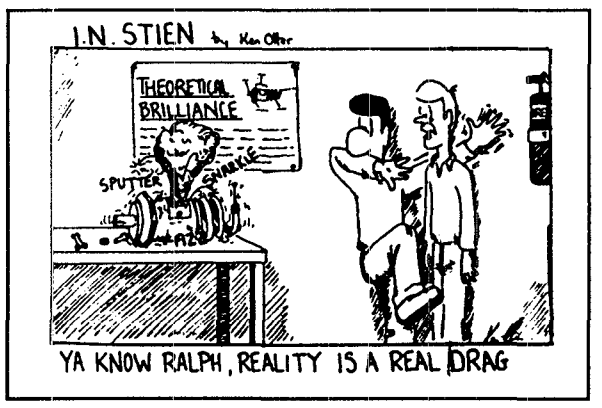
UBC Archives Serial

the 432

WEDNESDAY

UBC's SCIENCE NEWSPAPER

UBC, Vancouver November 18, 1987



Those totally Remarkable Dinosaurs

by Kyle R. Kirkwood

It is hard to imagine a scientist skulking through the bush to stick a thermometer under the tongue of a Tyrannosaurus, or up the rectum of a Diplodocus. Yet many scientists would literally give up an arm or a leg for the chance to solve a debate even more fundamental than extinction. Were the dinosaurs warm-blooded or cold-blooded?

Classically, dinosaurs were thought of as reptiles, because of their skeletal anatomy. The traditional syllogism of dinosaurs held that because modern reptiles are cold-blooded, the dinosaurs must have been cold-blooded too. A fresh look at the dinosaurs show many very non-reptilian habits and many mammalian and bird-like qualities.

Like birds and mammals, dinosaurs stood with their legs held in the vertical position below their hips and shoulder while the legs of modern reptiles extend outward from the sides of their bodies. Long limbs and muscle-scars, preserved on fossil bone, testify that many dinosaurs stood erect and could move with surprising speed. Fossil footprints reaffirm the speed of many of the dinosaurs, and indicate social groupings such as herds.

No cause and effect relationship between posture and physiology have been established, but only the dinosaurs and modern endotherms (warm-blooded animals) had erect posture and a swift gait (manner of walking or running). It seems likely that the long term energy expenditure required for the ostrich and horse like gaits of some dinosaurs, is far in excess of the levels attainable by modern ectotherms.

Cold-blooded, or ectothermic animals such as the modern reptiles and amphibians are dependent on their external environment to elevate their body temperature whereas birds and mammals are endotherms capable of thermoregulation. Temperature regulation is possible because endotherms produce their own heat by having a high basal metabolism, fueled by the oxidation of glucose and fatty acids.

Unlike endotherms, ectotherms do not have feathers, fur or an insulating fatty layer to maintain their body heat. Ectotherms also lack the ability to cool their bodies by panting or perspiration. Endotherms have four times the activity level of ectotherms and are thus able to be active day or night, under a variety of environmental conditions.

A great expenditure in time and energy is spent in maintaining the subsistence levels in endotherms. A Cheetah requires its own weight in food every ten days, to maintain a normal metabolism, while the Komodo Dragon, a carnivorous lizard, consumes its own weight in food every sixty days. A cheetah's ten day diet could easily sustain six Komodo dragons for a month!

The gigantic proportion of many of the dinosaurs is equaled only by their gigantic appetites, respiratory and cardiovascular systems. Dentition and jaw shape detail a herbivorous diet for most dinosaurs. An African elephant eats 120 kilograms of greenery a day and spend up to fifteen hours foraging. A twenty-five ton "endothermic" Brontosaur would consume over 800 kilograms of fodder a day. Quite a feat for an animal with a head the size of a horse, not withstanding the fact that most of the flora that sustains modern tetrapods did not exist. The dinosaur's world lacked angiosperms, flowering plants, grasses and grains, vegetables and fruits. The herbage of the Mesozoic era was just about as nutritious as dirt.

Hot & Heavy Gets a Cold Shoulder

Birds and mammals have a four chambered heart, two chambers work at high pressure to pump blood to the brain and vital organs, the others at a low steady pressure to maintain flow to the lungs without damaging the fine network of the body's capillary system. Reptiles have a two chambered heart that works at low pressure, although some crocodiles have an imperfect version of the four chambered heart. The greater the vertical distance from heart to brain, the greater the required pressures. The single low pressure pump of most reptiles would be useless, to the tall standing Tyrannosaurus. The long necked Brachiosaur, like the modern giraffe, would it seems have had a double pump, four chambered heart.

The imperfect double pump of the crocodile, helps support this hypothesis, an evolutionary path emerges the dinosaurs may have followed. It also indicates equally as well that ectotherms can develop four chambered hearts independent of endothermy. Proof of endothermy in dinosaurs is pre-emptory, it can only be said that the dinosaur heart and circulatory systems were capable of endothermy.

Armand de Ricqles, a french anatomist and paleontologist at the University of Paris has noted that dinosaur bones are riddled with tiny channels resembling the secondary Haversian canals found in mammals and birds. Capillaries are routed through the Haversian canals, which supply nourishment to bone cells and calcium and phosphorus to the bone as well. Dissolution and reformation of secondary Haversian canals has often been taken as an index of metabolic activity of an organism's mineral intake. A more active animal, an endotherm, would show greater activity because it has to eat more to maintain its metabolism—therefore the more it eats the higher its mineral intake.

The great size of the dinosaurs mean a huge biochemical budget, supplied by their vast appetites, which subsequently would be equated as a large mineral source. Large modern reptiles, such as crocodiles and turtles have Haversian canals, many small mammals do not. Haversian canals it seems may be related to the overall growth rate and body size rather than endothermy.

Endotherms grow quickly, ectotherms much more slowly, a crocodile may grow to full size in seven years, and ostrich in one year. Lots of Haversian canals are indicative of fast growing bone, the canals of crocodiles are generally less developed, additionally crocodiles have arrest lines, evincive of slow growth. Jack Horner of the Montana State University's Museum of the Rockies, surveyed the rate of growth of embryonic and juvenile duck-billed dinosaurs, Hardrosaurs. A fairly clear picture of a thirty-three centimeter hatchling growing to four meters in one year emerged. The Hardrosaurs showed signs of Haversian canals and no arrest lines, obviously very rapid growth. The problem in assuming this as proof that this dinosaur was warm-blooded, lies in the assumption that only endotherms show rapid growth, their have been no studies of living animals to support such a contention.

A good strategy if your adult form is inherently big, is to be born big and eggs can only be so large. The lack of Brontosaur eggs, the pitted infant bones like that of infant mammals, and the large birth canal of the female has lead Robert Bakker, an avid supporter of dinosaur endothermy and a paleontologist at the University of Colorado, to theorize that Brontosaurs gave live birth.

Some snakes give live birth, and the mammalian monotremes lay eggs as do birds, proof or disproof of endothermy is once more eluded.

Oddly enough the newly born Brontosaurs are about one-fourth their adult size, while the Hardrosaurs were born one—twenty-seventh their mature form. The large sized Brontosaur grows at a much slower rate, more like and ectotherm, the Hardrosaur sprouts up like an endotherm.

The number of prey animals required to support a vigorous predator community can be expressed as the predator-prey ratio. The carnivorous dinosaurs had big mouths, large teeth and were able to consume large quantities of high-protein flesh to sustain an endothermic metabolism, as Bakker's predator-prey ratio would seem to support.

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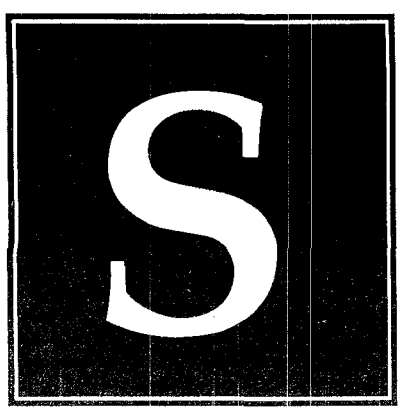
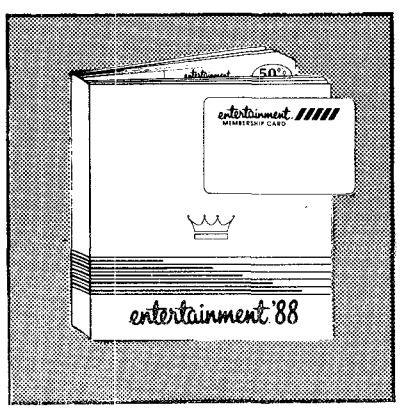
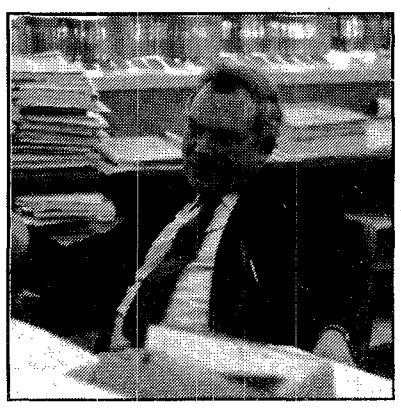






UBC Physics Department Joins Race For Superconductors

Superconductors. They could change your life, says UBC physicist Jess Brewer, who "can't help but marvel a little bit" at the latest phenomenon to cause high-energy excitement in the physics world. Superconductors transmit power without loss of energy. The trick is to make them at a reasonable cost.

"The world will never be the sam," says Brewer. "Superconductors will allow us to develop hydro-electric resources in the country and move power down to the cities with virtually zero loss of energy. This is going to have important industrial impacts." And superconductors will impact on many other areas such as transportation, where magnetic trains might be feasible; in medical diagnosis, in the field of nuclear magnetic resonance body-imaging, and in super computers.

Although superconductors were first discovered back in 1911, Brewer says "there has been more progress in the last six months than in the last 50 years. Everybody wants to know more."

To date the problem has been that known superconducting compounds have had to be cooled with costly helium. So the search over the past 75 years has been to find compounds that would become superconductors at less extreme temperatures, particularly above 77 Kelvin (-196 Celsius) the point at which nitrogen gas, a common and less expensive gas, liquifies.

"Armies of physicists have devoted their lives to the search for a high temperature superconductor to no avail - now suddenly it is sitting in our laps. Never in the history of material science has so dramatic a breakthrough occurred so suddenly with such complete awareness of its full technological implications already in place," Brewer said.

Last year, IBM in Zurich produced super-conducting compounds at 35 Kelvin. In recent experiments, U.S. physicists reported producing a superconductor at 93 Kelvin (-180 Celsius).

As scientists around the globe race to produce superconductors and congregation of 1,000 physicists met in New YOrk to compare notes, physicist Walter Hardy and undergraduate student Reinhold Krahn produced a superconductor at UBC.

Brewer reports that someone casually remarked "wouldn't it be nice to have some of this material at Open House. ONe thinks of these things as highly sophisticated and very expensive, but Walter simple looked at it and said, 'it doesn't sound too hard to me'."

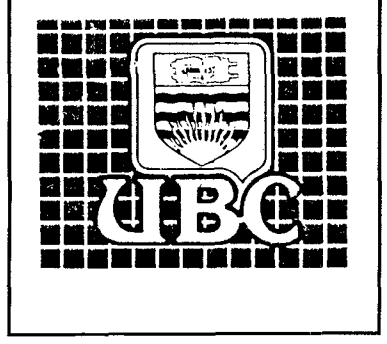
UBC's first superconductor was made at 35 Kelvin at Open House, March 6, 7 and 8. Experiments have continued, and on March 16 the physics department made a superconductor at 92 Kelvin.

It's been a co-operative effort. Since it is resistance that converts electric energy into heat, it is important to measure electrical resistance, a job tackled by physicist Jim Carolan and students Pinder Dosanjh and Rob Low. Fortunately, UBC has a ceramics expert in Asoke Chaklader, a professor of metallurgical engineering who with assistant Glenn Roemer is now producing the material in collaboration with the physicists. It is hoped to develop improved materials with appropriate metallurgical properties for practical application.

"We are riding on what other researchers have done," says Hardy, "At first we were working on rumors, then on an actual recipe."

At TRIUMF, one of the few facilities in the world where equipment exists to probe inside these materials, Brewer and other researchers tested the UBC superconductor and one from Bell Laboratories in New Jersey.

"It's something the whole world can't ignore. It is like the invention of the transistor. It is very hard to guess at the monumental effect it will have," says Hardy.



Giant Jellyroll Preserved at UBC

Every now and again nature produces a cruiosity, an exagerated feature far removed from the norm. One local geological feature is so unusual that the BC government recently stepped in to make a life-sized impression of it. The four by seven metre cast has just been installed in UBC's M.Y. Williams Geological Museum.

The Lytton jellyroll is not, as its name suggests, a tasty local dessert. It's a sedimentary formation of sand and clay tha tgeologists call a turbidite, and is open to view in a Ministry of Highways grave pit two kilometres south of Lytton. Structures such as the jellyroll are usually measured in centimetres, rarely in metres. The Lytton jellyroll is one of the largest, spreading four by five metres.

"SUch structure give scientists a considerable amount of information about the physical processes of sedimentation," said Joe Nagel, Curator of UBC's Geological Museum. "THe Lytton jellyroll is special because of it's size."

Scientists speculate the jellyroll was formed in an ice-bound lake during the last glaciation of the are, 12,000 years ago. An underwater lanslide disturbed the sedimentary deposits on the lake bottom causing them to slump away. Instead of breaking up and dispersing, the layers rolled up like a jellyroll. Subsequent deposits covered and protected the anomaly.

Mr. Nagel was a key figure in negotiations with the Bc government several years ago to mark and protect the jellyroll site. Working with the Lytton Heritage Society, and the Lytton Chamber of Commerce, he prompted the Heritage Conservation Branch to step in to preserve this unique feature of BC's natural heritage before it was lost to erosion.

The Heritage Conservation Branch called in PML Exhibit SErvices, a Calgary company which has developed a specialized process for this kind of project. Technicians first sprayed the jellyroll with a mixture of laytex rubber to hold the loose grains of sand in place. They then covered it with more than 1,000 patches of burlap dipped in rubber to take the impression, and backed the mould with fibergalss to sitffen it. The process takes a negative "copy" of the jellyroll; a positive reconstruction was then made from the mould.

It was a timely move, three days after work was completed, part of the Lytton jellyroll slumped away.

In addition to the jellyroll repica at UBC's Geological Sciences Museum, a second casting will go on display at the Lytton Heritage Park Museum.

UBC Scientists Create New Biopharmaceutical Industry

Six UBC scientists are moving from their ground floor university lab to an ocean front research facility to open a multi-million dollar biopharmaceutical industry.

Dr. Pieter Cullis, the biochemist who heads the venture, said the team is working to develop anticancer pharmaceuticals that will eliminate cancerous tumors without causing toxic side effects to areas of the body which are not diseased.

The new business, called the Canadian Liposome Company (CLC), is a subsidiary of the Liposome Company Inc. of New Jersey. The parent company is financing the venture at a guaranteed minimum of $1 million a year for three years to get the business off the ground. After that, a new contract will be negotiated. CLC opened its doors in the Lonsdale Quay area of North Vancouver on September 1.

"I believe in a few years, liposomes will form the basis of an important pharmaceutical industry," said Cullis.

Liposomes are tiny drug-carrying sacs composed of the same fatty acids or lipids that make up cell membranes. Lipid membranes can be made to form spheres which entrap drugs inside, for delivery later to a diseased site. Developers say one day they may be targeted almost as guided missiles, carrying massive doses of drugs to their targets without being absorbed by other parts of the body.

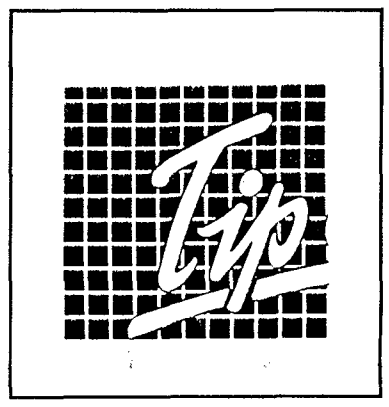
Dullis' team has developed the use of liposomes to deliver the highly toxic drug, doxorubicin, the world's largest selling anticancer drug. Administered freely into the blood stream at doses high enough to kill cancer, doxorubicin can cause cardiomyopathy which leads to congestive heart failure. When UBC researchers used liposomes to administer the drug to animals with tumors, they found their survival time increased with minimal heart damage.

CLC's task is to make the liposome-doxorubicin combination and other liposome-drug combinations suitable for commercial distribution. Cullis believes his company's research and the parent company's clout will make it work.

"It's been our tactic to get associated with somebody who really does have business expertise and the pharmaceutical contacts we need," he said. "The Liposome Company is based in an area where you find Squibb, Johnson and Johnson — just about every major pharmaceutical company you can think of — so they can set up research and development partnerships with those companies. From a business point of view, it's almost essential."

The new business was spawned from contract research by the university for the Liposome Company during the last three years. CLC will continue to use UBC resources through contract grants to the university and Cullis will maintain a tenured professorship.

He estimates it could take five years before his company is ready to market its research.



New Marine Research Program to Provide Practical Solutions

Scientists will soon be working together in a new laboratory to find the best ways to manage B.C.'s 12,000 kilometers of coastline.

A $150,000 grant from the Donner Canadian Foundation will enable researchers from the University of British Columbia, Simon Fraser University and the Federal Department of Oceans and Fisheries to set up a Marine Ecosystem Program (MEP). It's the first integrated marine research program of its kind in B.C.

"The growth of fisheries, industries and recreational use on the West Coast calls for a better understanding of the long-term effect of man's activities on the marine environment," says MEP spokesperson and UBC Oceanography professsor Timothy Parsons.

"MEP will provide the opportunity for specialists in a variety of disciplines to undertake joint projects with direct applications."

Program results will influence water management policies and affect the way in which fishermen, fish farmers, bathers, boaters, scuba divers, marina operators and others utilize coastal waters.

The Department of Fisheries and Oceans is donating space and services at the West Vancouver seawater laboratory. The project has received additional funding of $70,000 from the UBC Research Development Office, Simon Fraser University Research Development and the Natural Sciences and Engineering Research Council of Canada.

Parsons predicts the program will be in full operation by the spring of 1988.

Scientist Seek to Stimulate Nerve Regrowth

Some nerves in the human body regenerate and others don't. UBC zoology professor Dr. John Steeves would like to know why. When his research produces some answers, they may go a long way towards helping people who are disabled from spinal cord injuries.

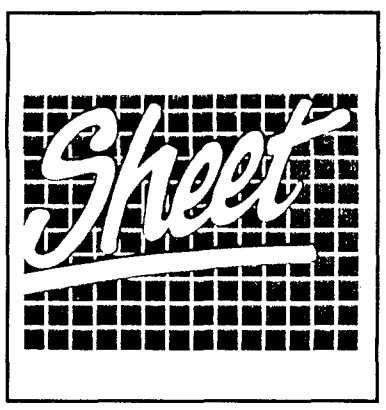
"If a person has an accident which servers a peripheral nerve in their arm, a surgeon can rejoin it and it will regenerate," says Dr. Steeves. "But if a person suffers an injury in which the nerves in the spinal cord or brain are damaged, they do not regrow. We are trying to understand what the criteria are for regeneration."

Before birth, embryonic birds and mammals (including humans) have an ability to regrow any nerves in the body. After birth, this ability is lost. Dr. Steeves works with chicken embryos in an attempt to find out what it is that stimulates the regeneration in the egg and why it is lost in the adult bird.

"As scientists our focus is shifting," says Dr. Steeves. "Until recently, spinal cord research focused on rehabilitation and mobility for disabled people, rather than a cure. There was nothing we could do for people with spinal cord injury except to help them regain maximum mobility. Now we have more resources and techniques available to us to try and find some answers."

He emphasizes there is no "quick-fix" cure. "This kind of problem cannot be solved in a few months, or even a few years," says Dr. Steeves. He has spent more than ten years on basic research trying to identify which neurons travelling from the brain to the spinal cord turn on locomotion — these neurons are now the focus of his current work into generation.

"Our project extends indefinitely," Dr. Steeves says.



Courtesy of UBC Community Relations

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Geneticist Says Family Medical History Key to Your Health

UBC Community Relations

A family medical history can be a priceless gift, according to Dr. Judith Hall, a professor of medical genetics at UBC and director of the Clinical Genetics Unit at Grace Hospital.

"We try to help people understand how important it is for them to know the medical history of their family. They know they are of German or French ancestry, that granddad was a ship's captain, but frequently they do not know what their grandparents or even their parents died of. Yet, practically speaking, they are likely to die from the same thing," says Dr. Hall.

She says knowing early enough that you are predisposed to a disease can help to decrease complications. And decreasing complications can reduce health costs. Studies show this approach can make a major impact on the individual.

"It seems to me that grandparents have a moral responsibility to inform the family about disorders which have occurred in the family and which family members may be at risk to develop. If people know their family medical history, they may be able to modify their lifestyle at am early age which will be very much to their own benefit."

She said a family doctor often can tell a patient what to do to keep healthy and avoid a disease to which they are predisposed.

She said thousands of diseases and disorders, like heart disease, strokes and some cancers, run in families. It is important to ask questions not only of family members but of the physicians who cared for them.

"Why did your father have a stroke? Talk to your father's doctor. Were there high lipids or fat in the blood? High cholesterol runs in families but there is a lot you can do if you have that predisposition. It may take 20 years to accumulate the fat in the lining of blood vessels which lead to strokes, but if you are forewarned you can modify your diet. If high blood pressure was the factor leading to a stroke in your family, you can have your blood pressure monitored regularly, go on a low salt diet, receive medication and other treatment if required."

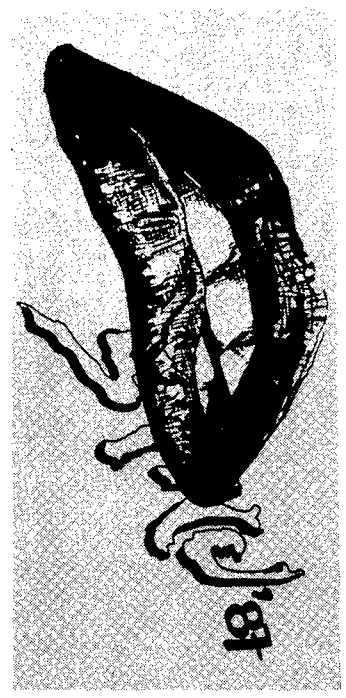
Dr. Hall stresses the importance of an autopsy.

"The more carefully we question the cause of death, the more aware we can become of our own and our children's risks.

"We are moving into an era where people talk about things which used to be family secrets and not discussed. Today, families need to talk about whether they want their organs to be used for transplantation. If they want to donate organs they might as well have an autopsy which may help the whole family know if there are familial conditions which can be prevented or treated."

The medical genetics clinic provides counselling to families who are predisposed to congenital anomolies and other familial disorders. Dr. Hall specializes in dwarfism as well as working with the parents of children born with spina bifida (open spine) and babies with arthrogryposis-stiff joints.

"Blown Away"

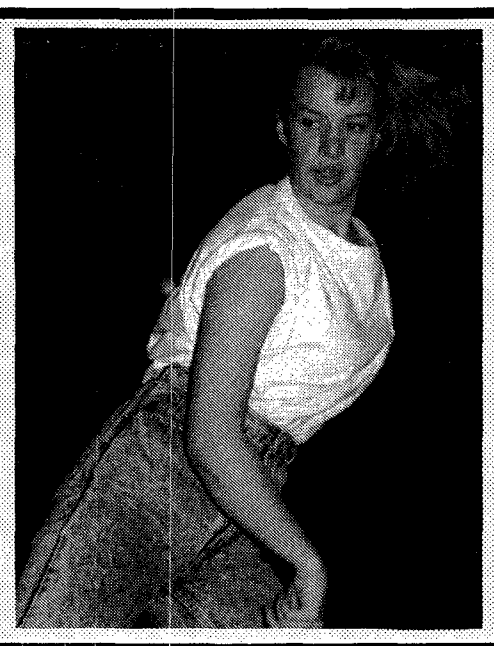


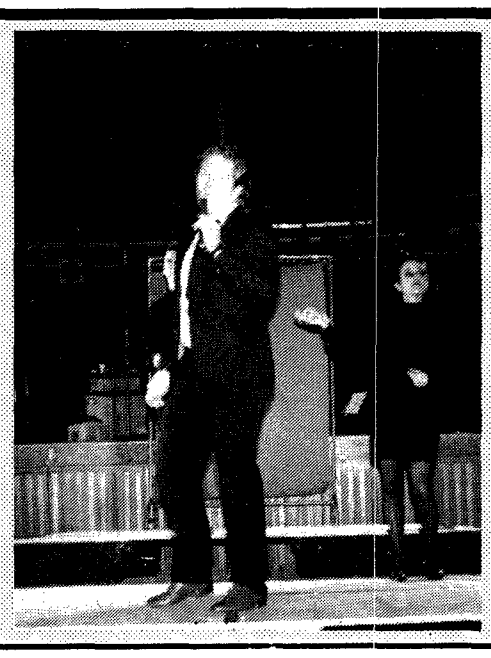
Teaching Excellence Award

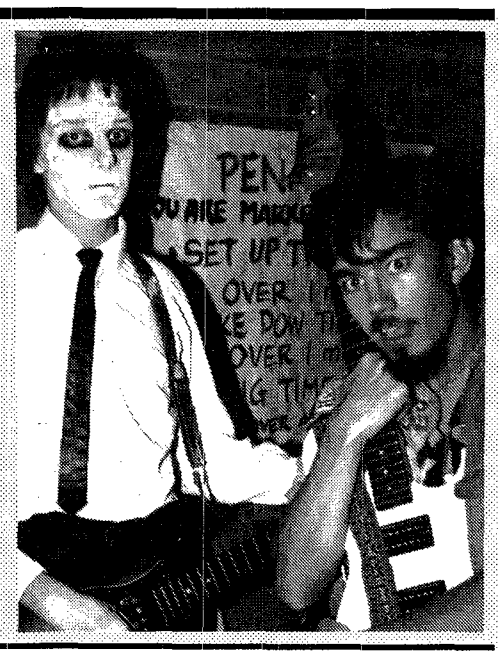
The following professors have been nominated for the Teaching Excellence Award. Class visits, to these professors, will be held from Nov. 16-27, by our committee members.

Professor	Department
Dr. G. Bates	Chem
Dr. A. Merer	Chem
Dr. W. Milsom	Biol
Dr. L. Roberts	Math
Dr. D. Godus	Pcth (pharmacology &therapeutics)
Dr. J. Pearson	Phyl (physiology)
Dr. E. Meagher	Geol
Dr. J. McMillan	Phys
Dr. P. Matthews	Phys
Dr. W. Ramey	Micb
Dr. M. Gerry	Chem
Dr. H. Brock	Zool
Dr. R. Anstee	Math
Dr. B. Ahlborn	Phys
Dr. R. Perkins	Chem

Academics Coordinator
Linda Lo.







SUN	MON	TUE	WED	THU	FRI	SAT
24	25	26	27	28	29	30
	* Departmental Display in SUB Concourse	* Departmental Display in SUB Concourse. * Chem Magic Show.	* Blood donor Clinic in SUB Concourse	* Paper Airplane contest 12:30 Hebb Theatre	* Departmental Tricycle Race down Main Mall	
Films Ratings 1. Star War Trilogy -308 2. Rocky Horror Show -264 3. Blade Runner -240 4. Star Trek IV -126 5. Platoon -114		* Films	* Car Rally	* Broomball Tournament (sign up a week before)	* Dance/Beer Garden * Scavenger Hunt	* Boat Cruise/ Crystal Ball.

DAY TIME

NIGHT TIME

Only 10 Weeks

by Rose Lai -Science Week Coordinator

Are you aware that Science Week is ONLY 10 WEEKS away. Ten weeks sounds distant but I must remind you that after our Christmas break, Science Week is just around the corner.
It is from January 24 to the 30th. Remember this!

-There is a *BROOMBALL TOURNAMENT* on Thursday night, January 28. Registration will be a week before the game night.
-*THE GROUSE MOUNTAIN SKI CHALLENGE* will be a pre-Science Week event, and it will take place on January 21st, the Thursday before Science Week. Please register *NOW* at the SUS office in Scarfe 9 or at the intramurals office(SUB lower floor). Registration ends on January 15 or the first 125 people to sign up, which ever happens first! There will be an awards dinner and dance after the race.
-If it is possible, we will do the *CHEMISTRY MAGIC SHOW* twice. This will give everyone a chance to see it.
-Each department will send a team of 3 students, 2 T.As and 1 professor to the *TRICYCLE RACE* on Friday noon, January 29. There is going to be an award for the best-looking tricycle.
-We will have a *BOAT CRUISE* on Saturday night, January 30.
I am in the process of looking for a boat cruise company that will accommodate 150 people or more on board with a price range between $15.00-$20.00 for each individual. Other factors such as a bar, a live band, food, etc., will be considered. If you have any information, please come and see me in Scarfe 9 or leave a message in my box. Your help will be greatly appreciated.

Remember, Science Week is *THE* time to show the rest of the campus who we are.

S

continued from page 1

The lower energy requirements of the ectotherms would, it is assumed, mean that ectothermic predators would make up a larger portion of the total population, and subsequently have a higher predator-prey ratio. In Africa such predator-prey ratios of modern animals range from 1-3%.

Bakker's calculation of the predator-prey ratio for late-Cretaceous Montana and Alberta dinosaurs was identical to that of modern Africa. For every three kilograms of Tryannosaur muscle, there was roughly 100 kilograms of herbivore. In the pre-Mesozoic world of the Thecodonts, the dinosaurs' immediate ancestors, the ratio is 35-60%.

Pierre Beland and Dale Russel of the National Museum of Natural Sciences in Ottawa, found error with Bakker's numbers; the recalculated total was four times greater, a ratio as high as 12%, which as Bakker pointed out still fell within the limit of the "endothermic" range.

Beland and russel argued successfully to many that the fossil record was not statistically reliable as proof for or against endothermy. THe relative abundance of fossils could more likely to be preserved. Disease, reproductive rates and natural disaster would affect the fossil census, skewwing it either up or down. While the pre-Mesozoic numbers would support Bakker's contention, they fall prey to the same problems. A question so far not raised or answered by paleontologist concerns the possibility of a warm-blooded predator hunting ectothermic prey - how would this affect the predator-prey ratio?

Nicholas Hotton, of the Smithsonian Institution surveyed known dinosaurs and reported that 80% of living mammals are smaller than the smallest dinosaur. The smallest adult dinosaur presently known, Compsognathus, weighs in at three kilograms. More than half of the dinosaurs weighed over two tons.

If any one physiological strategy was selected by the dinosaurs it was size. A large body will act as a thermal reservoir when it gets cold and an insulator when the outside temperature rises. Thermoregulation, something endotherms do all the time by having hair or feathers to maintain heat, or sweating and panting to lose heat that has been created by their basal metabolism. But thermoregulation is also something homeotherms do, by any other processes, such as being so big that the body stores heat like a reservoir - inertial homeothermy. Homeothermy is an endotherms way of being warm-blooded.

The giant sauropods, such as the Brachiosaurs and Diplodocus would have acted as warm-blooded because of their size. Hotton, Beland and Russell have collected data which indicated ectotherms and endotherms become more alike with increasing size. A similar metabolic rate would mean a low predator-prey ratio. Because the inertial homeotherms would spend less time eating than endotherms, of the same mass, and spend less energy just foraging the overall effect would be to decrease their energy need. A simple analogy would be to describe ectotherms as a bicycle, slow and very fuel efficient. Ectothermic homeotherms are less fuel efficient sedans, but with a lot more carrying power, finally an endotherm would simply be a gas guzzling Porsche or Ferrari, fast and zippy.

One-hundred-twenty-five million years ago and as early as 65 million years ago the world was very different. Paleobotany and palanology (the study of spores and pollens) indicate a mild, world wide climate somewhat warmer and dryer than today with less overall climatic variation. Giantism and hence inertial homeothermy would prove very successful under such conditions.

Dinosaur bones are found as far north as the Yukon, even then part of the Arctic, and far to the south in Argentina which suffered much colder winters than today. Bakker argues that the dinosaurs must have been warm-blooded, and that not even homeothermic dinosaurs could have wintered there. Yet the wild distribution of these same fossils hint that the dinosaurs may have migrated north and south as do modern birds. Bakker retorts that ectotherms are not capable of the prolonged exertion of migrating. Hotton suggests that the exertion of migration would generate a constant source of body warmth. Additionally migration dinosaurs would be exposed to similar temperatures year round and prevent over-grazing. The rock record offers no proof for either supposition, but inference has been made from the herd like collection of fossil footprints and the wide distribution of many genera.

Archaeopteryx, a small bird-like winged dinosaur had feathers, ectotherms have no need for insulating feathers or fur, but endotherms do. Their size means that many smaller dinosaurs could not have been effective inertial homeotherms. A good inertial homeotherm needs to be over 100 kilograms, as were most dinosaurs; the effectiveness of inertial homeothermy is severely tested with creatures smaller than 50 kilograms.

Deinonychus "terrible claw" was discovered in 1964 in south central Montana; John Ostrom, a paleontologist from Yale, found the foot of bipedal dinosaur with a single inner toe that ended in a scythe-like claw. The claw was obviously a weapon used to rip open prey, but its very use required Deinonychus to leap on one foot to slash out with the other. Such intricate manoeuvrers and extraordinary agility, poise and balance, are not at all reminiscent of modern sprawling, sluggish reptiles. Deinonychus had to have had a very unreptilian bioenergetic system, to be the predaceous hunter its physiology indicates it evolved into.

There is much inference and speculation involved in the debate over endothermy in dinosaurs, and a lack of cause-and-effect relationships to support much of that speculation. Overall the public as well as paleontologists have looked at the dinosaurs as a single entity, either warm-blooded or cold-blooded. The taxonomic variation between the dinosaurs is probably as great if not greater than that of the mammals who include such relics as the egg-laying platypuses.

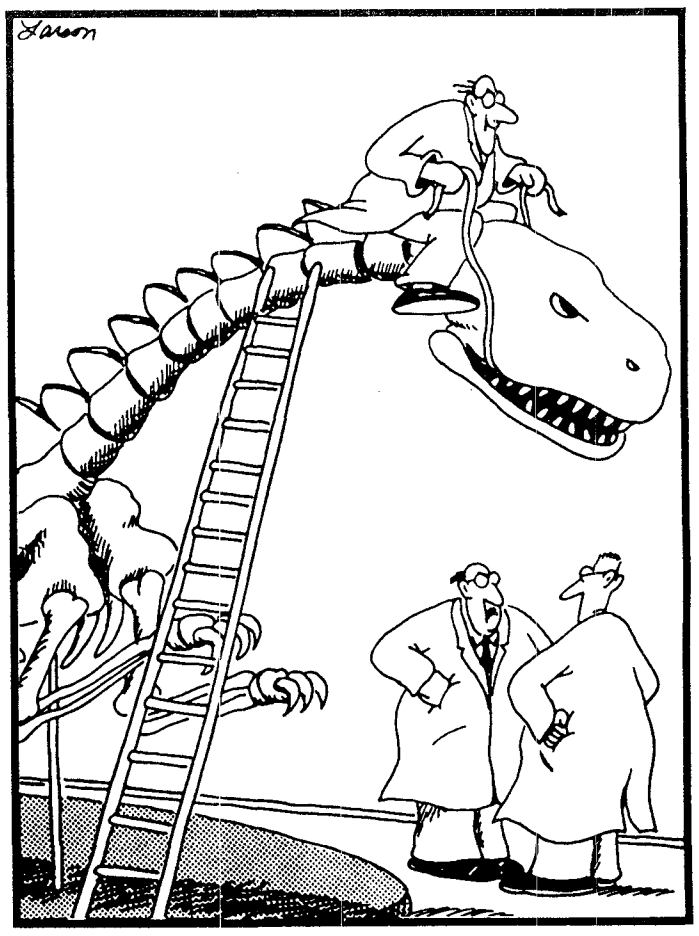
The giants of the dinosaur kingdom because of their large adult and birth size, the mild climate, and lack of an endothermic sustaining food resource, would best be served as ectothermic homeotherms by evolution. The nature of dinosaur selection for large size, helps to support this hypothesis,

Centrosaurus

DINO

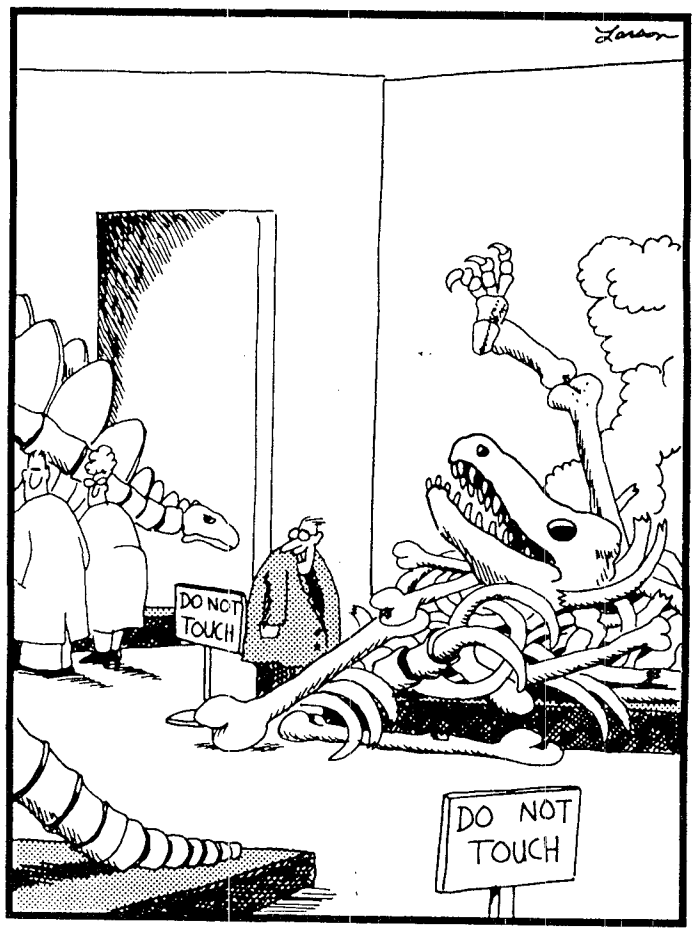
Pictures by William Stout

GAUR



"I assume you're being facetious, Andrews . . . I distinctly yelled 'second!' before you did."

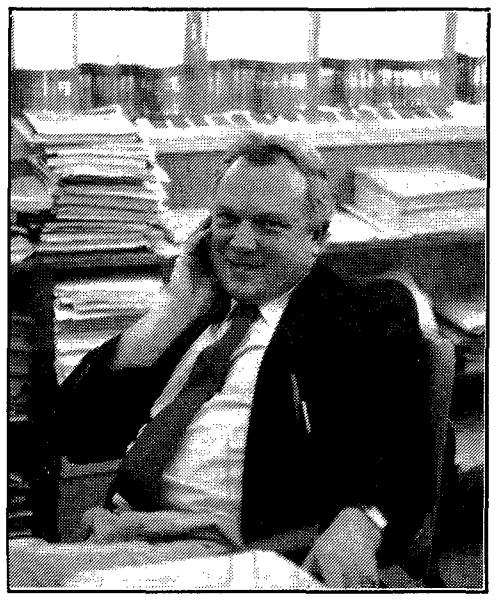
Illustrated by Tom Weller



"A clean desk is a sign of a sick mind."

by Gillian McNamara

When we walked into Dr. Scudder's office, one of the first things we noticed was a small sign reading "A CLEAN DESK IS A SIGN OF A SICK MIND." This is obviously a philosophy he lives by. Every square inch of desk, shelf, and floor space in his large office is covered with paper. There are stacks and stacks of it. Files, documents, drawings, research, newsletters, et cetera adorn every nook and cranny. As Dr. Scudder stood up to greet us it was hard to believe such an ordinary looking person could possible be responsible for all this paperwork. What drives someone to become this involved in his career?



Dr Scudder - Zoology

Naturally, one of the first questions we asked Dr. Scudder, after exclaiming over all the paper, was "What made you decide to go into Zoology? Why did you do it?"

"Well, I grew up in the country, so I started natural history observations very early on, and started work with insects when I was eleven. I wanted to be an entomologist when I was eleven, and never changed my mind."

A simple beginning for an extensive career... Dr. Scudder went on to obtain a Zoology degree at Wales university, and finished off with his PhD. at Oxford in Entomology. He eventually became a world expert on the seed bugs (Hemiptera) and, of course, head of Zoology at U.B.C.

Dr. Scudder describes Zoology as all studies involving animals, including such areas as organisms, processes, ecology, morphology, et cetera. He was appointed to the position as Head by a committee, and when asked why, he modestly says, "I don't know, maybe no one else wanted it - ha, ha."

Department administration takes up about 70% of his time, but he still carries a full teaching and research load, and has published 9 papers so far this year. He is also the academic curator of the Spencer Entomological Museum, a world-recognized collection of insects from B.C. and the Yukon, which is kept upstairs in the BioSci. building. His other activities include

- just finishing his term as president of Entomological Society of Canada
- chairing the Pacific Science Assn. standing committee in Entomology
- will be president of Zoological Society of Canada in 1-2 years
- has run the Biological Survey of Canada for the past few years, but is now stopping
- president of Western Universities Marine Biological Society, which runs Bamfield Marine Station

These added responsibilities take up about 5-6 days/month of Dr. Scudder's time, and then, of course, there's the paperwork....

Dr. Scudder describes research in Zoology at U.B.C. as very strong in ecology and comparative physiology. A new program in Biotechnology has now been added to research in Zoology, Botany, and Microbiology, with four labs devoted to this. Also, there is a new thrust in Zoological research towards aquaculture and fisheries.

Dr. Scudder mentions some recent developments and achievements in Zoology research at U.B.C.:

- Dr. P.W. Hochachka has just received the B.C. science gold medal for his research in adaptations to living without oxygen.
- Dr. C. J. Drebs has received a government grant for a controlled experiment in the Yukon to investigate the 7 year cycles in snowshoe hares. This is a costly project as it involves surrounding acres of land with nets so such factors as predation and food supply can be controlled.
- Dr. J.E. Phillips, who works on physiological processes in insects, has just discovered a new hormone and is trying to sequence this.

Dr. Scudder's own research is the systematics and taxonomy of the seed bugs (Hemiptera), including their ecology, physiology, and morphology.

"Why seed bugs?" we asked.

"I just like them. They're the first group I became interested in —at age eleven—and I guess it's also because I had someone to help me learn their names and a little about them."

In his lab, Dr. Scudder and his graduate students investigate such topics as the adaptations to saline ponds in aquatic Hemiptera, and the relationship between the bright red and black Hemiptera and the poisonous milkweed plants on which they live. He himself studies the Hemiptera of the entire earth, travelling to Africa and Asia often to do research. Only 2 people in the world study the entire earth's Hemiptera population, so Dr. Scudder's depth of knowledge is very unique, and he is known throughout the world as the expert in this field. He has most currently been studying the Hemiptera of New Zealand, and recently was concentrating on the populations of Indonesia and Korea as well.

Dr. Scudder considers this world classification as his "hobby", and his eventual goal is to produce an enormous monograph (book) on the Hemiptera of the world. He began his project in 1957.

Working towards his dream, Dr. Scudder spent 25 years mastering all the literature written by other seed bug researchers. He has worked in every major entomological museum in the world, photographing specimens and learning about them. He says he is very lucky to have started early so he had the time to do all this - now it is no problem to keep abreast of new discoveries.

We were allowed to see some photos of drawings done for Dr. Scudder in the course of his research. They are very detailed light microscope drawings done in pen and ink, perfect to the last detail.

"I have over 500 of these, all done for me by artists," he told us with pride. The drawings are all original, and of immense value to him - so immense he keeps the originals in a safety deposit box under lock and key!!!"

Dr. Scudder hopes to finish his book sometime in his seventies, taking a bit more time to work on it in the future. When it is finished (at least, as much as possible with all the new discoveries), he will have over 800 different taxa described and classified. It's a mammoth-sized project, but for someone will this kind of drive and determination - you can bet he'll finish!!!"

The Nutrasweet Fairytale

by Peter MacDougall

Aspartame; also known as Nutrasweet.

If you look carefully at the list of ingredients of a can of diet pop, it will give you some idea of what aspartame is.

It reads, "lipids 0 g/ml; carbohydrates 0 g/ml," at least for diet 7up, "proteins 0.05 g/ml; apsartame 50 mg/ml; may contain phenylalanine." Since 50 milligrams per ml is the same as 0.05 grams per ml and phenylalanine is an amino acid, you could expect that aspartame is a protein.

In fact aspartame is a substituted di-peptide, containing aspartic acid, phenylalanine, and a C-terminus carboxy methyl ester.

The result is a structure that in a 4% solution is 200 times sweeter than a 4% solution of sucrose. Because aspartame is so much more sweeter, and because it is a di-peptide, aspartame can give foods the same amount of sweetness as sugar could without giving the food the same amount of calories.

Since aspartame is a di-peptide, made of amino acids which occur naturally in our diets, there is less concern about aspartame causing cancer than saccharin. It also does not have the bad aftertaste. However, aspartame is not without its side-effects.

As a di-peptide, where carbohydrates cause your mouth to water, aspartame activates stomach activity, causing the release of gastric hormones, acid, and peptidases, like any other protein or peptide.

The digestive by-products of aspartame, aspartic acid and phenylalanine, have specific roles in the body's metabolism. Aspartic acid is converted to oxalo-acetic acid which is used in the tricaboxylic acid cycle in all mitochondria. Phenylalanine makes its way to the brain where it is used as precursor for various neurotransmitters; epinephrine (adrenaline), and dopamine are two examples.

Aspartame has been suspected of causing brain seizures mainly because large amounts of phenylalanine can possibly lead to an imbalance of neurotransmitters in the brain, causing brain dysfunction. Neurotransmitter imbalance has been linked to schizophrenia, and manic depression. However, it would take a great deal of phenylalanine to cause an imbalance.

If there is an excess of any amino acid in the body, the amino acid is degraded rather than stored. When phenylalanine is degraded, one of the intermediates produced is phenyl pyruvic acid which can cause damage to the myelin sheaths of developing brain cells if it is present in great quantities. PKU is the genetic disease where phenyl pyruvic acid accumulates due to an enzyme defect, leading to brain damage in children. The treatment for PKU consists of limiting the child's intake of phenylalanine. This is why it is recommended that pregnant women should generally avoid diet foods containing aspartame and stick to a diet which has a better balance of the required vitamins and amino acids. The developing fetus is more susceptible to high levels of excess phenylalanine and its by-products than an adult.

The main problem with aspartame is not that it is toxic but rather that by consuming large amounts of diet foods sweetened with aspartame, we increase our intake of phenylalanine above what we need. People with a reduced ability to metabolize phenylalanine are at risk if they consume large amounts of aspartame. However it is rare that anyone consumes enough aspartame to cause themselves damage.

How much aspartame does it take to do yourself in? Well, far beyond the amount anyone could readily stomach. From what is known about aspartame, it is safe for normal consumption. However, if you have your doubts, switch back to sugar and use less of it.

Science Students

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Langri-la

A Day in the Life of an E.X. U.B.C. Science Student

by Karl Friedrich Hieronymus von Muenchhausen

I walk away from my Physics lecture somewhat sobered. At least my Chem instructor is a person who takes his profession serious. With some trepidation I remember that an assignment was due today. Panic-stricken I check my notebook. Whew! I had finished it. Joining the growing line of students waiting to hand in their assignments, I idly glance down at my watch and notice there is less than one minute left before the bell rings. Is this line travelling fast enough? My turn comes, I hand my assignment in and turn away. The bell rings.

The instructors harsh grating voice cuts through the turmoil "All students who have not yet handed in their assignments; your assignments are late and you lose 15% of your grade." Justice reigns, and since justice is just, the students gratefully accept it.

Reaching my desk I look at the instructor. Aha, he's wearing brown today. Since his exhaustive wardrobe consists of a blue and a yellow shirt and a pair of brown and a pair of blue pants, we have organized a pool to see who could best predict what he would wear. Well, I guessed right today. By now everybody has taken their seat. The classroom is now packed to capacity with wide-awake students eagerly waiting for this genius to expound his knowledge. His impeccable teaching method imparts maximum time with minimum knowledge. He is a Master in this art!

His long thin hands attached to equally long thin but hairy arms madly scribble information and calculations onto the board. With utter finesse he punches in the correct numbers into his calculator and writes the correct to at least four significant figures answer on the board. His explanations go on and on and so do his calculations, but they all seem to prove one, actually very simple, principle. I wonder when he will actually teach us something. Never, probably, knowing him.

He seems to have made his point and decides to hand back an earlier assignment. When I receive my assignment I quickly scan over my marks. Wow, I got all the answers right but not all my sig. figs.. I look back at my mark. Horrified I see that he has taken off at least 60% of the marks for every question for every sig. fig. error. I am left with a bare Pass even though I had all the answers correct.

I look at the rest of the class who have made many of the same mistakes I did. They all accept this gratefully, thankful to him for taking such pains to be so painstaking. Now if he would only have the same approach in educating us. There is a lot of Chemistry he could cover in an hour. If he could teach us something we didn't know before, his choice of occupation, teacher, would be justified. With growing disillusionment with my classes, I silently reflect on this as I pack up my paraphernalia and leave. The class isn't over yet? So! His dispersal of knowledge certainly is. Let's hope my Physics lab can improve

The Cold

by Peter MacDougall

The first thing security did was purge him.

He had done his best to make it as easy as possible; he had eaten a high fibre,, low nutrient value meal some hours before. It was better than pumping a full or empty stomach but, still, it was awful. That, and his cold. In fact he never felt worse and they had barely begun.

He was coming out of the Union's tightest security institution and they could not allow any leaks of information.

The technicians pumped his stomach: empty. They gave him a purgative (and the worst case of diarrhea he had ever had): empty. He went through two hours of physical and chemical analysis: nothing, no marks or codes on him anywhere. He was X-rayed: nothing in him but a hip pin—which they removed. They tried ultrasound: nothing left in him but flesh and bone. The infrared heat scan showed only that his thyroids and lymph nodes around his neck were hot—but then this man obviously had a cold.

"Anything to declare?" They asked him in a sterile room after the first three hours.

He coughed, his muscles tensing in spasms under his blue skin. He felt awful. He was cold; his head was stuffed; his eyes were like a fish's; his throat was so sensitive. But they already knew that. "No," he said.

So they proceeded again.

They stuck a tube in every opening of his body to have a look by optic fibre. They tried Magnetic Resonance Imaging, Positron Emmission Tomography, a C.A.T. scan, and even flash fried the outer layer of his skin to white ash with ultraviolet light so as to remove any physical markings he might have.

Still they asked, "Anything to declare?"

"No." His nose was runny and red. He looked a pitiful sight but he knew from the beginning that he would have to go through all of this.

They gave him an acetaminophen tablet while he waited naked in the cool, white room. The scientists were conferring, checking and counter-checking. They could not agree and so they did it all again.

"Patience is a lab animal," the man thought as whatever had not come up or out before was purged again. Empty. Nothing.

Finally the security scientists were at an end. He had nothing; he was clean. No chemicals, no marks, no hidden capsules, false fillings, bone inscriptions, abnormalities ... or any way of carrying a message out of the security seal. He was a blank slate.

Packaged in new, featureless overalls so that he left with nothing but himself and the donated fabric, he was released.

"Better get that cold taken care of," the last sentry shouted with an accent.

"I will," the man said, and coughed again spraying bacteria and phlegm in a wide arc. The bacteria hung in the air, invisible, their extra-nuclear DNA jiggling with the encoded secrets of the Union.

Out of sight of the guard, the courier would have laughed hard and long but his lungs hurt too much. He coughed again with a wicked smile on his tortured face. Only a cold. Heh!

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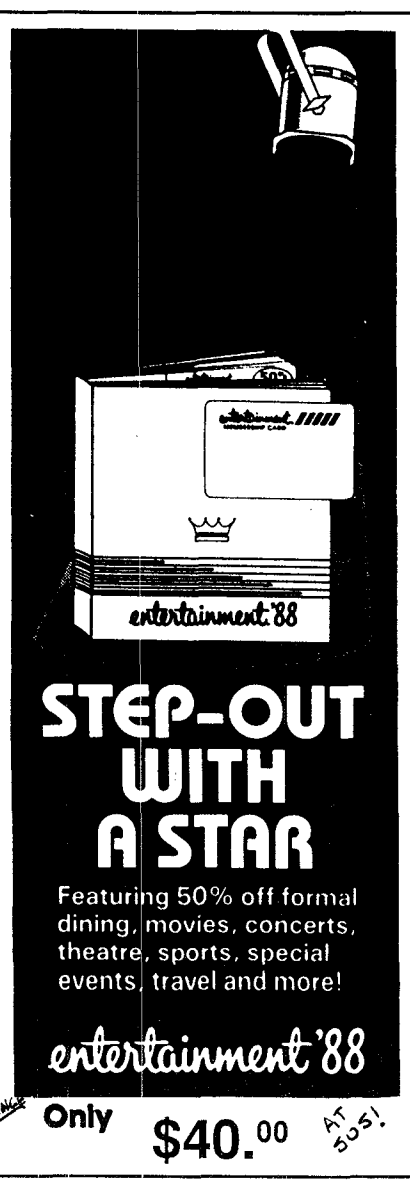

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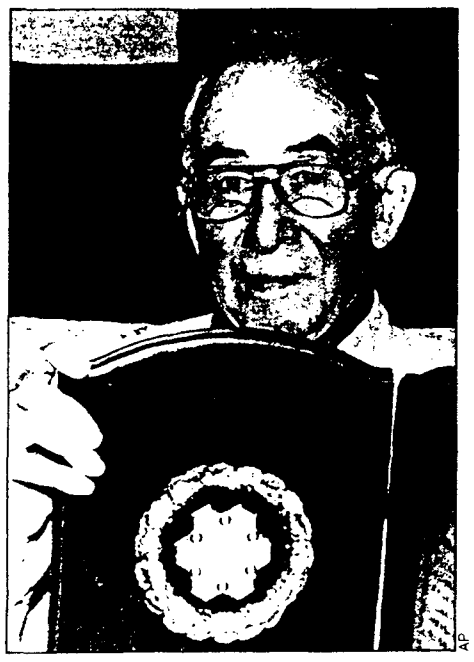
Pedersen's crowning achievement

The 1987 Nobel prizes have rewarded the hottest current areas in chemistry and physics. Prizes go to the chemists who developed molecular recognition, and the physicists who discovered high-temperature superconductivity

Lionel Milgrom

THIS YEAR's Nobel prize for chemistry goes to two Americans, Charles Pedersen and Donald Cram, and a Frenchman, Jean-Marie Lehn. The award acknowledges their contributions to the study of molecular recognition—known as "host-guest" chemistry. Molecular recognition has opened up a huge field of research, not just in chemistry but also in biology, medicine and materials science (*New Scientist*, 1 May 1986, p 44).

Chemists now understand, for example, how one large molecule, such as a protein,



Pedersen: the prize at 83

can recognise and react selectively with another. Molecular recognition has allowed biologists to understand how antigens know their antibodies. And, using the same principles, chemists are designing new chemical sensors to detect specific metals and lethal chemicals in the environment.

In medicine molecular recognition is leading to new systems of delivering drugs. And chemists can make small molecules that perform the same highly selective reactions as enzymes. The future could be more exciting still.

The concept of molecular recognition goes back to a chance discovery by Pedersen, 24 years ago. Pedersen, who is now 83 and retired, was born in Korea, of Norwegian parents. He became an American citizen in 1953. While working as a research chemist, for Du Pont in Wilmington, Delaware, he made a discovery that was pure serendipity. In one of his reactions he used some contaminated starting material. As a result, he obtained a small amount of a by-product along with the main compound he was making.

Being a careful chemist, he did not throw the by-product down the sink, but decided to examine it. He found that it had an unusual structure—a ring of 12 carbons and six oxygens, with two carbon atoms between every oxygen. Chemists now call such a molecule a cyclic polyether. When Pedersen came to study its chemistry, however, there was a surprise waiting.

Caustic soda will not dissolve in organic solvents, such as ether or benzene. However, when Pedersen added his new by-product to the organic solvent with the polyether present, the caustic soda gradually disappeared into solution. So what was Pedersen's new compound doing?

Caustic soda is a solid consisting of positively charged sodium ions and negatively charged hydroxide ions whose electrostatic forces of attraction holds the solid caustic soda together. But when we add water, it binds weakly to both ions, forming a "shell" of six water molecules around each ion. This reduces the electrostatic attraction between oppositely charged ions, loosening the structure so that the ions disperse in the water. In other words, the caustic soda dissolves. Organic solvents, such as ether and benzene, do not bind to ions in caustic soda, so they cannot dissolve it.

Pedersen's cyclic polyether does dissolve in organic solvents, and furthermore, it has six oxygen atoms which bind a sodium ion in the same weak fashion as six water molecules. The polyether then takes up a characteristic coronet shape. For this reason, Pedersen called his by-product a "crown ether". The chemical name is 18-crown-6 or 18C6, because it has 18 atoms in its ring, six of which are oxygens. Du Pont sat on Pedersen's results for four years while the company took out patents. In 1967, Du Pont allowed Pedersen to publish the results.

One of the first tasks for crown ethers was to coax metal ions, such as sodium and potassium, into organic solvents from aqueous solutions. Certain chemical reactions depend on these metal ions to work. Some of these reactions occur only in an organic solvent, and transferring the metal ions from aqueous solution, or phase, and into the organic phase can be a problem. Crown ethers solved that problem by helping the metal ions to change phase.

Chemists can tailor crown ethers to suit various sizes of metal ions. Select your crown ether and you can separate metal mixtures, useful in reclaiming expensive metals. Or hitch a crown ether up to an electrical circuit, with an electrode, and you have a sensor for detecting specific metal ions.

The way metal ions bind to crown ethers has helped biochemists understand the action of antibiotics, such as valinomycin, and how cells transport water-loving sodium and potassium ions across their water-hating cell membranes . One idea is that stacks of crown-ether-like molecules open up channels in a cell membrane, through which metal ions can pass.

Crown ethers do not just receive metals into their central holes. They can accommodate whole molecules if the hole is of the right size and geometry. This is where Cram enters the story.

Cram, now 68, is professor of chemistry at the University of California at Los Angeles. At the time, Pedersen was discovering crown ethers, he was also a

Cram, with his wife and molecules

consultant for Du Pont.

The story goes that Cram was so taken by Pedersen's discoveries he spent a sleepless 48 hours playing with "Lego kit" models of crown ethers, and stalking his laboratory dressed only in pyjamas and dressing gown. Cram realised that one could make modified crown ethers that recognise the difference between mirror-images of molecules that, in all other respects, are indistinguishable: in other words, chiral molecules. This is precisely what enzymes do. It is currently one of the hottest areas in organic chemistry. Mimic the selectivity of enzymes and the production of important fine chemicals, such as chiral pharmaceuticals and agrochemicals, becomes routine and highly lucrative.

Overnight, Cram completely redirected the efforts of his research group to making modified crown ethers. By 1973, the first papers were flowing out of his laboratory. His first success was to make crown ethers that could distinguish chiral amino acids (the building blocks of protein). ▸

▸ It was Cram who later gave molecular recognition the name "host-guest" chemistry. It encapsulates Cram's ideas about molecular recognition—molecules, such as crown ethers, are "hosts" and the metal ions and molecules they accommodate are the "guests".

Cram later designed and synthesised new types of host molecules which were like hollow spheres and hemispheres. Not surprisingly, he called them "spherands" and "hemispherands". They recognise and bind guests much more strongly and selectively than crown ethers.

Ironically, it was the Du Pont connection that led to Lehn's first important contribution to the study of molecular recognition. In 1967, he realised the importance of Pedersen's work. But Lehn also knew about a separate piece of research going on in a different branch of Du Pont. "He was very quick to perceive the possibility of marriage of two ideas from the same company",

Lehn: France's premier chemist

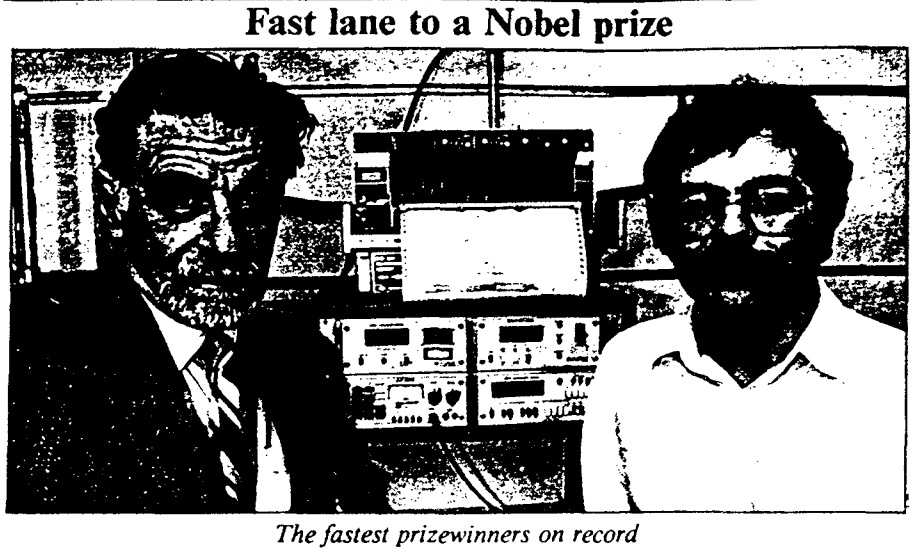
notes Fraser Stoddart, a chemist who specialises in molecular recognition at the University of Sheffield.

Lehn took Pedersen's two-dimensional crown ethers into the third dimension. By replacing two oxygen atoms in the original crown ether with nitrogen atoms, Lehn could add on a second polyether ring to give a bicyclic "cryptand". These bind metal cations more selectively than crown ethers.

Lehn could construct host molecules that specifically recognise biologically active substances, such as the neutrotransmitter, acetylcholine.

Some biochemists disparage the efforts of chemists to copy nature. "You have to be pretty arrogant to design an enzyme," says Stoddart. "What we're learning in molecular recognition will take chemistry beyond the molecule, into biology, materials science and to new electronic devices based on simple organic molecules. Pedersen, Cram and Lehn have pointed the way." □

Fast lane to a Nobel prize



The fastest prizewinners on record

THE AWARD of this year's Nobel Prize for Physics is one of the most amazing in living memory. The surprise is not that Georg Bednorz and Alex Müller snatched this award for their work on superconductivity. Ever since the work of these two scientists became widely known, it was only a matter of time before they collected a Nobel prize. The surprise is the speed.

The Royal Swedish Academy of Sciences usually measures time in decades rather than years when deciding to hand out its prestigious prizes. The academy cannot afford to make mistakes. It usually takes years for a scientific development to arrive and to receive universal confirmation and acceptance. The time scale with this year's prizewinning work was months. According to the academy's citation: "Last year, 1986, Bednorz and Müller reported finding superconductivity in an oxide material at a temperature 12 °C higher than previously known."

The background notes, accompanying the citation, talk of the two scientists reporting measurements in April 1986 of what has since come to be called "high-temperature superconductivity". In fact, the first paper in which the two confidently reported their findings did not appear until September 1986, and it is a safe bet that most of the people who decided to honour this work with the Nobel prize had not heard of it until earlier this year, when hysteria hit science and no laboratory worth the name could resist joining the bandwagon.

This was not, though, some fluke. Over the years, many scientists have tried to produce new superconductors, sometimes resorting to techniques that amount to little more than cookery—adding various chemicals together in an attempt to break the record for the critical temperature, which had stuck at 23 K since 1973. Müller and Bednorz did something far more substantial.

The citation describes the two scientists' work as "a result of systematic work, deep insight and experience of structural problems in the physics and chemistry of the solid state" (plus, one may assume, the intuition characteristic of the true audacity to concentrate on new paths in their research).

Alex Müller has certainly been interested, almost to the point of obsession, with superconductors for some years. Müller works at IBM's research centre in Zurich. In 1979 he spent a year working in New York State at IBM's research centre at Yorktown Heights. Richard Greene, who now works on superconductors at Yorktown Heights, recalls that even then Müller was thinking that he would have to ditch the materials that had so far set the temperature record for superconductivity—mixtures of different metals known as intermetallic compounds. An alloy of niobium and germanium held the record of 23·3 K. He decided to study metallic oxides.

In their first successful attempt to make a superconductor, Bednorz and Müller pushed the critical temperature to 35 K. Alongside materials that have come later, this increase of 12 K looks minor. Already this year, there have been confirmed measurements of transition temperatures around 90 K, plus more dubious claims of materials that are superconductors at around room temperature. But had not Bednorz and Müller put the scientific community on the right track, the record temperature could still be stuck at 23 K.

This is the second year running that the prize has gone to researchers at IBM's Zurich research laboratory. Last year, Gerd Binnig and Heinrich Rohrer won a share of the prize for physics for their work on the scanning tunnelling microscope (*New Scientist*, 23 October 1987, p 22).

This years's physics prize marks a continuation of the trend whereby prizes come from large laboratories, many of them run by companies that see it as an essential part of their R&D to be active at the frontiers of science. Even in the United States, large corporations, concerned about the relative demise of academic institutions, have built up large research laboratories where scientists have access to facilities that are far more modern and expensive than those available in academia. **Michael Kenward**