

# TRAVELS NOW AND THEN

© Christopher Earls Brennan

## IRELAND 1990

Trip to Ireland and Northern Ireland, Wed., Aug.8, to Sat. Sep.1, 1990



*Newcastle, County Down*



*Climbing Slieve Donard with Michael*





*Climbing Slieve Donard with Michael*



*Uncle Cecil Brennen and mum*



*Ballykelly*



*Ballymoney, Islandmagee*





*Ballymoney, Islandmagee*



*North Antrim coast*



*Fort Royal near Rathmullan, Donegal*





*Lough Swilly coast near Port Salen*



*Brennen gravesite, Magherafelt*



*Mum's new bungalow in Magherafelt*





*Mum's new bungalow in Magherafelt*



*Mum's new bungalow in Magherafelt*



*Mum's new bungalow in Magherafelt*

Either before or after this trip to the north I travelled to Limerick to visit the University of Limerick.

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*Last updated 7/30/99.  
Christopher E. Brennan*



## THE 1990 PLAYER'S CIRCLE MEMBERSHIP

### BENEFACTORS

Dr. & Mrs. Thomas Everhart  
Professor & Mrs. Horace Gilbert  
Al & Marka Hibbs

### ASCIT

The Caltech Y  
The Service League

### SUSTAINING CONTRIBUTORS

David & Judith Goodstein  
Bruce McLaughlin  
Thelma Macabitas

### CONTRIBUTORS

Charles and Phyllis Barnes  
Bill and Delores Bing  
Edward and Sylvia Posner

Delores Walker

### PATRONS

Ronald Arthur Gidseg  
Harry Porta

## CAN YOU HELP US?

FROM A GLEAM in the eyes of a few theatrically inclined Techers, the Theatre Arts at the California Institute of Technology (TACIT) program has grown into a major part of campus life, bringing together graduate and undergraduate students, faculty, staff and administrators from campus; their families and friends; alumni; representatives from JPL; and dedicated volunteers from the outside community.

YOU can be part of this exciting program by regular attendance at our productions. Just write your name in the guest book in the lobby so that we can add you to our mailing list. But, as the cost of quality theatre production rises steadily, we depend more and more on the generosity of The Player's Circle. This support group of donors is comprised of friends and patrons of the dramatic arts. Please become a member of the 1990 Player's Circle by mailing your check made payable to the Caltech Player's Gift Account to: California Institute of Technology, Attention Cashier, Pasadena, California 91125. Of course all contributions are tax-deductable if you itemize

### MEMBERSHIP CATEGORIES

STUDENT - \$10 TO \$49

PATRON - \$50 TO \$99

CONTRIBUTOR - \$100 TO \$199

SUSTAINING CONTRIBUTOR - \$200 TO \$499

BENEFACTOR - \$500 AND ABOVE

THEATRE ARTS AT  
THE CALIFORNIA INSTITUTE OF TECHNOLOGY  
PRESENTS

# CAMELOT



AT RAMO AUDITORIUM  
ON THE CALTECH CAMPUS, PASADENA  
FEBRUARY 23RD & 24TH AND MARCH 2ND & 3RD AT 8PM,  
FEBRUARY 25TH & MARCH 4TH AT 2PM

BOOKS & LYRICS BY ALAN JAY LERNER, MUSIC BY FREDERICK LOEWE, ORIGINAL PRODUCTION DIRECTED &  
STAGED BY MOSS HART, BASED ON "THE ONCE AND FUTURE KING" BY T. H. WHITE. THIS MUSICAL SHOW  
PRODUCED BY ARRANGEMENT WITH, AND DIALOGUE MATERIAL FURNISHED BY, TAMS-WITMARK MUSIC  
LIBRARY, INC., 560 LEXINGTON AVENUE, NEW YORK, NY 10022



# SCENES AND MUSICAL NUMBERS

## ACT ONE

### OVERTURE

Scene 1: A Hilltop near Camelot - A long time ago.

#### MARCH

I WONDER WHAT THE KING IS DOING TONIGHT - Arthur

THE SIMPLE JOYS OF MAIDENHOOD - Guenevere

CAMELOT - Arthur & Guenevere

GUENEVERE'S WELCOME

CAMELOT (Reprise) - Guenevere

Scene 2: Near Camelot - Immediately following.

FOLLOW ME - Nimue

Scene 3: Arthur's Study - Five years later.

CAMELOT (Reprise) - Arthur & Guenevere

Scene 4: Countryside near Camelot - A few months later.

C'EST MOI - Lancelot

Scene 5: A Park near the Castle - Immediately following.

THE LUSTY MONTH OF MAY - Guenevere & Ensemble

PELLINORE'S ENTRANCE

THE LUSTY MONTH OF MAY (Reprise - End of Scene) -

Guenevere & Ensemble

CHANGE OF SCENE

Scene 6: A Terrace of the Castle - Sundown, two months later.

HOW TO HANDLE A WOMAN - Arthur

Scene 7: The Dressing Tents outside the Jousting Field - The next day.

TENT SCENE

THE TUMBLERS

Scene 8: The Grandstand of the Field - Immediately following.

THE JOUSTS - Arthur, Guenevere & Ensemble

CHANGE OF SCENE

Scene 9: The Terrace - Early evening, the same day.

BEFORE I GAZE AT YOU AGAIN - Guenevere

Scene 11: The Great Hall - Immediately following.

FINALE ACT ONE

## ACT TWO

### ENTR'ACTE

Scene 1: Main Terrace of the Castle - A few years later, afternoon.

MADRIGAL and IF EVER I WOULD LEAVE YOU - Lancelot

THE SEVEN DEADLY VIRTUES - Mordred

CHANGE OF SCENE

Scene 2: The Terrace - Late afternoon, one month later.

WHAT DO THE SIMPLE FOLK DO - Arthur & Guenevere

Scene 3: A Forest near Camelot - The next day, late afternoon.

ENCHANTED FOREST

Scene 4: The Forest of Morgan Le Fey - Immediately following.

THE PERSUASION - Mordred & Morgan Le Fey

THE INVISIBLE WALL

CHANGE OF SCENE

Scene 5: Corridor of the Castle - Later that night.

CORRIDOR SCENE

CHANGE OF SCENE and INCIDENTAL MUSIC

Scene 6: The Queen's Bedchamber - Later that night.

I LOVED YOU ONCE IN SILENCE - Guenevere

Scene 7: Camelot - Immediately following.

GUENEVERE - Ensemble

Scene 8: The Battlefield outside Joyous Gard - Pre-dawn.

BATTLE CALL

FAREWELL

CAMELOT (Reprise) - FINALE ULTIMO - Arthur

MUSIC FOR CURTAIN CALLS AND EXIT



## CAST

ARTHUR - Mark Adler  
 GUENEVERE - Lynne Cooper  
 LANCELOT - David M. Stevens  
 PELLINORE - Bruce McLaughlin  
 MERLIN - David Goodstein  
 MORDRED - Todd Brun  
 MORGAN Le FAY - Diana Lynn Lettman  
 NIMUE - Amanda Heaton  
 DINADAN - Chris Brennen  
 LIONEL - Simon Morris  
 SAGRAMORE - Joseph Beckenbach  
 DAP - Paul Bartholomew  
 TOM OF WARWICK - Isaac Gary  
 CASTOR - Steve Kellogg  
 CLARIUS - Jonah Michaud  
 COLGREVANCE - John Hart  
 BLIANT - Dan Kegel  
 GUILLIAM - Allen Corcorran  
 LADY ANNE - Pamela Walton  
 ARCHIMEDES - Jonah Michaud  
 PRIEST - Doug Smith  
 HORRID - Sadie  
 GUARD - Matt Kidd  
 LUTE PLAYER - Kurt Ware  
 GUENEVERE SOLOIST - Allen Corcorran  
 HERALD - Richard Doherty

HERALD TRUMPETERS - Rick Koshi, Amitabh Mehra

PAGES - Matt Kanbara, Jonathan Murray

VILLAGE CHILDREN - Kenneth Parry, Ben Gary

SNOW NYMPHS - Carolyn Cabanski, Anna George, Patricia Houseworth,  
 Jessica Lee, Susan Lee, Diana Lynn Lettman, Ann Lindsey, Susan Odry,  
 Gina Walton, Melinda Wood

SPRING NYMPHS - Patricia Houseworth, Jessica Lee, Susan Odry, Gina Walton,  
 Melinda Wood"

LUSTY MONTH OF MAY" DANCERS - Mark Boyles, Carolyn Cabanski,  
 Richard Doherty, Jonathan Elliott, Dale Gary, Anna George, Amanda Heaton,  
 Susan Lee, Diana Lynn Lettman, Ann Lindsey, Jonah Michaud, Kurt Ware

ACROBATIC TROUPE - Mark Boyles, Carolyn Cabanski, Anna George,  
 Amanda Heaton, Rick Koshi, Jessica Lee, Susan Lee, Diana Lynn Lettman, Alan  
 Low, Dusty Martin, Kelly Martin, Gina Walton, Melinda Wood

MORGAN'S COURT/WOOD NYMPHS - Mark Boyles,  
 Carolyn Cabanski, Jonathan Elliott, Dale Gary, Anna George, Tim Gerk,  
 Patrica Houseworth, Susan Lee, Ann Lindsey, Jonah Michaud, Ross TenEyck,  
 Gina Walton, Kurt Ware

FIRE DANCERS - Anna George, Susan Lee, Diana Lynn Lettman, Ann Lindsey

DEATH BRIDES - Carolyn Cabanski, Patricia Houseworth

QUARTERSTAFF TEAM - Joseph Beckenbach, Tim Gerk, Ross TenEyck,  
 Kurt Ware

KNIGHTS - Mark Boyles, Jonathan Elliott, Dale Gary, Tim Gerk, Alan Low,  
 Fred Mallon, Doug Smith, Ross TenEyck, Kurt Ware

LADIES IN WAITING - Jackie Akers, Tien-Yee Chiu, Lori Fry, Kyle Gary,  
 Julie Hakewill, Tanya Kurosky, Ann Lindsey, Georgia Morton, Christina Olsen,  
 Eve Sheiman, Gina Walton, Susan Odry

## ORCHESTRA

CHARLOTTE MANLY - Violin  
 DAVID RHOADARMER - Violin  
 MIKE LOOPER - Violin  
 EMILY WEN - Violin  
 JANCIS MARTIN - Viola  
 DAVID MACKAY - Viola  
 DAVID ROSS - French Horn  
 AIMIE SMITH - French Horn  
 HONGEKI CHIO - French Horn  
 MARK LAND - Trombone  
 SCOTT BABCOCK - Percussion  
 JOHN GRADE - Percussion  
 SEAN JOHNSTON - Oboe  
 ANDY HYJER - String Bass  
 MILT DAVIS - Trumpet  
 CONNIE JOSIAS - Clarinet  
 ED LEWIS - Flute  
 DON GROSS - Clarinet  
 HARRY PORTA - Bassoon  
 BOB HARDAWAY - Guitar  
 JILL SOHA - Cello  
 LINDA LANG - Pianist  
 LINDA LANG, SEAN JOHNSTON, LYNN FINGER, AL PETERSON -  
 Rehearsal Pianists



## STAFF

DIRECTOR - Shirley Marneus  
ASSISTANT DIRECTOR - Richard Doherty  
CHOREOGRAPHER - Lisa Lyons  
ASSISTANT CHOREOGRAPHER - Jennie Butler  
MUSIC DIRECTOR - Russ Litchfield  
PRODUCTION COORDINATOR/PRODUCTION STAGE MANAGER -  
Mariette Peeters  
TECHNICAL DIRECTOR - Chris Marneus  
SET DESIGNER - Eric H. Warren  
LIGHTING DESIGNER - Rex Rogers  
COSTUME DESIGNER - Sandra Fogler  
WARDROBE MISTRESS - Jean Armistead  
WARDROBE MASTER - Harold Zatz  
SCENIC ARTISTS - Heidi Adams, Doc DiMaccio  
PROPERTY MASTER - Al Hibbs  
MASTER ELECTRICIANS - Michael Ricci, Ken Andrews  
SOUND DESIGNERS - Bill Woody, Alan Low  
SYNTHESIZER EFFECTS - Alan Low  
HAIR DESIGNER - Lorraine Cetani  
MAKEUP - Patti Sahagian  
FIGHT COORDINATOR - Chris Marneus  
GRAPHIC DESIGN AND TYPESETTING - Mark Heimback-Nielsen  
PHOTOGRAPHY - Ronald Arthur Gidseg  
COMPUTER LISTINGS/MAILINGS - Patti Sahagian  
BUSINESS MANAGER - Georgia Morton  
STAGE MANAGERS - Dan Dilling, Michael Ricci  
AUDITION ASSISTANTS - Bernie Long, Eve Sheiman  
DANCE CAPTAIN - Carolyn Cabanski

## SET CONSTRUCTION CREW

LEAD CARPENTER - Darryl Lee  
CARPENTERS - Erin Conrad, Ross TenEyck  
RIGGER - Patrick Maurer  
ASSISTANT RIGGER - Jose Restrapo  
CREW - Ben Gary, Dale Gary, Tim Gerk, Greg Harry, Tish Hauge, Peter Jones,  
Steve Kellogg, Russ Litchfield, Susan Odry, Jose Restrapo, Doug Smith

## PAINT CREW

Vicky Barlow, Larry English, Kimberly Kelley, Darryl Lee, Kathy Pearson,  
Tracy Tam, Becky Yang

## RUNNING CREW

FOLLOW SPOT OPERATORS - Tim Kennedy, Miguel McDonald,  
Chris Marneus, Pat Moore, Carlos Ramirez  
LIGHT BOARD OPERATOR - Ken Andrews  
PATCH BOARD OPERATOR - Mark Vaughan  
SOUND BOARD OPERATOR - Bill Woody  
DRESSERS - Annie Fenska, Toni Itano  
MAKE UP/HAIR - Laurel Auchampaugh, Jackie Beard, Linda Kanbara,  
Barbara Randolph, Nancy Severson, Courtney Smith, Karen Young  
HEAD FLYMAN - Jose Restrapo  
FLYMAN - Darryl Lee  
CREW - Jeremy Gollub, Greg Harry, Joe Holliman, Kathy Pearson

## LIGHTING CREW

Mark Adler, Joe Beckenbach, Jerry Carter, Allen Corcorran, Tim Gerk,  
Tim Kennedy, Lisa LaPome, Miguel McDonald, Mitch Scaff, Doug Smith,  
Ross TenEyck, Mark Vaughan, Lynne Villani, Kurt Ware, Derek Woolverton,  
Rich Zitola

## COSTUME CREW

SEAMSTRESS - Annie Fogler  
ASSISTANT BUYER - Cybelle Garcia  
CREW - Jackie Ackers, Joseph Beckenbach, Leif Bennett, Tien-Yee Chiu,  
Thelma Cowan, Bertha Gary, Kyle Gary, Amanda Heaton, Linda Kanbara,  
Diane Lynn Lettman, Suzzanna Murray, Kathy Pearson, Eve Sheiman,  
Pamela Walton, Jennifer Wright

## ARMOUR CREW

MASTER ARMOURER - Leif Bennett  
CREW - Janis Beckenbach, Joseph Beckenbach, Mark Boyles, Carolyn Cabanski,  
Tien-Yee Chiu, Allen Corcorran, Rich Doherty, Jonathan Elliott, Doug Smith

## PROPS CREW

CREW - Janis Beckenbach, Leif Bennett, Paul Bartholomew, Jennifer Forman,  
Marka Hibbs, Kathy Pearson, Pamela Walton, Harold Zatz



In Memory of  
Barry Robert Krueger  
July 19, 1965 - October 29, 1990



"It is plain that we exist for our fellow men  
-- in the first place for those upon whose  
smiles and welfare our happiness depends,  
and next for all those unknown to us  
personally but to whose destinies we are  
bound by the tie of sympathy."

-Albert Einstein



Ushers

Brian Biswell      Joseph Chiu  
Erin Cramer      Mark Humphreys  
Ben Masek      Baoquoc Pham

The music is played by Erica Alliston, a freshman in Fleming House. Erica is playing songs that Barry had taught himself on the piano.

Memorial contributions in  
Barry's name may be sent to:  
Phi Delta Theta  
Educational Foundation  
2 South Campus Avenue  
Oxford, Ohio 45056

"...The entire institute mourns the passing of a young man who was not only a vibrant and energetic young scientist and engineer, but was also an outstanding citizen who was a truly caring mentor and confidante. Few students who have passed through these academic hallways have given as much of themselves to this community."

-Christopher Brennen  
Dean of Students

Memorial Service  
November 30, 1990

Arden Albee  
Dean of Graduate Studies

Christopher Brennen  
Dean of Students

Andrew Mutz  
Graduate Student  
Materials Science

Thad Vreeland  
Professor  
Materials Science

Hyon Lew  
Sophomore  
Fleming House

David Lingrey  
Captain, Pasadena  
Men's Club (Rugby)

Please join us for refreshments  
following the service



THE EIGHTH SEMI-OCCASIONAL  
SOPS BANQUET

FRIDAY, MAY 18, 1990  
at the  
ATHENAEUM

Schedule of Events

- 6:30 - No host cocktail in the Athenaeum Library
- 7:15 - Dinner in the Hall of Associates

Salad

Breast of Chicken filled with white and  
wild rice - Mango glaze

Vegetables per Chef

Apple Pie à la Mode

- 8:30 - Entertainment

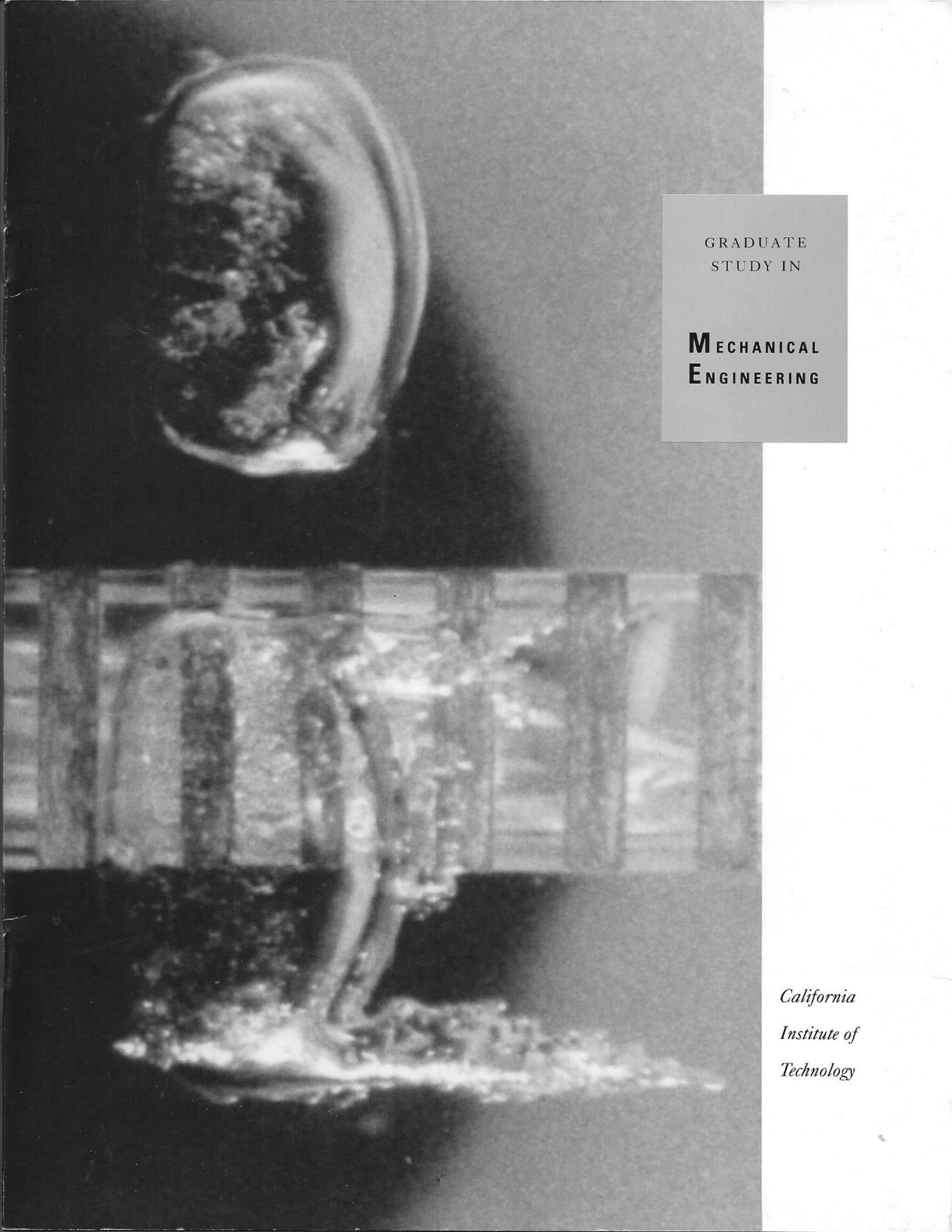
1. Quake, Rattle, and Roll  
Thomas Building Staff, Producers

2. The Thesis Defense  
Fossil Productions

3. Rap of the B.A.P.  
Assistant Professors' Guild

4. Entrainment Tonight  
SOPS Realizations, inc.

Awards to outstanding Thomas building  
residents and friends will be made by  
SOPS between the various  
presentations



GRADUATE  
STUDY IN

**M**ECCHANICAL  
**E**NGINEERING

*California  
Institute of  
Technology*



## Faculty

ALLAN J. ACOSTA

*Richard L. and Dorothy M. Hayman  
Professor of Mechanical Engineering  
and Executive Officer for Mechanical  
Engineering*

Applied fluid mechanics, cavitation, turbomachines

ERIK K. ANTONSSON

*Associate Professor of Mechanical  
Engineering*

Computer-aided engineering design, design of micro-electrical/mechanical systems, spatial computer vision

CHRISTOPHER E. BRENNEN

*Professor of Mechanical Engineering*  
Applied fluid mechanics, two-phase flow, cavitation

JOEL W. BURDICK

*Assistant Professor of Mechanical  
Engineering*  
Robotics, kinematics, mechanical systems

GLEN R. CASS

*Professor of Environmental  
Engineering and Mechanical  
Engineering*

Air pollution, aerosol mechanics, heat transfer

THOMAS K. CAUGHEY

*Professor of Applied Mechanics and  
Mechanical Engineering*

Dynamics, mechanics, vibrations

FRED E. C. CULICK

*Professor of Mechanical Engineering  
and Jet Propulsion*

Robotics, rocket propulsion, aerodynamics

RICHARD C. FLAGAN

*Professor of Chemical Engineering*  
Material processing, air pollution, aerosol mechanics, combustion

DAVID G. GOODWIN

*Assistant Professor of Mechanical  
Engineering*  
Chemical vapor deposition, optical diagnostics, combustion

MELANY L. HUNT

*Assistant Professor of Mechanical  
Engineering*  
Convective heat transfer, two-phase flow

FRANK E. MARBLE

*Richard L. and Dorothy M. Hayman  
Professor of Mechanical Engineering  
and Professor of Jet Propulsion,  
Emeritus*

Combustion, fluid mechanics, propulsion

ROLF H. SABERSKY

*Professor of Mechanical Engineering,  
Emeritus*

Heat transfer, granular flow

EDWARD E. ZUKOSKI

*Professor of Jet Propulsion and  
Mechanical Engineering*  
Jet propulsion, combustion, fire research

## Staff

JACQUELYN BEARD

*Administrative Assistant*

MARTIN GOULD

*Supervising Machinist, Mechanical  
Engineering Shop*

CECILIA LIN

*Graphics*

CONNIE YEHLE

*Options Secretary*

DANA YOUNG

*Senior Administrative Secretary*

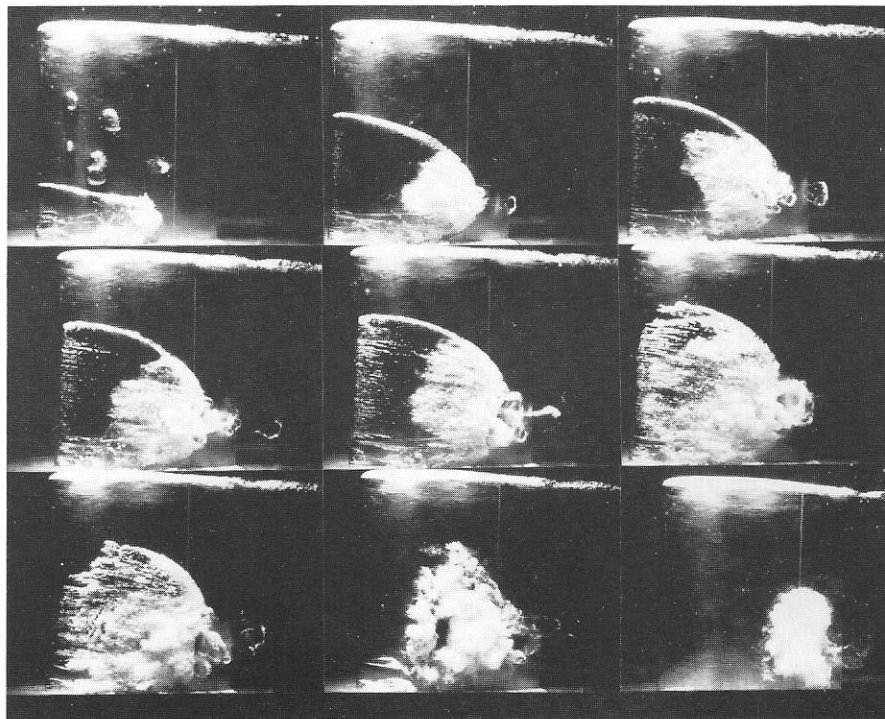
For additional information write:

Mechanical Engineering

Mail Code: 104-44

California Institute of Technology  
Pasadena, CA 91125

telephone: 818-356-4106



Sequences of photos showing progressive states of cavitation on an oscillating three-dimensional hydrofoil. Photographs taken by graduate student Doug Hart.

Virtually all current energy systems, existing and projected, require a more detailed knowledge of the properties of multiphase and multicomponent flows than is presently available in the engineering literature. Some mixture flows have been studied in considerable detail in the past. For example, there exists a considerable body of literature in dilute suspension rheology, in dilute dusty-gas fluid mechanics, and in simple liquid/gas mixture flow. Other areas, notably those involving concentrated suspensions, slurries, granular material, or chemically reacting mixtures (e.g., in fluidized beds) are poorly documented or understood.

Caltech has a long history of fundamental contributions in the area of multiphase flow. For example, one of the first high-speed cavitation water tunnels in the world was built at the Institute, and research in cavitation continues to this day.

Current research projects involve studies of the interaction of turbulence and boundary layers with cavitation; cavitating tip vortices on unsteady lifting surfaces; measurements of the microscopic nuclei causing cavitation, using optical techniques; and studies of the dynamics and acoustics of clouds of cavitating bubbles.

Multiphase flows with solid particles are of interest in a wide range of technologies. One current effort is a study of the mechanics and

heat transfer in flowing granular material in which the rheology is dominated by particle/particle and particle/wall collisions rather than by viscous effects in the interstitial fluid (see "Heat Transfer and Thermal Systems"). Most of these efforts are primarily experimental, and in many instances instrumentation of the flows represents a considerable challenge. The emphasis in the department is on novel approaches designed to identify the fundamental phenomena.

#### **Selected Publications**

Ahn, H., Brennen, C. E., and Sabersky, R. H. 1989. "Measurements of Velocity Fluctuation, Density and Stresses in Chute Flows of Granular Materials," To appear in *J. Appl. Mech.*

Brennen, C. E. and Ceccio, S. L. 1989. "Recent Observations on Cavitation and Cavitation Noise," *Proc. Third ASME Intl. Symp. on Cavitation Noise and Erosion in Fluid System*, FED Vol. 88, pp. 67-78.

d'Agostino, L. and Acosta, A. J. 1990. "Separation and Surface Nuclei Effects in a Cavitation Susceptibility Meter," *International Symposium on Gas-Liquid Two-Phase Flows*, ASME Winter Annual Meeting, Dallas, Texas.

Green, S. I. and Acosta, A. J. 1989. "Relating Trailing Vortex Cavitation Inception to Single Phase Flow Measurements," *22nd ATTC*, St. John's Newfoundland.

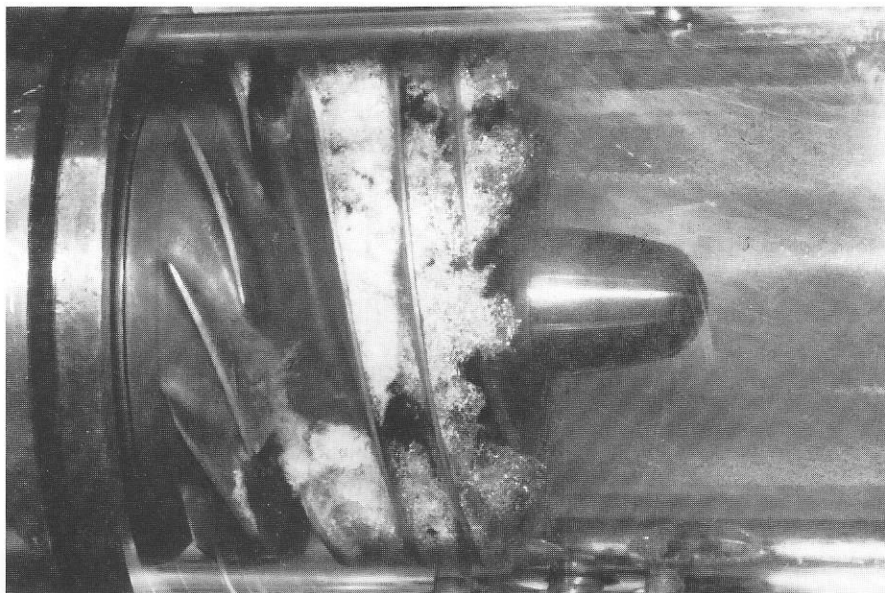
Hart, D. P., Brennen, C. E., and Acosta, A. J. 1990. "Observations of Cavitation on a Three Dimensional Oscillating Hydrofoil," *ASME Cavitation and Multiphase Flow Forum*, Toronto, Canada, FED Vol. 98, pp. 49-52.

Kumar, S., Hart, D. P., and Brennen, C. E. 1990. "Granular Pressure Measurement in Fluidized Beds," *ASME Cavitation and Multiphase Flow Forum*, Toronto, Canada, FED Vol. 98, pp. 107-113.



## Turbomachinery and Internal Flows

Caltech has had a long history of involvement with turbomachine development in practice and theory. A unique laboratory was developed by Robert Knapp (1900–1957) for the accurate testing of the pumps that bring water to southern California. Axial flow turbomachine technology was intensely pursued here in the forties and fifties by Professors Rannie and Marble. Currently, research is directed at unsteady internal flows of hydraulic turbopumps for rocket propulsion, although these machines are typical of modern industrial applications in most respects. Interaction between blades of rotors and stators in such machines can lead to highly unsteady, strong pressure fluctuations, causing material failure, noise, and cavitation damage. Other internal flow phenomena can lead to unsteady pulsating flow (surge) both in compressors and in hydraulic turbopumps, and propagating disturbances (rotating stall) can seriously limit performance and may lead to failure. Another, more recently discovered, phenomenon of centrifugal rotors affects the stability of the rotor support structure; in some flows the existence of a fluid dynamic force that results from flow through the rotor and from the pressure forces that act on external shrouds (if any), may tend to promote shaft whirl. This effect can lead in some circumstances to subharmonic shaft vibrations in high power density applications in current practice. The effects of rotor/diffuser spacing, blade type, axial or radial flow, and inlet velocity distortion are all important and are currently under study.



Cavitation in a scale model of the low-pressure liquid-oxygen turbopump of the Space Shuttle Main Engine.

### Selected Publications

- Acosta, A. J., Brennen, C. E., and Caughey, T. K. 1989. "Impeller-induced Rotordynamic Forces," Proc. U.S.-Korea Fluids Engineering Seminar, Seoul, Korea.
- Arndt, N., Acosta, A. J., Brennen, C. E., and Caughey, T. K. 1990. "Experimental Investigation of Rotor-Stator Interaction in a Centrifugal Pump with Several Vaned Diffusers," ASME J. of Turbomachinery, Vol. 112, pp. 98–108.
- Chen, G. T., Greitzer, E. M., Tan, C. S., and Marble, F. E. 1990. "Similarity Analysis of Compressor Tip Clearance Flow Structure," ASME Gas Turbine Conference, Brussels, Belgium.
- Guinzburg, A., Brennen, C. E., Acosta, A. J., and Caughey, T. K. 1990. "Measurements of the Rotordynamic Shroud Forces for Centrifugal Pumps," ASME Fluid Machinery Forum, Toronto, Canada, FED-Vol. 96, pp. 23–26.
- Imai, R., Tsujimoto, Y., and Acosta, A. J. 1990. "Nonlinear Calculations of Separated Flows in Centrifugal Impellers," 3rd Japan-China Joint Conference on Fluid Machinery, Osaka, Japan.

Mar 20/90

Chris,

After raising the matter, the least that I could do would be to repay you the \$2 that you loaned me (a long time ago) to save me from having to face an embarrassing discussion with the cashier at the cafeteria.

It was very gentlemanly of you to rescue me, and even more so, to not ask for the repayment. I'm truly sorry that it slipped my mind for so long — each time I thought about it was a time when I didn't have two dollar bills in my pocket.

With thanks, and apologies for my  
Tardiness,

Charles Barnes



Dear Chris,

7/30/90

Last week I got a letter from Gabriela in which she mentioned, in passing, the death of Bibi Tentott-Nilson. It came as quite a jolt to me. I don't know if you knew it, but Bibi and I became friends in my last few months at Tech. We exchanged a large number of letters in the two and a half years since I left. I feel I need to know what happened. Can you tell me? Also, I'd like to send a condolence letter to her sister (was her name Marit?). Do you have an address for her? Of course, this late, and at this distance, there's not much I can do for anyone. But, for my own peace of mind, I would like these small things before I try to put it ~~in~~ in my past. Thanks.

While I have pen and paper in hand, I guess I should give you an update on life on this side of the Pacific.

My teaching has gone extremely well. This year one of my two courses was evaluated by our equivalent of your TQER, and the results were unbeliavably good. The only problem is that they didn't leave me any room for improvement. And I believe I can (and will) improve my teaching, with time. I've also built a good relationship with the students. Several come by my office pretty regularly just to talk. And when the students discovered my birthday, my office became the center for what amounted to a 3 day long continuous (and often



raucous) party. We all had a great time, except maybe a few of the older faculty members down the hall who didn't really know what to make of it.

Somewhat unexpectedly, in the last year I've become something of a magnet for problem students too. During that time I've dealt with three different students (only one from my own classes) who've had to check themselves into Wellington Psychiatric Hospital. This was definitely not part of the job description.

My research is still slow, although I am now generating some reasonable data in one project. I have not (at least yet) taken any graduate students, and the teaching and other stuff don't leave me much time in the lab. But, these are the priorities that I am setting, so I have no right to complain.

The important news is that Betty is taking a one year fellowship at the Center for Strategic Studies and Arms Control at Stanford. She returns to the U.S. at the start of September. Obviously, I am staying here, and plans after the one year are uncertain. So I feel very much up in the air right now. It is quite possible that Betty will drop by Tech for a visit when she visits relatives in L.A. in September, so you ~~might~~<sup>might</sup> see her.

I know better than to ask you to write to me (except to give me the info. I asked for at the beginning of this letter)



but I would like to know how you are. Are Jeanne and Sue still there? If so, say hello for me. In fact, I'd have no objection to you passing this letter on to them.

I am, of course, not in contact with anyone at Tech right now. But I know that in her letters in April/May/June of '89, Bibi expressed a lot of disappointment with the fact that Caltech was becoming more cautious and protective (for legal reasons she understood) and arbitrary and non consultative (for reasons neither of us understood). Given that I thought that Caltech finally had all the right people in all the right positions, that came as a bit of a surprise to me.

Well, I'd better get back to work. Give my regards to Doreen. Take it easy Chris.

Love,  
Andy


Dear Chris,

It's been a long time since we've heard from you. I hope all is well. Now that another school year is over, I'm sure you'll get to do some resting (at least, I hope so.)

Sam and I finally bought a house. It's a cute little place in the mountains, with 8 acres, a pond, and a horse corral. Here's our new address in case you ever decide to drop us a note.

effective } 66 Gordon Creek Rd  
June 30, 1990 } Boulder CO, 80302  
(303) 258-7833 Gabriele





Chris,

8-13-90 (pg 1)

Don't feel under any pressure to write to me, just because you receive a letter from me. I am an avid letter-writer, and most people I write to usually respond by telephone or not at all. I suppose I'm one of a dying breed. That is: while my friends & ~~peep~~ peers are all communicating via "E-mail", I'm out picking out some new stationery.


In light of the fact that you don't write very often in general, I thank you sincerely for your letter. I have heard numerous things through the grapevine about how things are going at Tech. It seems a difficult time and I'm sorry you have to deal with it - but I'm glad it's not my problem anymore. I suppose everyone likes being able to feel that way now & then.

I know few of the administrators at Tech very well, but I feel I know you fairly well. Well enough to trust that you put your heart into the issues you deal with and this is comforting. I've always admired and trusted you a great deal, (still do), so I feel that, at least with you, the students are in good hands.

Sam and I are doing very well out here. Colorado seems to fit us both to a tee. <sup>← is that spelled right?</sup> We are very happy with our new home. It's little, but very cute and warm. A real good first home for a couple our age. Our dog, (a Siberian Husky named Sheba) really enjoys the 7 acres she has to run on. We want to get a companion for her; hopefully a full- or  $\frac{1}{2}$ - wolf. (There are surprisingly many of them here)

Graduate school is going well. At times it is exciting and fun. Other times it is pure frustration. But I have never regretted my decision to continue my education - even if Sam does make twice as much as I do.





(pg 2)  
Sam is doing essentially what a graduate student does. He is working in optics for a professor who got his undergraduate and graduate degrees from Caltech, (named Kelvin Wagner, dark, red-head, maybe you know him.) Anyway, the only real difference between what Sam & I do is that he doesn't get a PhD in 4 years, he gets to go home at 5:00 every day, and he gets a really good parking spot. Maybe in four years our salaries and perks will even out.

In terms of our personal lives, things are going smoothly. We made the transition to domesticity without many problems. We haven't discussed marriage, because Sam is "morally against it," (it's a long story; I'll get into it some other time.) But, in the back of my mind I'm still wishing for him to propose to me someday. I guess

I'm just a frustrated house-wife. (ha ha)

I hope things are well with your family - that your daughter hasn't destroyed many more cars. I hope, also, that you are not working too hard so that you can remain as youthful as you have always seemed to me. Take care of yourself. We are thinking of you...

your friend,

Gabriele Corago



Dear Chris,

I will have many fond memories of Caltech. One of my fondest will be the memory of you. You have been a wonderful person to know throughout my five year stay at Caltech.

I want to thank you for being so inspirational to me. It is not something you tried to do actively, but rather something that comes of the person you are. You have had many varied experiences throughout your life, some good and some bad. Most people who have been through as much seem to either forget that they were ever young, or become bitter because of the bad times they've had. The Chris Brennan I've come to know seems to have made the best of all he's seen and lived. You've given me bits

and pieces of your past, always with some Brennealy piece of wisdom which you've gained from that part of your life. But most importantly, you've not forgotten what it is like to be young: to think that you know everything, to feel invincible, and at the same time to be so uncertain about everything. And because you have not forgotten, you've always been able to help.

I don't believe I am exaggerating when I say to you that I would probably not have made it through Caltech without you. Your patience, understanding, and wisdom were really the fuel that kept me going at some of my most difficult times.

I hope that many other students are as fortunate as I have been and are able to find and appreciate the treasures that are in your heart. As for this student, here and gone in five years, I will always deeply appreciate what you've done.

Your friend, Gabrielle



# Marching on to greatness



Walt Mancini / Star-News

Graduating students, professors and alumni walk to their seats before Caltech's commencement Friday

## Speaker tells grads how not to flunk life

Caltech audience takes ceremony seriously

by JANE ESTES  
Staff Writer

PASADENA — Caltech's class of 1990 may have a superb education, but the graduates will flunk life if they don't possess courage and commitment, Cornell University resident Frank Rhodes told them at their commencement Friday.

Refusing to recognize the burdens, consequences, dignity and freedom of courageous commitment is to flunk life, Rhodes told the 97 graduates and twice as many relatives and friends on the lawn south of Beckman auditorium.

"Flunking life is the failure to recognize that from those to whom much is given, much is required," he said. "Flunking life is to ignore the link between professional practice and personal commitment. Flunking life is to deny that your diploma gives you not only an obligation to lead, but also to serve. Getting 'A's in life has at its heart not catchy slogans, but commitment reinforced by

deeply and courageously held conviction."

About to take their leave of an institution where students are notorious masters of mischief, the graduates took their commencement and its speaker seriously. Except for an inflated plastic shark that took an occasional sky dive, a student who blew bubbles and another who said, "Hi Mom," into the microphone as he received his degree, the graduates were decorous. And unlike the caps of many California State University graduates, only two were decorated — one with the words "Love Toad," the other with a snapshot of the graduate's family.

Tears came to more than one father and mother as their sons and daughters collected 192 bachelor's degrees, 157 master's degrees, and 148 doctorates, in engineering, chemistry, biology, physics, mathematics, geology and astronomy.

Rhodes reminded the graduates that the world has changed with unparalleled speed since they began their academic careers at Caltech. Not since the late 18th century has the ideal of freedom carried such force in the world, he said. He noted that in one year communism has collapsed in eastern Europe, Soviet states have demanded reform

and South Africa has shown hopeful signs of dismantling apartheid.

"It cannot be otherwise over the longer term, for the taste of freedom has energized the world. A new generation of leaders has been born," Rhodes said. "In a complex and often brutal world, these individuals are proving that change is possible, even after years of adversity, and that it can be affected by individuals of courage and commitment, vision and will."

And most of the new leaders, he pointed out, are not politicians, but include a playwright, a political prison, a shipyard worker, a music professor and a 60-year-old newspaper editor.

"These are people who have scored straight 'A's in life. What drives them and what unites them ... is that they are not only men and women of commitment, but men and women with the courage of their convictions," Rhodes said.

"If the yuppies of the '80s taught us anything, it is that life without commitment is superficial and unsatisfying and a triumphant career is not enough," he said. "Hollow men and moral nomads reap not fulfillment, but futility."




June 14, 1990

Chris,

Are you sure you're not  
selling something?!

Thanks for all the support you've provided me  
throughout this year. Who could have thought that  
only a year ago I prided myself on the fact that  
I never darkened the door of 102-31? Thanks also for  
the sage wisdom about not graduating quickly  
(didn't I take that to heart?) and your dedication  
to keeping Robney House intact. Don't worry - I'll  
still stop by when things are troubling me.

Thanks again,  
David



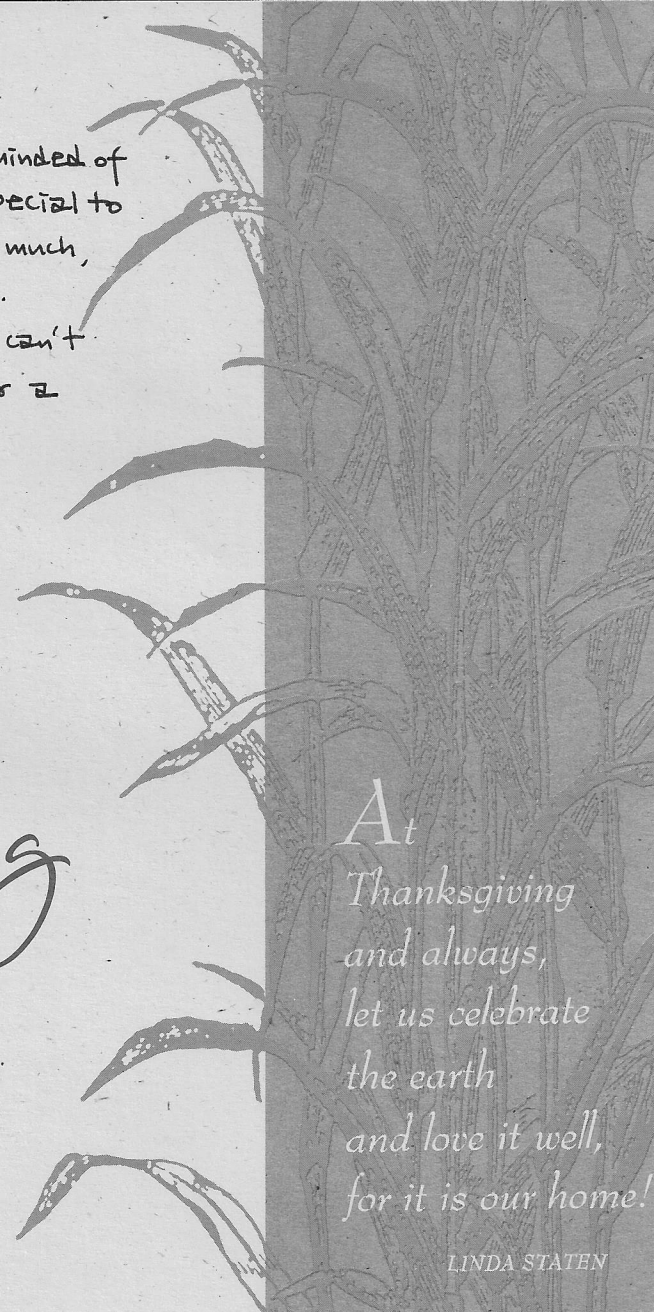
DEAR Prof. Brennan.

On this Thanksgiving Day, I am reminded of  
a few people who have been so special to  
me. I have been given by you so much,  
having never given back to you.

I guess, no matter what I do, I can't  
pay you back enough, except for a  
word of "Thank you."  
Happy Thanksgiving!

Hojin Ahn

Wishing  
You  
A Happy  
Thanksgiving



At  
Thanksgiving  
and always,  
let us celebrate  
the earth  
and love it well,  
for it is our home!

LINDA STATEN



7 March 1990

3 Woodland Drive  
Magherafelt  
Northern Ireland  
BT45 - 5RJ

Dearest Chris

I came up here about a week ago and found your letter which your Mother had not redirected to Dublin. It is dated 12 December 1989 and encloses the chapters on DICK and ARNOLD. I am delighted to have these and am only sorry that they have not been acknowledged sooner. It was very kind of you to send me my own personal copy of the Coltch News which is much nicer than the photo copy I have of the article about you.

Re the chapters DICK and ARNOLD the new printer is beautiful and I look forward to receiving the EARLS chapter.

Both Peggy Rea and Eileen Gray (née Jones) seem

to have been very helpful and have filled in a lot of blanks.

Have you by any chance got a copy of the History of Islandmagee by Dixon Donaldson? If not I could loan you my copy and you could photo any thing of interest in it. I am especially interested to learn that my great-great grandmother was a Milliken. You mention at bottom of page 1 (DICK) that my great grandparents Robert and Letitia leased a house and garden in Ballymoney from James Milliken. The farm of these Millikens was close to the Methodist Church (on the opposite side of the road) and I understand

they gave the land for the Church and school. In my day my grandfather James Earls left his pony and trap in their farmyard on Sundays when worshipping in the Methodist Chapel as it was called. When I get home again I shall look out the History and also an account of the history of the Church which was produced for a bi centennial year. The first MILLIKEN was quite an important person, if I remembered aright from Dixon Donaldson's History.

You will be glad to know that your Mother and Paula are in good form. Mum has made an excellent recovery from the operation to her jaw which was so well done as to leave no visible scar. It did alter the



inside of her mouth involving some dental work which is at present in progress. She is out to night with some women golfing friends for dinner at a newish restaurant near Hacoquin. The other ladies played golf just but Mum was called for and driven to the dinner party.

Paula is out too. She goes to the Gateway Club and is collected by a Mini-bus at 6pm. At 10pm. I go to the main Tobernmore Road to meet her off the return bus. Last night she was at Riding for the Disabled near Maghera. So you can see they have quite a good social life.

Your Mum, Paula & I hope to go for two weeks in May to Alcudia, Majorca. We have booked an Apartment for 3 and fly direct from Dublin to Palma on 14th May.

To-morrow is Mum's birthday but we had the festivities on Sunday when Mike, Lesley, Deborah and Kylie came for what I called a Thanksgiving rather than a Christmas dinner. Mum had got a present of a turkey at Christmas but it had been in the freezer awaiting a suitable occasion.

I was delighted to learn of Dana's engagement to Andrew. We liked him very much when he was here and they

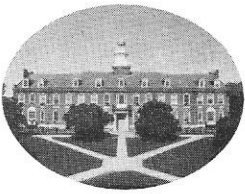
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Seem to have a lot in common.

Peter and Sue were in Argentina from mid Dec to mid Jan so I did not see them at Christmas.

My granddaughter Kate is leaving on the 11th for a Round the World Tour. When she finishes her degree at London University in Economics (she got a 2:1) she got a job with the Engineering Council and also worked in a theatre bar in the evenings to save enough money for the trip. Her plan includes Hong Kong, China, Malaysia, Thailand, Australia, New Zealand, Hawaii and L.A. So you may see her sometime in September 1990!! Fondest remembrances to Doreen, Kathy, Patrick and you with love from Irene.





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August 23 1990

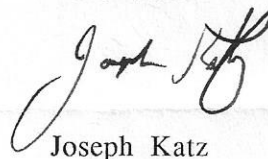
Professor Christopher E. Brennen  
Mail Code 104-44  
California Institute of Technology  
Pasadena, CA 91125

Dear Chris:

Thank you for your kind letter. I am really touched. You are right, ten years ago (it is that long, whether you believe it or not) you all shared a very difficult part of my life. The care and support that I received from everybody at Caltech left an ever lasting impression on me. Becoming a parent, an event that has a major impact on the life of any person, has a special meaning for me. There was nothing, that I could think of, that I wanted more than the privilege of hugging my own child. My wish was granted.

Michael is healthy and seems happy, and so is his mother. When he is unhappy, he lets everyone around him know it in no uncertain terms. After raising three kids you are obviously a veteran in these matters. I am still savoring every moment. As far as being penchant for accidents, that's what adds spice to my life and scares everybody around me.

Take Care



Joseph Katz