OAPT *THE CONFERENCE* 1992
June 28 - 30

The fourteenth annual conference will continue the format established in the past: Sunday workshops and two full days of invited and contributed papers, with special lectures, tours and fine social gatherings.

The Conference at a Glance

Sunday, 28th	1:00 to 6:00	Workshop/ Physics Labs
	7:30	IMPACT! - McLaughlin Planetarium
	8:30 -	Reception at Oakham House
Monday , 29th	9:00 - 12:00	Invited/contributed Papers
	1:30 - 5:00	Rogers Centre
	12:00 - 1:30	Barbeque lunch - residence
	6:00 - 7:30	Buffet at Oakham House
	8:00 - 9:00	Kenneth Laws - Ryerson Theatre
Tuesday, 30th	9:00 - 12:00	Invited/contributed Papers
	12:00 - 3:00	Rogers Centre
	3:00 -	Tours: Ryerson Graphics Labs, McLaughlin Planetarium...

Workshops

Coherent optics/ Quantum physics A choice of two lecture/demonstration sessions at CATE (Centre for Advanced Technology Education), session A; focusing on wave optics, Fourier methods, image processing and holography, session B on laser and hologram theory and practice. Both will begin with a demonstration of fibre optics and photonics using the latest equipment and techniques and finish with an examination of lasers and the CATE holography laboratory. Sunday, 1:00 pm to 6:00.

Workshop Leaders

V. Kushnir, M. Mills and R. Moore are professors in the Faculty of Engineering and Applied Science. Prof. Mills is also a member of the staff of CATE.

Physics laboratories

Merlan Scientific will present their latest offerings in conjunction with the Ryerson physics department in a workshop environment. Delegates will be invited to work through all or any of a selected group of experiments offered to our engineering students, and some new offerings from Merlan Scientific. A good opportunity to sample the latest (and some classic) experiments. There is no fee for these sessions, starting at 1:00 pm and continuing to about 6:00.

McLaughlin Planetarium

The last showing of **"IMPACT!"**, the story of the effects of meteorites and bolides on life and geology of this planet will be on Sunday evening. Special prices have been arranged for delegates!

Tours

As usual a number of tours will be offered both within and outside Ryerson. Some possibilities include the special graphics laboratories for computerised publishing and television video production, the McLaughlin Planetarium or the Ryerson theatre backstage.

Invited Speakers

Kenneth Laws, our Keynote speaker is a professor of physics at Dickinson College as well as a ballet dancer and teacher. Along with a professional ballerina, he will present a lecture/demonstration of the physical principles of dance.

Ernie MacFarland (Univ. of Guelph) will initiate a discussion of the problems of concepts vs. formulae. Ernie gave a paper earlier on popular misconceptions arising from student tests.

Ken Burkhardt (Ryerson) will speak on the need to improve physics curricula. By unifying fragmented knowledge structures, and translating general principles into a common language a simpler curriculum is possible.

John van Aalst has studied the use of computers in the classroom as part of his work at the College of Education. He will present the pedagogy of using software to develop conceptual approaches.

Bill Konrad, our section representative, will bring us the highlights of the Orlando AAPT conference, January 1992.

Paul Dunphy has been working with Dr. Roberta Bondar on the effects of weightlessness on blood flow. This CATE project was one of the experiments carried out in the space shuttle flight of last winter.

Accommodation

The new residence provides excellent single rooms but there are no doubles. If you are travelling with your spouse, special rates have been negotiated with the Ibis Hotel (very nice and close by: $62+tax) or with the Chelsea Inn (two blocks west: $76+tax). Request reservations with your registration form or telephone direct. Make sure you mention the OAPT conference and ask for the "University Rate".

Parking

Parking fees are not included in the residence cost, but reasonable rates are available in the lot under the residence.

Summer in Toronto

The city has a great deal to offer at this time of the year, both indoor and outdoor activities abound in the parks and theatres. Information can be sent on request. Rooms will be available for Saturday if you wish to come early, and for Tuesday if you wish to linger - on Wednesday, Toronto will help celebrate **"CANADA 125"**.

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
RYERSON POLYTECHNICAL INSTITUTE
JUNE 28, 29, 30, 1992

Registration Form

Your Name: (as it is to appear on your Name-Tag)

ERNIE McFARLAND

Home Address:

46 HARRISON AVE.

GUELPH, ONT. N1H 5K4

Business/ Employer: UNIVERSITY OF GUELPH,

DEPT. OF PHYSICS, GUELPH, ONT. N1G2W1

Conference Fees:

Registration: (Members 91/92)	$50.	50
(non-members)	$55.	—
Membership for 92/3: (new or renewal)	$8.	—
Workshop: A. Coherent Optics B. Quantum Physics session A _____ session B _____	$35.	—
IMPACT! McLaughlin Planetarium	$4.	4
Residence Accomodation: Bed and Breakfast no. of nights 2 x $51. (tax incl.)		102
Monday Lunch Barbeque:	$9.	9
Monday Evening Buffet:	$25.	25
Total:		190

Hotel Accomodation: Ibis $62+tax/night double
Chelsea $76+tax/night double
Please reserve a room at the _____
I will arrange my reservation: Ibis (416) 593-9400
Chelsea 595-1975

(receipt required sometime)

Please indicate approximate arrival time at the Residence:
4-6 ~~AM~~/PM (Sunday)

Please send this form and your cheque to:
OAPT
c/o F. N. Hainsworth
Ryerson Polytechnical Institute
350 Victoria St.
Toronto, Ont., M5B 2K3

THE DEMONSTRATION CORNER

NOT-SO-SIMPLE HARMONIC OSCILLATOR

by

John Wylie

The Toronto French School
306 Lawrence Ave. E.
Toronto, ON M4N 1T7

Two years ago when I was in The Netherlands for the International Physics Olympiad, the Soviet team-leader, Sergey Krotov[1], demonstrated a remarkable toy, crafted to the highest standards by the technical staff at Moscow State University. It consisted of a series of simple pendulums of varying lengths which, when swung together, formed very beautiful patterns. I built one of my own which works just as well, using only bits and pieces that I found in my high school physics lab.

I used a half-metre ruler, 12 bolts, washers and wing-nuts, 11 steel balls (about 2 cm diameter), string, duct tape, and a C-clamp, to build a contraption that looks like this:

A piece of duct tape encircles each ball and a length of string passes under the duct tape and is attached to the half-metre rule with the bolts, washers and wing-nuts through holes drilled for the purpose. Hence, each ball is supported in such a way that it will swing with no elliptical motion; the length of its supporting string may be easily changed by loosing the appropriate wing-nut. I support the whole thing on any handy shelf or table leg with the C-clamp.

The holes were drilled 4 cm apart and the first bob was hung 12.5 cm ($=\ell_1$) below the rule. The bob on the longest string, label it the 11th bob, was hung 25 cm ($=\ell_{11}$) below the ruler. From the formula for the period of a simple pendulum,

$$T = 2\pi\sqrt{\frac{\ell}{g}} \quad ,$$

the period of the short bob is $T_1 = 0.7$ s whereas the long bob's period is about $T_{11} = 1.0$ s. The remaining bobs are equally spaced and have lengths that satisfy the parabolic equation $\ell = kx^2$, where I used $k \approx 0.001$ cm^{-1}. Simple substitution gives for the first bob, $x_1 = 112$ cm. The x-value for the second bob is larger by 4 cm and so on.

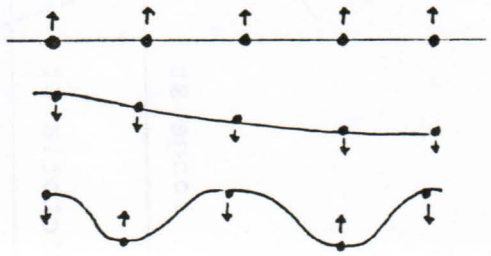
What is so special about this toy? Clearly the length of any bob obeys $\ell \propto x^2$ and its period follows $T^2 \propto \ell$ so that we have $T \propto x$. Then ΔT ($\propto \Delta x$) is the difference in period between any two adjacent bobs. Since the bobs are equally spaced, each bob has a period which is a constant ΔT longer than its adjacent shorter pendulum. Differentiating $T = 2\pi\sqrt{kx^2/g}$ gives:

$$\Delta T = 2\pi\sqrt{\frac{k}{g}}\Delta x \quad .$$

Substitution gives $\Delta T = 27$ ms.

When the bobs are all displaced a certain amount together and released, they will start swinging in phase with one another but will very quickly deviate from this symmetry. At a least common multiple of the periods of all the bobs, they will be back in phase again. For my device, this occurs after the long bob has executed 26 periods. The short bob will have done 36 periods. We can write that $26T_{11} = 36T_1 = 35T_2 = 34T_3$, and so on.

From this we see that after 13 swings of the long bob, every second bob is in phase. Generally, at any time that any two bobs are in phase with each other, a sine-wave pattern is formed by the toy. (If we had a very great number of very small bobs spaced very closely, there would always be at least two bobs in phase...but we are limited by our time and materials.) Successive snapshots of the toy in action, as viewed from below, might look as follows:



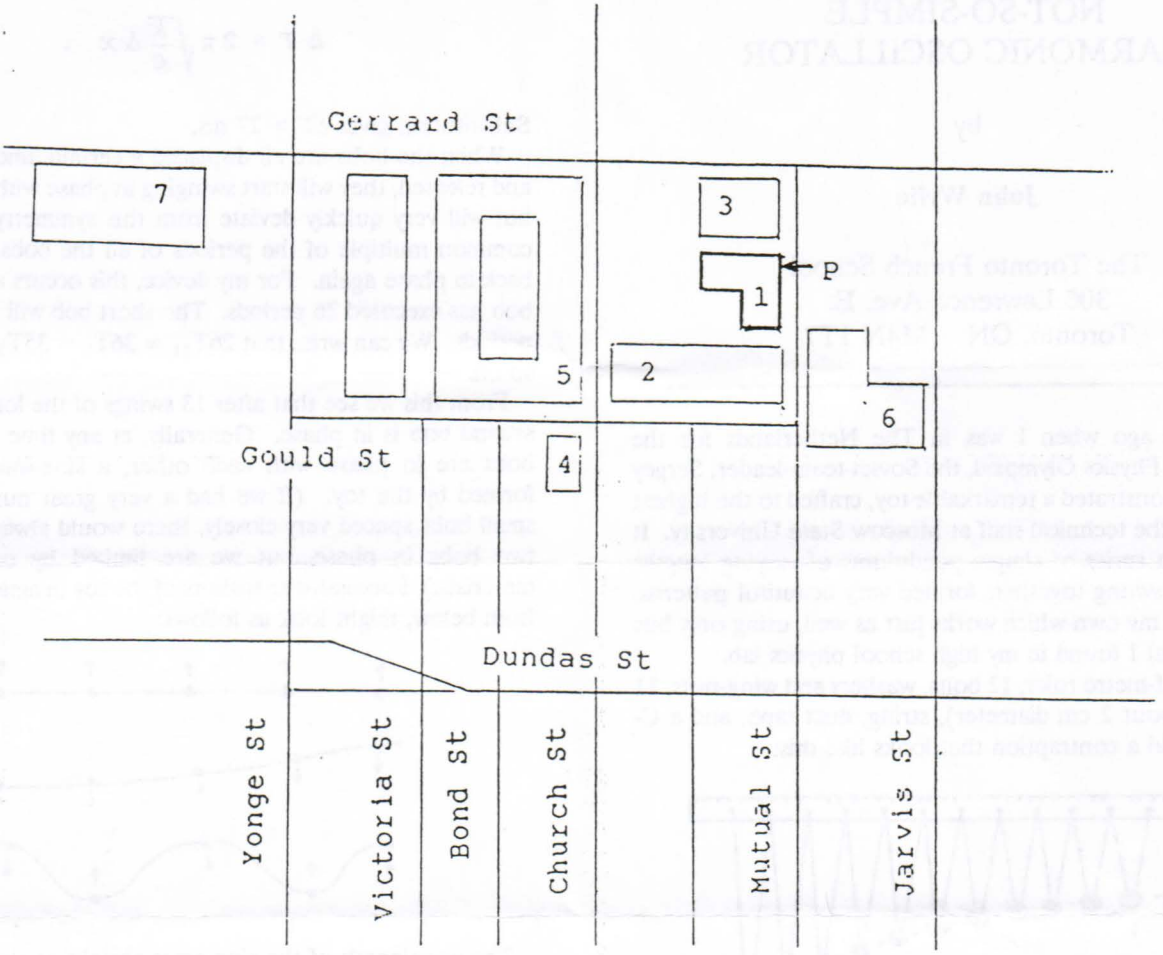
The wavelength of the sine wave shrinks as the oscillations develop and then expands again as the first and last bobs come back into phase. The tricky part of the construction is the fine tuning of the lengths of the strings. After calculating approximate lengths, I spent almost an hour adjusting them bit by bit, bringing each bob into character. As you might expect, the shorter ones are the trickiest since they are the least "simple" and their true period deviates slightly from that given in our formula.

The toy, apart from being useful in demonstrating the physics of a simple pendulum and beating is almost a work of art. Once you have one, you will be looking for ways to show it off to your students.

[1] Sergey Krotov is the editor of Kvant Magazine published by the Soviet Academy of Sciences. An English-language version, called Quantum, is now published by the NSTA in the U.S.A., and should be on every physics and math teacher's reading list.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



1 Residence
2 Rogers Communication Centre
3 CATE
4 Oakham House
5 Kerr Hall
6 Ibis Hotel
7 Chelsea Inn

Approaches to Downtown:
From the north-west: Hwy 401 to Avenue Rd/University Ave
East on Gerrard to Mutual
From the south-west: Queen Elizabeth Hwy to the Gardiner
North on York/University, Bay/Yonge or Jarvis
From the east: Hwy 401 to the Don Valley Pkwy, exit on
River to Richmond, north on Jarvis to Gerrard
The closest TTC Subway station is at Yonge and Dundas Sts