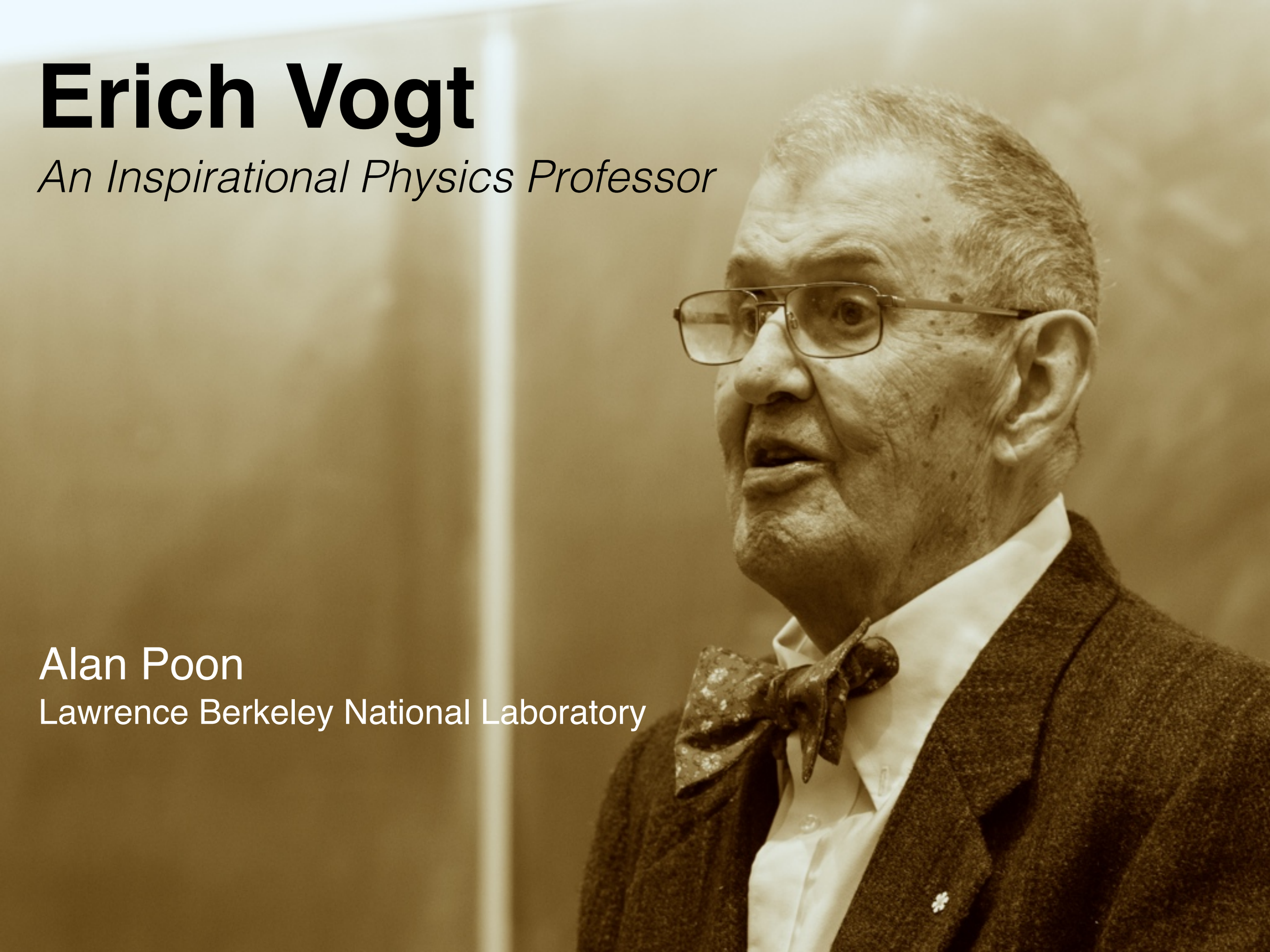
# Erich Vogt

*An Inspirational Physics Professor*




Alan Poon

Lawrence Berkeley National Laboratory

GUEST COMMENT

# The special joy of teaching first year physics

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Am. J. Phys. **75**, 581 (2007)

**The general goals of any undergraduate physics course are:**

***to impart knowledge of the physics content;***

***to enhance the students' sense of wonder***, which is such an important human attribute, especially for the pursuit of science;

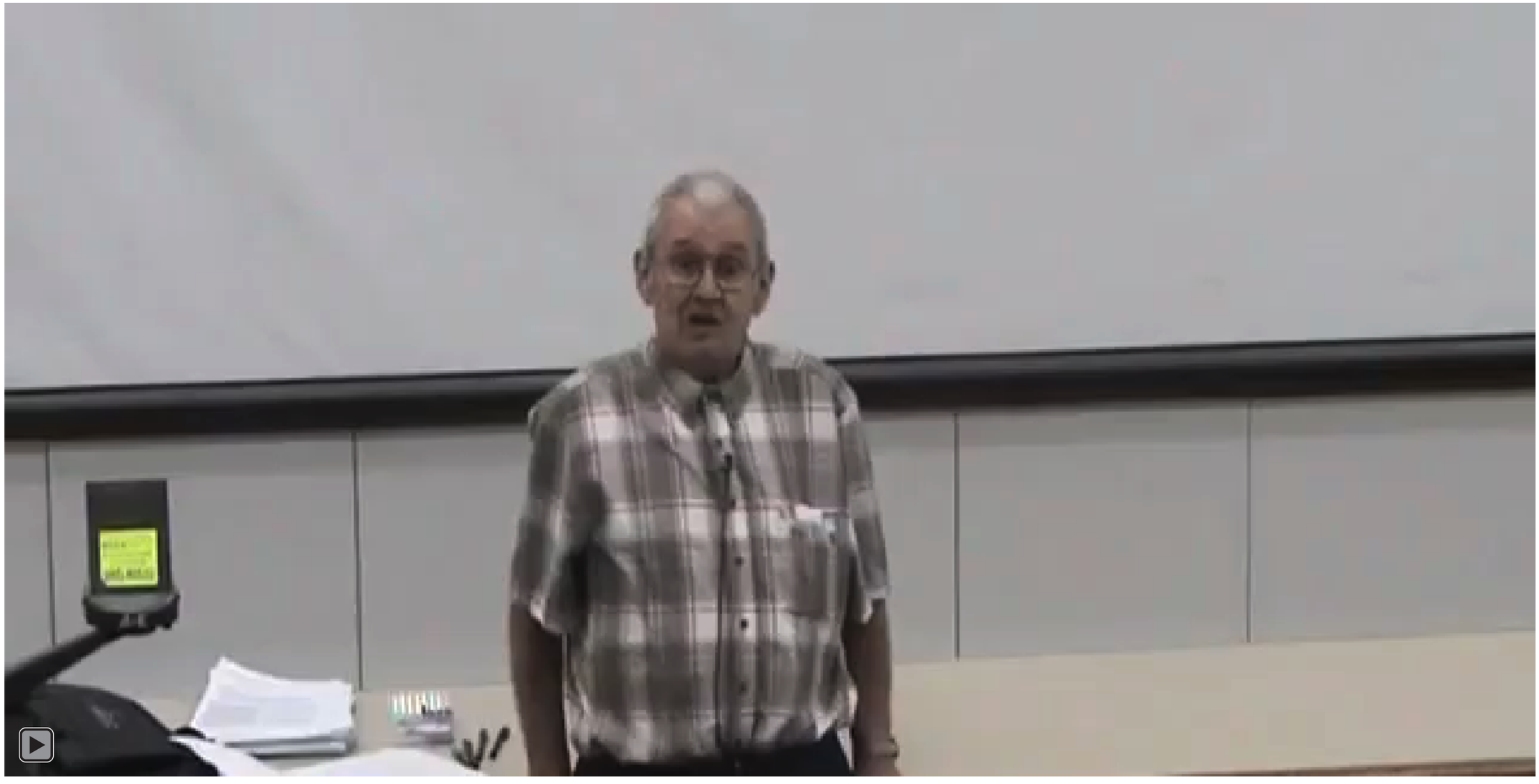
***to develop the students' analytical skills***, which are essential not only for understanding physics but for almost any other field of human inquiry;

***to describe how science works and how effective mathematics is for this purpose***;

***to contribute to life changing experiences***, which should be part of a university education; and

***to make the course a challenge to the intellect and an enjoyable learning experience***.

# Sense of Wonder



Video: courtesy of Tel Aviv University

# Sense of Wonder

“I was growing up on the prairies,...because the village had very few lights, the sky was very brilliant – you even could see things like Andromeda, the nebula in the Milky Way – and I wondered what it was all about. And you know, one of the biggest gifts we have...is **the human sense of wonder**. I had a great deal of pleasure growing up in a rural community in which you were close to the forest and the birds and the stars, and that’s what got me interested in nature.” (UBC Physics Newsletter, 2009/01)

Video: courtesy of Tel Aviv University

# Sense of Wonder

## My first Physics 120 assignment

U.B.C PHYSICS 120

Assignment #1

September 9, 1987
Due September 16, 1986

1. Estimate the following and indicate how you arrived at your answer.

   a. How many piano tuners are there in New York City?

   b. The number of trees required to produce enough paper for the text books purchased this fall by all university students in B.C.

   c. The final Toronto stock exchange 300 composite index for September 16, 1987. [The current index, (Sept. 3, 1987) is 3962.6].

⋮

3. After adapting your eyes to darkness (in your closet at night, with lights out perhaps) break up and rub together the sugar from an ordinary sugar cube. What do you see?

BONUS PROBLEM

Speculate why you see what you see and suggest possible experiments to clarify the mechanism.

# Sense of Wonder

## A typical solution handout

PHYSICS 120

SOLUTIONS FOR ASSIGNMENT 1 — Sept. 16/1987

1.1) For every estimation problem there are many different and acceptable methods for arriving at an answer. Therefore the solutions given here are only to be considered as examples of appropriate answers.

a) To estimate the number of piano tuners in NYC I would first count the number of tuners in the Vancouver Yellow pages (=37). Because many of the listings likely correspond to companies employing more than 1 tuner each I would estimate that there are roughly double this number (=75) in Vancouver. NYC is roughly ten times bigger than Vanc. and therefore has about 750 tuners

b) There are about 75,000 university students in B.C. If each student purchase about 15 kg. of books the total mass of paper required is about $1.1\times10^6$ kg. A typical pulp tree (which is smaller, generally, than the large coastal timber trees) has a volume ($=\pi r^2 l$) with $r\simeq 0.2$m, $l\simeq 15$m. It has a density of about $0.7\times10^3$ kg/m$^3$. Therefore the mass of my typical tree is about $0.7\times10^3\times15\times\pi\times(0.2)^2\simeq 1.2\times10^3$ kg. In making paper we add some chemicals and throw away some tree material but perhaps these two effects cancel out. Therefore we need about 1,000 trees.

c) If any of us could really answer this question accurately we should be rich. We know that the market fluctuates almost daily, but not by many percent. It has, in the past few months increased by a few percent per month on the average. Therefore an estimate of $4000 \pm 100$ is not an unreasonable answer.

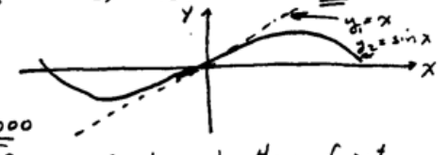
Acceptable range of answers: a) 300–2000, b) 100–10,000, c) $4000 \pm 300$

1.2) a) $383^\circ = 360^\circ + 23^\circ$, $\therefore \sin 383^\circ = \sin 23^\circ = 0.3907$ (from my calculator)

b) $10^{12}/360 = 2{,}777{,}777{,}777.7777\ldots$ which is a whole number $\times 360^\circ$ plus $0.77777\times360^\circ = 280^\circ$, $\therefore \sin(10^{12})^\circ = \sin 280^\circ = -0.9848$

c) $\cos(\frac{14\pi}{3}$ radians$) = \cos(\frac{4}{3}\pi$ radians$) = \cos(240^\circ) = -0.5$

d) we can easily plot the l.h.s, $y_1 = x$ and the r.h.s $y_2 = \sin x$ to see that $y_1 = y_2$ only for $x = 0.0000$




1.3) One sees, as Francis Bacon, Boyle and others first noted, "a sparkling light" when sugar is scraped. This phenomenon is called "triboluminescence" from the Greek word "tribein", to rub.

Bonus Problem: Light is emitted by atoms or molecules. Clearly when we scrape a substance we are giving it frictional energy. Sometimes this energy may excite atoms or molecules which then emit light. To understand the phenomenon we should try to measure the wavelengths of the light and thus identify what is radiating in sugar. I give here excerpts of a paper by Zink (Accounts of Chemical Research, Vol. 11, page 289, 1978) which describes how the light from rubbing sugar can be associated with $N_2$ emission.

## Triboluminescence

JEFFREY I. ZINK

Triboluminescence (TL) is the emission of light caused by application of mechanical energy to a solid. The word was coined by Wiedemann in 1895[1] and takes its root from the Greek "tribein", to rub. The word is of broad general usage and covers a variety of mechanical methods of excitation, spectroscopic origins of the luminescence, and mechanisms of excitation. All of these aspects of TL will be discussed in this Account.

The history of TL is long and varied. The first recorded observation of TL known to the author is contained in Francis Bacon's "The Advancement of Learning".[2] Bacon reported that lumps of sugar emitted light when scraped. The triboluminescence of sugar was known to other early writers, including Boyle, who observed that "hard sugar being nimbly scraped with a knife would afford a sparkling light".[3] The best examples of TL using common household substances are demonstrated by grinding sugar or certain candies such as wintergreen lifesavers in a dark room.

A different form of TL, that caused by the motion of mercury over a glass surface in a vacuum, was first reported by Picard in 1675.[4] This type of TL was also independently reported by Hauksbee in 1705[5] and by Newton in 1718.[6] Other early studies of historical interest include the reports of Muschenbrock in 1661[7] and Wiedemann and Schmidt in 1895.[1]

The mechanical energy which is used to excite TL can take a wide variety of forms. The two most common forms are anisotropic pressure by grinding or crushing crystals and the motion of a fluid over the surface of a solid. Other important methods of excitation include thermal shock which causes strain, cracking or phase changes of a crystal, and rapid crystallization which also can cause strain or cracking. The most convenient method of exciting crystals or powders for spectroscopic studies is by crushing or grinding them against an optical window.

The borderline between TL and other forms of luminescence such as thermoluminescence or chemiluminescence is often not well defined. For example, the mechanical energy applied to the crystal in the TL experiment could be converted to heat energy which in turn could cause either thermoluminescence or a chemical reaction producing a product in an excited electronic state. These effects will be respectively called tribo-induced thermoluminescence and tribo-induced chemiluminescence. Two trivial forms of TL are also covered by the definition of TL. The incandescent fragments produced when two hard objects are struck together or frictionally heated might be called TL. Electrical arcing produced by static electrification when dissimilar objects are rubbed might also be called TL. The luminescence caused by flowing mercury falls in the latter category. Most of the triboluminescent substances to be considered in this Account do not have such simple origins and explanations.

Triboluminescence links the spectroscopic, structural, mechanical, and electrical properties of solids. The two primary goals of current research are to elucidate the excited-state origins of the luminescence and to determine the mechanisms by which those states are populated.

**Gas TL.** The TL of the earliest known triboluminescent crystal, sucrose, had $N_2$ emission as its origin. The first TL spectrum, also that of sugar, provided clear evidence for $N_2$ emission.[12] In addition, many workers have inferred the presence of $N_2$ emission by studying crystals under an atmosphere of Ne and visually observing the characteristic red emission of that gas.[14,38]

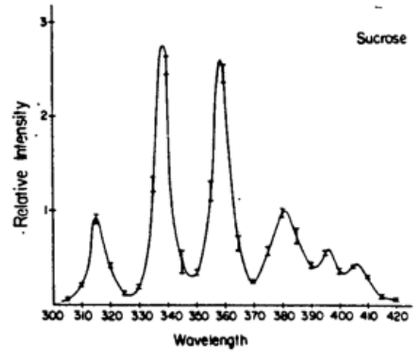



**Figure 6.** Triboluminescence spectrum of sucrose, emission from molecular nitrogen.

The nitrogen emission which is observed is the $^3\Pi_u \rightarrow {}^3\Pi_g$ fluorescence with a maximum at 330 nm.[39] A well-defined vibronic band structure is observed, as shown in Figure 6.[15] In order to excite nitrogen to its $^3\Pi_u$ excited state, a minimum energy of $8.9\times10^4$ cm$^{-1}$ is needed. It is a surprising aspect of TL that energy of the magnitude implied by the nitrogen emission can be generated simply by pressing crystals with a hand-held rod.

# Sense of Wonder

## Erich's favourite: Olbers' Paradox

"In first year physics there are endless opportunities to excite wonder and to make the students' eyes light up. One example that illustrates what works for me is Olber's Paradox...for which the proper formulation of the question leads to an analogy with the logic of Gauss' theorem in electromagnetism and the shell theorem for gravity inside the Earth. Beyond its helpfulness as an analogy, the paradox remains deeply embedded in the students' minds because it teaches them how astonishingly simple observations can raise profound questions."

Am. J. Phys. **75**, 581 (2007)

# On teaching

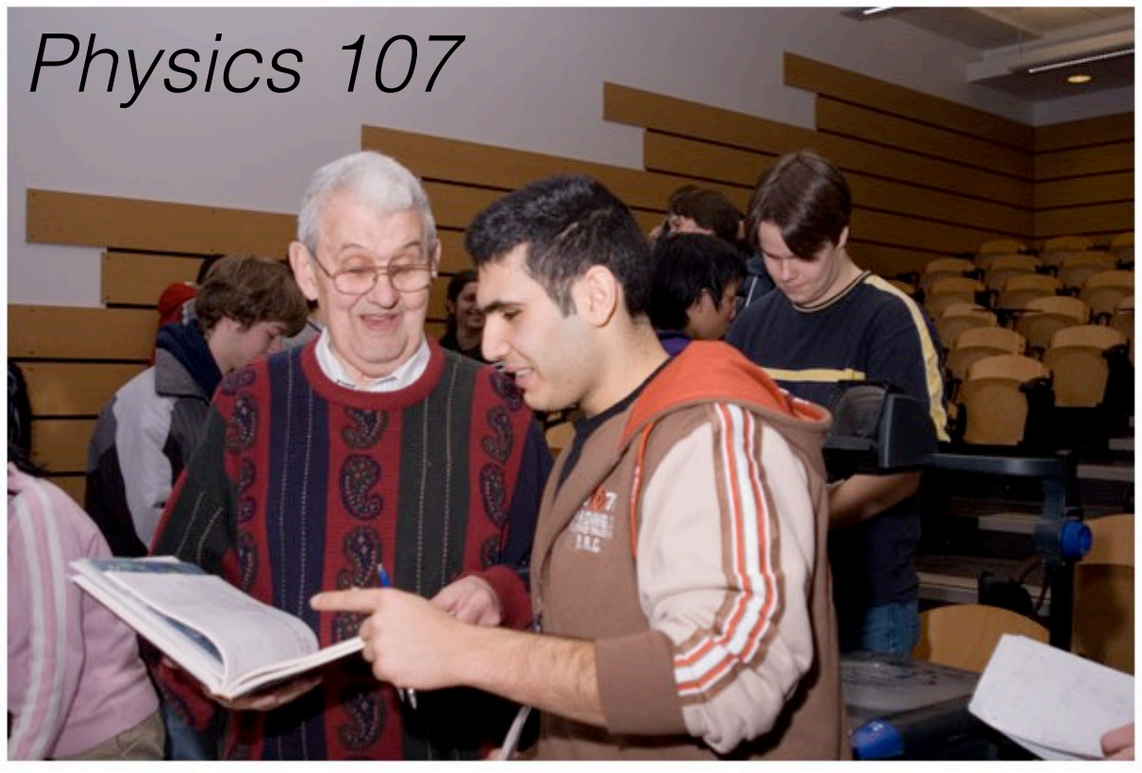
Video: courtesy of UBC Archives and UBC Legacy Project

# "...and that you care."

My first encounter with Dr. Voyt was on my first day at UBC. I was a few minutes early, and found Dr. Voyt asking a few students where they were from. Having rushed from a lecture of 300 students with a professor who acknowledged how difficult it would be to personally know and connect with students given the class size, I was very pleasantly surprised – the founder of TRIUMF was curious about my story. I learned why very shortly after; Dr. Voyt pointed out that the pursuit of knowledge, and the sense of wonder wired into our minds brought us together – in P107 – in spite of the many differences that divide us. Such was his joy in teaching; he marvelled at how our sense of wonder brought us all together.

**-Euweng Chan(P107, 2009)**

# “...and that you care.”


THE UNIVERSITY OF BRITISH COLUMBIA

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**Office of the Dean**

February 7, 1991

Mr. Alan W.P. Poon

Dear Alan:

[redacted]

The dinner will be held on Tuesday, March 12 in the Ballroom of the Faculty Club. The reception will begin at 5:30 PM with dinner at 6:30 PM. Dr. Eric Vogt, Director of TRIUMF, sometimes better known as Dr. Kaon, has agreed to give an after dinner talk on an interesting scientific topic. He is a witty, engaging speaker, many of you may remember as one of your favourite first year physics profs.

[redacted]

Yours sincerely,

Barry C. McBride
Dean of Science

He loved to be surrounded by students

# The demos

I believe his students' favourite demo was "Rocket Propulsion", in which he sat on a swivel chair and used a $CO_2$ fire extinguisher to spin himself around at dangerous angular velocities. I suspect it was also *his* favourite.

\- Jess Brewer

...and the story of an injured Erich during one of his demos

# Getting attention of the students

Examples of Erich getting attention of the students through well-meaning pranks:

- Called out students' names at random times and asked for their inputs
- Threw money at the students who caught his mistakes

> The first class on my first day of university was Phys 120 in Hebb Theatre. Erich was the professor...There was a chair out at the front of the theatre and sitting on it was an apple. Erich comes in and begins his lecture. About half way through it, he makes some reference to Newton or gravity or some such thing and then the apple suddenly rises up to the rafters. Can't remember the joke Erich made but the levitating apple stuck in my head. Of course that was only the tiniest hint at Erich's sense of humour. I remember Erich once proudly explaining to me how he got into trouble playing a funeral dirge on a piano at the armoury as students marched in for their Christmas exams.
>
> - Fraser Duncan

# Challenge the students

Video: courtesy of UBC Archives and UBC Legacy Project

# Challenge the students

"Systematic appraisals of the course and the teacher are valuable, but high ratings should never be achieved, as often happens, by easy examinations or otherwise reducing the challenge."

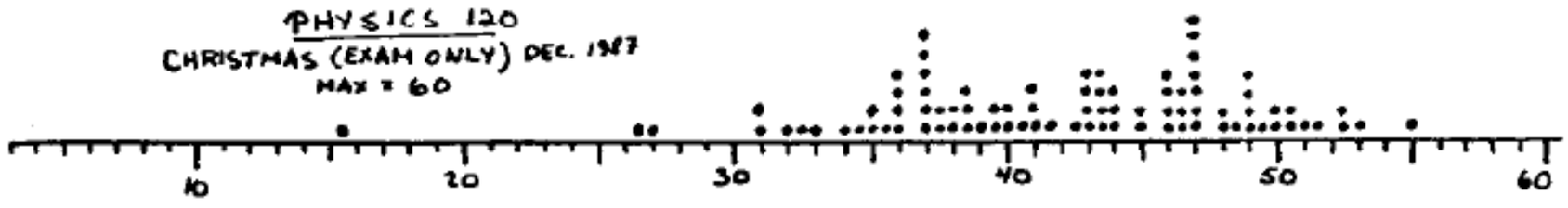
- E.W. Vogt, Am. J. Phys. 75, 581 (2007)

THE UNIVERSITY OF BRITISH COLUMBIA

Christmas Examination - December 11, 1987

PHYSICS 120

Professors F. W. Dalby and E. W. Vogt



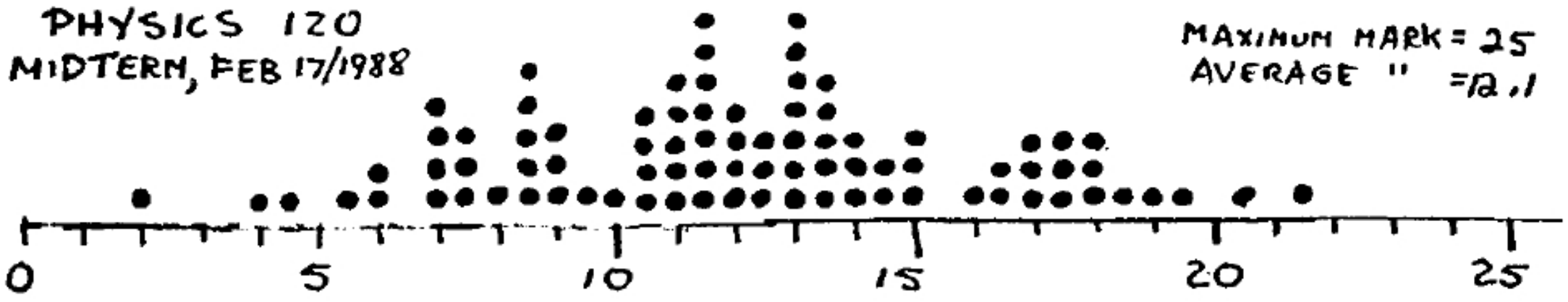

Grade distribution for the first semester:

# Challenge the students

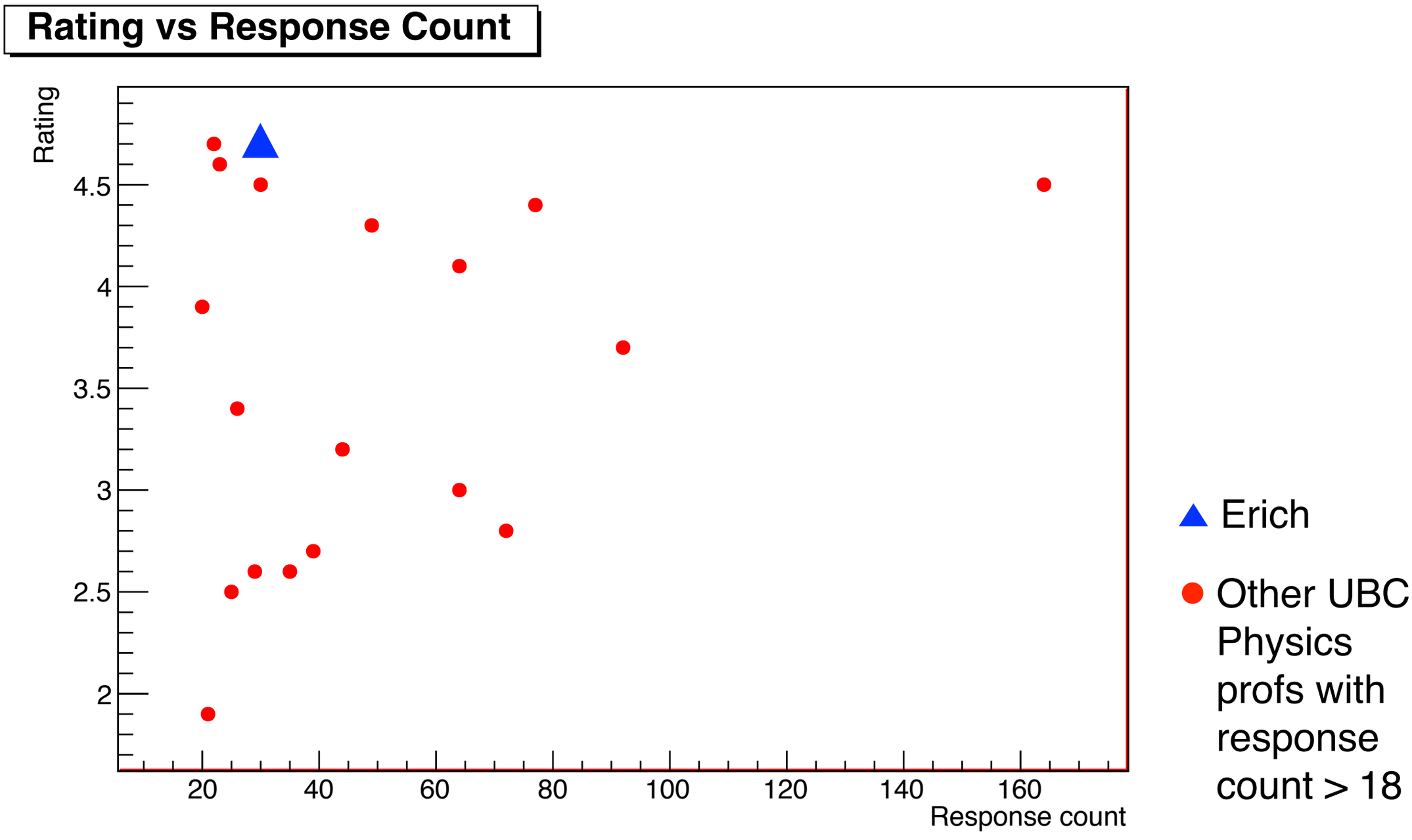
"Systematic appraisals of the course and the teacher are valuable, but high ratings should never be achieved, as often happens, by easy examinations or otherwise reducing the challenge."

- E.W. Vogt, Am. J. Phys. 75, 581 (2007)

Mark distribution for the first mid-term in the second semester:



# An excellent teacher




Data obtained publicly from ratemyprofessor.com (June 2014)

# Dedication to teaching

When I get up in the morning, and consider who I am, I think of myself as a teacher, first and foremost. Well, after being a father and grandfather.

⋮

I had a deal with my department...namely that I would teach — when I made this deal I was not being paid — but I would teach as long as I achieved some of the highest student ratings in the department, and if that was no longer true, then I would stop.

- E.W. Vogt
UBC Physics & Astronomy Newsletter (2009)

# Impact on students

I think my effect on young students has been, for me, more important than creating TRIUMF or the things that I was able to achieve as a research physicist.

Over four decades, I have taught more than five thousand first-year students. I constantly meet former students in many professions who took my course many years ago. It is a special joy to hear what impact my physics course has made in their lives.

- E.W. Vogt, Am. J. Phys. 75, 587 (2007), and UBC P&A newsletter (2009)

# Impact on students

They decided, as a result of the course, to go in a completely different direction. That's an awesome responsibility because when it happens — for the good, you know — you think "that's perhaps the best feedback I know of". In fact, I think the best feedback about teaching is the considered opinion of people years later about which teachers really matter.

- E.W. Vogt, UBC P&A newsletter (2009)

# A personal note

I took Erich's Physics 120 class (co-taught by Bill Dalby) in the 1987-88 academic year.  There have been four mentors (all Canadians) who have made lasting impacts on my career.  More importantly, they are the role models for me to learn how to be a better human being.

Erich is one of them.  If I had not taken his class, which helped me discover my passion in physics, I probably would not be wondering the elusive behavior of neutrinos now.

Thank you, Erich.  Rest in peace.

# Acknowledgements

Prof. David Andelman, Prof. Doug Beder, Prof. Jess Brewer, Mr. Euweng Chan, Mrs. Penny Crowe, Dr. Fraser Duncan, Prof. Aksel Hallin, Prof. Wick Haxton, Prof. Ernest Henley, Mr. Chris König, Ms. Theresa Liao, Prof. Janis McKenna, Dr. Marcello Pavan, Ms. Krista Sheppard, Mr. David Swinnard, Prof. Brian Turrell

I thank Tel Aviv University for giving me the permission to show video clips from the lectures that Erich delivered in January 2009. You can watch the lectures in their entirety at:

https://www.youtube.com/watch?v=Rtc3-5jsTEM

https://www.youtube.com/watch?v=__RhApdTWgQ

I thank the UBC Archives and the UBC Legacy Project for giving me the permission to show clips from Erich's interview, which was conducted on March 18, 2013. The entire interview can be found in:

http://digitalcollections.library.ubc.ca/cdm/singleitem/collection/ubcavfrc/id/63