

TRAVELS NOW AND THEN

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SEQUOIA 1981

Camping Trip to Kings Canyon and Sequoia National Parks with Michael Brennen



Kings Canyon National Park



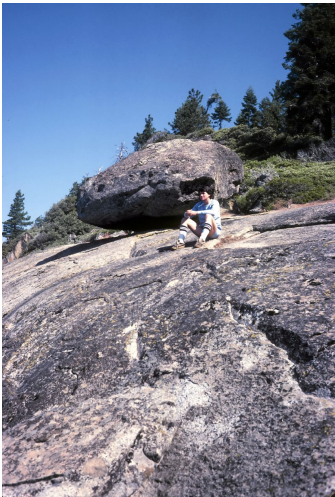
Kings Canyon National Park



Kings Canyon National Park



Sequoia National Park



Sequoia National Park

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



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June 1, 1982

Dr. Christopher E. Brennen
Associate Professor of Mechanical Engineering
Caltech 104-44

Dear Dr. Brennen:

Congratulations on your selection as a recipient of the ASCIT Award for Excellence in Teaching. The Board of Directors of ASCIT commends you highly for your teaching success at Caltech in general and particularly during the 1980-81 academic year in ME 19.

We hope this award will help you and the faculty become more aware of the importance of quality teaching to the undergraduates. We also hope that this honor will single out you and your six similarly honored colleagues as being particularly worthy of emulation by other faculty members.

Enclosed you will find a list of the recipients of the Award for the 1980-81 academic year. I think you will agree this is quite a distinguished group. We are extremely pleased that you are among them.

The presentation of the Awards will take place at the Faculty meeting on Wednesday, June 9 in the Athenaeum. We hope you will be able to attend.

Again, congratulations.

Sincerely,

Arthur P. Brazy

Arthur P. Brazy
ASCIT President

Julia A. Kornfield

Julia A. Kornfield
Director for Academic Affairs

Recipients of the ASCIT Award for Excellence in Teaching 1980-81

Christopher E. Brennen, ME 19, Fluid Mechanics

Richard P. Feynman, Ph 236, Relativity

David L. Goodstein, Ph 1, Classical Mechanics and
Electromagnetism

Robert D. Middlebrook, EE 114, Electronic Circuit
Design

Ray D. Owen, Bi 122, Genetics

David Sundelson, Lit 8, The Self in Literature
Lit 114, Shakespeare

Robert R. Wark, Art 102, British Art of the Georgian
Period

Doctor's skill 'due to Troubles'

By Nigel Brown

THE FATHER of the six-year-old Co Clare boy, whose leg was severed in a farm accident and successfully sewn back on by surgeons at the Ulster Hospital in Belfast at the weekend, said yesterday that he was amazed at the efficiency of all those involved in the operation.

Mr Patrick Meade, who farms a 67-acre holding at Ballyvaskin, Milltown Malbay, was driving a tractor on his farm on Saturday when his eldest child, Joseph, ran behind and jumped on the back of a slurry sprayer being pulled by the tractor to spread manure.

The rotary blades of the sprayer severed the boy's leg about two inches below the knee. Mr Meade stemmed the flow of blood from the boy's leg by holding it tightly with his hands and carried the boy and the severed leg to his car. He continued to hold his son's leg while his wife, Irene, drove them to the County Hospital at Ennis. Mr

Meade's prompt action and bravery more than likely saved his son's life.

He told me yesterday that he had read about the successful operation last August when a 13-year-old boy who lost an arm in a sawmill accident in Co Cavan was flown to the Ulster Hospital to have it sewn back on. The doctors at Ennis had got in touch with the Belfast hospital and packed the severed leg in ice. The boy and his leg were, then taken to Shannon Airport where he was flown in an Air Corps Beechcraft to Belfast and was in the operating theatre 35 minutes after take-off from Shannon.

Doctors in Belfast told Mr Meade that his son's condition yesterday was good. There would be further tests and he had no indication when he would be home, but the surgeons had said that their policy was to go for a complete recovery.

Mr Meade said he knew that the technology and skills used in reconnecting severed limbs was at

least partially due to experience gained from the troubles in the North and the treatment of bomb victims and said: "It seems that always some good comes out of bad. It shows," he added, "that we can always learn from the bad things that happen in life."

Mr Meade, in expressing a wish to thank all those involved in the incident, said he hoped also to publicise the fact that such an operation was possible for the benefit of other people who might need it in future. He also praised the bravery of his son who, he said, was conscious all the time and talked freely to him while he tried to comfort him.

Mr Meade first drove to his local GP, who sent him straight on to the casualty department of the County Hospital. He said he was with his son all the time and kept in touch with the arrangements. The hospital first got in touch with St Vincent's Hospital in Dublin where they confirmed that it was

possible that the leg could be sewn on again at the Ulster Hospital. An Air Corps Beechcraft was taken off fishery patrol off the West coast to take the patient to Belfast when it was realised that a helicopter would not have the range to reach Belfast.

The Meades have two other children, girls aged two and four.

Doctors at the Ulster Hospital yesterday said that Joseph's condition was satisfactory. The eight-hour operation had gone as they wanted it to and blood circulation and muscle control were functioning reasonably well. However, it would be some time before it was known if the operation had been a complete success. The operation was carried out by 11 medics, including five surgeons who were ready and waiting in the operating theatre when the patient arrived from Shannon.

The hospital is reputedly one of the most advanced in Europe in the field of micro-surgery — the joining up of tiny blood vessels and nerves in torn sinews and muscles.



Mr Michael Brennan, consultant plastic surgeon and spokesman for the team which performed the operation, speaking at a press conference in the Ulster Hospital yesterday.

Boy watches TV after leg ordeal

A six-year-old Co Clare boy whose leg was severed in a farm accident sat up and watched TV at the Ulster Hospital, Dundonald, yesterday.

A top surgeon said the eight-hour operation to sew his leg back on had been a success — so far.

But it may be a year before the final outcome of his ordeal is known — and he could have a permanent limp.

Little Joseph Meade had his right leg severed below the knee in an accident with a muckspreader — when the high-speed rotating spikes of the machine hit him.

The accident was on his family's farm near Ennis, Co Clare at lunch-time last Saturday.

He was in the operating theatre at

the Ulster Hospital, the only micro-surgery hospital in Ireland, six hours later.

Mr Michael Brennan, the plastic surgeon who led the operating team, said yesterday: "It was a race against time. Another two hours might have been too late."

From the farm, Joseph was rushed to Clare County Hospital where doctors immediately contacted the specialists at Dundonald.

The child was taken to Shannon airport and flown with a doctor in a special plane to Aldergrove.

The police then escorted an ambulance from the airport to the hospital.

All this time his leg was packed in ice.

The operation on Joseph's leg began at about 7 pm — and went on until shortly after 3 am.

Mr Brennan said: "This was really the first major limb plantation we had undertaken."

"The first task was to get blood circulation going again. I must give credit to the people who got him here in about six hours."

"We were bordering on the limits of time. Eight hours would have been the maximum amount of time the leg could have survived."

"There was some crushing of the limb in his injury. It was not a clean guillotine break entirely. This meant the operation was slightly more complicated."

"Newsletter" May 5, 1981.

ME 19A
FLUID MECHANICS AND GAS DYNAMICS
C. BRENNAN

9 units (3-0-6) lecture - first term

responses received: 11 out of 30
 lecture attendance: 90%
 homework completed: 96%
 hours per week spent on this course:

1-3	4-6	7-9	10-12	13-15	16-18	19<	nr	mean
0	0	7	2	0	0	0	2	7.9

	1	2	3	4	5	6	7	nr	mean
understanding	0	0	0	0	1	4	6	0	6.5
enthusiasm	0	0	0	0	0	8	3	0	6.3
organization	0	0	0	0	2	6	3	0	6.1
clarity	0	0	0	0	2	3	6	0	6.4
text	0	0	0	1	1	0	1	8	5.3
class rapprot	0	0	0	0	1	5	5	0	6.4
indiv. rapport	0	0	0	0	1	5	3	2	6.2
course rec.	0	0	0	0	2	5	4	0	6.2
prof rec	0	0	0	0	1	7	3	0	6.2
valuable	0	0	0	1	2	2	6	0	6.2

required yes: 5 no: 6
 classes SO: 1 JR: 8 SR: 2
 grades A: 4 B: 4 C: 1 P: 1
 options APh: 1 CE: 1 Eng: 6 ME: 3

6 comments:

People found the course well-taught. One student remarked, "Brennan is very good, well prepared, explains clearly, and cares about students." Another commented that the course was "one of my favorite courses at Caltech." Another student commented, "The problem sets were very interesting." No text was required, but one student felt that the lectures and the handouts were sufficient. Two others suggested that a text would be useful. (D)

ME 19B
FLUID MECHANICS AND GAS DYNAMICS
C. BRENNEN

9 units (3-0-6) lecture - second term

responses received: 14 out of 31
 lecture attendance: 91%
 homework completed: 98%
 hours per week spent on this course:

1-3	4-6	7-9	10-12	13-15	16-18	19<	nr	mean
0	1	12	1	0	0	0	0	7.9

	1	2	3	4	5	6	7	nr	mean
understanding	0	0	0	0	0	5	9	0	6.6
enthusiasm	0	0	0	0	0	6	8	0	6.6
organization	0	0	0	0	2	6	6	0	6.3
clarity	0	0	0	0	2	2	10	0	6.6
text	0	0	1	1	0	2	0	10	4.8
class rapprot	0	0	0	0	1	6	7	0	6.4
indiv. rapport	0	0	0	0	2	4	7	1	6.4
course rec.	0	0	0	1	0	3	10	0	6.6
prof rec	0	0	0	1	0	3	10	0	6.6
valuable	0	0	0	1	0	6	7	0	6.4

required yes: 7 no: 7
 classes SO: 2 JR: 10 SR: 1
 grades A: 7 B: 4 C: 2
 options AMA: 1 APh: 3 Eng: 6 Env: 1 ME: 3

6 comments:

Everyone commented favorably on the instructor. The course was very well liked and some even considered it the best course they had ever taken at Tech. Homework was felt to be very relevant. (VP)

ME 19C
FLUID MECHANICS AND GAS DYNAMICS
C. BRENNEN A. J. ACOSTA

9 units (3-0-6) lecture - third term

responses received: 8 out of 26
 lecture attendance: 90%
 homework completed: 99%
 hours per week spent on this course:

1-3	4-6	7-9	10-12	13-15	16-18	19<	nr	mean
0	1	7	0	0	0	0	0	7.9

	1	2	3	4	5	6	7	nr	mean
understanding	0	0	0	0	0	2	6	0	6.8
enthusiasm	0	0	0	0	1	4	3	0	6.3
organization	0	0	0	0	0	3	5	0	6.6
clarity	0	0	0	0	1	3	4	0	6.4
text	0	0	1	0	0	2	0	5	5.0
class rapprot	0	0	0	0	1	4	3	0	6.3
indiv. rapport	0	0	0	0	0	2	6	0	6.8
course rec.	0	0	0	0	1	3	4	0	6.4
prof rec	0	0	0	0	0	2	6	0	6.8
valuable	0	0	0	0	1	3	4	0	6.4

required yes: 4 no: 4
 classes SO: 1 JR: 6 SR: 1
 grades A: 3 B: 3 C: 1
 options APh: 1 Eng: 3 Env: 3 ME: 1

8 comments:

Most said it was a very good class, and Brennan was an excellent lecturer. Acosta taught second half, and was rated O.K., but not nearly as good as Brennan. (MLB)

TQFR 80-81

ME 19

FLUID MECHANICS AND GAS DYNAMICS

C. BRENNAN

9 units (3-0-6) lecture

responses received: 11 out of 30

lecture attendance mean: 90%

st.dev: 11%

homework completed mean: 96%

st.dev: 9%

hours per week spent on this course:

1-3	4-6	7-9	10-12	13-15	16-18	19<	nr	mean
0	0	7	2	0	0	0	2	7.9

	1	2	3	4	5	6	7	nr	mean
concept und.	0	0	0	0	1	4	6	0	6.5
enthusiasm	0	0	0	0	0	8	3	0	6.3
organization	0	0	0	0	2	6	3	0	6.1
clarity	0	0	0	0	2	3	6	0	6.4
text	0	0	0	1	1	0	1	8	5.3
class rapport	0	0	0	0	1	5	5	0	6.4
stud. rapport	0	0	0	0	1	5	3	2	6.2
course rec.	0	0	0	0	2	5	4	0	6.2
instr rec.	0	0	0	0	1	7	3	0	6.2
valuable	0	0	0	1	2	2	6	0	6.2

required yes: 5 no: 6

classes: So: 1 Jr: 8 Sr: 2

grades: A:4 B:4 C:1 P:1

options: APh:1 CE:1 Eng:6 ME:3

6 comments:

People found it a well-taught course. One student remarked, "Brennan is very good, well prepared, explains clearly, and cares about students." Another commented that the course was "one of my favorite courses at Caltech." Another student commented, "The problem sets were very interesting." No text was required, but one student felt that the lectures and the handouts were sufficient. Two others suggested that a text would be useful. (D)

Going Against the Grain

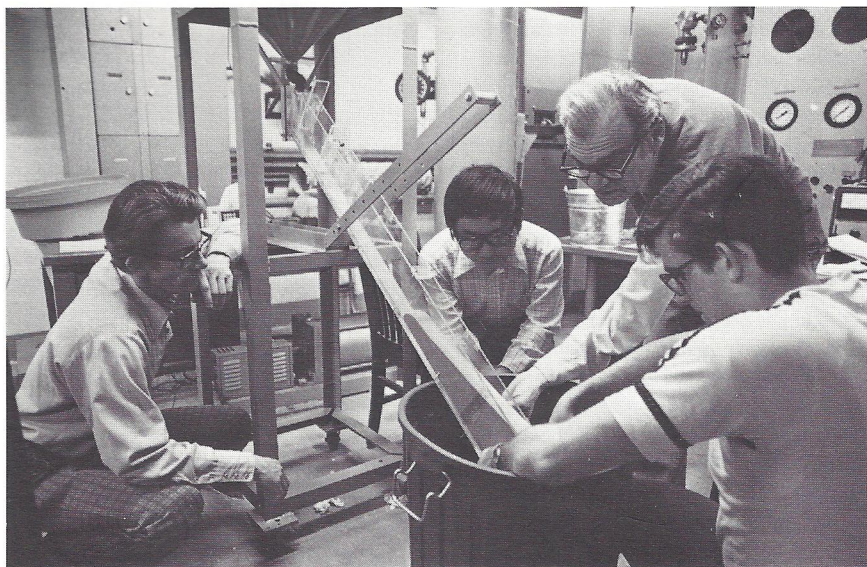
Granular materials flow somewhat like fluids — but with enough differences to flow right into the cracks between the traditional disciplines of classical fluid mechanics, kinetic theory, and soil mechanics. While the flow of liquids and gases has been studied for centuries, the properties of granular flow are not well understood.

Rolf Sabersky, professor of mechanical engineering, stumbled onto this surprising interdisciplinary crack several years ago when he heard about a heat exchanger in which hot soap granules were cooled by pouring them over water pipes. The interesting problems encountered in this seemingly simple operation led him and Christopher Brennen, associate professor of mechanical engineering, to begin a research project on granular materials in general. Many such materials — coal, gravel, ores and grains of all kinds, ferti-

lizers, even plastic stock — are transported and handled in enormous bulk quantities.

Heretofore, the rather simple transport contraptions — hoppers, chutes, conveyors — as well as more complex processing machinery have been designed by trial and error with very little scientific knowledge of how the material moved through them. As energy and construction costs increased, however, the benefits that might be derived from more effective designs have also become more apparent. In addition, many of the suggested solutions to the energy situation involved transporting and processing even greater quantities of bulk material, such as coal and shale.

Nature also presents problems of granular flow — mud and rock slides and avalanches. Scientists are interested in how the sand patterns recently discovered on Mars and Venus might have been formed

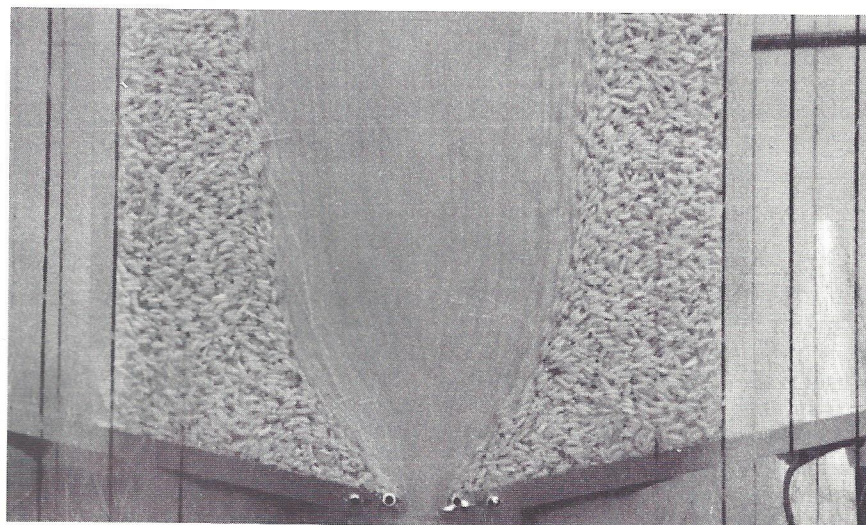


As sand flows down the chute, it is partially backed up behind a gate while a layer of sand continues flowing over the top, a phenomenon known as a hydraulic jump when it occurs in water. Rolf Sabersky points out an element of the flow to students Henry King (center) and Bill Ledebor. Christopher Brennen observes at left.

and in how the soil of the Los Angeles basin might behave during a great earthquake.

Brennen and Sabersky's research, which has been funded by Union Carbide and the National Science Foundation, deals with both the theoretical and experimental aspects of these flows, which are two-phase flows, that is, a mixture of solid and fluid (air or water). In very low concentrations, such as dust in wind, the mixture behaves as a normal fluid with stresses determined by the suspending medium (air). But as concentration of the solid increases to the point where particles collide with sufficient frequency, the stress communicated by the collisions may increase to the point where it dominates that transmitted by the suspending medium. Of course, many granular flows are determined by both of these effects — collisions and the viscous forces in the suspending medium.

These particle collisions have an analogy in kinetic, or molecular, theory but with two problems that make granular materials more difficult to deal with than gases: their high density, or solids fraction, and the inelasticity of the collisions; that is, energy is dissipated every time a particle collides with another. (Energy is conserved in collisions of atoms or molecules.) The flow behavior involves the relationship between the stresses, or pressure, on the one hand and the solids frac-



Rice grains remain stagnant at the sides of this hopper, while only the center moves as a "funnel flow." Most hoppers are designed to avoid stagnant regions.

tion and the random motion of particles (analogous to temperature in molecular theory) on the other.

Work in Sabersky and Brennen's groups (currently including graduate students Charles Campbell, Scott Patton, and Karel Spelt) involves postulating certain of these relationships, putting them in the equations of motions, solving for certain flows, and then comparing them with experimental results from relatively simple flows in hoppers and chutes. They are developing new instrumentation and tech-

niques to get inside these flows in order to measure velocity and density at particular points. They also have simulated flows on a computer. One of the problems they have encountered in the experiments is the buildup of electrostatic charge. Friction between particles can turn a hopper into a Van de Graaff machine, creating substantial voltage differences. This phenomenon may in fact be involved in some of the explosions in grain elevators.

Substantial progress has already been made in a specific engineering problem — designing hoppers to avoid "funnel flow," which leaves stagnant regions along the sides. To achieve the desired mass flow, Brennen and Sabersky investigated the geometry of the hopper; its height and width, the shape of its parts, and the shape of the particles intended to flow through the hopper (for example, the elongated grains of rice) are all factors that needed to be considered.

Experimenting with granular flow means carrying a lot of sand around (or rice, mustard seed, glass beads, or plastic granules), and this has generated some transport problems of a local nature. Bucket brigades from the bottom of the chute to the top of the hopper are one solution, but it becomes more complicated when the stuff must be trucked to another floor so it can descend steeper chutes. A hole in the basement of Spalding to accommodate the lower end of the chute will soon solve that problem. Students researchers carrying buckets, however, will probably continue to joke about majoring in sandbox. □



The backed up stationary layer of sand can be seen in this cross-sectional view of the "hydraulic jump" experiment. There is another very interesting spot of stationary granules near the top of the curve, where a vortex is created adjacent to the main flow. Lighting from above makes the top surface appear light.