NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an affiliate of the American Association of Physics Teachers)
Volume XVII, Number 4 Summer 1995

Report: AAPT Winter Meeting

Orlando January 14 - 19, 1995
reported by Peter Scovil, Section Representative

This year's winter meeting was held in Orlando, a city that has grown by leaps and bounds over the past few years. Apart from tornado warnings on the 14th, the weather was better than Ontario, and actually got quite warm towards the end of the conference. The first two days were involved in workshops. I attended one on light wave communications, and I intend to demonstrate how to use inexpensive materials in demonstrating how light can carry information, at the conference in Guelph next June. A good photocell attached to a small amplifier with speaker can give some interesting effects. You can listen to the 120 Hz hum of lights, or the flicker of a candle flame. A LED can be easily modulated by a signal generator, a microphone, or a pocket radio. The signal can then be picked up by the photocell, and the students can hear the results. It is interesting to "hear" your TV remote or a bar code. I will prepare a parts list so you can make a similar set of equipment as well. You may even be able to make up enough sets for a student lab. I think with fibre optic communications being so widespread, students should be exposed to how it works. And it fits very well into our grade 12 curriculum in the units on sound and on refraction of light.

Texas Instruments gave a very interesting workshop on their new Calculator-Based Laboratory (CBL). The CBL will accept data from a number of compatible sensors. This is then processed by a TI82 or 85 graphing calculator. It has a number of advantages over computer-based labs because of its much lower cost, and its portability. They are available in current catalogues.

There were some excellent plenary sessions by scientists in various fields related to physics. Jeffrey Hoffman, NASA astronaut talked about fixing the Hubble Space Telescope. The main mirror was out by a thickness of 1/50 the thickness of a human hair, but had to be within 1/10 of the wavelength of light. A repair mission was planned fo 1995 anyway to make other repairs and replace various pieces of equipment to allow for new experiments. Another such mission is planned in 1997. Astronaut training involved 400 hours of working underwater, and virtual reality simulations to choreograph each step of the repairs. The object is to keep time outside the space vehicle to a minimum. The result is a telescope of incredibly good resolution. We saw this as Heidi Hammel, a very animated astronomer from the Naval Astrnomical Lab, described her team's work in studying the impact of the Shoemaker-Levy 9 comet on Jupiter. The pictures from Hubble revealed the different impacts in great detail, and even showed Jupiter's aurora in an ultraviolet scan. The Imax film, "Destiny in Space", apparently includes much of the repair work.

OAPT Conference Details

Starting on page 4 is the programme for the June OAPT Conference in Guelph. Get your registration in early.

See you there!

PHYSICS DEMOS

Compiled by Pat Cannan
Physics Institute
Woodrow Wilson National Fellowship Foundation
Box 642, Princeton, NJ 05842

The Swing Era:
Hang several pendula of different lengths from a semi-rigid support. Challenge students to get a particular pendulum swinging to the exclusion of the others by pulling on a rubber band attached to the support.

Spring String:
The classic demonstration of a mass suspended between two strings, protecting the upper string from breaking by its inertia does not communicate the importance of a stretchable string. If the string were absolutely unyielding, the upper string would break every time. By replacing the upper string with a spring, a slow motion of the mass downward stretches the spring and visibly puts tension on it. A rapid jerk on the string breaks it without significant stretch of the spring.

The Big Attraction:
With a charged lucite rod, rubber rod, or golf tube, attract an empty pop can. Balance objects on the dome of a watch glass and observe the effects— everything up to a 2-meter 2X4 will work. Small charged objects may be discharged with an anti-static gun available at a record store. The gun has a piezoelectric crystal connected to a sharp pin. The potential developed on the point creates ions that stream off the point and discharge whatever.

Funneling Momentum:
Suspend a large funnel from a support so that it can spin freely. Fill it with sand and release it, giving it a small initial angular velocity.

Splitting Hairs:
A human hair held in the laser beam will produce a single-slit interference pattern. (The hair forms a single thin barrier.) The width of the hair can be

THE PRISONER

by

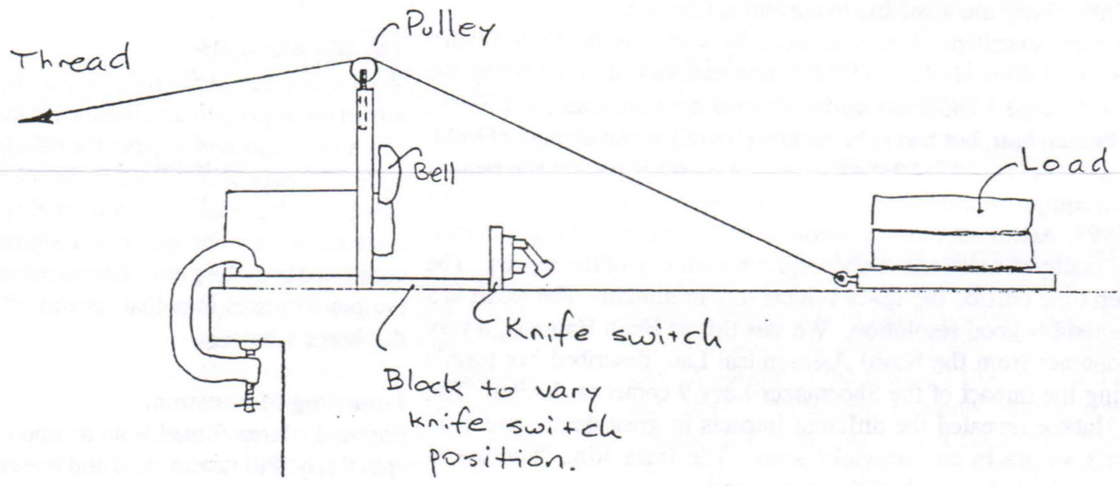
John Childs

Grenville Christian College
P.O. Box 610
Brockville, Ontario K6V 5V8

This is an exciting force vector demonstration, which is guaranteed to create some pandemonium in your classroom! It can be done just as a visual demonstration, or as the introduction to a stimulating and challenging problem to get everyone in the class working. Your better grade-12 students can pursue the solution to a considerable length.

Set up the apparatus as shown in the diagram. The basic idea is to mount a low-friction pulley wheel (such as the PASCO smart pulley) about 40 cm above the edge of a table. It should be rigidly mounted, so as not to flex. Three pieces of wood as shown, with the vertical piece drilled to accept the rod of the pulley, work well and allow for a C-clamp to hold it down. Arrange a push button or knife switch near the base of the pulley. Wire a loud bell to ring if the switch is closed. A plastic box or wooden slab that allows for a variable mass load is then pulled toward the pulley with a doubled thread. By looping the thread through a hole or screw eye, you can avoid a knot which would significantly reduce the tensile strength of the thread.

Using a strong cord, display the setup to your class, and diagram the forces and their components. Pull the load up to the switch and ring the bell. A good loud ringing bell always helps for an effective demonstration! Now slap a $5 bill on the table and announce that you'll give it to the student who can repeat the demonstration, making the bell ring. Your "ace in the hole" is that you get to substitute the thread for the string! To pull on the thread, you will need to wind it around a pencil, or supply a glove. As the force required to move the load increases, the tension in the thread and the classroom increases dramatically. The student doing the pulling knows from experience when the breaking limit of the thread is near, and will become more and more desperately careful to try and win the prize. I am always amazed at how everyone in the class seems to hold their breath, or even gather around the table to cheer on their friend. I have had students repeatedly come within a millimetre of the switch when the thread broke! The snapping thread brings down a chorus of hoots and hollers as students yell "let me try!"



With some testing before class, you can arrange things pretty easily so that the string <u>always</u> breaks before it rings the bell. (Except for Murphy's Law!) You can modify the load to increase or decrease friction, or move the switch in or out from the base to change the angle necessary to reach it.

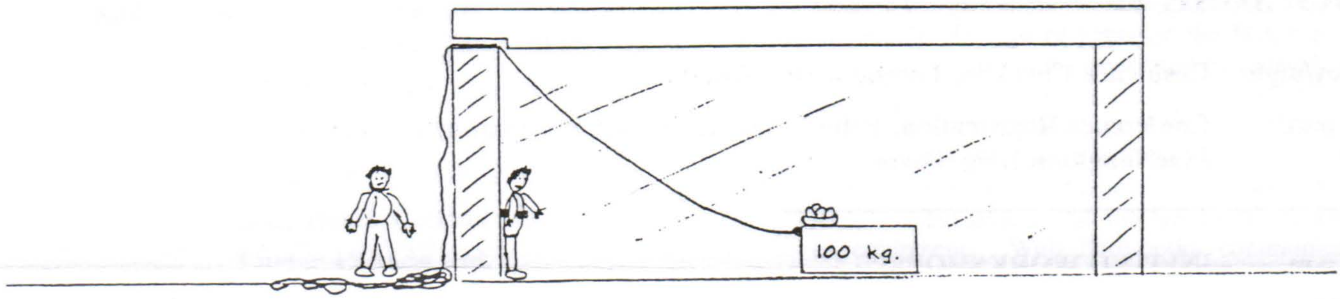
The analysis of the force vectors shows that, when the load is far away (about a metre or more to start), the applied force is nearly the same as its horizontal component, due to the small angle. As the box approaches the switch, the applied force acts at a greater angle, so it must increase considerably in order to apply the same horizontal component to keep the box sliding against friction. Of course, as the vertical component also increases, it reduces friction, and makes things even more interesting.

With a load of two bricks (3 to 5 kg), the thread should break when it is about 10 cm out from the base of the pulley. As the load gets closer to the switch, and more likely to break, students invariably slow down the motion of the box for fear of "overdoing it". If the dimensions are set up to bring the box within millimetres at the breaking point, a good student may realize that this is the most crucial time not to stop, as static friction is greater than kinetic friction, and could easily mean the difference between success and failure.

The demonstration can be set in the form of a test or extra credit problem in an interesting "Indiana Jones" format, as below. As the problem has several ways of arriving at a solution, it lends itself to a thorough discussion and analysis. I have prepared detailed notes that I use as student handouts, covering the solution explanations, that I would be glad to send to anyone requesting them.

"The Prisoner"

Your wealthy friend has been chained to the wall of a dungeon, without food, for many days. You cannot get into the room, and the only way to save him is to pull on the rope and drag the 100 kg box with the food and keys on it so they can reach him. Your friend can reach out only 1 m, and the top of the box is 1 m above the floor, and 7 m away from the wall where he is chained. The rope goes through a hole in the wall 5 m above the floor. The coefficient of friction between the box and the floor is 0.55. The rope is old and rotten, and will break if you pull on it with more than 500 N of force. Can you save your friend? Prove your conclusion in detail, using short explanations as you work. If you can save your friend, you will be rewarded with one million dollars! If you cannot save him, how close does the box get before the rope breaks?



Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, NIG 2Wl.
Email: elm@physics.uoguelph.ca

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

Talk to me!

(But not through the Village. More E-mail problems. If you sent me I message and you didn't hear back from me—my reply is floating around in cyberspace somewhere...Sorry...try my UWO account, its more reliable)

Send comments, compliments, criticisms to: Paul Laxon, 201 Chestnut Street, St. Thomas, ON, N5R 2B5

fax: 519-633-9014
e-mail: plaxon@edu.uwo.ca

Membership Due?

The date on your address label is the expiry date for your membership. If it says **June 95**, your membership will be expiring soon. You may use the coupon below (or a reasonable facsimile) to renew it.

Membership Application Renewal

Name ____________________

Address ____________________

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$8.00 per year, payable to the OAPT
Send to: Ernie McFarland, Department of Physics,
University of Guelph, Guelph, Ontario N1G 2W1

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (OAPT) CONFERENCE

June 22 - 24, 1995

University of Guelph

Celebrating 100 Years of Physics Teaching on the Guelph Campus

DETAILED PROGRAM

THURS. JUNE 22

All day/night **Residence Check-in, Lambton Hall Residence**

6 - 9 p.m. **Conference Registration, Folder Pickup, Workshop Assignments, etc., MacNaughton Bldg. Foyer**

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7 - 9 p.m. **INVITED WORKSHOPS:**

CHAOS AND FRACTALS

John Childs (Grenville Christian College, Brockville)

Discover the unimaginably beautiful, complex, exquisitely stunning world of fractal geometry and chaos! This fascinating new subject is storming every area of modern science. The new laws of chaos describe everything from heartbeats to hurricanes, forest ferns to continental coastline. The fractal images that can be generated from the Mandelbrot set (discovered in the early 1980s and called the most complex object in mathematics) reveal an infinitely large world to explore. We will look at the wonderfully simple means to generate these images and demonstrate a half-dozen computer programs that explain and describe their formation. These programs are available free of charge to anyone interested. This topic can be a wonderful independent study for the OAC Physics course, and this workshop can provide enough background to get you started. (MacNaughton Bldg. Rm. 101)

USING INTERNET TOOLS AND RESOURCES IN SCIENCE TEACHING

Tom Craig (Administrative Consultant, Wellington County Board of Education)
and **Susan Moziar** (Microcomputer Software Co-ordinator, College of Physical and Engineering Science, University of Guelph)

This workshop will focus on the use of the Internet resources in science teaching. It will be aimed at beginners and explain the use of tools such as ftp, gopher, and the WWW (World-Wide Web) for finding and downloading useful scientific information. (MacNaughton Bldg. Rm. 306)

MAKING HOLOGRAMS

Dianne Ness (Humberside C.I., Toronto)
and **Bill Konrad** (Chatham Kent S.S.)

A limited budget need not keep holography out of reach for your students. Attend this workshop and see first-hand how about $200 to $250 will equip your lab for holography. The benefits to physics enrolment and interest is fantastic. And it's a lot of fun! Workshop participants will make holograms using a simple process that has been proven to be effective in the classroom. (MacNaughton Bldg. Rm. 301)

TEACHING MODERN ELECTRONICS TO HIGH SCHOOL STUDENTS

John Wylie (Toronto French School)

The International Baccalaureate program in physics has an optional unit on modern electronics in which the students experimentally investigate a variety of simple solid state circuits and learn about switching, memory, signal amplification, and logic. The unit could easily be used as a locally designed unit for the OAC course in physics. Participants in the workshop can work through four labs used in the unit as well as play with a number of demonstration circuits. A shopping list, unit syllabus, and sample examination questions will be provided. It is a relatively inexpensive experimentally-based unit -- a set of five lab setups can cost less than $150. (MacNaughton Bldg. Rm. 302)

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9 - 11 p.m. **Social (hosted by Physics Dept., U. of Guelph), University Club, Level 5, University Centre**

FRI. JUNE 23

All day/night **Residence Check-in, Lambton Hall Residence**

8:30 a.m. - 3 p.m. **Registration, Folder Pickup, MacNaughton Bldg. Foyer**

8:30 - 9 a.m. **Exhibitors: MacNaughton Bldg. Foyer**

Addison-Wesley Publishers

Boreal Labs Ltd.

Canadian Nuclear Association

D.C. Heath Canada Ltd.

Luctor Canada Ltd.

Merlan Scientific Ltd.

Northwest Scientific Supply

Tangent Scientific Supply Inc.

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9 - 10:15 a.m. **Welcome & Invited Paper, MacNaughton Bldg. Rm. 105**

SIMULATION OF WIND AND SNOW ENVIRONMENTAL PROBLEMS BY SCALE MODELS AND ANALYSIS BY PHYSICS AND ENGINEERING

Frank Theakston (F.H. Theakston Environmental Control Inc., Consulting Engineers, Fergus, Ont.)

By applying the fundamental principles of physics and engineering (particularly fluid mechanics and hydraulics), the simulation of environmental problems and solutions related to city planning, high-rise buildings, architecture, airports, Arctic townsites, hospitals, schools, ski resorts, agricultural projects, highways, etc., has been made possible by laboratory techniques. The presentation will be accompanied by some rather exciting slides to show the development of this type of simulation, with the conceptual research beginning at the University of Guelph.

10:15 - 11:00 a.m. **Exhibitors, coffee, and 100th Anniversary Unveiling, MacNaughton Bldg. Foyer**

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11 a.m. - 12 noon **CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105**

LIGHT-WAVE COMMUNICATION

Peter Scovil (Waterford D.H.S.)

11:00 - 11:30 a.m.

This presentation will show the use of inexpensive materials in demonstrating how light can carry information. A good photocell attached to a small amplifier with speaker can give some interesting effects. You can listen to the 120-Hz hum of lights or the flicker of a candle flame. An LED can be modulated by a signal generator, a microphone, or a pocket radio. The signal can then be picked up by the photocell, and the students can hear the results. It is interesting to "hear" a TV remote-control unit or the reflection of a laser from a bar code. A parts list will be available so that teachers can make a similar set of equipment. With fibre-optics communications so widespread, it is important for students to see what light modulation is and how it works. It fits very well into our grade 12 curriculum in the units on sound and refraction of light.

DOING SOMETHING ABOUT THE WEATHER

Stuart Quick

(Scarborough College, University of Toronto)

11:30 - 11:45 a.m.

The hardware and software now exist at reasonable cost to enable teachers in the schools to receive real-time weather pictures from the polar orbiter satellites, NOAA12 and NOAA14. This activity could support the teaching of aspects of physics, meteorology, geography, and other sciences. In this talk I will display some samples of the pictures I have received with the station at Scarborough College, and provide hard-copy details of suppliers of the equipment and resource people one can call upon for (free!) advice.

I UNPACKED MY GRANDMOTHER'S TRUNK -- A LOOK AT PHYSICS TEACHING IN THE 1890s

Malcolm Coutts

(Retired, but not inactive; Guelph)

11:45 a.m. - 12 noon

I will give a brief description of the Ontario Secondary School system as it was in the 1890s. Copies of old textbooks, and perhaps examination papers, will be on display. Using the overhead projector, I will show excerpts from old physics texts and comment on them.

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12 - 1:30 p.m. **Lunch, South Residence, Mountain Cafeteria**

Exhibitors, MacNaughton Bldg. Foyer

FRI. JUNE 23 (continued)

1:30 - 2:50 p.m. **INVITED PAPERS: MacNaughton Bldg. Rm. 105**

HIGH TECH AND HIGH TOUCH: TEACHING PHYSICAL SCIENCE TO NON-SCIENTISTS

Richard Jarrell (York University)

1:30 - 2:30 p.m.

This presentation gives a description of an experimental course in astronomy for non-science students, given during two summers at York University to classes of 140 and 165. It combined high-tech multi-media lectures with high-touch group work and should be applicable to any teaching of science to non-scientists.

WHAT'S NEW ON PHYSICS DAY AT CANADA'S WONDERLAND?

Alan Hirsch (Port Credit S.S., Mississauga)

2:30 - 2:50 p.m.

Physics and Science Day at Canada's Wonderland has become very popular. This presentation will address several questions, including the following:

(a) What are ways of getting the most out of a field trip to Canada's Wonderland?
(b) What changes are planned for 1996?
(c) What suggestions can physics teachers make to help improve the event?

BONUS: door prizes will be given at this presentation.

2:50 - 3:20 p.m. **Exhibitors and coffee, MacNaughton Bldg. Foyer**

3:20 - 5 p.m. **CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105**

TEACHING OBSERVATIONAL ASTRONOMY FOR GRADE 10 SCIENCE USING SKYGLOBE

Dianne Ness (Humberside C.I., Toronto)

3:20 - 3:35 p.m.

Skyglobe is shareware software that is available for PCs. It is a wonderful tool to let students investigate the night sky over hours, days, months, and years. Using sheets written especially for the purpose, students at Humberside C.I. investigated the motion of stars over a night, the retrograde motion of Mars through Leo this winter, and the phases of the moon. In light-saturated Toronto, our students made their observations using our cross-curricular computer lab. This computer program has changed the way we teach astronomy.

THE UNFOLDING OF THE UNIVERSE

Presiding: **Greg Marshall**
(Ottawa Board of Education)

3:35 - 4:00 p.m.

This talk will provide information about a number of issues of importance and relevance to physics educators in Ontario.

THE SPEED OF 1.25-MeV PHOTONS IN SOLIDS

Kari Dalnoki-Veress, John Dutcher,
and Innes MacKenzie (University of Guelph)

4:00 - 4:15 p.m.

It used to be a common practice to calibrate time-to-amplitude converters (TACs) by measuring the flight time of gamma rays over a pathlength of the order of 50 cm. Because gamma rays cannot be refracted appreciably to form collimated beams, these measurements depended on positron annihilation for the production of anti-parallel pairs of 0.511-MeV gamma ray photons. From that background, there evolved an experiment for undergraduate students in which the "refractive index" of solid rods having low atomic number (Z) could be measured for these annihilation photons. Absorption limited the range of possible media to those having $Z \leq 12$ (magnesium).

Replacement of the conventional plastic scintillators by very efficient, fast, inorganic scintillators allows us to use the photon pairs (mean energy of 1.25 MeV) from the radioactive decay of ^{60}Co. The improvement in time resolution permits a reduction in the flight path to 10 cm, and the increased penetration permits a choice of media with Z up to 40 (zirconium). The apparent speeds, precise to about 0.3% in a 5-hour measurement, will be shown for a range of densities up to 7.8 g/cm^3. The deviations of up to 3% in the "refractive index," depending on density and rod diameter, are caused by scattering.

GENERATING FORCE VS. TIME GRAPHS OF MODEL ROCKET ENGINES

John Childs (Grenville Christian College, Brockville)

4:15 - 4:30 p.m.

A highly motivating investigation into the impulse of a model rocket engine is possible using a simple apparatus setup. Using a home-made device that mounts a model rocket engine on a spring-loaded sliding arm, and a record player to drag a strip of paper under a felt-tipped pen, an accurate and reliable force vs. time graph can be generated. After calibrating the force and time apects of the equipment setup, students can analyze the area under the curve to find total impulse. These graphs compare favourably with those made by the engine manufacturer. Your students are not likely to forget watching and hearing the static test firing of a model rocket engine!

FRI. JUNE 23 (continued)

USING CD-ROMs IN TEACHING PHYSICS
Judy Evans (Streetsville S.S., Mississauga)
Bill Konrad (Chatham Kent S.S.)
Alan Hirsch (Port Credit S.S., Mississauga)
4:30 - 5:00 p.m.

CD-ROM technology provides a valuable research tool for both students and teachers. Our talk will focus on the skills required to find information using CD-ROMs as well as the advantages of doing so. This will be followed by practical, hands-on experience using CD-ROMs.

5:00 - 6:30 p.m. **Free time [Optional: trying CD-ROMs (see previous paper), or research lab tour]**

6:30 - 9 p.m. **Banquet, Peter Clark Hall, Level 0, University Centre**

Guest speaker:

Jim Hunt (University of Guelph)

100 Years of Physics Teaching on the Guelph Campus

(Spouses & Friends Welcome)

SAT. JUNE 24

9:00 - 10:00 a.m. **INVITED PAPER: MacNaughton Bldg. Rm. 105**

HIGH LATITUDE CYCLOGENESIS AND AIR-SEA INTERACTION: A LINK BETWEEN THE FAST AND SLOW CLIMATE SYSTEMS
Kent Moore (University of Toronto)

The scientific community has identified the need to improve our understanding of both the ocean circulation and the global atmospheric transport of water vapour (the predominant greenhouse gas), if we are to refine our predictions of anthropogenic climate change. An important unknown pertaining to the circulation in the ocean is the mechanism(s) responsible for the formation of the cold, salty, and dense water that forms in the high-latitude marginal seas of the Arctic Ocean and which sinks to the bottom of the ocean. It has been recently observed that the formation of this dense water is a highly episodic event that occurs in convective plumes that may be only 10 km in diameter. Concerning the transport of atmospheric water vapour, more information is needed on the mechanisms responsible for the formation and evolution of coherent cloud systems. At high latitudes, the short-lived and intense atmospheric phenomena known as polar lows represent an important class of such cloud systems about which we know very little. Fluxes of heat, moisture, momentum, and trace gases across the air-sea interface play a key role in coupling the ocean's circulation to the transport of water vapour in the atmosphere.

In this talk, I will discuss the idea that the very large surface fluxes of sensible and latent heat associated with polar lows and other cyclonic systems may be sufficiently large so as to trigger the formation of these oceanic plumes. If this is so, then it represents a potential coupling between the "fast" climate system and the "slow" climate system that warrants further study.

10:00 - 10:30 a.m. CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105

A LAB TO MEASURE AND COMPARE THE ACCELERATION OF A CART AND A BALL-BEARING AS A FUNCTION OF TRACK ANGLE
Dianne Ness (Humberside C.I., Toronto)
10:00 - 10:15 a.m.

Using a track, two photogates, a Y-adapter (available from Pasco for $40) and a software program (free from Humberside C.I.), students measure the acceleration of first a cart and secondly a ball-bearing as a function of track angle. An instruction sheet is available outlining the experiment and how to use the apparatus.

THE GUELPH-WATERLOO-McMASTER INTERACTIVE VIDEO-LINK
Jim Hunt (University of Guelph)
10:15 - 10:30 a.m.

The development and operation of the Guelph-Waterloo-McMaster interactive Video-link will be described. The link was built to service primarily senior and graduate courses in physics and chemistry, and so particular attention has been paid to the transmission and legibility of graphic material and the layout of the classrooms. In addition, the system has been designed to operate without technical attendance, using microprocessor control to simplify the lecturer's control functions.

10:30 - 11:00 a.m. **Coffee MacNaughton Bldg. Foyer**

Video-Link Room open (see previous paper), MacNaughton Bldg. Rm. 101

SAT. JUNE 24 (continued)

11 a.m. - 12 noon INVITED PAPER: MacNaughton Bldg. Rm. 105

SUDBURY NEUTRINO OBSERVATORY (SNO)

John Simpson (University of Guelph)

SNO is an international project led by Canadian universities to build a detector of solar neutrinos in a mine near Sudbury. This project has been ten years in the proposal, planning, and construction phases, and is now about one year from completion. The scientific purpose, technical aspects, and construction progress will be reviewed in this talk.

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12 - 1:15 p.m. Lunch, South Residence, Mountain Cafeteria

1:15 - 3:10 p.m. CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105

THE ELECTRIC HOT DOG AND THE ELECTRIC PICKLE

Roland Meisel (Ridgeway and Crystal Beach H.S.)

1:15 - 1:30 p.m.

A nice example of a change in electrical resistance with heating occurs when 120-V AC is directly applied to a hot dog. This can be extended to a kosher pickle whereupon an additional interesting phenomenon occurs.

MAGNETIC MONOPOLES

John Wylie (Toronto French School)

1:30 - 1:55 p.m.

While magnetic monopoles do not officially exist, there are compelling reasons to believe that they might. Starting with a simple comparison amongst magnetism, gravity, and electostatics, the concept of a magnetic monopole is developed and its properties characterized. By understanding how monopoles may be detected (should they exist), and touching upon the concept of superconductivity, insight is gained into one of the great mysteries of nature: charge quantization. This talk is based on an article written for "Quantum" magazine, and uses only basic high school physics to develop a topic that is fascinating to most young physicists, but rarely touched upon at the high school level.

MY EXPERIENCE USING "PRESENTATION SLIDES" IN THE CLASSROOM

John Earnshaw (Trent University)

1:55 - 2:15 p.m.

Here's how I taught an entire lecture course with nothing but a notebook computer. I'm overwhelmed at how easy it was, and at the student responses.

I will describe what "presentation slides" are, give two or three examples from my actual classes, and show how easy it is to make them and show them.

SEARCHING FOR SOMETHING FUNDAMENTAL IN BODE'S RULE

Elio Covello (Huron Heights S.S., Newmarket)

2:15 - 2:30 p.m.

Bode's rule is a curious relationship discovered by Titius and popularized by Johann Bode in 1772. It is used in predicting or memorizing the distances of the planets from the Sun. My students and I have been trying to express Bode's rule as a rational physical relationship that contains the gravitational constant, G, so that this "rule" is not just an empirical descriptive coincidence. This is the story of that exercise, its successes and failures.

PHYSICS AND ART

George Vanderkuur (Toronto Board of Education)

2:30 - 2:55 p.m.

Art and science are both creative activities which are surprisingly similar. While scientists see aesthetic merit in their work, artists may find satisfaction in applying scientific principles to communicate their message.

This talk uses soap bubbles, birefringence, optical activity, random numbers and trajectories to describe projects where students integrate Physics and Art.

ALTERNATE CONCEPTIONS IN CURRENT ELECTRICITY

Elgin Wolfe
(Faculty of Education, University of Toronto)

2:55 - 3:10 p.m.

Alternate conceptions (sometimes referred to as misconceptions) refer to a person's understanding of a concept that differs in significant ways from the commonly accepted scientific understanding. This presentation will give an outline of the research that has been done around the world concerning students' misconceptions about current electricity. As well, a classroom research project that took place in Ontario in 1994 with over 400 stuents will be described. A selection of the instruments used and the results will be shown, the findings will be summarized, and strategies and activities will be suggested for helping students narrow the gap between their understandings and scientists' and engineers' views. Students' conceptions ranging from the Intermediate Level to the Senior Level and beyond will be discussed.