet@lbl"

RECEIVED
91 NOV 12 P5:00
OFFICE OF THE
DIRECTOR

November 1, 1991

Dr. D.A. Bromley
Executive Office of the President
Office of Science and Technology Policy
Old Executive Office Building
Room 360, 17th and Pennsylvania Ave.
Washington DC, 20506

Dear Dr. Bromley,

During the recent meeting of the Division of Nuclear Physics (DNP) held in East Lansing, it was announced that the Nuclear Science Advisory Committee (NSAC) had been charged with giving advice on Department of Energy budgets which would involve a ten percent cut in FY1993 coupled with decreasing or low growth future projections. As members of the Executive Committee of the DNP, we are writing to you to request your assistance in averting the great harm that such a budget scenario would create. We believe strongly that this plan is not in the best interests of the United States, is clearly counterproductive, and breaks the implicit agreement made with the nuclear science community only two years ago when we struggled to produce a responsible long range plan which was presented to DOE and NSF in 1989. While we realize that DOE is suffering from budget constraints, both the severity and particularly the suddenness of the proposed cuts directed at nuclear physics will cause serious and perhaps irreparable damage to a significant and vital part of the US scientific enterprise.

Recognizing the importance of community involvement, the DNP organized a series of workshops and town meetings to help formulate a responsible Long Range Plan. These meetings involved the various sub-fields and were held in several locations to permit all active scientists in the field to participate. The ideas developed were presented to NSAC at the Long Range Plan Working Group, which met for a week in Boulder, Colorado in August, 1989. The

resulting plan was responsible in that it fit within the financial constraints presented at that time and was one which the community endorsed. The solution involved considerable sacrifice and included recommendations for imminent closing of several facilities which had excellent science programs and strong user groups. This plan, so carefully and responsibly wrought, is now in grave danger of unravelling because its implementation would be undercut by the recent precipitous action proposed by the DOE.

As the proposed budget reduction will affect all construction and operations in nuclear physics, our community is concerned that nuclear physics is particularly threatened. Such a sudden cut will have the regrettable consequence that the hiring of students and young researchers will be most severely affected, since hiring decisions for this group are made each year. This diminished capacity to contribute to the training of young people seems a false economy from the perspective of an increasingly competitive and technological world market. It is estimated that a 10% decrease in funds would result in a decrease of about 200 scientists in nuclear physics, some at the Ph.D. level and others still in graduate school. These losses will be compounded if budgets remain flat. We emphasize that approximately two thirds of the Ph.D.'s trained in nuclear physics are recruited into areas beyond the basic research environment of the field because of the strong demand for their technical training and broad expertise.

The extent and depth of nuclear physics was once again demonstrated at the recent East Lansing meeting. The crucial role of nuclear physics in understanding the evolution of the universe, the properties of neutrinos, and the behavior of hadronic matter give it unique importance in the scientific enterprise. Nuclear physics as a field has also contributed greatly to our society through the transfer of technology. The examples of detector, accelerator, and radioisotope techniques being applied to our national needs are numerous. We worry that the cessation of ongoing or planned accelerator or detector development in our field would harm this constant flow of technology from the nuclear physics laboratory to the marketplace.

Some years ago, the Department of Energy accepted the stewardship of nuclear physics as a national trust, to be supported not only because of its continuing role in the development of energy resources, but also because of the crucial need for basic research and graduate

education as building blocks for applied research and technology development. While we sympathize with the financial constraints being faced by our country and the Department of Energy, we are gravely concerned that the DOE's role as guardian of this national trust is being compromised by the DOE budgetary emphasis on other aspects of its program.

Thank you for your attention to this crucial matter.

Sincerely,

Gerard M. Crawley,
Chairperson

Wick C. Haxton
Vice-Chairperson

Virginia R. Brown
Secretary-Treasurer

Gerald T. Garvey
Division Councillor

James B. Ball
Committee Member

John Cameron
Committee Member

Richard F. Casten
Committee Member

Stuart J. Freedman
Committee Member

Noemie Benczer-Koller
Committee Member

Peter D. Parker
Committee Member

Leo L. Riedinger, Jr.
Committee Member

cc: Admiral James Watkins, Secretary of Energy, Department of Energy
Dr. Walter Massey, Director, National Science Foundation
Dr. William Happer, Director of Energy Research, Department of Energy
Dr. David Sanchez, Assistant Director, Mathematical and Physical Sciences, NSF

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124551
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: BOWERS, Betty: FLUOR CORPORATION

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 10/24/91

SUBJECT: A THANK YOU FOR THE MEETING DR. BROMLEY HELD WITH THEM, AND PROVIDING MORE INFORMATION ON THE FORT ST. VRAIN AND PEACH BOTTOM.

****

DIRECTORATE ASSIGNED:

STAFF ASSIGNED:

ACTION REQUIRED:

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE:

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

****

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OSTP RECEIVED: 10/29/91 DEPT RECEIVED:

FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

4551

FLUOR CORPORATION

1627 K Street, N.W., Suite 300
Washington, DC 20006
(202) 955-9313

B. H. Bowers
Vice President, Government Relations

RECEIVED
91 OCT 29 A10 : 44
OFFICE OF THE
DIRECTOR

October 24, 1981

Dear Dr Bromley,

I hope the attached information answers your questions regarding Ft. St. Vrain. If not, please let me know and we will provide more data.

Thanks again for the kind hospitality today.

Regards,

Billy Bowers

P.S. We have also enclosed a short paper on the successful application at Peach Bottom

John G. Berra
VICE PRESIDENT

FLUOR

FLUOR CONSTRUCTORS
INTERNATIONAL, INC.
Suite 215, Koger Center
150 Executive Center Drive, B-40
Greenville, SC 29615

Office: (803) 234-7335
Panafax: (803) 297-5476

Document Originally
Attached to
Previous Page

FLUOR CORPORATION
1627 K Street N.W., Suite 300
Washington, D.C. 20006
(202) 955-9313 Fax: (202) 833-1630

Betty H. Bowers
Vice President, Government Relations

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01a. Report	Fort St. Vrain Power Station (6 pp.)	4/1/91	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Physical Science: General [3 of 8] [1991]

Date Closed:	3/19/2010	**OA/ID Number:**	62041-003
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01b. Report	Peach Bottom Atomic Power Station Unit 1 (5 pp.)	4/12/91	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Physical Science: General [3 of 8] [1991]

Date Closed:	3/19/2010	**OA/ID Number:**	62041-003
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

THE WHITE HOUSE

WASHINGTON

December 4, 1991

Dear Betty:

Many thanks for providing me with the additional information that I had requested on the Fort St. Vrain and Peace Bottom power plants. This is precisely what I required and has been extremely helpful.

It was good to see you and your associates again and I look forward to working with you.

In the meantime, warmest best wishes,

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Ms. Betty Bowers
Vice President for
Government Relations
Fluor Corporation
1627 K Street, N.W. - Suite 300
Washington, D.C. 20006

"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9124985
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: COMFORT, Joseph R.: ARIZONA STATE UNIVERSITY

TO: TOWNES, Charles

DATE OF CORRESPONDENCE: 10/21/91

SUBJECT: HE IS FORWARDING A COPY OF HIS LETTER TO DR. TOWNES REGARDING THE PROPOSED DOE BUDGET CUTS IN THE NUCLEAR PHYSICS PROGRAM, AND STATES THAT HE HOPES WITH DR. BROMLEY'S ASSISTANCE THE CUTS CAN BE AVERTED.

****

DIRECTORATE ASSIGNED: PHYSICAL SCIENCES

STAFF ASSIGNED:

ACTION REQUIRED: FOR DAB'S SIGNATURE

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: 12/17/91

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: 2/11/92

****

COPIES TO: D. Allan Bromley

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WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE: EXT:

REMARKS:

OSTP RECEIVED: 12/03/91 DEPT RECEIVED:

FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

Allen,

With your help,
I hope we can
turn things
around.

Thank you,
Joe

Document Originally
Attached to
Following Page

4985

Copy

Arizona State University

Tempe, AZ 85287

Department of Physics and Astronomy
Prof. Joseph R. Comfort
Bitnet: COMFORT@ASUCPS

(602)-965-3561
(602)-965-6377
Fax: (602)-965-7954

RECEIVED
91 DEC 3 P4:19
OSTP
MAIL ROOM

October 21, 1991

Professor Charles H. Townes
Chair, SEAB Task Force
Physics Department
557 Birge Hall
University of California
Berkeley, CA 94720

Dear Professor Townes,

I wish to express my deep concerns about the proposed 10% cut for the FY93 DOE budget, and caps on subsequent budgets. I believe very strongly that such cuts are counterproductive to the best interests of this country.

During 1989, the nuclear physics community through NSAC developed a comprehensive and imaginative long-range plan for the field. Many compromises had to be made, but the vision has been broadly accepted. My group at ASU has already shifted its focus towards the "exploration of the quark degrees of freedom and the underlying theory of the strong interaction, QCD, in the nuclear medium" in experimental programs at LAMPF, Bates, CEBAF, and other facilities. These programs will exploit new techniques and observables, including polarized targets, out-of-plane observables, and novel detectors, for incisive studies of frontier issues. We have a group, currently with seven students, who are very excited about these programs.

I devoted a very substantial part of my life during 1988-89 in support of the SSC site proposals. I did so partly on behalf of Arizona, but more so because I am committed to enhancing the scientific and technological underpinings of this country. I gave numerous public talks, always emphasizing the importance of the SSC to the education and stature of this country. I am equally committed to the goals expressed by NSAC and our own aspects of the new research themes.

As I am sure you understand very well, university physics faculty must teach the importance of clear analytical thinking, critical inquiry, scientific methodology, and discovery through research to vast numbers of students who are primarily interested in medicine, engineering, architecture, and other technical professions. The best teachers are those who are fully involved is such activities themselves and who therefore convey a sense of professional commitment and excitement. There is, or soon will be, a very large deficit of capable teachers for our universities, secondary, and elementary schools. Congress has already declared Physics to be an area of National Need. Precipitous reductions in the budgets for nuclear and particle physics will have an impact far beyond the identifiable research needs of these fields — they will in fact impair the quality of the education of our youth.

I appreciate that the country is in serious financial constraint. I plead, however, that the penalty for problems generated elsewhere not be assessed in areas that are critical for the current and future fabric of this country. The well-considered plans of NSAC need to be fully supported.

Sincerely yours,

Joseph R. Comfort

Joseph R. Comfort
Professor of Physics and Associate Chair

xc: Dr. William Happer, Director of Eenergy Research, DOE
Dr. Walter Massey, Director, National Science Foundation
Dr. D. Allen Bromley, Assistant to the President

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124496
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS
****

FROM: CAHILL, Thomas A.: UNIVERSITY OF CALIFORNIA, DAVIS

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 10/18/91

SUBJECT: A THANK YOU NOTE FOR DR. BROMLEY'S SUPPORT IN THE RECENT NEGOTIATIONS OVER SO2 CONTROL ON THE NAVAJO GENERATING STATION, AND ENCLOSING RESULTS AND INFORMATION ON THEIR NETWORK.

****

DIRECTORATE ASSIGNED: STAFF ASSIGNED:

ACTION REQUIRED: STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

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COPIES TO: D. Allan Bromley
ENVIRONMENT
PHYSICAL SCIENCES

****

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:

REMARKS: ENCLOSURES TO DAB.

OSTP RECEIVED: 10/22/91 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

4496

UNIVERSITY OF CALIFORNIA, DAVIS

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CROCKER NUCLEAR LABORATORY
AIR QUALITY GROUP

DAVIS, CALIFORNIA 95616-8569
TELEPHONE (916) 752-1120
FAX (916) 752-4107

October 18, 1991

The Honorable D. Allan Bromley
Assistant to the President
For Science and Technology
Old Executive Office Building
Suite 358
17th Street and Pennsylvania, NW
Washington, DC 20500

RECEIVED
91 OCT 22
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
DIRECTOR'S OFFICE

Dear Allan:

Thank you for your support and encouragement in the recent and successful negotiations over SO_2 control on the Navajo Generating Station. The fine outcome is all the more appreciated since things looked so bleak in February. I am also pleased to learn that by June the Salt River Project Team had essentially conceded the key points in the NPS argument, which will strengthen the administration's hands in future negotiations.

I promised you information on our network, firmly based on modern techniques but largely implemented on the oldest operational accelerator (counting Crocker as the continuation of the old Berkeley 60" cyclotron, 1939).

I am enclosing examples of the results we get from our combination of techniques - nuclear, atomic, optical, and gravimetric, including synchrotron analyses at Stanford for special samples (i.e. Kuwait). These results are a good start, but the demands of atmospheric optics and Mie Scattering Theory are clear - we must have continuous time and adequate size resolution to understand visibility reduction. We have developed such devices, with both 110v (220v) power and solar power, and they ran this summer at Shenandoah N.P.

Finally, a meeting was held four weeks ago at Davis with NOAA (John Miller and others) and the UN's WMO (Rumen Bojkov, Doug Whelpdale) to expand the US IMPROVE protocols to the world. We already have 13 countries working with us bilaterally but we will be responsible for the WMO's aerosols, too.

Well, this was just supposed to be a "thank you" note, and that is the way I will end. Please feel free to call or write if there is anything I can do to help you.

Yours truly,

Tom

Thomas A. Cahill
Prof. of Physics and
Head, Air Quality Group

TAC:lb

Enclosures

Reprinted from Analytical Chemistry, 1987, 59, 829.
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The Vinland Map, Revisited: New Compositional Evidence on Its Inks and Parchment

T. A. Cahill,*[1] R. N. Schwab,[2] B. H. Kusko, R. A. Eldred, G. Möller,[3] D. Dutschke,[4] and D. L. Wick[5]

Crocker Historical and Archaeological Projects, Crocker Nuclear Laboratory, University of California, Davis, California 95616

A. S. Pooley

Peabody Museum, Yale University, New Haven, Connecticut 06520

The Vinland Map, once considered the first cartographic evidence of the North American continent, purportedly dates from the mid-15th century. In 1974 compositional evidence derived from microparticles removed from its surface led McCrone Associates to conclude that ink in the Map was made up of 20th century titanium-based pigments containing up to 50% anatase (TiO_2) and that the Map was therefore a forgery. Recently at Davis, 159 multielemental PIXE (particle induced X-ray emission) analyses of the Vinland Map were performed, including spatial analyses of the parchment, 33 closely matched ink–parchment pairs, and transects across inked lines with 0.5 mm resolution. The results show that titanium and other medium and heavy elements are present in only trace amounts in the inks, with titanium reaching a maximum value of 10 ng/cm^2, or about 0.0062% by weight. In the light of these results the prior interpretation that the Map has been shown to be a 20th-century forgery must be reevaluated.

The Vinland Map of the Beinecke Rare Book and Manuscript Library at Yale University was for several years after 1965 thought to be the first cartographic evidence of North America, as well as a rather complete charting of other areas of the world, including the Far East. Extensive discussion of the possible historical setting of the Map can be found elsewhere (*1*, *2*). Since the date of the document is purported to be the mid-15th century, it seemed to indicate a more extensive knowledge of the world than previously thought to exist in the time before Columbus. However, questions about its origins and authenticity were raised and have persisted since its discovery. For this reason, compositional studies were performed in 1974 by McCrone Associates (*3*, *4*) on 29 microparticles removed from the surface of the Map and 25 microparticles removed from two other documents, the Tartar Relation and the *Speculum Historiale*, that are possibly associated with the Map. The results of these studies were interpreted as showing that the Map was a 20th-century forgery, made by drawing the map twice, first in a yellow-brown line and then overdrawing this line with a black ink which was partially chipped away in order to simulate antiquity. It was reported that the ink drawn first was a "firmly adhering yellow-brown substance containing up to 50% anatase, a form of titanium dioxide" (*3*). Since ink pigments based on crystalline TiO_2 became available only in the 1920s, McCrone Associates concluded the Map had to be a forgery. A critical analysis of the 1974 study by Towe (*5*) raised a number of questions regarding the earlier work without challenging its conclusion.

There has been continuing interest in the Vinland Map as either an important document in cartographic history or an exceedingly clever forgery. In order to answer some of the outstanding questions concerning the Map's composition, we undertook to examine the Vinland Map, the Tartar Relation, and the *Speculum Historiale* using nondestructive techniques that do not require the removal of any material from the documents.

EXPERIMENTAL SECTION

With the cooperation of the Beinecke Rare Book and Manuscript Library of Yale University, the Vinland Map, the Tartar Relation, and the *Speculum Historiale* were flown to the Crocker Nuclear Laboratory, University of California, Davis. The Crocker Historical and Archaeological Projects team and representatives from Yale University subjected the documents to 2 days of study and analysis. We took numerous photographs in reflected light, transmitted light, and long and short wave ultraviolet light, and obtained 32 colored microphotographs from among the over 100 locations microscopically examined on the Map. With the optical studies and earlier work as guides, we made 159 elemental analyses of the Map's parchment and ink using the proton milliprobe. In addition to the 159 analyses of the Vinland Map, we made 45 elemental analyses of the parchments and inks of the Tartar Relation and the *Speculum Historiale*.

The Davis proton milliprobe consists of a beam of 4.5-MeV protons with dimensions that can be set in the range of 0.1–25 mm^2. For the present study the beam was collimated to 1.0 mm × 0.5 mm, since the width of an inked line on the Map is on the order of 0.5 mm. The energetic proton beam passes out of the vacuum system of the Crocker Nuclear Laboratory's 76" (193 cm) isochronous cyclotron, through about 3 cm of air, generates X-rays while passing through the sample, and is collected by a Faraday cup (Figure 1). A Si(Li) energy dispersive X-ray detector is placed about 2 cm from the sample, resulting in a large solid angle and absolute efficiency (*6–8*). The technique gives a minimum detectable limit of a few parts per million by mass of the sample in 2 min, for all elements from silicon through uranium, although rare-earth sensitivities are poorer due to common elemental interferences (*9*). A vital point is that the PIXE milliprobe system is completely harmless to even fragile, thermally insulating materials such as paper (*10*), so that small parts of large objects can be safely analyzed without the necessity of removing aliquots from their surfaces.

All Davis PIXE programs operate under formal quality assurance protocols, most of which utilize an independent research laboratory for validations (*9*, *11*). In these studies, three standards were used: two Micromatter, Inc., thin elemental standards (Fe, Pb) and NBS-SRM 1533, a thin-film multielemental standard covering over a dozen elements heavier than silicon. Each standard was run twice to ensure consistency as well as absolute accuracy. Finally, since the technique is nondestructive, a standard parchment sample from about 1180 A.D. was analyzed at precisely the same location used on scores of previous tests since 1978. Two runs were made on the parchment. The full agreement of all analyses to within the nominal ±5% absolute accuracy was achieved before the tests were begun.

[1] Department of Physics.
[2] Department of History.
[3] Department of Chemistry.
[4] Department of French and Italian.
[5] Integrated Studies Program.

0003-2700/87/0359-0829$01.50/0 © 1987 American Chemical Society

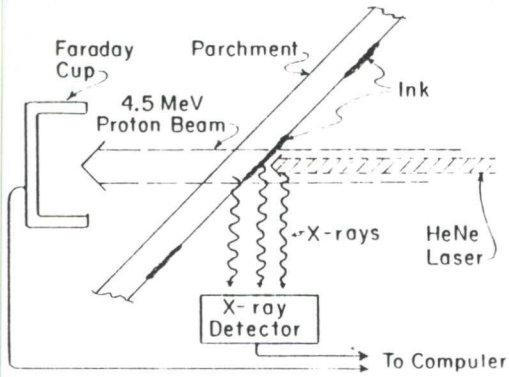

Figure 1. Schematic diagram of the Davis external PIXE milliprobe.

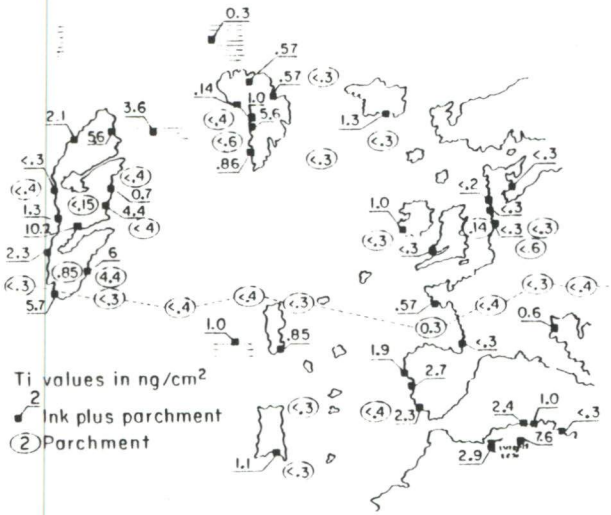

Figure 2. Titanium levels for part of the Vinland Map. The values in ellipses give titanium in ng/cm² for the parchment, while analyses of ink, also in ng/cm², are underlined. Note that, while all titanium values are low, the highest values occur in "Vinland", "Algeria", and "Spain".

RESULTS AND DISCUSSION

The full results of the study, including selected microphotographs, are included in a 75-page report to Yale University (*12*). The results of all elemental analyses for the 18 most common elements detected by PIXE are included in Appendix A of that report, as are internal and external quality assurance protocols.

The elemental analyses by the proton milliprobe of the Vinland Map parchment showed that it is similar to other parchments studied at Davis. We found titanium in the Vinland Map parchment in several locations (at the ng/cm² level), along with iron, zinc, and a number of lighter elements including sulfur, chlorine, potassium, and calcium. We have detected titanium in several other early parchments in similar amounts. These include a 12th-Century Italian manuscript, a 13th-Century Oxford Bible, a 1457 Mainz Psalter, a 1470 Donatus (Speculum), and a 1470 Donatus (Saliceto). However, we found no titanium in the Tartar Relation or the *Speculum Historiale* above the minimum detectable limit. The locations of all analyses for the part of the Vinland Map that shows the North Atlantic are seen in Figure 2. Figure 3 shows transects across the parchment, first west to east, then north to south, for three common transition metals: titanium, iron, and zinc.

The compositional complexity of the parchment, including its titanium, and the very low levels of titanium in the ink, made efforts to isolate the composition of the ink alone more difficult than in our studies of ink on papers, for most individual sheets of paper are relatively homogeneous chemically. Since the proton milliprobe analyzes the entire sample, ink and parchment, the values for the ink are summed with the values from the underlying parchment (Figure 1). The two

Table I. Ink-Parchment Pairs (Ink-Plus-Parchment Value)/(Parchment Value), All Values in ng/cm²[a]

pair	Ti	Fe	Cu	Zn	other[b]
1	10.2/<0.3	2.5/1.6	0.9/0.5	1.4/1.3	
2	0.3/<0.3	1.1/1.5	0.7/0.2	0.8/0.7	
3[c]	5.9/2.6	1.9/2.7	0.8/0.9	3.3/8.6	
4	0.7/<0.4	1.3/1.5	0.3/<0.3	0.5/0.5	Co/-
5	3.6/<0.3	0.9/1.4	<0.1/<0.2	0.5/<0.2	
6[c]	4.4/<0.3	1.6/1.5	0.4/0.5	0.6/1.1	Co/-
7	1.0/<0.5	0.6/0.9	<0.1/<0.3	0.7/<0.3	-/Mn
8	0.4/0.5	0.6/0.9	<0.1/<0.2	0.4/<0.2	-/Mn
9	1.0/<0.3	0.8/0.8	<0.1/<0.1	<0.1/<0.1	
10	<0.2/<0.2	0.7/0.9	<0.1/0.2	0.6/0.4	-/Mn
11	<0.2/<0.6	0.6/<0.5	<0.1/<0.7	0.4/<0.9	
12	5.6/<0.4	2.3/1.6	1.2/0.6	8.3/3.8	
13[d]	5.6/<0.2	0.8/1.2	<0.1/0.3	0.6/2.7	
14[d]	0.2/<0.4	0.7/<0.1	<0.1/<0.2	0.5/<0.2	
15	3.5/0.4	0.6/0.9	<0.1/<0.1	0.5/0.5	
16	1.9/<0.4	1.0/<0.2	<0.1/<0.2	0.5/<0.2	
17	2.1/<0.3	0.7/<0.1	<0.1/<0.1	<0.2/<0.1	
18	1.9/<0.4	0.8/<0.1	<0.2/<0.2	<0.2/<0.2	
19	0.5/<0.3	1.4/0.9	0.3/<0.1	0.7/0.4	
20	0.9/0.6	0.9/1.0	<0.1/<0.2	0.7/1.1	
21[d]	0.8/<0.3	0.8/0.8	<0.1/<0.2	0.2/<0.2	
22[c]	0.3/<0.3	0.8/0.9	<0.1/0.1	0.4/0.3	
23	1.9/<0.3	0.6/0.6	<0.1/<0.1	0.6/<0.2	
24	0.2/<0.3	0.9/0.9	<0.1/<0.1	0.4/0.5	
25	1.2/<0.3	0.7/1.0	<0.1/<0.1	<0.1/0.4	
26	0.4/<0.2	0.9/1.1	0.3/0.6	<0.1/0.7	
27	1.1/0.4	0.8/1.3	<0.1/<0.2	0.3/<0.2	
28	2.7/<0.3	0.8/1.4	0.2/<0.2	0.5/0.4	
29	<0.3/<0.3	0.6/<0.1	<0.1/<0.2	<0.1/<0.2	
30	0.3/<0.5	0.5/<0.8	<0.1/<1.2	0.4/<1.5	
31	1.3/<0.3	0.7/<0.1	<0.1/<0.1	<0.1/<0.2	
32	<0.2/<0.2	0.7/1.0	<0.1/<0.1	0.7/0.5	
33	1.6/<0.3	1.3/0.8	<0.1/<0.1	0.9/0.6	

[a] Typical uncertainties, ±0.2; 3σ minimum detection limits marked by a <. [b] The elements S, Cl, K, and Ca were found in every parchment analysis. [c] Parchment value is average of two different locations. [d] Ink-plus-parchment value is average of two different locations.

Table II

Occurrence of Selected Elements in the Vinland Map Ink Taken from the 33 Ink–Parchment Pair Analyses

elements	frequency of occurrence	av value, ng/cm²
Ti	65%	(2 ± 2)
Zn	35%	(0.7 ± 1.0)[a]
Fe	35%	(0.6 ± 0.2)
Cu	12%	(0.4 ± 0.2)

Frequency of Occurrence of More Than One Element in an Analysis

Ti and Zn	24%	Fe and Cu	9%
Ti and Fe	24%	Ti, Zn, and Fe	9%
Ti and Cu	9%	Zn, Fe, and Cu	6%
Zn and Fe	18%	Ti, Zn, Fe, and Cu	6%
Zn and Cu	6%		

[a] Omitting run 52 (Zn = 4.5), Zn av = 0.31 ± 0.08.

methods that yielded the most satisfactory results for isolating the composition of the ink alone were as follows: first, to pair each analysis of ink-plus-parchment with an analysis of an immediately contiguous parchment location alone, and second, to make transects across inked lines.

The results of the paired analyses are given in Table I and II. About two-thirds of all ink samples showed titanium, but the highest level encountered was only 10.2 ng/cm². The lack of uniformity in the ink is indicated by the lack of correlation between the titanium content and other transition metals, zinc, iron, and copper, which were also present in only trace

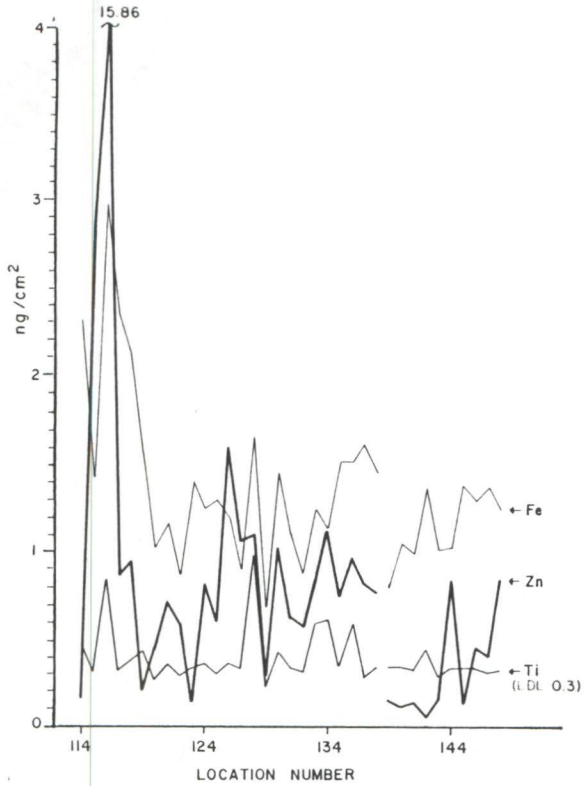

Figure 3. Parchment transects for titanium, zinc, and iron, in ng/cm². The locations 114 to 138 represent a west to east transect across the middle of the Map (the first nine locations are shown in Figure 2), while locations 139 to 149 represent a north to south transect of the "Atlantic Ocean".

amounts (Table I). Compositions tended to be similar in adjacent areas of the Map, but no clear patterns emerged. The left edge of the parchment was rich in transition metals, including titanium. Relatively high titanium readings in the ink occurred in the "Vinland" region, but also in Spain, "Tunisia", and "Japan" (Figure 4), while the low titanium values were found in "Greenland", most of Europe, and "India". Transitions in ink composition along a single line could occasionally be followed.

Figure 4 shows a transect across a black-inked line. In this figure, the presence of a "rimmed" ink line is shown in the elemental analyses, and microphotographs show visually that the ink trace is fainter in the center of the line than at the edge or "rim". Another transect across a dark inked line on the western coast of Europe showed relatively high iron and zinc in the ink, but no titanium above that occurring in the parchment. This further illustrates the high degree of variability in ink composition. Because of the importance of this result, the analysis was repeated, yielding results identical within an average of 0.07 ng/cm² for iron and zinc, illustrating a precision of better than 5% at the sub-part-per-million level. Again, no titanium was found above that occurring in the parchment alone. Such variability was not unexpected by us, since in several hundred earlier analyses done at Davis on parchment manuscripts, we have had to deal with a high level of compositonal variability of ink and parchment even within a single page.

The inks of the Tartar Relation and the *Speculum Historiale* were very similar to each other but different from those of the Vinland Map (Figure 5). While they have higher metallic content than the Vinland Map inks, most of their ink mass consists of elements lighter than silicon, most likely carbon and organic binders common in typical iron gall inks of the times.

Comparison with Earlier Work. McCrone Associates' argument is that the presence of anatase crystals of what they

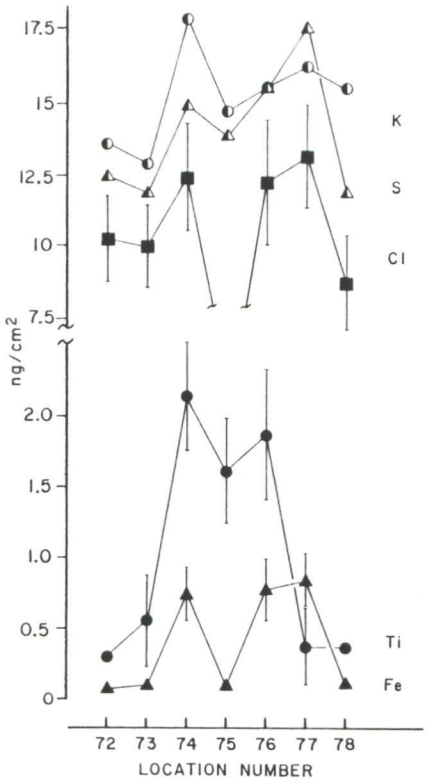

Figure 4. Transects across a single line of ink on the coast of "Japan(?)", from east to west. Values for sulfur, chlorine, potassium, titanium, and iron show enhancement in the ink. The "rimmed" ink can be seen in all transects, since the edges are blacker than the middle. The distance from location 72 (parchment, east) to 78 (parchment, west) is about 3 mm.

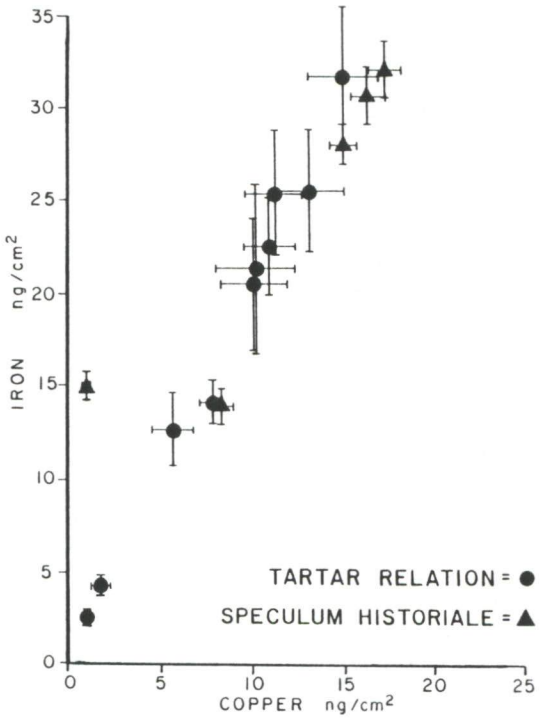

Figure 5. Relationship of copper to iron in the inks of the Tartar Relation and the *Speculum Historiale*. Great similaries are seen in these inks, favoring a hypothesis of a common source for these two documents.

believe to be modern origin in the yellowish brown ink is proof that the Vinland Map is of 20th century manufacture. They allege that modern TiO_2 was the source of the yellowish brown pigment in a separately applied underlayer on the Vinland Map. This was intended by the forger to look like the vestiges

of lines of 15th century inks that have their black layer flaked away. We found about one-third of all inked lines showed no titanium whatsoever above our minimum detectable limit of 0.2 ng/cm^2 and yet the yellowish brown color is clearly visible. We therefore conclude that TiO_2 could not possibly be the base of the yellowish brown pigment of the alleged underlayer. It must be noted that a yellowish brown color in an anatase-based pigment is usually due to iron impurities of a few percent. The same modern manufacturing methods that produce uniform anatase crystals also ensure that the pigment is free of impurities giving the brilliant white for which the product is so well known.

In order to compare the McCrone Associates relative values (*3*) to our areal mass values (mass per unit area), an estimate had to be made of the total mass of ink adhering to the parchment. We performed a short study during which three sources of titanium pigment were diluted by solvents into inks that were capable of giving fine lines similar in dimension to those on the Vinland Map. Two were oil-based artist paints (Grumbacher Titanium White and Grumbacher Quick Drying Titanium White) and the third was a modern error correction fluid (Rembrandt Opaque White). Fifteen lines were drawn on a 17th-century parchment that has an elemental compositon similar to that of the Vinland Map. Line widths varied from 1.5 mm to the thinnest that could be applied, about 0.7 mm. Further, half of a 1 mm wide line was deliberately erased, to the point where no observer could, by eye, detect the presence of the line continuation. The pure white TiO_2 pigments used in this test stood out even more clearly than yellow pigment on tan parchment, and thus we were assured visually that the erasure was complete.

The lines were scanned by the PIXE milliprobe as was done in the case of the Vinland Map analysis. The results show, for all pigments (Ti or Ti + Zn) and all lines measured, a mean pigment mass of 1400 ± 750 μg/cm^2. The minimum value of titanium seen in the thinnest line was 230 μg/cm^2. When we determined the level of titanium in the erased line we found it still had 400 μg/cm^2 of titanium. This was not unanticipated, since to make fine lines, inks had to be used that were observed under magnification to penetrate the parchment fibers. Even McCrone points out that the yellowish brown color is "in a line that tightly adheres to the parchment fibers" (*13*).

Thus we find it inconceivable that erasure or wear can reduce any titanium pigment from the minimum titanium value of 230 000 ng/cm^2 we see in these tests to the maximum titanium value of 10 ± 2 ng/cm^2 we see in the Vinland Map. Assuming that the entire ink mass had the composition of the particles McCrone Associates removed in the earlier study (up to 50% anatase or 30% titanium), there would be about 69 000 ng/cm^2 of titanium for the minimum value, as contrasted with our maximum observation of 10.0 ± 0.8 ng/cm^2. Likewise, reasoning from the McCrone Associates data, the average level of titanium (12% by weight) would have been 27 600 ng/cm^2, contrasted with 2.0 ng/cm^2 that we found.

It must be realized that the McCrone Associates conclusions about the heavy concentration of anatase in the ink of the Vinland Map rests on one X-ray diffraction pattern and four electron diffraction patterns from particles less than 8 μm in diameter, weighing less than about 100 ng (*3*), plus qualitative observations of optical behavior. The McCrone Associates data also demonstrated a high degree of compositional variability from particle to particle. Our results show that it is not valid to generalize about the composition of the ink as a whole from these small aliquots. When we tested dozens of ink locations throughout the Map, we found that the amount of titanium in the ink is at most only 0.007% of the average amount estimated by McCrone Associates extrapolating from the aliquots they tested.

McCrone Associates concluded that a forger made a double application of ink, laying a black ink over a previously applied yellowish brown ink. The results of extensive observation of the Map with a 10–15× light microscope both at Davis and at the Beinecke Library show that the visible ink trace does in fact consist of two components. The first is a yellow-brown color absorbed into the fibers and varying considerably in intensity. The second component is a dense black film loosely adhering to the surface which has flaked away to a great extent. The darkness of the ink to the eye is largely a measure of how many of the black particles remain. McCrone Associates have suggested that the black component was separately applied and deliberately flaked off the yellow-brown underlayer to simulate age and to disguise less than perfect register between the two components (*4*). Our microscopic examination however, leads us to the hypothesis that the lines were a result of a single application of ink which separated into layers over time and whose black film on top chipped off, as is widely seen in vellum manuscripts. We observed excellent register throughout the Map even in the extremely fine inscriptions, typically to about 0.1 mm. The original edges of the lines can be seen clearly in nearly all parts of the Map and even in the more faded yellowish brown sections of the lines small residual black particles usually extend to the clearly defined limit of the original edge.

In one location on the coast of Wales there is a small discrepancy between the black and yellow which has been observed previously (*5*). The fact that in this one place there seems to be a double application of ink is no proof that the work was done by a forger. For comparative purposes we carried out an inspection, with 16× magnification of many 15th and 16th century vellum manuscripts of undoubted authenticity housed at the Bancroft Library at the University of California, Berkeley. The manuscripts examined at the Bancroft Library are a mixture of vellum legal and religious documents with the following identification numbers: f2MS/A2M2/1400: 3,4,6,7,9,11,50; 1500: 1,2,4,5,6; ff2MS/A2M2/1400: 50; 1500: 8,9,10,11,14. We found that ink characteristics such as are seen in the Vinland Map are common, where the black layer of pigment is flaked off, leaving patches and specks of black on brownish yellow vestiges of lines. There are many places in these documents where the brownish yellow vestigial lines appears alone, without any trace of black on them, and other places where parts of brownish yellow lines are out of the registration completely with the blacker vestiges of lines. In any case, there is no reason for postulating that a forger made a double application of ink on the Map in the first place, since titanium cannot be the source of the yellowish brown pigmentation of the lighter lines in the Vinland Map, as we have shown.

Because our investigations have thrown the question of its authenticity open again, we recommend additional scientific investigation of the Vinland Map. One obvious step would be to determine the age of the parchment by using modern carbon-14 techniques that would require that only a few milligram sample of the parchment be used. Of course, carbon-14 analysis will have a major effect on interpretation only if the parchment is proved to be modern. It is possible that a forger could have obtained an old sheet of parchment dating from the 15th century.

In conclusion, we must stress that, while our work argues strongly against the specific McCrone Associates proof that the Map is fraudulent, we do not claim therefore that the Map is authentic. Such a judgement must be based on all available evidence, cartographic and historical as well as compositional.

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Registry No. Ti, 7440-32-6; Zn, 7440-66-6; Fe, 7439-89-6; S, 7704-34-9; Cl_2, 7782-50-5; K, 7440-09-7; Cu, 7440-50-8.

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Visibility and Aerosols During the 1986 Carbonaceous Species Methods Comparison Study

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A modest change in synoptic meteorology occurred during the 1986 Carbonaceous Species Methods Comparison Study at Glendora, CA, resulting in a sharp change in visibility. This occurrence allowed comparisons of carbon species, soot and nonsoot, sulfates, and other aerosol components in two similar meteorological conditions with different visibilities. The results show that improvement in visibility was most strongly associated with a sharp decrease in sulfur mass median diameter, from 0.50 to 0.33 μm, with important contributions from nitrogen particles and volatile species such as water.

INTRODUCTION

The primary goal of the 1986 Carbonaceous Species Methods Comparison Study (CSMCS), August 12–21, 1986, at Glendora, CA, was detailed comparison of particulate collection and analysis of carbonaceous species by 29 participating groups from the United States and Canada (Lawson and Hering, 1987). Besides a wide variety of measurements of carbon species, data were also collected on many other air quality and meteorological parameters designed to aid interpretation of carbon data. The study lasted 9 days. Data were collected in 4-hour increments from 0800 hours, August 12 to 0800 hours, August 21 except for one 8-hour sampling period each night, from 0000 to 0800 hours.

The primary goal excluded an analysis of the effects of aerosols, carbonaceous or otherwise, on visibility. We took no on-site visibility measurements, although we did take morning color photographs of the foothills of the San Gabriel Mountains north and west of Glendora each day. Routine hourly nephelometer readings were taken by the South Coast Air Quality Management District monitoring site at Azusa, approximately eight km west of Glendora. Our interest in visibility intensified when a sharp improvement in visibility occurred on August 17, roughly in the middle of the study. An intensification of the upper-level high-pressure cell over southern California lowered the inversion layer and blocked efficient transport of the coastal marine layer to the sampling site (Zeldin and Wylie, 1988). In addition, the period from August 12 through August 16 was, meteorologically speaking, almost a perfect match to the historical mean, and thus typical of southern California summers. Though many aerosol parameters remained unchanged before and after the front passed, a dramatic change in visibility occurred. It changed from 8.8 km average before the front passage, to 15.5 km after the front had passed (Figure 1).

In this paper, we present a "differential visibility analysis": i.e., an analysis of the change in visibility versus the change in concentration. This technique offers a way to

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DATING ROCK VARNISHES BY THE CATION RATIO METHOD WITH PIXE, ICP, AND THE ELECTRON MICROPROBE

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ABSTRACT

The measurement of rock varnish cation-ratios [(K+Ca)/Ti] and barium is evaluated by analyzing the same varnish scrapings with PIXE, inductively coupled plasma, neutron activation and wavelength dispersive electron microprobe. Results among these different methods are generally similar for ratios, but absolute concentrations differ in part due to uncertainties associated with weighing small samples. Barium concentrations are typically less than 1% by weight; higher concentrations can be found in varnishes with depressions eroded into the varnish by fungi and lichens, and later infilled with aeolian detritus often including barium sulfate. Since these infilled hollows are known to produce anomalous varnish cation ratios, high barium values can, therefore, be used as an indicator that a sample is inappropriate for cation-ratio dating. The glacial chronology at Pine Creek, California, is revised in light of new data and a better understanding of variables influencing varnish chemistry.

Keywords: rock varnish; cation-ratio dating; PIXE; geochronology; Sierra Nevada; moraines

1. Introduction

Rock varnish is a thin film composed of mostly clay minerals that are cemented to rock surfaces by oxides of manganese and iron. Although often called 'desert varnish', these accretions are found in every terrestrial environment, from hyper-arid deserts to

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PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124485
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: BARRETT, Gerald D.:

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 10/15/91

SUBJECT: RE: HIS CONCERN FOR THE COMMERCIAL SATELLITE BUSINESS IN THE U.S. AND THEIR NEED TO USE FOREIGN SPACECRAFT TO LAUNCH PRIVATE SATELLITES.

****

DIRECTORATE ASSIGNED:

STAFF ASSIGNED:

ACTION REQUIRED:

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE:

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

****

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE: EXT:

REMARKS:

OSTP RECEIVED: 10/22/91 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCE

CENTRAL FILES:

4485

October 15, 1991

Gerald D. Barrett
160 Timber Way
Coos Bay, Orgeon 97420

RECEIVED
91 OCT 22 P12:48
OFFICE OF THE DIRECTOR

Mr. Allan Bromley
Presidential Assistant for Science and Technology

MR. Bromley,

The U.S. leadership in space has resulted in a healthy and thriving industry that has produced commercial communication satellites that we have sold to many other nations, thereby exporting high tech products to the world. We are in danger of losing this Commercial satellite business to overseas competition because American companies have no way to launch an American made satellite in America. Hughes Aircraft Company designed and built the huge Intelsat VI spacecraft for the european Intelsat consortium, but must ship these spacecraft to Courou in French Guiana in order to have them launched on the French Arieanne booster. Hughes has also gone to the Communist Chinese in order to get the HS-601 spacecraft into orbit using their "Long March" launch vehicle. The HS-601 is a Hughes communication satellite built for the Australian government. When NASA eliminated all commercial launches from the Shuttle, our only launch vehicle, they cut off American manufacturers from any means to launch their hardware. We are in danger of losing a great industry that employs many thousands of highly educated, high tech engineers. What is sad about it is that the damage was done by our own government. The european space agency ESA is rapidly developing its own spacecraft since it has better launch capability than U.S. manufacturers. Japan has a huge new launch complex at Tanagashima.

Having worked on spacecraft for many years, I never thought I would see the day that American spacecraft would have to be launched by foreign countries, but they do, and it is here and now. Hughes has been a leader in communication satellites for many years. Does the fact that they must now go to Communist China for launching in order to sell one to Australia not ring any alarm bells in Washington? We are in danger of losing not only a vital leadership position in this industry, but a huge piece of our export business. Worse yet, we as a country are doing nothing about it. I hope you can help turn this around before we are no longer in the communication satellite business.

Sincerely,

Gerald D. Barrett

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124706
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: FOWLER, T. Kenneth: UNIVERSITY OF CALIFORNIA, BERKLEY

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 10/12/91

SUBJECT: PROVIDING DR. BROMLEY WITH A COPY OF THEIR BOOK "CONVERSATIONS ABOUT ELECTRICITY AND THE FUTURE", BASED ON THE SEMINAR HELD LAST YEAR.

****

DIRECTORATE ASSIGNED: STAFF ASSIGNED:

ACTION REQUIRED: STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

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COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

****

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:

REMARKS:

OSTP RECEIVED: 11/08/91 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

UNIVERSITY OF CALIFORNIA, BERKELEY 4706

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SANTA BARBARA • SANTA CRUZ

COLLEGE OF ENGINEERING
DEPARTMENT OF NUCLEAR ENGINEERING
TELEPHONE: (415) 642-5010
FAX: (415) 643-9685

BERKELEY, CALIFORNIA 94720

October 12, 1991

Dr. Alan Bromley
Science Advisor
Executive Offices of the President
Washington, DC 20506

Dear Dr. Bromley:

The book based on the Seminar held last year has now been published, and a complementary copy is enclosed. You may have heard about our work at the time. Our Findings and Conclusions were submitted to the hearings in development of the U.S. National Energy Strategy.

Despite the many months, we believe that you and others who may read this book will find that our messages are timely today. We hope that with the many changes that have taken place since our Seminar, there may be more minds open to recognizing the importance of energy and electricity to our future, and to the environment that future generations will enjoy.

Sincerely,

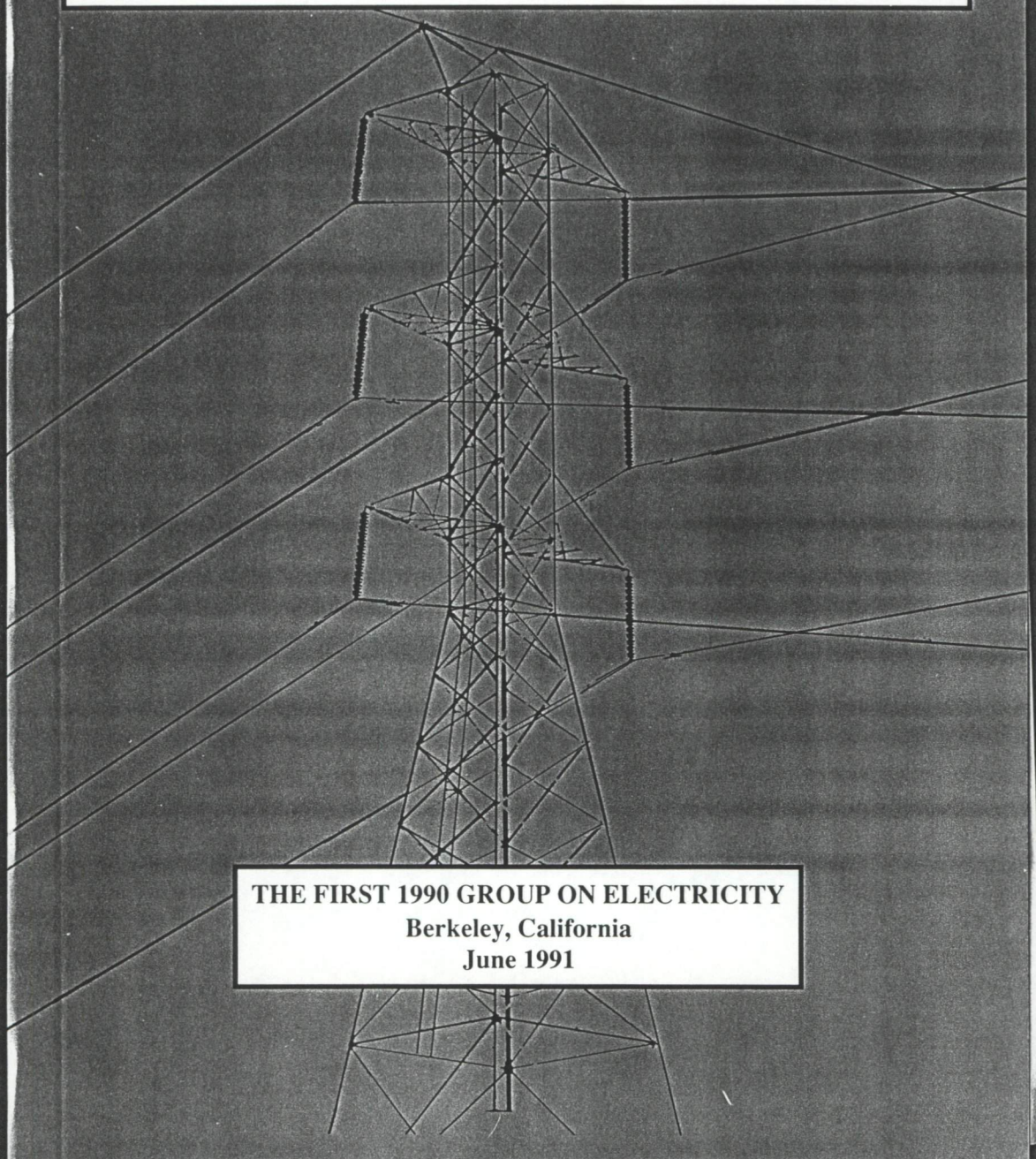
T. Kenneth Fowler

A. David Rossin

Enc. (one book)

CONVERSATIONS ABOUT ELECTRICITY AND THE FUTURE

FINDINGS OF AN INTERNATIONAL SEMINAR AND LESSONS FROM A YEAR OF SURPRISES



THE FIRST 1990 GROUP ON ELECTRICITY
Berkeley, California
June 1991

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124464
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS
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FROM: WALKER, W.D.: DUKE UNIVERSITY

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 10/11/91

SUBJECT: A LETTER EXPRESSING HIS OPINIONS OF THE COMMITTEE CONVENED BY ADMIRAL WATKINS UNDER PROFESSOR CHARLES TOWNES, REGARDING RESEARCH PROGRAMS AT DOE. HE ALSO PROVIDES IDEAS ON DISPOSAL OF NUCLEAR WASTE.

****

DIRECTORATE ASSIGNED:

STAFF ASSIGNED:

ACTION REQUIRED:

STAFF ACTION:

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SENDER'S DUE DATE:

OSTP DUE DATE:

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

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COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES
ENVIRONMENT

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WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE: EXT:

REMARKS:

OSTP RECEIVED: 10/17/91 DEPT RECEIVED:

FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

4464

Duke University
DURHAM
NORTH CAROLINA
27706

RECEIVED
91 OCT 18 A10:18
OFFICE OF THE DIRECTOR

DEPARTMENT OF PHYSICS

WILLIAM D. WALKER
J.B. DUKE PROFESSOR OF PHYSICS

TELEPHONE 919—684—8210

October 11, 1991

Dr. D. Allan Bromley
Presidental Science Advisor
Office of Science and Technology
Washington, DC 20500

Dear Allan,

Recently Admiral Watkins and Dr. Happer at DOE convened a committee under Professor Charles Townes to look at research in DOE. Every research project was to be looked at with the exception of the SSC (the super collider). Apparently the results of these deliberations will be cuts in almost everything; fusion, the Tevatron, RHIC. You, I'm sure, know the details better than I do.

I believe that the results of their plan if implemented will be a near disaster for many research programs. This will inevitably bring about further serious questioning of the validity of the SSC program. People in many branches of physics will question even more the importance of the SSC. The resulting warfare could seriously damage the SSC effort.

I believe that the work of the committee was inherently flawed by the original decision to leave the SSC untouched. For goodness sake let the SSC stretch by a couple of years. Perhaps one might install only one-half the bending magnets and leave three of the four experimental areas nearly unfinished. Everyone should face the fact that the SSC is a shot in the dark! There are no known thresholds that one is aiming at. In the next eighteen months the top quark might be discovered at the Tevatron collider, and its mass would give insights as to the mass of the Higgs boson. What if the SSC is way above the threshold necessary for a Higgs search? Maybe it would make sense to go for one-half to three-fourths of the ultimate design energy or, conversely, maybe more than the design energy.

Leaving Fermilab without the funds to carry on a fixed target program will

deal a terrible blow to the high energy community. The ultimate effect will be to drive a lot of talented people out of the field. Even if the SSC were on time, a much weakened group of people will be preparing for it. It is very important to keep a healthy program going rather than to suck the life out of the community in order to gain a couple of years in time with the SSC.

On another subject, I believe there is a viable alternative to the high-level nuclear waste business that should be considered. This might impact DOE's budget. A look at a map of the world will show that most of it is covered by water so that the oceans should be considered as an ultimate disposal location. In this scheme, high level waste should be kept in the reactor's swimming pools for a mandatory twenty years. Then the waste would be transferred to large communal swimming pools near an ocean. After an additional twenty years there would be a separation of fission products from the heavy elements. The fission products should then be glassified and buried in high integrity containers in ocean mud at a depth of 1000 feet or more. This final burial should have no environmental impact. The remaining heavy elements could be used in reactors.

I would believe that such an arrangement would have less political repercussion than the present course. This option should be seriously tested. The net exposure to workers doing the transport, separation etc. should be carefully calculated and minimized. Since the time on any state's home turf would be limited by statute I would believe that the political reaction would be minimized.

I might write a detailed proposal of my ideas on waste. Connie has been personally involved in a commission siting a low level waste facility so I have thought about waste quite a bit. My ideas were stimulated by Luis Alvarez's suggestion in his autobiography.

I was very saddened to hear about Pat's death.

With best wishes,
Sincerely,

Bill Walker

W.D. Walker
J.B. Duke Professor of Physics

"Document Control"

TYPE: INFORMATION DOCUMENT NUMBER: 9124325
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: SERR, Kai: GWYNN ACRES LABORATORY

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 10/03/91

SUBJECT: RE: EXPRESSES DEPLORABLE CONDITIONS EXISTING IN THE FIELD OF METEOROLOGY.

****

DIRECTORATE ASSIGNED:

STAFF ASSIGNED:

ACTION REQUIRED:

STAFF ACTION:

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SENDER'S DUE DATE:

OSTP DUE DATE:

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

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COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES
ENVIRONMENT

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WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE: EXT:

REMARKS:

OSTP RECEIVED: 10/07/91 DEPT RECEIVED:
FILE: P-PHYSICAL SCIENCES

4325

GWYNN ACRES LABORATORY
9722 Gwynn Park Drive
Ellicott City, Maryland 21042
(301)461-2206

RECEIVED
91 OCT 7 A11:42
OFFICE OF THE DIRECTOR

Dr. Allan Bromley, Director
Office of Science and Technology Policy
Old Executive Office Building
Washington, D.C. 20500

Dear Dr. Bromley:

I thought you might be willing to listen to my observation of deplorable conditions existing in the field of meteorology.

At present J.B. Klemp, R. Rotunno and R.P. Davies-Jones are regarded as authorities on tornadoes. Their theory is based on an absurd notion that the convergence of wind velocity provides exponential growth of wind velocity and vorticity. A year before their theory was published in 1983, R.A. Anthes who is regarded as an authority on hurricanes published a monograph on hurricanes presenting his theory that says that the divergence of wind velocity gives rise to exponential growth of wind velocity and vorticity in a hurricane.

I spent 8 years to rebut their ideas and to develop electromagnetic theory of hurricanes and tornadoes and last March submitted my manuscripts to Dr. Steven J. Rothman, editor, Journal of Applied Physics, Argonne National Laboratory, Illinois, who could not find a person who could review both papers. He had to find two reviewers for my papers, one for hurricanes and one for tornadoes. Last month Dr. Rothman forwarded to me reviewers's reports rejecting my papers. The reviewer of my paper on tornadoes was quite belligerent, calling my rebuttal of Klemp-Rotunno theory gibberish. The reviewer of my paper on hurricanes said Lenz's law prevents Maxwell stress from having any influence on a hurricane.

These reviewers are in fact saying that all the physics and mathematics taught in colleges and universities are wrong or that meteorology is not governed by physics or mathematics.

It amazes me to realize that people like Anthes, Klemp, Rotunno, Davies-Jones are looked up to as authorities on hurricanes and tornadoes for their puerile, false assertion that the convergence or divergence of wind velocity can provide exponential growth of wind velocity and vorticity. What authority does this reviewer have to say that plasma physics (Maxwell stress) is wrong because of Lenz's law?

I am convinced that a cabal of "meteorologists" are entrenched in their positions as arbiters of meteorology to block any progress in meteorology that might jeopardize their reputation or career.

Sincerely yours,

Kai Serr

Kai Serr
3 October 1991

"CORRESPONDENCE TRACKING"

TYPE: ACTION DOCUMENT NUMBER: 9123894
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

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FROM: FEINSTEIN, Avram: ISRAEL

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 08/25/91

SUBJECT: REQUEST FOR A RESPONSE REGARDING THE FEASIBILITY STUDY OF THE FUNDAMENTAL THEORY OF ANALYTICAL MODELING OF INFORMATIONAL SYSTEMS ("AMIS-THE ANTIDOTE AGAINST MANAGERIAL SYSTEMS' DRIFT")

****

DIRECTORATE ASSIGNED: PHYSICAL SCIENCES

STAFF ASSIGNED:

ACTION REQUIRED: AS YOU DEEM APPROPRIATE

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: 09/18/91

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

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COPIES TO: INTERNATIONAL/POLICY

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WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE: EXT:

REMARKS: 9/10/91: per Dr. Wong, ignore this correspondent's letter. He has a P.O. Box address; we don't know who he is, and there is no sense in giving him another name to correspond with.

SS

CLOSED

OSTP RECEIVED: 08/21/91

DEPT RECEIVED:

FILE: P-INTERNATIONAL*PHYSCIAL SCIEN

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

September 9, 1991

Dear Mr. Feinstein:

Thank you for your letter of August 26, 1991. A review of your paper on "AMIS" indicates to me that our office has no interest in considering it further. Nonetheless, we appreciate your sending it to us.

Sincerely yours,

Eugene Wong
Associate Director
for Physical Sciences and Engineering

Mr. Avram Feinstein
P.O. Box 2631
Haifa 31025
Israel

3894

August 25, 1991

RECEIVED
91 SEP 4 P12:21
OFFICE OF THE
DIRECTOR

Mr. D. Allan Bromley
Assistant to the President for Science and Technology and Director
Office of Science and Technology Policy
New Executive Office Building
Washington, DC 20506

Dear Mr. Bromley:

There are almost five months (my registered letter No. 23495 of March 27, 1991) since I have submitted to your attention the feasibility study of the foundamental theory of Analytical Modelling of Informational Systems ("AMIS - THE ANTIDOTE AGAINST MANAGERIAL SYSTEMS' DRIFT"), with the request to be organized a debate in the view of a rapid information of its new concepts and techniques, however I haven't received any answer till now.

This defiant silence is, first of all, a frustration against AMIS, rejecting it without knowing its advantages and power in making obvious the hidden self-regulating mechanisms of big organization systems, and taking under control their actions, reactions and behaviours. And second, it is an impolite and offending attitude against the discoverer of a new and very important theory.

I am neither paranoiac nor megalomaniac. I have addressed to you because AMIS is the theory of analysis, modelling and control of big organization systems at the national and/or international levels in the simplest, the most comprehensive and the most reliable mode, and because it is your duty to promote the scientific progress into the USA benefit.

USA needs AMIS, and this because USA is now at the top of the scientific progress in the world, but it can't keep this position without new efficacious discoveries like AMIS capability to control complex self-regulating mechanisms of any organization system.

Disconsidering AMIS, you do not serve the scientific progress, and you do not serve the USA interests, but contrarily, you delay a qualitative leap forward in science, and you jeopardize the USA power and position in the future times.

In this context, I hope you will try to understand the value of AMIS for the USA future prosperity, and I should appreciate your promptness to let me know your decision as soon as possible.

Yours faithfully,

Avram Feinstein, Eng.
PO Box 2631
Haifa 31025
Israel

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9121130

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FROM: FEINSTEIN, Avram: Haifa, Israel

TO: DR. BROMLEY

DATE OF CORRESPONDENCE: 03/27/91

SUBJECT: THE FEASIBILITY STUDY OF A FUNDAMENTAL THEORY OF ANALYTICAL MODELLING OF INFORMATION SYSTEMS.

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ASSIGNED TO:

ACTION REQUIRED:

****

SENDER'S DUE DATE: OSTP DUE DATE:

DATE COMPLETED:

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COPIES TO: Thomas Ratchford
Dr. Wong

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

REMARKS:

DATE RECEIVED: 04/15/91 FILE: INTERNATIONAL

9121130

RECEIVED
91 APR 15 P12:09
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
DIRECTOR

March 27, 1991

Mr. D. Allan Bromley
Assistant to the President for Science and Technology and Director
Office of Science and Technology Policy
New Executive Office Building
Washington, DC 20506
U. S. A.

Dear Mr. Bromley:

Enclosed, please find the feasibility study of a foundamental theory of Analytical Modelling of Information Systems ("AMIS - THE ANTIDOTE AGAINST MANAGERIAL SYSTEMS' DRIFT"), which outlines the keys and ways of managerial, organizational, operational or any other software system's global analysis, description, quantification and control on the basis of these systems' Self-Regulating Mechanisms (SRMs) revealing, and on the background of their Standard Info-Analytical Reference Structures (SIARSs) building.

For a rapid information of AMIS imperatives, I suggest to be organized a discussion of its foundations with the best economists, econometrists, strategists, policy-makers, business and operations analysts, information engineers or catalysts, and mathematicians from USA or from the whole world.

In this approach USA risks only a day of those personalities work-time, while it saves years of their man-hours research-time necessary to find the lawlike info-analytical background and SRMs of our vital systems control, and of some contemporary major problems, as:
- to have control over national economies (domestic SIARSs),
- to guide the process of peace, democracy, and justice of a new order in the world (international SIARS and its availabilities for concessions and compensatory means), etc.

If the organizer of the above mentioned discussion, needs more details about AMIS foundations, then it can be submitted another available work "AMIS - THE THEORY OF MANAGERIAL SYSTEMS CONTROL".

Hoping you will give this your immediate attention, I remain,

Yours faithfully,

Avram Feinstein, Eng.
PO Box 2631
Haifa 31025
Israel

Copies sent to other interested authorities:
- Council of Economic Advisers, and
- Office of Policy Development.

Encl.: The above mentioned work (16 pages) and Annex 1 (3 pages).

AMIS - THE ANTIDOTE AGAINST MANAGERIAL SYSTEMS' DRIFT

by Avram Feinstein, Eng.

Motto: A compact theory of Analitical Modelling of Informational Systems (AMIS) is ready to cause a scientific revolution of systems' global analysis and universal guide of their understanding, description and control.

1. The demand for a theory of systems' global analysis

In his article, "A coalition of growth", published in The Jerusalem Post of June 2, 1989, Mr. Shimon Peres, then the Vice Premier and Minister of Finance in the Israeli government, pointed how "The economic globe is changing at an unbelievable pace.", and "No Wonder these tremendous changes are seeking a theory that will explain them; we know some of the reasons, and we know some of the results, but we lack the theories and intellectual lines of analysis to guide us.". And other related considerations stated in the above mentioned article, are:

..."the major conflicts in the future will be waged more in the R & D laboratories than on the battlefield."

..."Today's economies are becoming more and more a global economy. Science is universal, technology is universal, and communications and marketing are global in scope." ... "Not only marketing has become international - production has also become a global affair."

..."Most of the economic advantages are to be found in scientific innovations - rather than in the material world."

If production, marketing, and economies have become global affairs, then, we have no choice, we need to find a fit theory able to deal with our vital global matters, and to guide us to pragmatic issues.

If Mr. Peres has felt the lack of an explanatory theory, this means that not only he, but all politicians and economists feel the same, and he is one who could clearly express their general need.

If "the major conflicts in the future will be waged more in the R & D laboratories", and "most of the economic advantages are to be found in scientific innovations", then the sciences must be able to cope with such great tasks. But, are the present concepts, principles and techniques of the natural and social sciences and disciplines enough to satisfy the society's changes and development requirements for now and in the future? As long as there are yet

unsatisfied theoretical requirements, the answer seems to be NOT.

Therefore, the politicians, the economists, the analysts, the designers, the producers, the customers, the businessmen, the physicians, the teachers, the professors, and even the scientists need a magic theory that would be able both to explain the social, political, technological and economical contemporary changes, and to serve as a standard reference of analytical consistency in order to determine or to predict the future directions of the humanity's survive in a higher standard of living.

That is, we need a compact theory of global analysis and universal guide of depiction, foundation, building, control and development of our society's vital systems, in conjunction with our insatiable material wants and our ever scarce resources.

2. The profile of a compact theory of systems' global analysis

The humanity's vital systems (economical, educational, medical care or any other managerial or operational system) becoming more and more complex, vast, global, interdependent, in ever changing conditions, overburden, and/or defective, they can't be more controlled by roundabout ways and/or rudimentary means.

The managers, economists, strategists, policies-makers, business and operations analysts, etc lack the theories and tools to guide them to such systems' comprehensive understanding, consistent global analysis, accurate modelling and full-control operating.

The essence of our vital systems management consists in discovering their self-regulating machanisms, which are necessary and sufficient to handle concessions and compensatory means in order to maintain their reliable operating or to determine their recovery.

In order to achieve this target, they are necessary new concepts and new techniques of any system's info-analytical items determination and configuration in order to make obvious its static and dynamic self-regulating mechanisms of general equilibrium and of its healthy course of operating.

The main characteristic of a mathematical approach is the exactness or accuracy of its solutions. This is the reason that mathematic is also called "the science of sciences". And, this is the reason that the scientists of any specific area look - more or less successfully - for analytical techniques.

There is a steady tendency to find analytical solutions to the managerial, operational, or any other software systems' matters, but they have not been yet satisfactory due to the lack of a guide of consistent foundation and comprehensive superstructure development.

But, a managerial, operational or any other software system is a behavioural & mptomatic system, which need a special approach in order to locate and to interpret the symptoms and effects with respect to a standard info-analytical reference structure.

An economical, political, educational, medical care, or any other managerial, operational or software system is centred or an informational system, which expresses the informational items (inputs,

processing procedures and their outputs) in action to satisfy the missions, purposes, business rules, driving forces (strategic areas), and alternative directions of that real systems.

Today's approach to the informational systems' modelling is guided by the Information Engineering (IE) methodologies, which are based on data identifying from relevant documentation, and on data relationships learned by so-called catalysts (IE performers) by means of questioning, provoking, prompting, and successive discussions in sessions with the top managers and/or other representatives of the real systems, in the following manner.

- The manager is that who knows (more or less) the business rules, and who has the responsability of the strategic requirements statements, but "he can't describe what he knows and what to claim", if there isn't a catalyst to ask him hypothetical questions, and

- The catalyst is "that who doesn't know the business rules, but who knows to ask hypothetical questions" aiming to learn what do the managers know about the business matters, strategic areas, alternative directions, etc. for now and in the future, in order to be inserted in the data model of that business-organization, or of that real system.

And this symbiosis originates the IE foundation stone of so-alleged "reliable" data models, which will mirror the management's statistical-functional understanding, and the catalyst's perception of that understanding, which won't clarify the business problems, but they will be simply translated in a new dress of data processing.

That is, the IE catalyst's approach, in the manner of "tell me a story of your real system, and I give you a data model" - using "top-down" opinions, "bottom-up" stories, "pyramid" foundation, "layer" classification, "cluster" development, etc - is like a sort of "hocus-pocus" juggle with a system's data items discovering by doubtful means, and outlining ad-hoc solutions of data models, which are based more on intuitive considerations and less on scientific proved rules and/or info-analytical techniques.

In contrast with this approach, Analytical Modelling of Informational Systems (AMIS) - treated in this work - is a scientific compact theory, according to which, each informational system is determined by a logistics configuration, it is synthetized (filtered and condensed) in a strategic configuration, and it is developed in certain info-analytical coordinates, as follows:

- The logistics configuration is based on two sorts of logistics pivots (key input/output nodes, and four pole routine loops), which describe wholly the natural order of "things" from a real system, outlining its main I/O factors and relationships according to the Resource Centric Concept and Utility Centric Concept, and which make up the substructure of an informational system,

- The strategic configuration is based on two sorts of strategic layers (specific classes and coupling interfaces), which describe the functional-operational frameworks of a real system, and which make up the necessary and sufficient elements of the superstructure of an informational system.

. The logistics pivots and the strategic levers are determined by driving factors and info-analytical relationships, which make up the info-analytical coordinates of any informational system;

. The logistics pivots, the strategic levers and the info-analytical coordinates make up a standard reference structure of info-analytical consistency of an informational system, and mirror the informational items of the static and dynamic mechanisms of the considered real system's equilibrium and self-regulating state.

And all these can be made obvious and proved scientifically only by Information Algebra, or shortly Infoalgebra (IA), and developed by System Decomposition and Reintegration Techniques (SDRTs), and Fundamental Modelling Rules (FMRs), which are nothing else than the main component parts of AMIS.

Infoalgebra is the study of separation of any system and/or any relationship in distinct informational items, and their processing, by means of general symbols in macro-analytical expressions. It is:

. the algebra of systems' description, quantification and modelling by means of global relationships among typical collective elements and aggregate operations, determining the system's key I/O nodes, algorithms, routines, loops, chains and their canonical relationships as a skeleton of system foundation in the most comprehensive, condensed and reliable mode;

. the algebra of equivalents, cycles, compensations, complements, routings, etc, among the I/O factors in direct (primal) and inverse (dual) relationships of action, reaction, and interaction (The Universal Duality Concept);

. the algebra of a new objective of optimization (balanced state of a system), and a new technique of reasoning (equilibrium logic of global terms) in necessary, sufficiency and self-regulating conditions with repect to a Standard Info-Analytical Reference Structure (SIARS);

. the algebra of filtering and condensing any informational system by means of CEPs and FPRs, KIONs and FPRLs conditions, logistics pivots and strategic levers, Rule of 3Ls & 1M BSOs, structured classification of self-regulating mechanisms, keys and ways (for the meaning of used abbreviations, please, see Annex 1);

. the theory of systems' global analysis, handling and control, aiming their general equilibrium and self-regulating state;

. a comprehensive analytical interface between natural and social sciences and disciplines, on the one hand, and data modelling and processing, on the other hand, concerning how to consider a system in routing and analytical terms, and how to discover and to outline the necessary and sufficient informational items of a certain informational system;

. the mathematics of economics and its interface to operations research, econometrics, information modelling and data processing, aiming reliable policies-planning and timely decision-making.

The SDRTs and FMRs are the tools which complete the IA theoretical concepts and relationships with pragmatic knowledge for efficient and reliable applications of informational systems and subsystems description, determination and control.

AMIS deals with typical frameworks, collective elements, aggregate operations, resources allocation, and flows of physical and monetary informational items (grouped in inputs, pragmatic knowledge, and the results of their processing), as well as, with their global analysis by means of an universal guide of system determination, indifferent of their nature: economical, political, educational, medical care, or any other managerial system or subsystem.

It seems to be strange that - in the time when there is a steady tendency of sciences to infinitesimal, to decomposition, to modularization, to "devide and conquer" - someone dares to launch a conception of an inverse approach, of studying global relationships among collective elements and aggregate operations grouped in three (primal, dual and interacting) streams of algorithms, in an info-analytical successive and nesting structure.

This might be considered like a normal reaction to a certain tendency, but it is rather justified by the practical reasons of the today's complex course of the society's systems and subsystems, and our need of "seeing the wood rather than the trees" (knowing how to consider a system in global analytical terms), which are the pivots, levers, and driving factors of a system's statics and dynamics, which are the necessary and sufficient elements of mirroring the self-regulating mechanisms of a system, what entails a system's decomposition and reintegration, which are the relationships among the inner driving factors and those from other systems, etc.

AMIS must not be confounded with today's Information Engineering.

AMIS is a compact objective comprehensive polyvalent theory of analytical modelling of all informational items of any system or subsystem, while IE is, on the one hand, a collection of rudimentary subjetive vulnerable methods of only data discovery, and only for subsystems (only IA defines clearly the demarcation between the informational systems' and subsystems' areas, and their determination), and on the other hand, a valid powerful tool of data normalization and modelling.

Therefore, if it will be replaced the rudimentary subjective methods of data discovery from IE with AMIS, then, the humanity will benefit by a comprehensive reliable tool both of analytical determination of all informational items, and of data normalization and modelling of informational systems and of their subsystems.

Elaborating the informational systems according to the above three components of AMIS (IA, SDRTs, and FMRs), the activity of policies planning and decision-making will become a trivial reasoning of identifying conditions, interpreting strategies and performances, and choosing the best fit variant from all feasible solutions, which will best satisfy the general equilibrium recovery and self-regulation freeing.

The first application of the AMIS package is the elaboration of the Informational Model of an Economic System (IMES), which mirrors the

basis and superstructure of an economy's complete description.

The further applications of AMIS and IMES must deal with the repercussions of the new principles and concepts on the natural and social sciences. And this because, after the industrial revolution, two centuries ago, and the computer revolution, in the last half century, now, it comes the time to filter, to condense and to correlate our scientific works (which are, in fact, a sort of software systems), if we don't want to deepen the discrepancy among the traditional and new principles, concepts and methods, as well as, if we don't want to be flooded by heaps of overabundant and/or irrelevant data, information and knowledge, besides their high cost, and their involved huge waste of valuable resources.

But first, AMIS and IMES must be acknowledged and assimilated by scientific bodies, education institutions, governments, industries, and in business administrations. As a matter of fact, this is the aim of this work.

3. A sample of structures and dimensions of AMIS and IMES

AMIS is the theory and the tool of necessary and sufficient concepts, keys and ways of our vital systems' easy understanding, comprehensive description, accurate quantification and full control.

In Annex 1 are described the "Typical Dimensions of AMIS and IMES" and the used abbreviations, which can be considered the most condensed summary of AMIS main concepts and their extent.

In order to outline their involvement in economic strategies determination and fit policies development, I shall refer to what represents reaganomics in this context, and what possibilities remain to be explored for any other economic policy development.

Reaganomics (to cut the tax rates in order to invigorate the private enterprise economy, and to make free an economic expansion) has dealt with only one KION from 11 of an economical system, with only two FPRLs from 55, with only two primal and dual loop algorithms from 110 CEFs, with only two FPRL conditions from 55, with only one KION logical equation from 165 KION conditions, with only one and incomplete FPRC from 512 chains of FPRs, it has considered no operating and monitoring economic classes, and involved coupling interfaces by their relationships within an IMES technological or socio-technological model, and it has used no info-analytical coordinates of IEs and driving factors. (For the meaning and dimensions of the used abbreviations, please see Annex 1).

Thus, we have an enough large range of strategic areas and directions in order to determine rational continuations of reaganomics, or to build other economic policies, which can be extracted from an Informational Model of an Economical System (IMES).

Certainly, reaganomics was an incomplete reasoning of its foundation, but it was successfull because it caught the most flagrant lack of balance (between the households' purchasing power and the businesses' costs of goods and services) due to the most severe two recessions (1973-1975, 1981-1982) since the Great Depression of the 1930s (1925-1932).

But, neither reaganomics nor any other successfull economic policy can be ever valid and in an expansion course. Each economic policy is valid only a period of time when it works to compensate the previous identified unbalanced conditions of the self-regulating mechanisms, while in this time it generates other unbalanced conditions, which require new fit changes.

An economic system must be permanently supervised, discerning its symptoms, interpreting their causes and effects, identifying the logistics pivots, strategic levers and info-analytical coordinates in IMES, and selecting the required changes for general equilibrium conditions recovery and self-regulation freeing. And from this principle isn't exonerated either a market economy, or a command economy, which can't avoid "perestroikas".

An incomplete reasoning, which doesn't take into account all equilibrium conditions of a system, and their dynamics, can lead to worsen the ignored unbalanced conditions, to disturb some of the balanced conditions, and to push that system into an unavoidable drift of unpredictable behaviour and effects.

In this context, AMIS and IMES depict the most comprehensive model of any informational system, and respectively, of an economical system, making obvious, in a filtered and condensed form, all basic logistics pivots (KIONs, FPRLs), strategic levers (SCs, CIs), and info-analytical coordinates (DFs, IRs), which force us to take into account all availabilities, possibilities, and performances for selecting the best strategy, and planning the fit policy of a system, or a subsystem, for its general equilibrium and self-regulating state during a certain period of time.

A comprehensive and reliable reasoning of an economic policy can be completed, if and only if we consider all logistics pivots (the 11 KIONs and 55 FPRLs), which generate 55 FPRL equilibrium conditions of assets-liabilities (capital) type and 165 KION equilibrium conditions of demand-supply type, combined in 910 FPRCs of industry type. And only on this basis, we can determine the strategic levers (7 or 8 SCs, and 42 or 56 CIs) as filtered and condensed frameworks of driving factors and info-analytical relationships development. In this way, an economic system is taken under control both as substructure and as superstructure, and we have the complete documentation of possible strategies and fit policies planning in changing conditions of time (short-run, long-run), events, behaviour, performances, etc. And only so, we can avoid our vital systems' drift.

4. The classical sciences are too poor and powerless to deal with the present and future society's changes or disorders

Economics have ever been focused on the study of the disequilibrium symptoms, equilibrium conditions, and how to solve the conflicting states of the economic phenomena.

Of course, different scholars argued these in different ways, but none of them did it in a complete reasoning of considering all self-regulating mechanisms of an economic system's SIARS.

For example, Adam Smith, the founder of modern political economy, wrote in 1776, in his book "An Inquiry into the Nature and Causes of the Wealth of Nations" that there is an "invisible hand" that

causes the producers to promote the interests of the society, and for this reason, the best policy is generally one of "laissez fair" (leave it alone).

On the contrary, John Maynard Keynes, the father of modern macroeconomics, argued in 1936, in his book "General Theory of Employment, Interest and Money", that the government has the duty to intervene in the economy, stimulating the aggregate demand in order to reach an equilibrium with the aggregate supply, in the condition of a large scale of unemployment.

Even if, each of them was right, because the government should do more in some respects, and less in others, they didn't discern the objective and global economic mechanism of general equilibrium and self-regulating state with respect to a SIARS.

The equilibrium condition, to which refers Smith and Keynes, is nothing else than the supply-demand equilibrium of the KION of produced goods and services, ranging from individual (market) conditions between perfect competion and pure monopoly, until the aggregate conditions explaining unemployment and inflation according to the classical or keynesian approaches. And, this is only one typical KION of an economical system from the total of eleven KIONs, and it uses only one condition from the total of 165 KION conditions. But, what does it happen in the other ten KIONs, in the maked up 55 FPRLs, and with the other 164 KION conditions of an economic system? Which are the connections between the studied KION and all others of an economic system? Perhaps the answers to these questions would clarify many unexplained occurrences and behaviours.

A. Smith, J.M. Keynes, and their disciples have started their studies from a state of facts in the world, trying to explaine them, and to give feasible solutions.

All of them have brought an important contribution to the society's knowledge development, but for a limited sphere of application, and this because of their inadequate study means, reference frames, starting premises and reasoning criteria.

Both the general equilibrium of Walras'law (the total money of all items supplied in an economy must equal the total money value of all items demanded), and all forms of supply-demand equilibrium analyses and interpretations are deficient not only because they refer to only one KION load and to only one KION condition of an economic system, but also because they ignore the fact that each of supply and demand belongs to different FPRLs, which have their own equilibrium state, and in conjunction with all other FPRLs of that system. It is acceptable a "ceteris paribus" assumption (other things remain unchanged) for analysis of the sole dependence of the supplied and demanded quantities to their prices only, but it is inconceivable to uproot them from their FPRLs and from the system's chain of KIONs and network of FPRLs, which must be all in a correlated general equilibrium and self-regulating state.

In this context, neither John W. Zimmermann's strategic areas (nine driving forces) from his book "Top Management Strategy" (1983), nor James Martin's data modelling from his "Information Engineering" reports (1981, 1986/7), have valid foundation premises of their strategies, respectively, data models development. The strength of

the mentioned works is in the used methods of outlining strategies, respectively, of normalizing data models, but all these are uncertain due to their inadequate starting premises and background.

Even mathematics, with its immense arsenal of all sort of analytical techniques of magic power to transform unknowns into knowns, has failed to build the canonical equations of processing (CEPs), the four pole routine loops/chains, the Universal Duality Concept, any system's Standard Info-Analytical Reference Structure (SIARS), and their tremendous consequence of making obvious the self-regulating mechanisms of any system's general equilibrium.

It must be understood that it can't be studied a real (material) system alone, but it must be associated with its informational model of logistics pivots and strategic levers configurations, which depict all systems' informational items, and the canonical relationships of their static and dynamic elements in order to maintain the general equilibrium and self-regulating state, and any other approach is incomplete, uncertain, and idly costly.

The logistics pivots, the strategic levers and the info-analytical coordinates of an informational system are nothing else than the static and dynamic mechanisms of a real (material) system, and only knowing these mechanisms we can locate and/or control that system's business rules, working regimes, strategies, policies, performances, as well the involved maintenance, renewal, development, etc, in order to keep the general equilibrium and self-regulating state.

It becomes clear, information must be considered one of the main production factors like land with all natural resources, human resources, and capital (man-made resources), so that instead of the classical production function of land, labor and capital, the complete function of production must be:

Output = f(Land, Labor, Capital, Information),

and this because:

- Information has universal involvement in any human activity, and this due to the informational load and/or analytical potential of all systems' inputs, outputs, and processings;

- Information is scarce like any other resource, and this because it is not available as much as we want at no cost;

- Information is the counterpart of technology, operation, statistics, valuation, planning, control, management, R & D, and other alike activities in the production function, which, only so, it becomes, finally, a complete defined economic category;

- Information has an increasing weight in production function, both as independent factor, and as embodied part in other factors of production, due to the permanent scientific progress;

- Information has become today countable and measurable like any of the main factors of production, due to the epoch-making discoveries of Infoalgebra, AMIS and Information Engineering.

It must be clear for anyone that, today, we live in a world of individual and aggregate entities with all sort of interests, which generate the most complex range of institutions and forms of orga-

nization ever known, and all these work in unceasing changing equilibrium states. We can't control this changing equilibrium states and all consequences if we don't understand the determinative elements (CEPs, logistics pivots, strategic levers, analytical coordinates) of our systems and subsystems. And we can't discover the determinative elements and to understand fully the society's systems and subsystems with the present study means, frames, premises, and reasoning criteria. The sciences are today too poor and powerless to deal with the present society's changes and curing their disorders for general equilibrium recovery and self-regulation freeing.

Our living becomes more and more dynamic, complex and difficult. It is the time to clarify, to simplify and to lighten it. And for this reason, one way is to use powerful means, which lead us directly and positively to complete, filtered and reliable outcomes, without doubtful zigzags, costly efforts, and waste of resources. We need an efficient tool of information comprehensive management.

For this mission, a compact theory of Analitical Modelling of Informational Systems (AMIS) is ready to cause a scientific revolution of global analysis and universal guide of any system or subsystem directly determination and control.

5. The systems' pathology requires systems' anatomy and physiology

Frequently, we are determined to study an existent managerial, operational, organizational or a certain software system, when such a system discloses some symptoms of disorders or abnormal changes (diseases). That is, we are often confronted with the pathological (abnormal) facets of the systems' operations and/or behaviour.

In this conditions, we try to explain the revealed state of facts and to find feasible solutions for their improvement or recovery.

Thus, we tackle the study of our systems directly from their diseases, having no pre-established knowledge of two essential matters:

- the systems' anatomy (components and structure), or the standard info-analytical reference structure of key pivots, levers and ways to any development of different systems, and

- the systems' physiology (functions and operations of the structural parts), or the functions and the working regimes (normal and abnormal operations of isolated components and/or the whole system) mirrored by any system's relationships of self-regulating mechanisms and of general equilibrium.

Therefore, the study of our systems is more symptomatic and intuitive, and less based on a canonical reference structure and relationships of normal (balanced or healthy) operating and behaviour.

But, it is impossible to make diagnoses and to cure diseases, or to make prophylaxy, without knowing systems' anatomy and physiology, and this because it leaves out just the structure and location of a system's consistency. It can't be accepted in the 20th century to treat organizational systems in the quacks' manner. For this reason, we need a standard info-analytical reference structure with the assignment of systems' anatomy and physiology.

The gap between practising a symptomatic activity and its anatomy and physiology elaboration is not a matter which happens for the first time in the history of sciences' development.

From the history of medicine, we know that, in order to elaborate the human anatomy, it was necessary more than twenty centuries from the beginning of medicine practising (Hippocrates' time of 5th.century BC) until the publication of Andreas Vesalius' account of human anatomy, in 1543.

If we consider the beginning of managerial systems practising from the industrial revolution in the second half of the 18th century, which also coincides with the publication of Adam Smith's "The Wealth of Nations" of the foundation of modern political economy in 1776, then, there are already more than two centuries till now, and we have no systems' anatomy and physiology yet.

Taking into account the scientific progress in this time, as well as the needs for the future society's development, we must first end the lag behind between the vital systems' pathology and their anatomy, and for this aim we must not wait twenty centuries.

AMIS offers a strong tool of systems' foundation with respect to a standard info-analytical reference structure of systems' description and control, which constitutes the corner stone of systems' anatomy and physiology, within a compact theory of systems' global analysis of their general equilibrium and self-regulating state.

6. Impact and receptivity

Appealing to the present concepts of the natural and social sciences and disciplines, are the contemporary experts and scientists able to elaborate the table from the Annex 1, and to use its foundation in order to provide rational continuations of reaganomics, or of any other economic policy in the best possible manner? But, if nobody can do it, why don't we meet together the best economists, econometrists, strategists, policies-makers, business and operations analysts, information engineers, and mathematicians, in order to learn what means Infoalgebra, AMIS and IMES, and how can they contribute to lessen our efforts of wandering on uncertain ways, and to increase the comprehensiveness and the reliability of the informational systems models elaboration, for healthy economies and all other systems and their subsystems?

There is no doubt, that the unprecedented achievements in technology and in economic potential and growth of our world, as well as their social and political consequences, are the result of notable scientific accomplishments. But, now, the economic, social and political phenomena have taken various turns, more or less known and explained. And this because, the scientists haven't find yet a comprehensive directory solution to systems understanding, analysis, description and control.

Now, if there is a demand for a theory of system's comprehensive analysis and control, and such a theory already exists, but it is unknown yet by the public, then the logical approach is to proceed to this theory assimilation, promotion and dissemination into the humanity's benefit.

The scientific achievements are discovered by individuals, but they belong to the humanity, making up the society's knowledge in different subject areas, which open ways for practical applications in order to satisfy people's insatiable material wants.

The big ideas and original works were hardly accepted in any time, and especially today, when the explosion of the scientific achievements and the competitive conditions are unprecedented. But, this doesn't mean that, there is no more place for other discoveries, and the society is perfectly studied, built, and equiped in order to get a satisfactory standard of living now and in the future.

Today, if somebody researches lonely and makes an extraordinary scientific discovery, but he is unknown, he has no relations with a scientific personality in the fit subject area and he has no means, then he has no chance to launch it into the humanity's benefit, indifferent of the size of that discovery's obvious advantages.

It seems to be excluded the possibility of making extraordinary discoveries by a lonely scientific researcher. And if he does it, then he has to face incredible obstacles, even more than in the Kafka's depressing "Castle"

I accept the difficulties of the novelty's impact. I understand the people's distrust, their fear to be cheated or to kill the time for studying useless works, their envy for others' discoveries, and/or their fear to be left behind. Nevertheless, nobody can accept that a fundamental discovery may be ignored or obstructed because of these reasons, and to frustrate the humanity from profits of earlier applications of advanced methods and techniques.

In this context, for a lonely innovator the unique ways to launch his discoveries remain either by a professional association or by an administration authority through its consultative bodies on the basis of the real practical advantages into the people's benefit and of the efficient means of their achievement.

Thus, the professional associations in the information management and in the economic fields, as well as the councils of government advisers of all kind of managerial, operational, organizational or any other alike systems, must understand that:

The decision of AMIS assimilation is not only a matter of being or not to be receptive as against an authentic novelty, but it is also a matter of responsability, both to stop the dissemination of wrong and dangerous premises of systems' analysis and control, and to promote the scientific progress with new opportunities for the humanity's prosperity in a complete, reliable and efficient mode.

In sum, AMIS becomes more and more unavoidable, and this because: it can't last to the infinite the abysmal ignorance of our systems and subsystems understanding, description and control; it is better to use the antidote against our systems' drift than to get drowned; it is the time to update the sciences in order to be able to cope with the society's present and future changes and consequences; and, it is tremendous to understand what's going on, and what we have to do for now and in the future with our vital systems.

Annex 1

TYPICAL DIMENSIONS OF AMIS AND IMES

by Avram Feinstein, Eng.

Indicator	Standard Informational System (AMIS)		Economic Informational System (IMES)					
			Technological Model			Socio-techno. Model		
	Opera- ting	Moni- tor	Opera- ting	Moni- tor	Govern. involv.	Opera- ting	Moni- tor	Govern. involv.
1. LOGISTICS CONFIGURATION								
- LINEAR STRUCTURE								
NN (KIONs)	var.	var.	11	11	11	11	11	11
NL/C(main)	"	"	10	10	10	10	10	10
- RAMIFIED STRUCTURE								
NL (FPRLs)	"	"	55	55	55	55	55	55
NLA(P+D CEPs)	"	"	110	110	110	110	110	110
NLC	"	"	55	55	55	55	55	55
NNC	"	"	165	165	165	165	165	165
NC (FPRCs)	"	"	512	512	512	512	512	512
2. STRATEGIC CONFIGURATION								
- BASIC (STANDARD) STRUCTURE								
NBSC	3	1	3	1		3	1	
NBCI(P+D CIs)	6	6	6	6		6	6	
NBIF(SC+CI)	9	7	9	7		9	7	
- ADAPTED (PARTICULAR) STRUCTURE								
NASC	-	-	-	2	1	-	3	1
NSC(B+A SCs)	3	1	3	3	1	3	4	1
NCI(P+D CIs)	6	6	6	24	12	6	36	14
NIF(SC+CI)	9	7	9	27	13	9	40	15
3. INFO-ANALITICAL COORDINATES								
- TYPICAL INFO-ANALYTICAL ELEMENTS (IEs)								
NIIE(SC,DF)	243	81	243	243	31	243	324	81
NFIE(CI,DF)	378	378	378	1,512	756	378	2,268	945
NIE(I+F IFs)	621	459	621	1,755	837	621	2,592	963
IM(I,J)	2	35	2	53	53	2	62	71
IU(I,J)	28	1	48	8	1	56	8	1
IP(I,J)	30	36	51	61	53	58	70	72
ID(I,J)	.071	35	.041	6.625	62	.036	7.75	71
MRO of IO	1	493	1	162	1,512	1	215	1,972
- TYPICAL INFO-ANALYTICAL RELATIONSHIPS (IR)								
NIR(SC)	216	72	216	216	72	216	288	72
NFR(P+D CIs)	486	486	486	1,944	972	486	2,916	1,134
NR(SC+CI)	702	558	702	2,160	1,044	702	3,204	1,206
%K	56	44	18	82	27	14	63	23

Annex 1 (continuation)

Note of used abbreviations:

AMIS = Analytical Model of an Informational System

CEPs = Canonical Equations of Processing

CIs = Coupling Interfaces

DFs = Driving Factors

ECs = Economic Classes

EIS = Economic Informational System

FMRs = Fundamental Modelling Rules

FPR = Four Pole Routine

FPRCs = Four Pole Routine Chains

FPRLs = Four Pole Routine Loops

IA = Information Algebra, or Infoalgebra

ID(I,J) = Info-analytical Difficulty of the Jth DF in the Ith SC

IE = Information Engineering

IEs = Info-analytical Elements

IFs = Info-analytical Frameworks

IM(I,J) = Info-analytical Means of the Jth DF in the Ith SC

I/O = Inputs and/or Outputs

IP(I,J) = Info-analytical Potential of the Jth DF in the Ith SC

IRs = Info-analytical Relationships

IS = Informational System

IU(I,J) = Info-analytical Utility of the Jth DF in the Ith SC

KIONs = Key Inputs/Outputs Nodes

MRD of ID = Maximum Relative Gauge of IDs of a system

NASC = Number of Additional Specific Classes (SCs)

NBCI(P+O CIs)= Number of Basic Coupling Interfaces (on Primal and Dual branches) of an IS

NBIF(SC+CI) = Number of Basic Info-analytical Frameworks including all Specific Classes and Coupling Interfaces of an IS

NBSC = Number of Basic Specific Classes of an IS

NC(FPRCs) = Number of all FPR Chains of an IS

NCI(P+D CIs) = Number of all CIs (for basic and additional SCs on Primal and Dual branches) of an IS

NFIE(CI,DF) = Number of Interfered IEs of an IS (for all DFs of all SCs)

NFR(P+D CIs) = Number of Interfered Relationships of a system's CIs (on Primal and Dual branches)

NIE(I+F IFs) = Number of IEs of all DF of an IS (for inner and interfered relationships)

NIF(SC+CI) = Number of all Info-analytical Frameworks (for basic and additional SCs, and their CIs) of an IS

NIIE(SC,DF) = Number of Inner Info-analytical Elements (IEs) of an IS for all driving factors (DFs) of all SCs

NIR(SC) = Number of Inner Relationships of a system's SCs

NL(FPRLs) = Number of all FPR Loops (successive and ramified)

NLA(P+D CEPs) = Number of FPR Loop Algorithms (on Primal and Dual branches) of an IS

NLC = Number of FPR Loop Conditions

NL/C(main) = Number of Successive FPR Loops from the main FPR Chain of an IS

NN(KIONs) = Number of key I/O Nodes of an informational system

NNC = Number of key I/O Node logical Conditions of an IS

NR(SC+CI) = Number of all inner and interfered Relationships (of all SCs and CIs) of an IS

NSC(B+A SCs) = Number of all SCs (Basic and Additional) of an IS

RS = Real (material) System

Rule of 3Ls & 1M BSCs = Rule of three Ls (load, loop, and logic) and one M (monitor) Basic Specific Classes

SCs = Specific Classes

SDRTs = System Decomposition and Reintegration Techniques

SIS = Standard Informational System

%W = Percentage Weight

"CORRESPONDENCE TRACKING"

TYPE: ACTION DOCUMENT NUMBER: 9123455
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: WANG, T.F.

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 08/12/91

SUBJECT: TWO PROPOSALS FOR DR. BROMLEY'S REVIEW, " FURTHER DEVELOPMENT OF SECONDARY BEAMS AT ATLAS" AND "DEVELOPMENT OF THE A17F BEAM FOR ASTROPHYSICAL REACTION RATE STUDIES".

****

DIRECTORATE ASSIGNED: D. Allan Bromley

STAFF ASSIGNED:

ACTION REQUIRED: AS NECESSARY

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: 08/27/91 STAFF DUE DATE

DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

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WHITE HOUSE TRACKING #:

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REMARKS: Enclosures to DAB.

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91 AUG 13 A9:50
OFFICE OF THE DIRECTOR

Dear Professor Bromley,

Finally got a chance to report to you what I am doing recently. Andrea and her mom are visiting relatives over Chicago so that I could have a chance to do something else. This baby is restless (18 months old already... still feel like that she was born yesterday). She can at least now recognize 22 characters of alphabetic and speak some simple (few words) sentences and enjoy good classical music. About two weeks ago, I was listening to P.D.Q. Bach (you know, the notorious one) 's 1712(not 1812) overture for fun, she went to the amplifier and pointed at the volume knob and complaint. After I switched Mozart's piano quartet, she stopped complaining and sit back listened till the end of the music.

Thank you very much for your little note to Jolie about my paper on superdeformation, I am pretty sure that you didn't correlated that T.F. Wang with this T.F. Wang. No body would(could) believe I am doing high-spin stuffs these days. As you probably known, I am the person who always teasing people doing γ-γ coincidence measurements since they might miss a lot of 5-MeV γ-rays(a joke, but possible). A good example is the linking transition of the SD band-- no body found any yet. Right now I am still have my doubt about the L=2 assignment (at least for the mass ~ 190 region) is right, I still suspect they are L = 1. For a band of about 1 % intensity and no definite linking to low-lying states (bypass isomer?), I doubt a good DCO measurement (let alone the angular correlation measurement) can be made. A lot of tricky background subtractions invloved (and none of them are right) which also complicated what have seen. Believe or not, I am even doing a DSAM measurement of some interesting bands in ^{198}Pb. Will definitely will send you a preprint. Enclosed please find a reprint of the ^{198,196}Pb paper.

After the shut down of the radioactivity beam facility at Livermore, I was saved by this the so called "shape-isomer task force" -- I always making fun to myself that I am only doing this job for living. This will be my last year with this group, and I am trying to find other positions in the Lab.. I hope with a Q-clearance I be able to find a real job in the Lab. (Help! Help!). Thing interests me most these days is my proposal (one of those once in 6-years) of doing a measurement of the $^{14}O(\alpha,p)^{17}F$ reaction. Of course, I bug John (Schiffer) a lot so that he lets me torture his machine (another joke, Lowell Bollinger even supports this experiment).-- I have also enclosed two proposals of this task for your

review. You know I like to do things backward (please do not take it seriously), instead of measuring $^{14}O + \alpha$ (~ 5MeV ^{14}O on a "Helium" target) , I propose to measure ^{17}F + p, even worse a ^{17}F beam (~ 40 or more MeV beam energy because of the Q-value) on a hydrogen target so that you can catch the recoil ^{14}O's with a spectrograph. The ^{17}F will be produced via H(^{17}O,^{17}F)n reaction at higher energy (~ 90 MeV) for high production cross-section and then deaccelerate to the usable energy -- only ATLAS can do this job since each resonator behaves like a battery and you can always reverse a battery. Another advantage of doing this deacceleration process is to clean up the primary beam (because of the differences in rigidity and time-of-flight), this method almost costs nothing (apart from the hydrogen target) compared to the other methods. This is something I am pushing (probably John is pushing, too) these days. Hope will work out.

Was over Tower Record yesterday, and was attracted by the background piano music played in the store. Not because I can play all of them but this guy play in such a way that makes me appreciate these pieces more. He is not a perfectionist but he plays with style. Got two copies so that we both can share his music. Listen how slow he plays Schubert's "Moment music", and how light he plays Ivanovici's "Waves", and how unusual he plays first few notes of the Beethoven's "Moonlight". Hope this music will make you feel relaxing after a day of intense work....

With warmest wishes,

Sincerely,

Ju-fang Wang

To "DAB"
Best wishes
Tzu-fang

PHYSICAL REVIEW C
NUCLEAR PHYSICS

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RAPID COMMUNICATIONS

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Superdeformation in ^{198,196}Pb

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A weakly populated rotational band with energy spacings characteristic of superdeformation has been found in the reaction ^{154}Sm(^{48}Ca,xn) at $E(^{48}\text{Ca})=205$ MeV. This band has seven transitions with an average γ-ray energy spacing of approximately 42 keV. It is assigned to ^{198}Pb on the basis of the excitation-function results. We also confirm the isotopic assignment of a previously reported superdeformed (SD) band in ^{196}Pb via the cross bombardments ^{176}Yb(^{26}Mg,xn) and ^{176}Yb(^{24}Mg,xn). Three SD bands have now been identified in the Pb isotopes with neutron numbers 112, 114, and 116.

Three-dimensional Hartree-Fock calculations of Bonche *et al.*[1] and Girod *et al.*[2] (who employed an effective two-body interaction with pairing), as well as a cranked Strutinsky calculation of Chasman,[3] all predict well-developed secondary minima in nuclear energy surfaces throughout the $A\sim194$ mass region, suggesting the presence of superdeformed (SD) nuclear shapes. These predictions have been verified experimentally in a number of Hg (Ref. 4), Tl (Refs. 5 and 6), and Pb (Refs. 7 and 8) nuclei. There are now approximately 25 SD bands observed in 12 nuclei in this region. These SD nuclei show similar moments of inertia, identical transition energies, and quantized alignment. Our experiments are motivated by the desire to understand these new phenomena associated with superdeformation. We report here results from our continuing experimental work in the Pb isotopes: (1) a new SD band in ^{198}Pb, and (2) confirmation of a previous[7] tentative isotopic assignment for a SD band in ^{196}Pb.

Experiments were carried out at the Lawrence Berkeley Laboratory 88-Inch Cyclotron using HERA. HERA is an array of 20 Compton-suppressed Ge detectors together with a 4π, 40-element bismuth germanate inner ball. ^{198}Pb was populated via the ^{154}Sm(^{48}Ca,$4n$) reaction at two incident energies, $E(^{48}\text{Ca})=205$ and 210 MeV. The ^{154}Sm target was made of three stacked 500 μg/cm^2 foils. ^{196}Pb was studied by bombarding a ^{176}Yb target with two Mg isotopes: ^{24}Mg at $E(^{24}\text{Mg})=122$ MeV and ^{26}Mg at $E(^{26}\text{Mg})=135$ MeV. These energies were chosen to maximize the population of ^{196}Pb via the $4n$ and $6n$ evaporation channels, respectively. The ^{176}Yb target was composed of three stacked (450, 450, and 700 μg/cm^2) foils. Doubly-coincident (twofold) Ge events were recorded, along with sum energy (H) and multiplicity (K) information from the inner ball, if at least six inner-ball detectors were triggered. Coincidence events between three or more Ge detectors were always recorded (with H and K information). In the ^{198}Pb study, $\sim$280 million coincidence events were stored at each energy. For the ^{196}Pb

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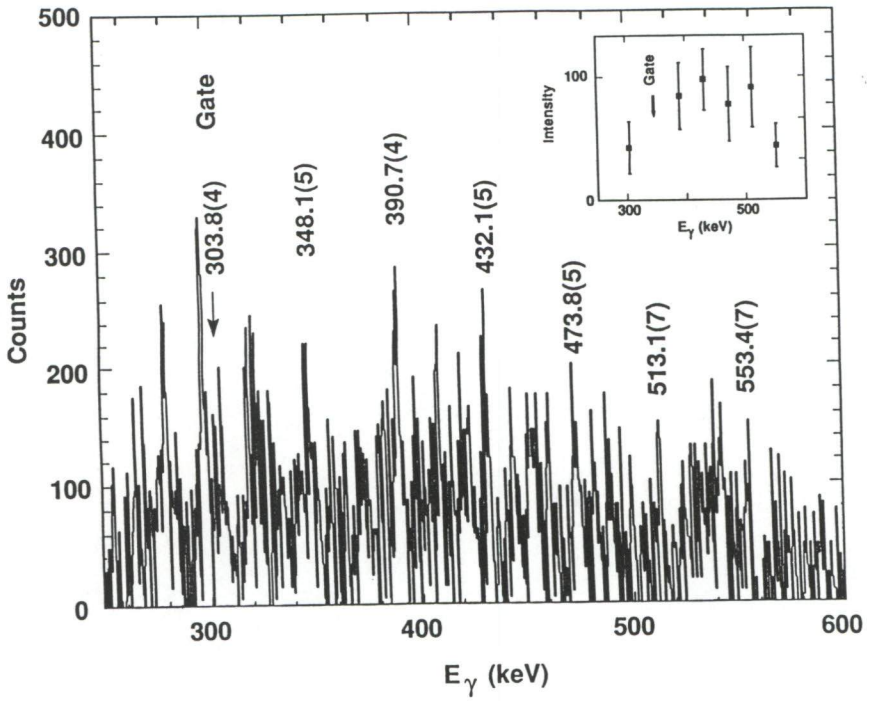

FIG. 1. Single-gated coincidence spectrum for the SD band in ^{198}Pb; transition energies with errors are shown. The intensity pattern of the SD band gated on the 348.1-keV transition is illustrated in the upper right corner.

study, ~130 million and ~400 million coincidences were stored at $E(^{24}\mathrm{Mg})=126$ MeV and $E(^{26}\mathrm{Mg})=135$ MeV, respectively. In each instance, ~80% of the total recorded events were twofold coincidences.

Analysis of the ^{198}Pb data was done with conditions $H \geq 4.0$ MeV and $K \geq 8$. Figure 1 shows the energy spectrum and the intensity pattern of the SD band observed in the $^{154}\mathrm{Sm}(^{48}\mathrm{Ca},xn)$ reaction at $E(^{48}\mathrm{Ca})=205$ MeV. This band consists of seven transitions and is populated at ~1% of the total ^{198}Pb yield. The γ-ray energy difference between two adjacent transitions, ΔE_γ, decreases gradually from ~44 keV for the lowest-energy transitions to ~40 keV at the highest-energy transitions. The change in ΔE_γ per transition with increasing E_γ is the smallest among the SD bands so far found in Hg and Pb. The intensity ratios [the intensity obtained at $E(^{48}\mathrm{Ca})=205$ MeV to that at $E(^{48}\mathrm{Ca})=210$ MeV] of (i) the SD band, (ii) the high-spin states in ^{198}Pb, and (iii) the high-spin states in ^{197}Pb are summarized in Table I. There is no difference between the $K \geq 8$ and $K \geq 11$ results. The number of events with $K \geq 11$ is ~40% of the number with $K \geq 8$. The SD band appears to have the same (within errors) excitation-function behavior as the high-spin states in ^{198}Pb. We, therefore, assign this SD band to ^{198}Pb. Coincidences between SD band members and transitions between known states below the 12^+ ($\tau=240$ ns) isomer[9] were not observed.

TABLE I. The ratio of the intensity [normalized with respect to the corresponding total double-coincidence events; two different multiplicity conditions ($K \geq 8$ and $K \geq 11$) were selected] obtained at $E(^{48}\mathrm{Ca})=205$ MeV to the intensity at $E(^{48}\mathrm{Ca})=210$ MeV for (i) the SD band observed in the $^{154}\mathrm{Sm}(^{48}\mathrm{Ca},xn)$ reaction, and (ii) the high-spin states in ^{198}Pb, and (iii) the high-spin states in ^{197}Pb.

	$K \geq 8$	$K \geq 11$
SD	2.5(9)	2.3(10)
^{198}Pb	1.9(2)	1.8(2)
^{197}Pb	0.8(1)	0.8(1)

Figure 2(a) shows an 11-transition SD band observed in the $^{176}\mathrm{Yb}(^{26}\mathrm{Mg},xn)$ reaction at $E(^{26}\mathrm{Mg})=135$ MeV. Analysis was done with conditions $H \geq 3.25$ MeV and $K \geq 8$. This band was previously found[7] in the $^{176}\mathrm{Yb}(^{24}\mathrm{Mg},xn)$ reaction at $E(^{24}\mathrm{Mg})=122$ MeV. Data from the latter reaction are shown in Fig. 2(b), along with the intensity pattern of the band. ^{196}Pb is the only common nucleus populated in these two reactions and, therefore, we unambiguously assign this band to ^{196}Pb. For this band ΔE_γ decreases gradually from ~44 to ~36 keV as E_γ increases from 215 to 620 keV. No known low-lying transition between states below the 12^+ ($\tau=265$ ns) isomer[10] in ^{196}Pb was found in coincidence with SD band members. No meaningful intensity pattern can be obtained from the data at $E(^{26}\mathrm{Mg})=135$ MeV. The spectral peaks of the SD band are more prominent in the spectrum obtained at $E(^{24}\mathrm{Mg})=122$ MeV than in the spectrum obtained at $E(^{26}\mathrm{Mg})=135$ MeV, although the intensity ratio of the 959-keV ($14^+ \rightarrow 12^+$) transition[10] in ^{196}Pb normalized to the total double-coincidence events at $E(^{26}\mathrm{Mg})=135$ MeV to that at $E(^{24}\mathrm{Mg})=122$ MeV is 0.86(2). This may be due to the population mechanism of the SD band or background produced by the other evaporation channels and fission at the higher incident energy.

The spin assignments of the members of these bands were obtained from least squares fits to the expression

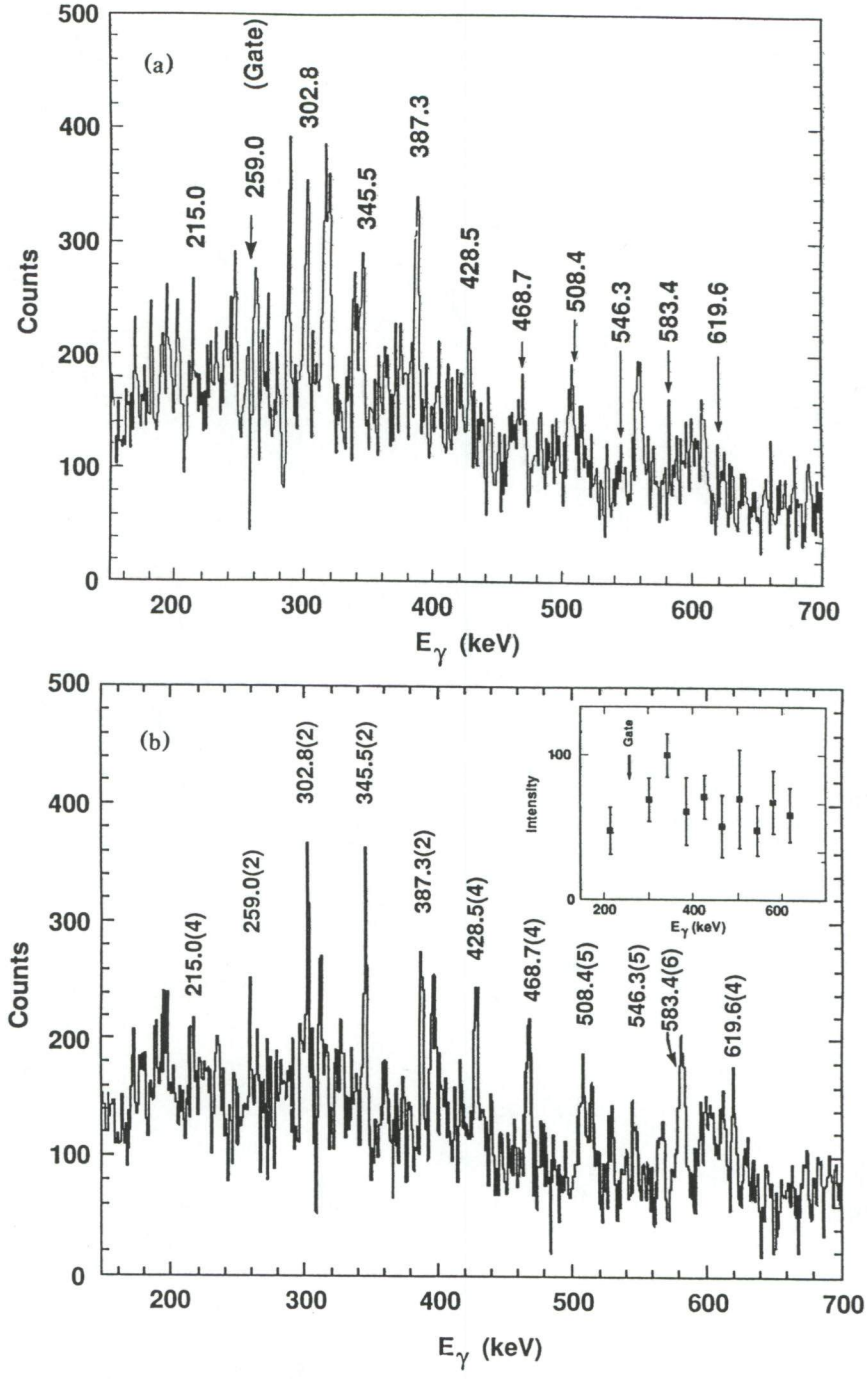

FIG. 2. (a) Spectrum for the ^{196}Pb SD band (obtained from gating on the 259.0-keV γ ray) observed in the ^{176}Yb(^{26}Mg,xn) reaction at $E(^{26}\text{Mg})=135$ MeV. (b) The same band was found in the ^{176}Yb(^{24}Mg,xn) reaction at $E(^{24}\text{Mg})=122$ MeV; the spectrum was obtained from summing the 215.0-keV, 259.0-keV, and 508.4-keV gates. The intensity pattern obtained from the 259.0-keV gate is also shown.

($\hbar=1$):

$$I+\tfrac{1}{2}=2\alpha\omega+\tfrac{4}{3}\beta\omega^3. \quad (1)$$

With the choice $\omega=dE/dI=E_\gamma/2$, I is the intermediate spin in the transition $I+1\rightarrow I-1$ (see also Refs. 11 and 12). The ^{198,198}Pb data do not have sufficient statistics for making directional correlation analysis, and we made a reasonable assumption that these cascade γ rays of the SD band have multipolarity $L=2$. There are three free parameters in the fit: I_f (the spin of the lowest band member) and the inertial parameters α and β. All seven transitions were used in the fit for ^{198}Pb, and only the nine lowest-energy transitions were used for ^{196}Pb. Results are summarized in Table II. The 303.8-keV γ ray in ^{198}Pb is assigned as $I_i\rightarrow I_f=14\rightarrow 12$, and the 215-keV γ ray in ^{196}Pb corresponds to an $I_i\rightarrow I_f=10\rightarrow 8$ transition. In the ^{198}Pb spin assignment, we use the fact that the level spin of an even-even nucleus is integer.

Figure 3 shows $\mathcal{J}^{(2)}$, the dynamic moment of inertia, for the SD bands in ^{198}Pb and ^{196}Pb, as a function of $(\hbar\omega)^2$. Lines through the data points are obtained with the parameters for integer values I_f in Table II. The $\mathcal{J}^{(2)}$ values

TABLE II. Least-squares parameters from a fit of measured transition energies to $I+\frac{1}{2}=2a\omega+\frac{4}{3}\beta\omega^3$ (see text). The errors are statistical only, and when $\chi^2/\nu<1$, the error represents the uncertainty: $(\chi^2/\nu)^{1/2}\sigma$. The second row for a given nucleus represents the fit done with a fixed integer value I_f.

^AZ	E_γ (keV)	a ($\times10^{-2}$) (keV^{-1})	β ($\times10^{-8}$) (keV^{-3})	I_f
^{194}Pb	169.7(2)	4.408(24)	8.17(43)	6.02(5)
		4.398(4)	8.33(16)	6
^{196}Pb	215.0(4)	4.344(20)	6.28(27)	7.94(5)
		4.369(2)	5.95(11)	8
^{198}Pb	303.8(4)	4.265(65)	5.87(74)	11.74(17)
		4.361(7)	4.83(21)	12

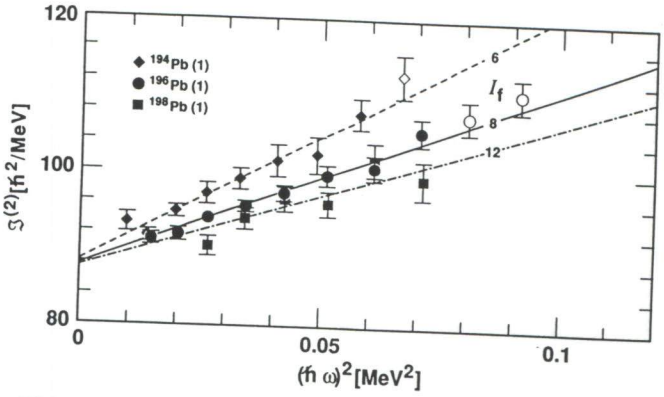

FIG. 3. The dynamic moment of inertia $\mathcal{J}^{(2)}$ of the SD band in ^{194}Pb, ^{196}Pb, and ^{198}Pb as a function of $(\hbar\omega)^2$. The lines are calculated from the parameters a and β obtained with integer values of I_f. The solid symbols indicate the transitions which were used in the fits.

of the SD band[7,8] in ^{194}Pb are included in Fig. 3 for comparison. While many of the even-even nuclei have similar $\mathcal{J}^{(2)}$, the $\mathcal{J}^{(2)}(^{198}\text{Pb})$ and $\mathcal{J}^{(2)}(^{196}\text{Pb})$ are different than $\mathcal{J}^{(2)}(^{194}\text{Pb})$, although all three nuclei have almost the same moment of inertia, $2a$. The change in $\mathcal{J}^{(2)}$ per transition decreases with increasing neutron number. A possible interpretation is that the pairing does not change as much with frequency in ^{198,196}Pb as in ^{194}Pb. The alignment[13] of the ^{198,196}Pb SD bands with increasing $\hbar\omega$ does not saturate at a quantized value (i.e., integer or half-integer) with respect to the ^{192}Hg (or ^{193}Tl) reference SD band (see Refs. 13 and 6 for the prescription and details), in contrast to the many other SD bands in this region. Furthermore, the SD bands in ^{198,196}Pb do not show quantized alignment with respect to any reported SD band in the $A=194$ region.

An important result of this experiment is that the region of superdeformation is extended to $N=116$. All calculations predict well-defined secondary minima in ^{194}Pb, ^{196}Pb, and ^{198}Pb; however, the excitation energy of the second well increases with increasing neutron number. For example, Bonche *et al.*[1] predict that the depth of the second minimum increases from 1.73 MeV for ^{194}Pb to 2.59 MeV for ^{198}Pb while the excitation energy increases from 4.86 MeV to 8.28 MeV. The calculation of Chasman[3] includes angular momentum. He predicts that the second minimum in ^{198}Pb at $I=40$ has depth $\sim$3.4 MeV and excitation energy $\sim$4.2 MeV above yrast. Based on Chasman's calculation, our observation of the SD band in ^{198}Pb is surprising and suggests that the population mechanism is not yet well understood.

Bonche *et al.*[14] have discussed the termination of the SD cascade and the decay to the first well states. They made fully self-consistent generator coordinate method calculations on a basis of quadrupole constrained Hartree-Fock plus BCS wave functions. In-band *versus* out-of-band quadrupole decay was evaluated, and they find (i) the depopulation of the SD band takes place at approximately the correct spin value in Hg and Pb and (ii) the decay of the SD band occurs in 1-2 transitions. Also, the predicted trend of the cascade termination with A is consistent with experimental results. They predict that the SD band depopulates at $I=12$ in ^{198}Pb, as we observed in our experiment.

The behavior of the inertial parameter a with mass A is interesting (see Table II): a is constant within 1% as A changes from 194 to 198, while the rigid body moment of inertia ($\propto A^{5/3}$) would give a 3% change. Krieger *et al.*[15] have calculated the moment of inertia and the electric quadrupole moment for the even-even Pb isotopes with A between 190 and 218. The predicted moment of inertia show a 3% increase between $A=194$ and 198, and a flat plateau which changes $\sim$1.5% (per four mass units) in the mass region $A=198$–210.

In summary, we have extended the region of superdeformation to $N=116$. ^{198}Pb is the heaviest nucleus in this mass region where the superdeformation is known. Further experiments, e.g., a search for SD bands in heavier Pb nuclei (^{199,200}Pb) and lighter Pb nuclei (^{191,192}Pb), as well as finding linking transitions are essential to understanding the physics associated with superdeformation.

The authors thank M. S. Weiss, P. Bonche, S. J. Krieger, and R. R. Chasman for fruitful discussions. We also thank the LBL 88-Inch Cyclotron operating crew for flawless operation. We acknowledge R. A. Belshe, M. Lee, and D. R. Manatt for their help in the data acquisition during the experiment. This work was supported in part by the Department of Energy, under Contract No. W-7405-ENG-48 (LLNL), in part by the U.S. Department of Energy under Contract No. DE-AC03-76SF-00098 (LBL) and by the National Science Foundation (Rutgers).

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[15]S. J. Krieger *et al.* (unpublished).

Table 1. Projected goals from the results of the experiment of September 1990 to investigate the secondary beam production of 64-sec ^{17}F via the $H(^{17}O,^{17}F)n$ reaction.
Primary ^{17}O beam: E = 90 MeV
Secondary ^{17}F beam: Mean energy = 75 MeV, Energy spread = ±5 MeV, Angular spread = ±31 mrad (1.8 deg)

Parameter	Achieved	Hoped-for Improvement	Goal
$^{17}O^{5+}$ beam	2.5 pnA	1000	2.5 pμA
$(CH_2)_n$ target	905 $\mu g/cm^2$ 130 $\mu g/cm^2$ H	7	1 mg/cm^2 H
cross section	100 mb	1	100 mb
fraction of phase space accepted for ^{17}F	0.005 (est.) [a]	100	0.5
$^{17}F^{9+}$ stripping fraction	0.5	1	0.5
transmission from target to spectrograph	0.1	1	0.1
$^{17}F^{9+}$ beam at spectrograph	11 pps (30 est.) [b]	$7x10^5$	$8x10^6$ pps
Luminosity for a target [c] of 1 mg/cm^2 $(CH_2)_n$	$1x10^{21}$ $cm^{-2}s^{-1}$	$7x10^5$	$7x10^{26}$ $cm^{-2}s^{-1}$
reaction rate for a cross section of 1 mb	$1x10^{-6}$ s^{-1}	$7x10^5$	0.7 s^{-1}

[a] estimated from the geometrical acceptance of the 40-degree bending magnet.

[b] estimated counting rate from the quantities given above.

[c] for a reaction on hydrogen, e.g. the $H(^{17}F,^{14}O)^4He$ reaction.

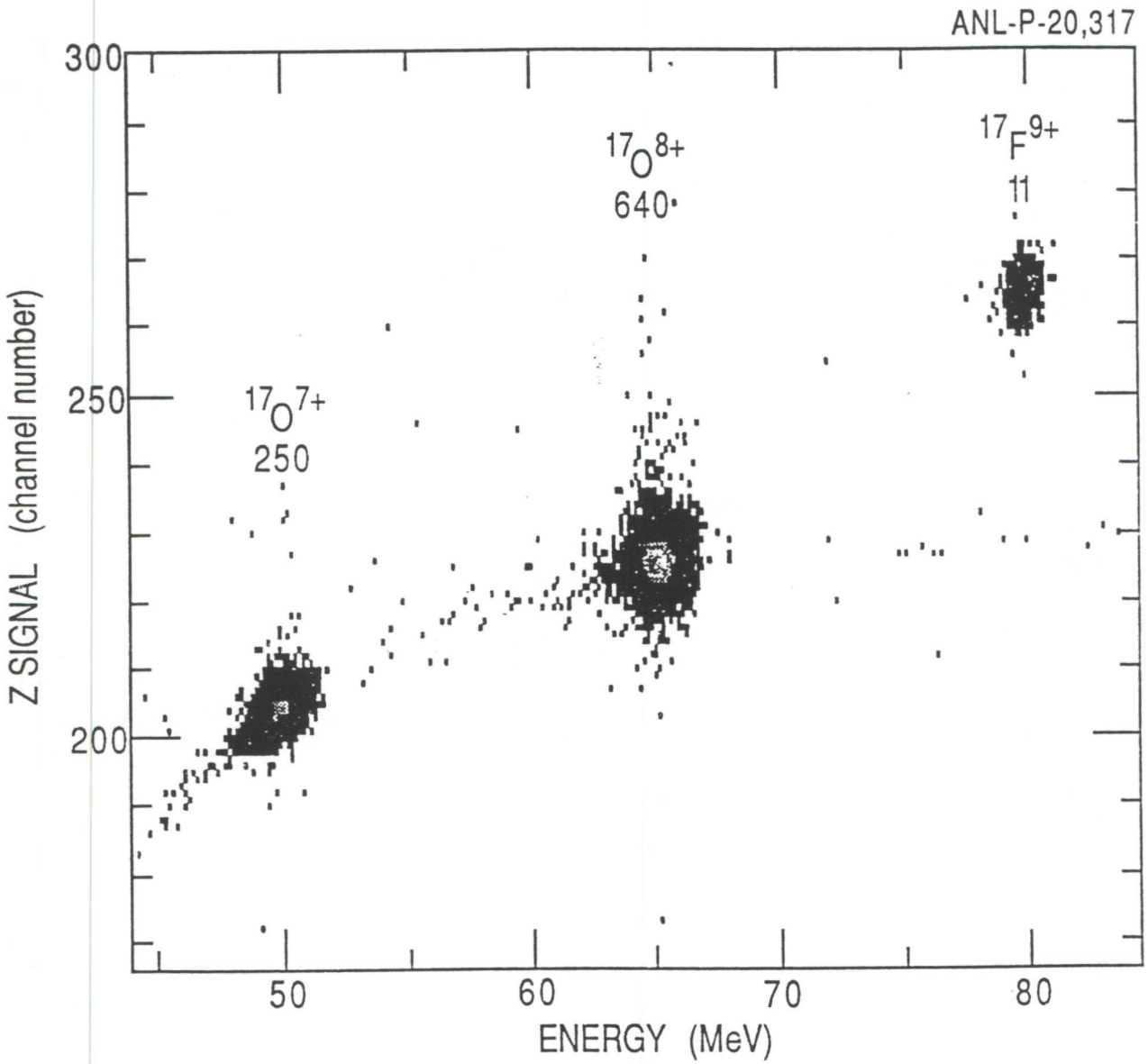

Fig. 2. Secondary-beam spectrum from the H(^{17}O,^{17}F)n reaction measured in the Bragg-curve focal-plane detector of the split-pole spectrograph. The peaks are labeled by ion species and their respective intensities in ions/sec.

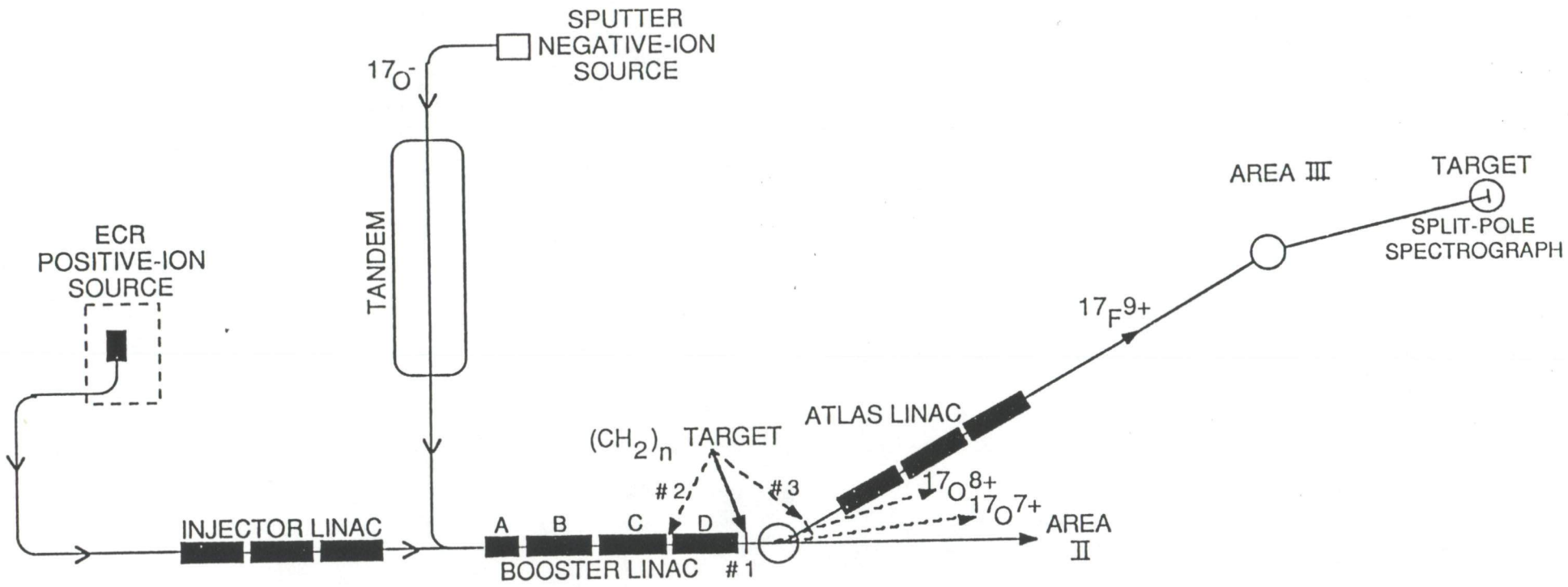

Fig. 1. Schematic view of the setup to study a ^{17}F-beam production with the reaction $H(^{17}O,^{17}F)n$. Position #1 of the polyethylene target was used in the first experiment. The alternate positions (#2 and #3) are discussed in the text.

DEVELOPMENT OF A ^{17}F BEAM FOR ASTROPHYSICAL REACTION RATE STUDIES

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We propose to develop a secondary beam of the short-lived radioisotope ^{17}F ($T_{1/2}$ = 64.5 s) with the goal to use it for studies of the $^{1}H(^{17}F,^{14}O)^{4}He$ reaction. (For a discussion of the astrophysical significance of this reaction see Appendix.)

Two reactions have been considered as possible routes to produce a secondary beam of ^{17}F which can be accelerated or decelerated and transported to a target station: (i) $^{1}H(^{17}O,^{17}F)n$, Q = -3.544 MeV; (ii) $^{2}H(^{16}O,^{17}F)n$, Q = -1.624 MeV. We propose to investigate the first of these reactions, since it is kinematically more favorable. Figure 1 shows the lab angle of ^{17}F reaction products versus their lab energy for incident ^{17}O energies of 65 and 80 MeV, respectively. For a good secondary-beam intensity we need a hydrogen target which can stand a high ^{17}O-beam intensity of 1 to 5 pμA. Such a target will consist of a 30-cm long gas cell filled with 100 torr H_2 and terminated by two 1 mg/cm^2 thick Be windows. However, for the initial tests we want to use a solid hydrogen target of similar thickness in the form of polyethylene, $(CH_2)_n$, and a much lower ^{17}O-beam intensity of about 10 pnA. With this condition we want to explore the relevant parameters for a ^{17}F-beam production.

The target will be located at the booster linac exit. From the known [1] excitation function of the $^{17}O(p,n)^{17}F$ reaction, a cross section of 100 to 150 mb can be found at ^{17}O-beam energies between 75 and 85 MeV (see Fig. 2).

Allowing an energy spread of ±1.5 MeV for the resulting ^{17}F beam (mainly due to target thickness) and an angular spread of ±0.15 degrees, we estimate that about 0.1% of the ^{17}F particles will reach the secondary target location at the Enge split-pole magnetic spectrograph. For a primary ^{17}O-beam intensity of 10 pnA we would then obtain a few hundred ^{17}F ions per second at the spectrograph. To cleanup the ^{17}F beam from primary ^{17}O ions we will select only fully stripped ^{17}F ions with the 40-degree bending magnet between booster and ATLAS linac. At the projected ^{17}F energies the fully stripped fraction should be at least 50% [2]. The initial tuning of the post-booster system will be accomplished by using a "macroscopic" beam of $^{17}O^{8+}$ which matches the ion-optical properties of $^{17}F^{9+}$ ions as close as possible. The secondary ^{17}F beam will be analyzed for its composition and other properties with the split-pole spectrograph. Deceleration to energies around 40 MeV and energy variations will be tested. For these first tests we would like to have three days of beam time. Depending on the outcome of these tests, we would then propose the development of the high-intensity setup using a gas target and an intense ^{17}O beam from the ECR source. For this we will use enriched ^{17}O gas in the source. The goal is to achieve eventual a ^{17}F-beam intensity of 10^5 to 10^6 ions/s at the spectrograph, where we then intend to investigate the $^{1}H(^{17}F,^{14}O)^{4}He$ reaction.

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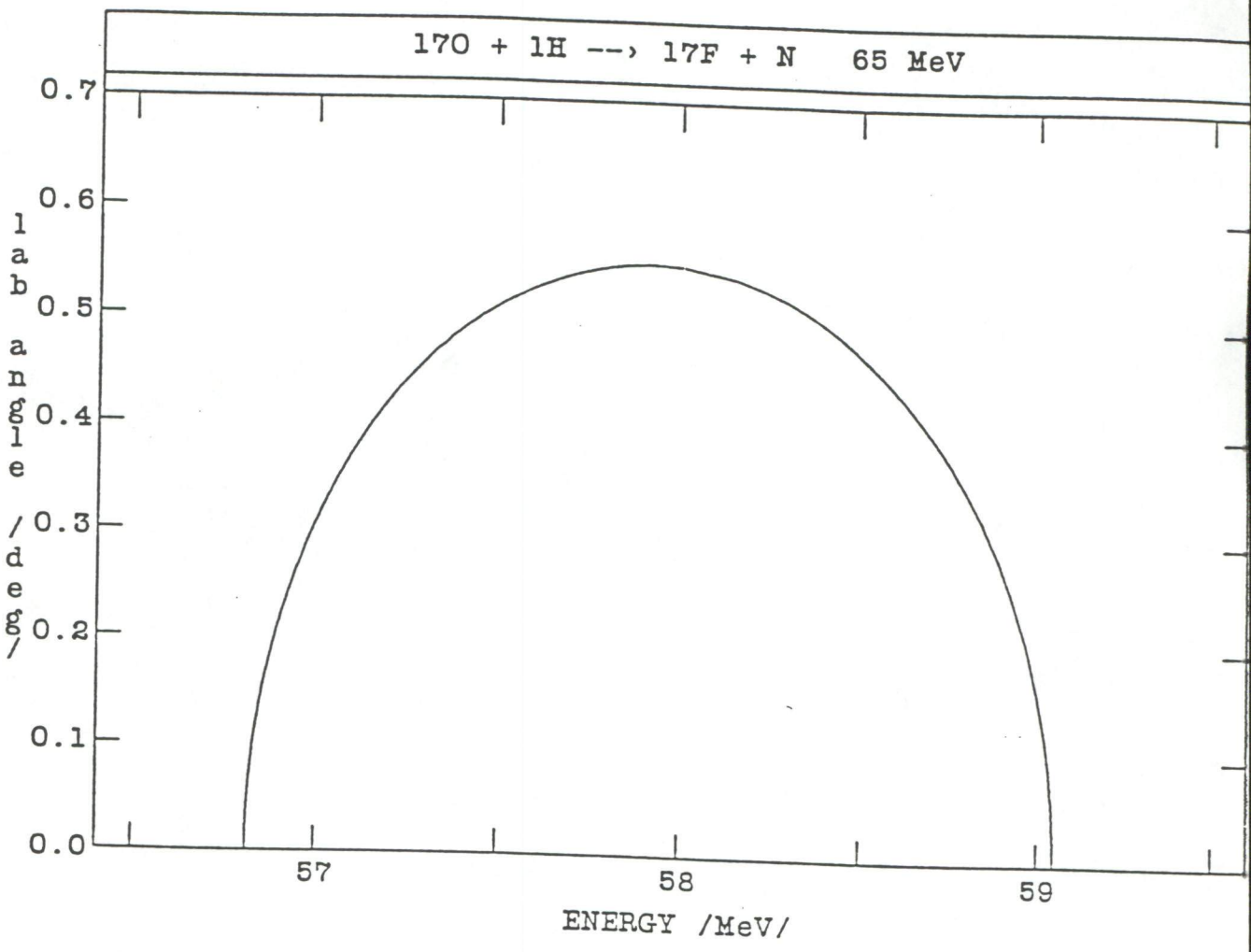
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57
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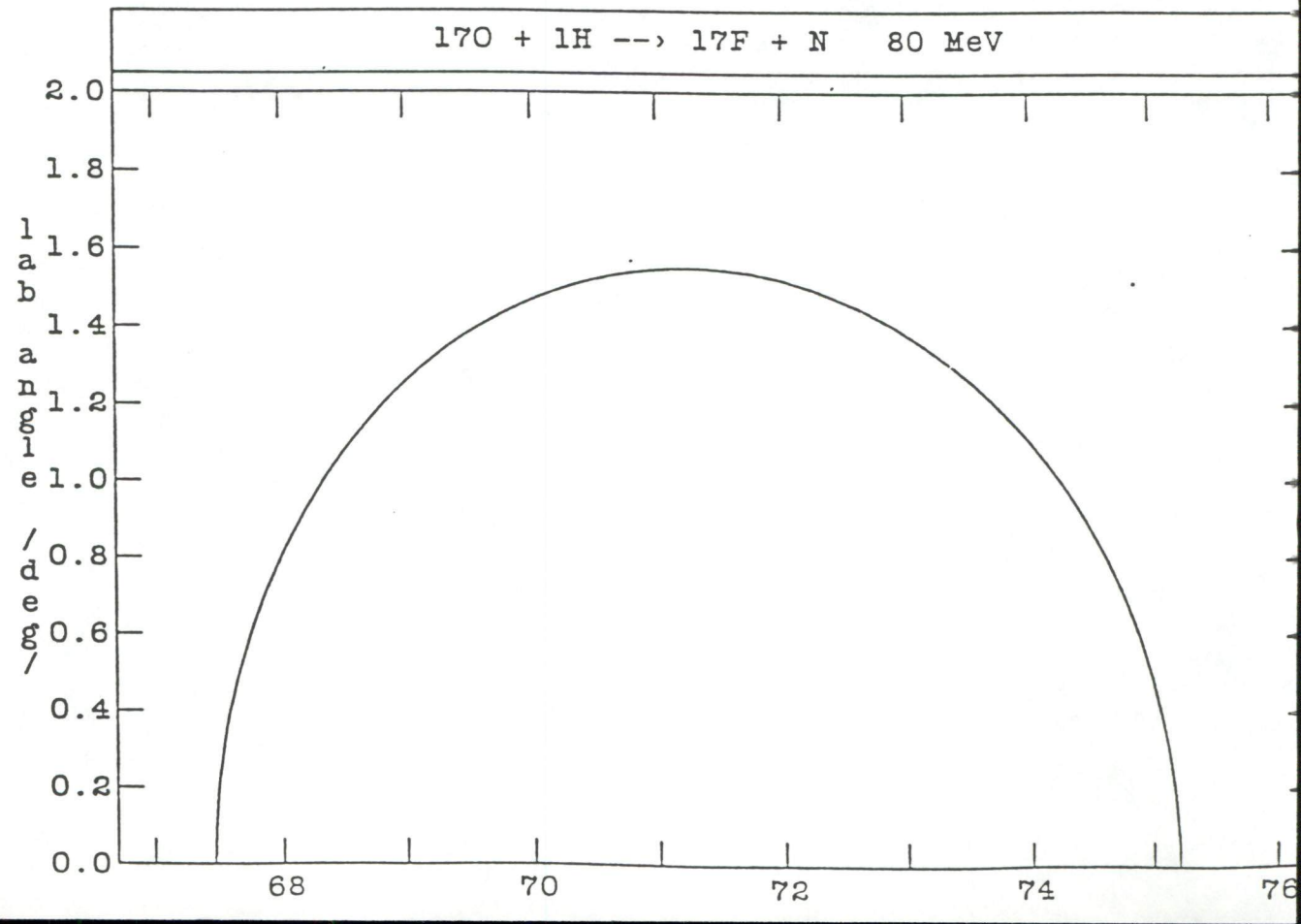
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70
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74
76

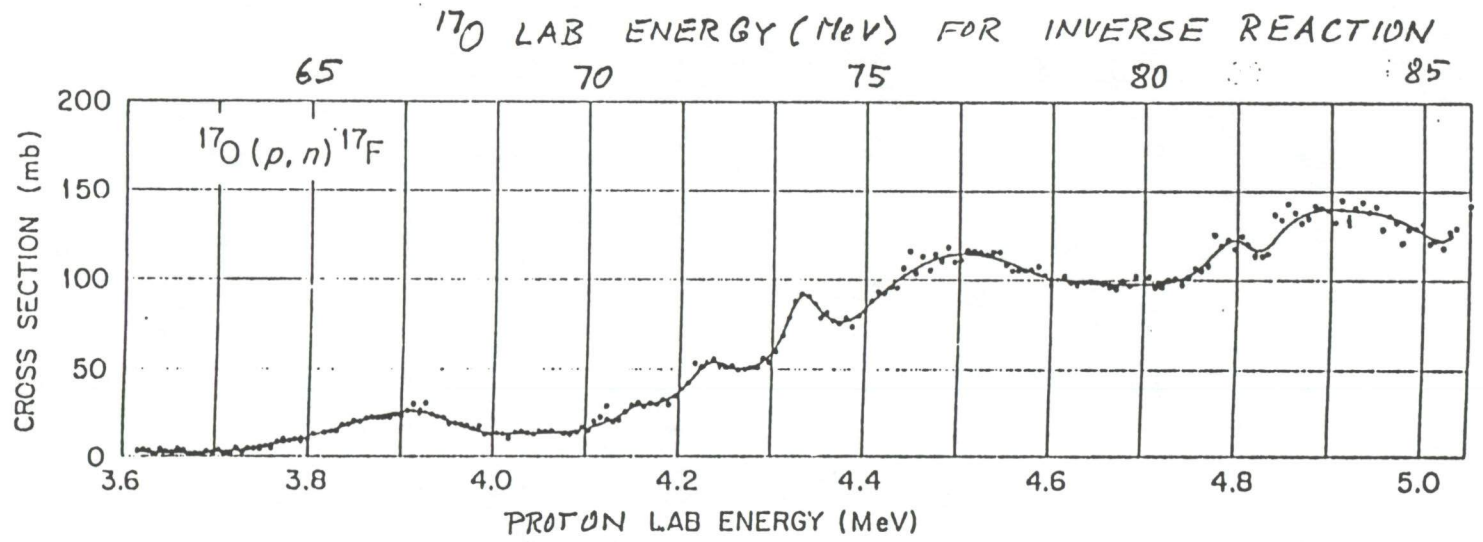


FIG. 2. Shows the total neutron-production cross section for the reaction $^{17}O(p,n)^{17}F$. The target was a "drive-in" type having a thickness of 9 keV for 2.5-MeV protons. The energies are in the laboratory system and have been corrected for target thickness. From Ref. [1].

Further Development of Secondary Beams at ATLAS with the $H(^{17}O,^{17}F)n$ Reaction

T.F. Wang

Lawrence Livermore National Laboratory, Livermore, CA 94550

P. Fernandez, W. Kutschera, R.C. Pardo, K.E. Rehm and J.P. Schiffer

Argonne National Laboratory, Argonne, IL 60439

We propose to continue the effort to develop a ^{17}F beam at ATLAS, with the goal to study reaction rates relevant to "hot" nucleosynthesis. As the general concept, the booster linac is used for production of secondary beam particles at a favorable primary beam energy, and the ATLAS linac is used for decelerating the secondary beam to an energy range useful for astrophysical reaction studies.

In a first experiment in September 1990, we investigated the production of 64-sec ^{17}F via the reaction $H(^{17}O,^{17}F)n$. Figure 1 shows a schematic view of the experimental setup. A $(CH_2)_n$ target (0.9 mg/cm^2) after the booster linac was bombarded with 90 MeV ^{17}O. In order to separate the bulk of the primary ^{17}O beam, $^{17}F^{9+}$ ions were selected in the 40° bend region (no $^{17}O^{9+}$ ion is possible). The secondary ions were transported through the ATLAS linac and further to the Enge split-pole spectrograph, where they were analyzed in a Bragg-curve focal-plane detector. A two-dimensional spectrum measured in this way is displayed in Fig. 2. Besides the $^{17}F^{9+}$ ions, fractions of low-energy tails of the primary ^{17}O beam, matching the magnetic rigidity of $^{17}F^{9+}$ ions, arrive at the spectrograph. It is expected that deceleration of $^{17}F^{9+}$ in the ATLAS linac will eliminate the ^{17}O particles due to their rf-phase mismatch relative to ^{17}F. By tuning one of the resonators in the ATLAS linac to optimize the ^{17}F yield, we actually observed strong effects on the ^{17}O background. Table 1 summarizes the results of the experiment and also the improvements necessary to reach our goal of 10^6 to 10^7 ^{17}F ions/sec at the spectrograph.

Two major improvements are required to push the secondary beam intensity into the desired range. First, the large increase of ^{17}O beam intensity expected from the ECR source requires a production target capable of withstanding such high beam intensities. Although a solid target is preferred over the H_2 gas cell discussed in the previous proposal, it has to be seen how much beam a rotating-wheel target of $(CH_2)_n$ can actually withstand. Second, an efficient recovery of both longitudinal ($\Delta E \Delta t$) and transverse ($\Delta r \Delta \phi$) phase space must be implemented in order to collect the major part of the secondary particles. The large energy spread of ^{17}F ($\Delta E/E \approx 10\%$) can be reduced by debunching since ATLAS accepts a much longer time spread than the very short (~200 ps) primary beam pulses. Debunching can be accomplished with an ATLAS resonator at the proper distance from the production target. The transverse phase space of ^{17}F is dominated by the angular spread ($\Delta \phi \approx 30$ mrad) due to reaction kinematics. With a primary beam radius of 1 mm, this produces a ^{17}F emittance of about 30 π mm mrad which we believe is acceptable for ATLAS and the beam transport system. However, the large divergence requires a refocussing shortly after the production target, before the beam diameter has grown larger than the aperture of the focussing element. A standard ATLAS superconducting solenoid at about 0.5 m from the target would do the job. We have performed raytrace calculations to verify the debunching and refocussing conditions, and the deceleration mode in the ATLAS linac for the ^{17}F particles. From these calculations we concluded that an excellent location of a production target would be between cryostat C and D of the booster linac (see Fig. 1). The last solenoid of C could be used to focus the primary beam to a tight beam spot on the production target and the second resonator in D could be used for debunching. However, the first solenoid in D comes only after the second resonator which is too far away from the production target. For proper refocussing of the secondary particles, the first resonator would have to be replaced by a solenoid. In addition, there is not enough room between C and D

to install a production target. Placing the target at this location would require to move cryostat D about 10 to 20 cm downstream. Although these changes are possible, they are non-trivial considering their impact on the overall experimental program at ATLAS. Therefore, before venturing into such a booster linac configuration change, we want to test another secondary beam scheme described below.

In order to test the phase space debunching and refocussing scheme without any changes in the accelerator configuration, we want to place a $(CH_2)_n$ target between the 40-degree bend magnet and the debuncher/rebuncher system of the ATLAS linac, which is preceded by a superconducting solenoid (see Fig. 1). This setup would allow us to study the effectiveness of both longitudinal and transverse phase space recovery. In addition, we could study the effectiveness of suppressing the primary ^{17}O beam in the ATLAS linac with the decelerating mode. We expect that in the deceleration mode of the ATLAS linac the primary ^{17}O particles will quickly come out of phase with the rf tuned for ^{17}F deceleration. This will lead to vastly different energies of ^{17}O and their particle loss in ATLAS. The beam transport system from ATLAS exit to the spectrograph including a 23-degree switching magnet should remove most of the remaining ^{17}O particles.

In order to perform this experiment we propose to use three days of ^{17}O beam time. Since only a few pnA of ^{17}O beam is required, this test can be performed with tandem injection. No access to the experimental area is required during beam operation.

APPENDIX

DIRECT DETERMINATION OF THE $^{14}O(\alpha,p)^{17}F$ REACTION RATE AT STELLAR TEMPERATURES

At high temperature and high density astrophysical environments (e.g. novae, accreting neutron stars), the normal CNO cycle will be transformed into the hot CNO cycle[1]:

$$^{12}C(p,\gamma)^{13}N(p,\gamma)^{14}O(\beta^+\nu)^{14}N(p,\gamma)^{15}O(\beta^+\nu)^{15}N(p,\alpha)^{12}C.$$

At even higher temperature, the alpha burning of ^{14}O and ^{15}O via the $^{14}O(\alpha,p)^{17}F$ and the $^{15}O(\alpha,\gamma)^{19}Ne$ reactions seems to be the only two paths which can transform the CNO nuclei to nuclei with Z > 10 (Ref. 2-5). Several experimental investigations using transfer reactions to determine the resonant contributions of these two reaction rates have been carried out at Yale, Princeton and University of Washington at Seattle[6,7]. However, to determine the non-resonant contributions (or contributions from the tail of a resonance) of these two reaction rates require the use of either radioactive beams or targets.

Because the nuclei involved in these reactions are short-lived, it is not practical to make a radioactive target. Therefore we have decided to make radioactive beams via extracting the radioactive products from the primary beam after a production target. Furthermore, since the intensity of the secondary beam is much lower than the primary beam, we have to limit ourselves to measure reaction rates which involve true "nuclear" reactions. Therefore determining the $^{14}O(\alpha,p)^{17}F$ reaction rate becomes our present goal.

The ground state contribution of the $^{14}O(\alpha,p)^{17}F$ reaction rates at $T_9 > 0.4$ will be determined via the detailed balance of the $^{1}H(^{17}F,^{14}O)^{4}He$ reaction. Although there are several drawbacks to measure the reaction rate in this way

(e.g. spin factor, contributions of excited states in ^{17}F to the reaction rate etc.), the advantages gained in the kinematics are obvious (for example, to measure the resonant contribution of the states in ^{18}Ne around 6.3 MeV require $E_{lab}(^{14}O)$ = 5.33 MeV if measured through the $^{14}O + \alpha$ channel compared to $E_{lab}(^{17}F)$ = 42.8 MeV via the ^{17}F + p channel. Higher incident beam energies result in higher recoil energies as well as better kinematical focusing which will allow us to determine the reaction rate to a sensitivity that has never been achieved. With ^{17}F-beam intensities between 10^5 and 10^6 ions/s on a reasonably thick polyethylene target (~500 $\mu g/cm^2$), we estimate that cross sections in the range of tens of microbarns should be measurable in a day of running. Once a reasonable quantity of ^{17}F can be produced, we will request beam time to measure the resonant as well as the tail of the resonant contributions of the 7.06-MeV state in ^{18}Ne. This state, from several theoretical investigations, is thought to be a p-wave resonance in the $^{14}O + \alpha$ channel, and it "controls" the rate of alpha burning of ^{14}O in the temperature range $0.4 < T_9 < 2.0$.

1) P. Fernandez et al., Bull. Am. Phys. Soc. 33 (1988) 1598; Phys. Rev. C (Dez. 1989), in press.

2) R. K. Wallace and S. E. Woosley, Astrophys. J. Suppl. 45 (1981) 389.

3) M. Wiescher et al. Astrophys. J. 316 (1987) 162.

4) C. Funk and K. Langanke, Nucl. Phys. A480 (1988) 188; and C. Funk, B. Grund, and K. Langanke, Z. Phys. A332 (1989) 109.

5) P. Descouvemont and D. Baye, Phys. Rev. C31 (1985) 2274.

6) P. Magnus et al., Nucl. Phys. A470 (1988) 206.

7) P. Magnus, private communication.

THE WHITE HOUSE

WASHINGTON

September 20, 1991

Dear Wang:

I was delighted to get your news-filled letter of August 13 which arrived while I was away on vacation. As soon as I returned I took off for the west coast and so I hope that you will understand the delay in responding.

Let me first of all thank you for the superb piano disk that you sent me. I really have enjoyed listening to it and you are entirely correct that the playing is done with style.

Your daughter obviously has the appropriate sense of music already and, having just come back from visiting with my 20 month old granddaughter, I was delighted to find that she too has very real preferences in terms of the music that she is prepared to listen to and is already well attuned to a classical repertoire.

I was pleased to get the reprint of your lead paper and will look forward to the DSAM preprint as soon as it becomes available. From the sound of things you are still having a certain amount of good fun and doing good physics at LLNL and Argonne and your proposed experiment on the reversed oxygen plus alpha particle reaction sounds interesting.

I have not been back to Yale recently but gather that there are some major changes. The new accelerator appears to be running exactly as advertised and a lot of good work is on the point of being published.

I should tell you that I did send off the requested letters of reference to Dr. Woodworth.

Again, warmest thanks for the compact disk and all the news. If your travels should bring you to Washington at any time, please do let me know so that we can arrange to have our paths cross.

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Dr. Tzu-fang Wang
Physics Division
Lawrence Livermore National Laboratory
Livermore, California 94550

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9123503
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: DUGGAN, Jerome L.: INTERNATIONAL CONFERENCE ON THE APPLICATION OF ACCELERATORS IN RESEARCH & INDUSTRY

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 08/07/91

SUBJECT: RE: THE ELEVENTH INTERNATIONAL CONFERENCE ON THE APPLICATION OF ACCELERATORS PROCEEDINGS (Part I and II) AND HOPE THAT YOU WILL ATTEND THE CONFERENCE IN NOVEMBER OF 1992.

****

DIRECTORATE ASSIGNED:

STAFF ASSIGNED:

ACTION REQUIRED:

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE:

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
PHYSICAL SCIENCES

****

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

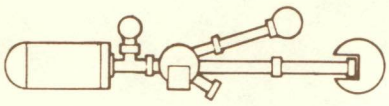
REMARKS: Enclosures to DAB.

OSTP RECEIVED: 08/16/91

FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

3503



International
Conference on the Application of
Accelerators in Research and Industry
Department of Physics
University of North Texas
P.O. Box 5368
Denton, Texas 76203-5368

August 7, 1991

D. Allan Bromley
Assistant to the President
Executive Office of the President
Office of Science and Technology Policy
Washington, DC 20506

Re: Eleventh International Conference on the
Application of Accelerators in Research and Industry
November 5-8, 1990, Denton, Texas

Dear Allan:

Enclosed please find the Eleventh International Conference on the Application of Accelerators Proceedings. The committee felt that your contributions to low energy nuclear physics have been unparalleled in the past and probably in the foreseeable future. I hope that you will be able to attend our conference in November of 1992. I realize that you are busy, but please try to break away if you can. Thank you for all that you have done for accelerator physics.

Sincerely yours,

Jerry

Jerome L. Duggan
Co-Chairman

JLD/bs

Overnight Delivery Address:
Physics Building • Avenue A & Mulberry • Denton, TX 76203
Ph: 817-565-3252 or 817-565-3250 • FAX: 817-565-2227 • BITNET: FC66@UNTVAX.BITNET

THE WHITE HOUSE

WASHINGTON

September 19, 1991

Dear Jerry:

Many thanks for the two volumes of proceedings from the **Eleventh International Conference on the Application of Accelerators.** I was delighted and touched by the dedication and would take this occasion to congratulate you on the excellence of this series of conferences. You have made a major contribution to alerting the entire scientific community to the tremendous flexibility and adaptability of small accelerators in fields far removed from the nuclear physics for which they were first developed.

I would very much look forward to the possibility of attending the 1992 conference but, as you recognize, the fall of 1992 will be more than a little hectic here in Washington. All I can say at this time is that I will try.

Again, my thanks and warmest best wishes,

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Professor Jerome L. Duggan
International Conference on the Application of
Accelerators in Research and Industry
Department of Physics
University of North Texas
Post Office Box 5368
Denton, Texas 76203

"CORRESPONDENCE TRACKING"

TYPE: ACTION DOCUMENT NUMBER: 9123208
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: BREWER, G. Daniel

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 07/23/91

SUBJECT: A COPY OF THE BOOK, "HYDROGEN AIRCRAFT TECHNOLOGY" AND A REQUEST TO REVIEW THE DEVELOPMENT PROGRAM RECOMMENDED IN THE REPORT IN ORDER TO PERSUADE YOU TO SUPPORT INITIATION OF IMMEDIATE ACTION.

****

DIRECTORATE ASSIGNED: PHYSICAL SCIENCES

STAFF ASSIGNED:

unable to review, not having book. Please close out, Phys Sci responsibility
JAE 8/7

ACTION REQUIRED: REVIEW FOR DAB

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: 08/15/91 STAFF DUE DATE

DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
NATIONAL SECURITY
Carl Bretscher

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

PHONE: EXT:

REMARKS: Enclosure to DAB; please forward after review to Physical Sciences for action as necessary.

CLOSED

OSTP RECEIVED: 08/02/91 FILE: P-NAT'L SECURITY*PHYSICAL SCI

DEPT RECEIVED:

"CORRESPONDENCE TRACKING"

TYPE: ACTION DOCUMENT NUMBER: 9123208
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: BREWER, G. Daniel

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 07/23/91

SUBJECT: A COPY OF THE BOOK, "HYDROGEN AIRCRAFT TECHNOLOGY" AND A REQUEST TO REVIEW THE DEVELOPMENT PROGRAM RECOMMENDED IN THE REPORT IN ORDER TO PERSUADE YOU TO SUPPORT INITIATION OF IMMEDIATE ACTION.

****

DIRECTORATE ASSIGNED: PHYSICAL SCIENCES

STAFF ASSIGNED:

ACTION REQUIRED: REVIEW FOR DAB

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: 08/15/91 STAFF DUE DATE

DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
NATIONAL SECURITY
Carl Bretscher

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

PHONE: EXT:

REMARKS: Enclosure to DAB; please forward after review to Physical Sciences for action as necessary.

No answer

OSTP RECEIVED: 08/02/91 FILE: P-NAT'L SECURITY*PHYSICAL SCI

DEPT RECEIVED:

3208

The Honorable D. Allan Bromley
Assistant to the President for Science & Technology
Old Executive Office Building
17th Street & Pennsylvania Ave.
Suite 358
Washington, D.C. 20506

RECEIVED
91 AUG 2 P2:44
OFFICE OF THE DIRECTOR

July 23, 1991

Dear Dr. Bromley:

The enclosed is a complimentary copy of my book, "HYDROGEN AIRCRAFT TECHNOLOGY", which has just been published by CRC Press, Inc. I thought you might find it of interest in connection with the Energy Policy proposals which are currently being considered.

Recognizing the many demands on your time, may I suggest that you might find the first five pages of Chapter 11, The Outlook for Hydrogen: A Summary, (starting on page 399) of particular interest in obtaining a synopsis of the content. In addition, if time permits, Chapter 6, starting on page 301 presents a discussion of potential benefits the military services could derive from use of hydrogen.

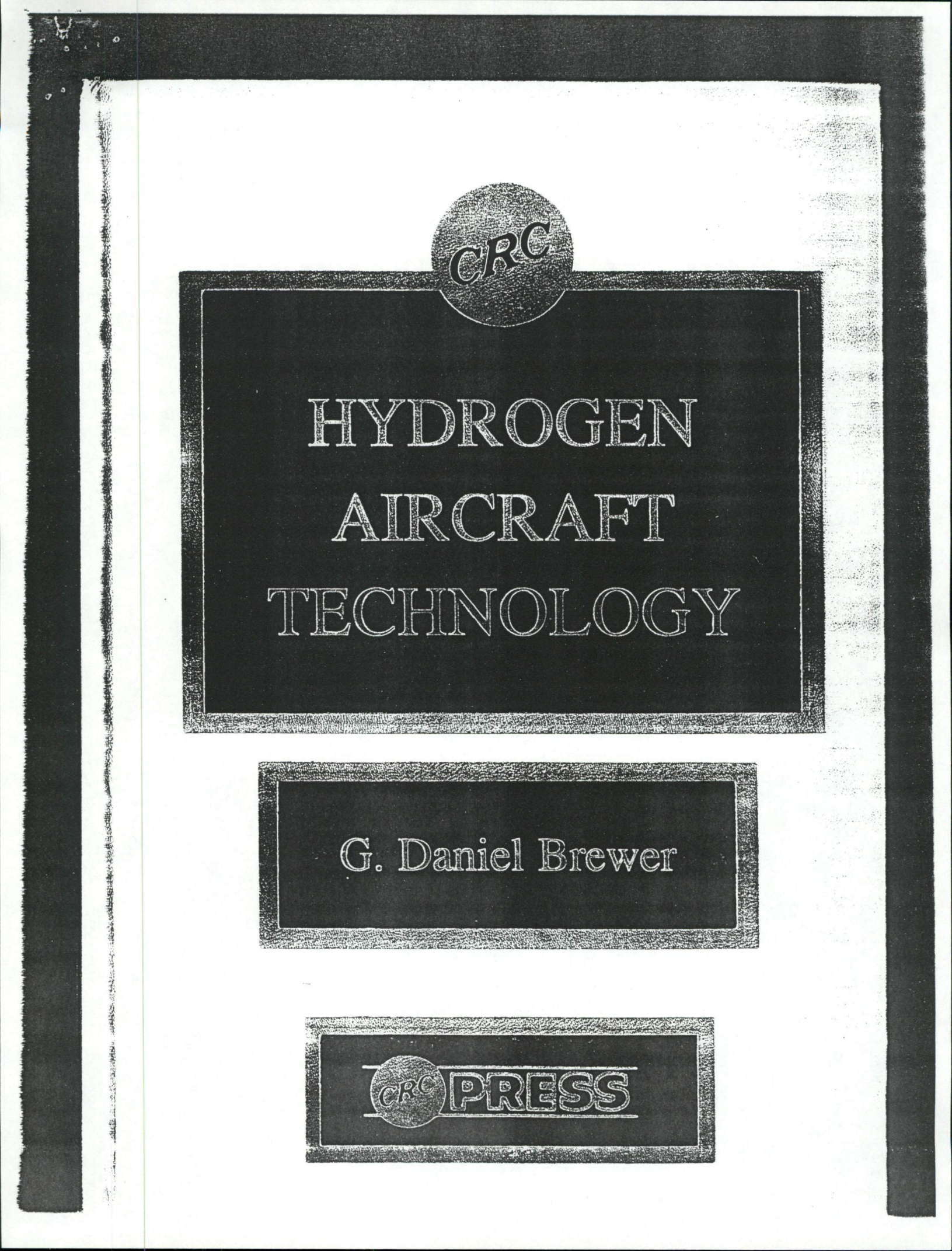
Obviously, my objective here is to put the book in the hands of someone who might be motivated to influence positive action to initiate development of LH_2 for aircraft. For your information, I am also sending a copy of the book to Representative George Brown of California in connection with his proposed Bill H.R. 2793, A Hydrogen Research & Development Program, which he introduced in the 1st Session of the 101st Congress. You will recognize this as a companion of Senate Bill S. 639 carrying the same title which was introduced by the late Senator Spark Matsunaga of Hawaii.

A report "Hydrogen Fuel for Subsonic Transport Aircraft", dated April 1991, recommends an appropriate initial course of action. The report was prepared by Atlantic Research Corporation and Eagle Engineering, Inc. for NASA Office of Aeronautics, Exploration and Technology, under Contract NASW 4430. I hope perusal of my book and review of the development program recommended in this report will persuade you to support initiation of immediate action.

Thank you for your consideration.

G Daniel Brewer

G. Daniel Brewer
1214 San Julian Drive
Lake San Marcos, CA 92069


CRC
HYDROGEN
AIRCRAFT
TECHNOLOGY
G. Daniel Brewer
CRC PRESS

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9122169
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: HUANG, Tsang C.: COMPUTING DIALOGUE

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 07/11/91

SUBJECT: LETTER TO DR. W.S. BUTCHER (NSF) REGARDING A GRANT PROPOSAL.

****

DIRECTORATE ASSIGNED:

STAFF ASSIGNED:

ACTION REQUIRED:

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE:

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT:

****

COPIES TO: PHYSICAL SCIENCES

****

WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS:

CLOSED

OSTP RECEIVED: 07/15/91

FILE: P-PHYSICAL SCIENCES

DEPT RECEIVED:

2169

Dr. W.S. Butcher
Senior Engineering Adviser
Office of the Assistant Director
for Engineering
National Science Foundation
Washington D.C. 20550

Tpang C. Huang, alias Tony
Huang, ph.D., U.S. citizen
President, Computing Dialogue
Inc.
Apt. 10H, 3 Stuyvesant oval
New York, N.Y. 10009-9998

RECEIVED
91 JUL 15 P4:04
OFFICE OF THE DIRECTOR

July 11, 1991

Dear Dr. Butcher:

Thank You for your letter dated July 1, 1991 along with three Publications of National Science Foundation on behave of the Director on matters relevant to possible NSF Science & Technology Center; a Celestial mechanics Research Center, of which I made a planning Grant proposal to NSF hoping it Applies to the nearst closing date. Also communicated to the possible NSF Engineering Research Center; G.H.W. Bush Shale Oil Retort Engineering Research center that I communicated with an informal working proposal, that is most likly your letter addressed.

Sample
Working Copy

I been doing some preparations relevant to the retort Center, even though I am more qualified to do the Celestial mechanics research center. I will talk to some Faculties of Universities, including Chemical engineers as You suggested to discuss my ideas, I tend to think I did most of the research. I am not sure what "help identify a suitable person" meant, but to assume that a planning Grant from NSF is definitely of the Nation's interest.

Enclosed is an informal communication in the form of working proposal of planning Grant possibility, that I'll must also be useing while I talk to Universities, here at New York City. Thank You for your suggestions, please keep me informed, let me know whether you like it.

The three publications are excellent, my best wishes.

Sincerely Yours,

Tpang-Chi Huang, Tony
U.S. citizen
President, Computing Dialogue
Inc.

cc Science Advisor
The White House
Washington D.C. 20500

COMPUTING DIALOGUE
#10H, 3 STUYVESANT OVAL
EAST 14th STREET
NEW YORK, NEW YORK 10009

Data Support Services Section
Attn: Director, and S&T Research
Centers Program
National Science Foundation
1800 G Street, N.W.
Washington, D.C. 20550

Tsang C. Huang, alias Terry
Huang, U.S. citizen
President
Computing Dialogue Inc.
P.O. Box 924
New York, N.Y. 10009-0924
JAN. 9, 1991

Dear Sir; Enclosed please find 25 copies of proposal on planning Grant of 35,000 dollars for the planning of ~~celestial mechanics, planetary motion, and Space Flight~~ G.H.W. Bush Shale Oil Retort Engineering Research center. Submitted by Computing Dialogue Inc.

The planning grant is intended for principal investigator Tsang C. Huang, alias Terry Huang, U.S. citizen Chairman and president Computing Dialogue Inc. to teach a course in ~~Celestial mechanics~~ Thermodynamics to plan on the establishment of ~~Celestial mechanics~~ G.H.W. Bush Shale Oil Retort Engineering Research center Planetary Motion, and ~~Space Flight~~, at a Host University, preferably Columbia University at the City of New York.

Your further communications on the matter is deeply appreciated, thank you. Hoping to hear from you at your earliest convenience.

Sincerely Yours,

Tsang Chi Huang, Terry

TSANG C. HUANG alias TERRY HUANG.
U.S. CITIZEN
CHAIRMAN & PRESIDENT, COMPUTING DIALOGUE
INCORPORATED.

Sample
Working Copy

COMPUTING DIALOGUE
#10H, 3 STUYVESANT OVAL
EAST 14th STREET
NEW YORK, NEW YORK 10009

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
03a. Form w/ attachments	Proposal to the National Science Foundation [personal information redacted] (13 pp.)	7/11/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Physical Science: General [3 of 8] [1991]

Date Closed:	3/19/2010	**OA/ID Number:**	62041-003
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

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P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
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(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

OFFICE OF THE
ASSISTANT DIRECTOR
FOR ENGINEERING

Dr Tsang C. Huang
Computing Dialogue Inc.
#10H, 3 Stuyvesant Oval
East 14th Street
New York, NY 10009-9998

July 1, 1991

Dear Dr. Huang:

This is in reply to your communication to the Director of the National Science Foundation, who has asked me to respond on behalf of the Foundation.

First, as your material is both handwritten and then copied, it is possible that I may not have understood your statements clearly. You present many chemical equations and many sketches of reactors, but it is not clear what research issues you plan to address and how you plan to go about the work.

For your information, I am enclosing a copy of three publications. The first of these is our Fiscal Year 1991 "Guide to Programs" which describes all of the programs of the Foundation. The second one is the Directorate for Engineering's "Program Descriptions" which gives more detail of the programs within the Directorate for Engineering . The third is our proposal writing guide, "Grants for Research and Education in Science and Engineering" which contains the instructions and forms needed to prepare a proposal to the Foundation.

If you are thinking of writing a proposal, I suggest that you discuss your ideas with someone who is expert in your topic area and I'm sure that person will be able to help you clarify your ideas and possibly help you embody them in a proposal. I would expect that the kind of person you should talk to will be in the Chemical Engineering Department within an engineering college. You might start by calling the chairman of a chemical engineering department and asking him to help identify a suitable person.

Sincerely

William S. Butcher
Senior Engineering Adviser

to this mixed long-term programme would be the BRs of higher conversion ratio and correspondingly ng time, or reactors requiring a smaller quantity of en output.

in several countries on the design of a FBR cooled by Design studies indicate that a conversion ratio of 1.4 is a fuel-doubling time of about 10 years, but these atively early stage.

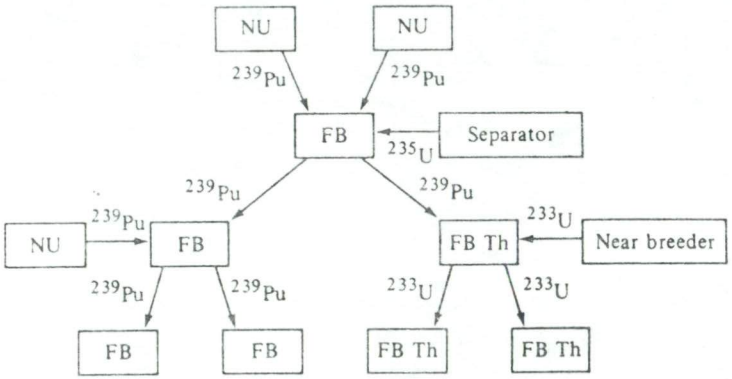
YCLE

um in the breeder blanket could be replaced by thorium referred to briefly in Chapter 14 takes place, namely

$$\xrightarrow{} {}^{233}\mathrm{Th} \xrightarrow{\beta^-} {}^{233}\mathrm{Pa} \xrightarrow{\beta^-} {}^{233}\mathrm{U}$$

isotope of uranium which does not occur in nature but e used as a fuel in the same way as ^{235}U or ^{239}Pu. m have never been extensively evaluated as supplies dequate for present limited applications, but it seems reserves are at least as large as uranium reserves. osits of thorium exist in the Indian continent, where the energy sources is amongst the more urgent.

ance of the thorium cycle, however, is that, because of ss section of ^{232}Th to thermal neutrons, it is possible to thorium in thermal reactors and to obtain conversion ly in excess of unity, which is not possible with uranium articularly true if the reactor is fuelled by ^{233}U because ion capture cross section of ^{233}U compared with its . PWRs with breeder cores consist of a central region of ched with ^{233}U and surrounded by a ^{232}Th blanket are in the USA and conversion ratios slightly in excess of tained at the cost of a 40% reduction in power output standard PWR of the same size. CANDU reactors orium cycle, i.e. using ^{233}U as a fuel mixed with fertile conversion ratios in excess of unity. Thermal reactors clearly produce enough fissile material to replace their ut with conversion ratios marginally above unity the would be so long as to preclude expansion of any xclusively on these reactors. 'Near-breeder' reactors of could form a valuable source of ^{233}U for injection into me if necessary. A possible composite programme is This would have relatively low uranium demand if the



Key

NU	Natural uranium reactor (Candu or Magnox)
FB	Fast breeder (liquid metal cooled)
FB Th	Fast breeder (with thorium blanket)
Separator	^{235}U isotope separator
Near breeder	Molten salt or Candu with thorium

Fig. 15.8. A mixed reactor system of reduced fuel-doubling time.

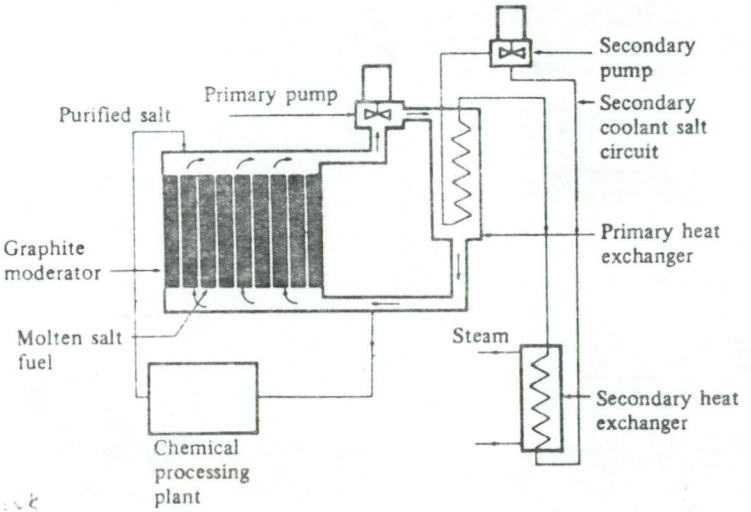


Fig. 15.9. A molten salt thermal breeder reactor.

material in this chapter represents a balance of widely held views, the reader may wish to dismiss this particular scheme as a flight of fancy by the author.

The possibility of enhanced conversion ratios in the 'pebble bed' HTR

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