

GFD Newsletter 2003

Faculty of Walsh College



The 2003 GFD Photograph; the one featuring the Directorial Boat, kindly provided by the fellows.

A Sketch of the Summer

In 2003, with Professor John Hinch (University of Cambridge) at the helm, the Principal Lectures entered the realm of non-Newtonian fluid dynamics. We discovered how fluid microstructure, as brought about by interactions between such things as suspended particles, crystals or polymers, could affect macroscopic flow properties and lead to a wealth of new physical phenomena. In particular, we found out how microstructure could lead to viscoelastic or even viscoplastic flow properties, and these behaviours could be measured and quantified. On the theoretical side, we learned how to develop rheological constitutive equations to describe non-Newtonian fluids, and in some situations, to build macroscopic models based on the microscopic physics. Following on from John's lectures, the seminar schedule of the summer covered topics ranging from the MHD-Oldroyd-B connection and the dynamics of viscoelastic bubbles, to the applications in geophysical fluid dynamics, such as mantle convection and the flow of lava and mud. Several participants were motivated to experiment with non-Newtonian phenomena on the porch and in the laboratory; some of the photographs document their efforts.

Neil Balmforth acted as Director for the summer. Janet Fields, Penny Foster, and Jeanne Fleming provided the administrative backbone to the Program. As always, Woods Hole Oceanographic Institution offered the perfect setting for the program – Walsh Cottage. Keith Bradley provided much needed technical expertise in both the laboratory and with the bicycles.

Schedule of Principal Lectures

Monday

- Lecture 1: Phenomena and Rheometry
- Lecture 2: Constitutive Equations

Tuesday

- Lecture 3: Simple Flow Calculations

Wednesday

- Lecture 4: Experiments and Computing
- Lecture 5: Microstructural studies for Rheology I

Thursday

- Lecture 6: Microstructural studies for Rheology II
- Lecture 7: Stress Relaxation

Friday

- Lecture 8: Instabilities
- Lecture 9: Strong flows



Experiments from the porch: an open siphon with Anshuman's Boger fluid

Fellows Reports

Amit Apte, University of Texas at Austin
The geophysical applications of non-Newtonian fluid dynamics: waves in the Oldroyd-B ocean

Neil Burrell, University of Colorado
A novel layered QG model

Junjun Liu, Caltech
Stability of viscoplastic flow

Joel Miller, University of Cambridge
Elastic critical layers

Julia Mullarney, Australia National University
Experiments on nonlinear Rossby adjustment in a channel

Anshuman Roy, University of Michigan
The viscoelastic catenary

Alison Rust, University of Oregon
Flow-induced oscillations: a source mechanism for volcanic tremor?

Andy Thompson, Scripps Inst. of Oceanography
Diffusively-driven overturning of a stable density gradient

Christopher L. Wolfe, Oregon State University
Eddy generation by flow over variable topography: Some experiments

Softball Report



Dynamo action (photographs by Atichart Kettapun.)

The GFD Fellows in 2003 turned out to be unusually sophisticated in the arcane art of softball. The Dynamos vanquished several times during the summer and emerged with a commendable 50 percent record against the other WHOI teams (it really does say “GFD 11, Biology 6” in the photographs). Special mentions to Andy Thompson for his technical skills and Joel Miller for his athletic catches (prompting the question: did he really need to dive for them all?). Nor shall we forget the fate of Alison Rust’s tooth. At the summer’s close, the Staff were no match for the Fellows, and went down by several runs in the contest that has in recent years been dominated by the seasoned veterans.

The GFD Website

The lectures and reports are available on the GFD official website,

gfd.whoi.edu

which also contains:

- announcements of summer themes,
- lecture schedules,
- e-versions of the proceedings and newsletters,
- lists of alumni and visitors,
- application materials,
- life at GFD,
- gallery of photographs,
- useful information and links.

The GFD Public Lecture

This past summer marks the first time in recent memory that GFD has organized a lecture for the general public in the Woods Hole area. Andy Woods delivered a lecture entitled “Volcano Mechanics,” in which he explained the similarities between magma chambers and soda bottles to a diverse audience (bubbles can cause both to explode). The lecture was followed by a lively reception where GFD participants interacted with scientists from WHOI as well as interested laypeople. Following this success, we will certainly repeat the experience in the coming years.



Experiments from the porch: Dan Joseph's rod climber.



Caught in an unprecedented act: Steve Childress and Ed Spiegel correcting the proofs of a paper submitted originally in 1981.

Neil Balmforth
University of British Columbia

Oliver Buhler
Courant Institute of Mathematical Sciences

Claudia Cenedese
Woods Hole Oceanographic Institution

Eric Chassignet
University of Miami

Charles Doering
University of Michigan

Glenn Flierl
Massachusetts Institute of Technology

Karl Helfrich
Woods Hole Oceanographic Institution

Lou Howard
MIT and Florida State University

Joseph Keller
Stanford University

Richard Kerswell
University of Bristol

Norman Lebovitz
University of Chicago

Willem Malkus
Massachusetts Institute of Technology

Philip Morrison
University of Texas at Austin

Michael Proctor
University of Cambridge

Antonello Provenzale
ISAC-CNR, Torino

Richard Salmon
Scripps Institution of Oceanography, UCSD

Edward Spiegel
Columbia University

Melvin Stern
Florida State University

Jean-Luc Thiffeault
Imperial College London

George Veronis
Yale University

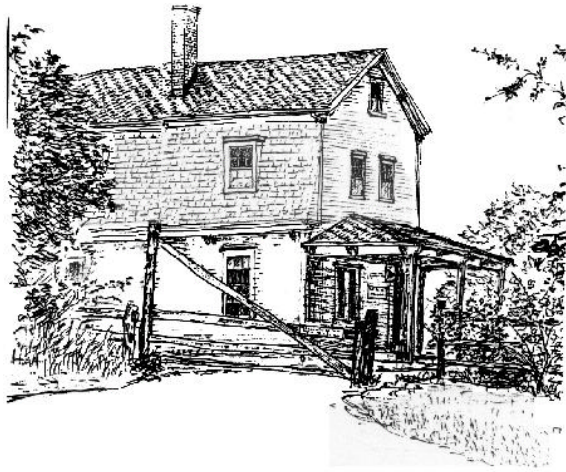
John Wettlaufer
Yale University

Jack Whitehead
Woods Hole Oceanographic Institution

William Young
Scripps Institution of Oceanography, UCSD

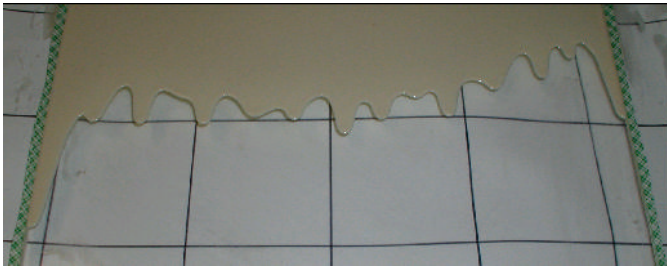
The GFD Faculty

The GFD Faculty handles the scientific and administrative duties of the school. This group is made up of members of the scientific community, across several disciplines, united by their interest in GFD. These are the faces to be seen at GFD over the coming summers, and who will help run the Program. They serve as contact people and “ambassadors” of GFD. The research interests of the Faculty help to define the scientific direction and flavor of the Program. This year, we welcome Oliver Buhler and Claudia Cenedese into the Faculty.



circa 1973
By R. Kimura

Kimura's familiar sketch of Walsh Cottage



Fingering in a viscoplastic fluid (experiments by Shilpa Ghadge in the Coastal Research Lab)

Special GFD Lectureship

In 2003, we established a *Special GFD Lectureship* at Walsh College. This is a specially funded position at the GFD Program intended to help support the extended visit of a key participant, such as the summer's Principal Lecturer. In 2003, the GFD Lecturer was Professor John Hinch (University of Cambridge).

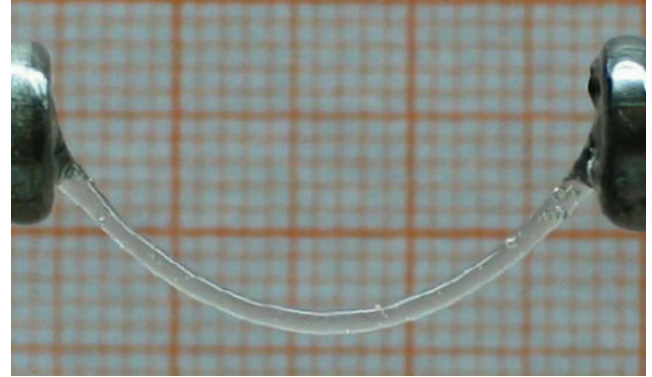
In order to finance the Lectureship, we are asking previous participants and alumni to make donations to a special GFD fund. The fund is to be administered by W.H.O.I., under the guidance of George Veronis. If you would like to contribute, please send your check (made payable to WHOI) to

Woods Hole Oceanographic Institution
GFD Fund, MS 40
Woods Hole, MA 02543

Donations can also be made by credit card by calling the Development office at 508-289-4895. Contributors making larger donations will be thanked with gifts such

as a framed reproduction of the GFD group photograph from a year of their choice (for example, their year as a fellow).

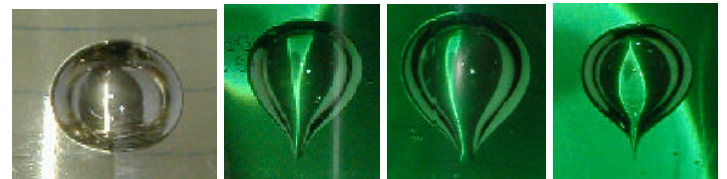
We gratefully acknowledge recent gifts from Fritz Busse and Rainer Hollerbach.



The viscoelastic catenary – experiments performed by Anshuman Roy and Jean-Luc Thiffeault in the Coastal Research Lab.

Please send comments to njb@ams.ucsc.edu or jeanluc@imperial.ac.uk if you have any suggestions regarding this newsletter or the GFD Program.

The GFD Program is funded by the National Science Foundation and the Office of Naval Research.



Experiments from the porch: Bubbles in bottles. Rounded bubbles in corn syrup (Newtonian fluid) and cuspy bubbles in shampoo (Viscoelastic fluid).

