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THE VIEWS EXPRESSED IN CARET DO NOT NECESSARILY REFLECT THE OPINIONS OF THE
EDITOR, THE FACULTY OR THE UNIVERSITY.

OUR COVER arises from the article, "A Chemist in Thailand". Originally a Buddhist temple wall relief, it depicts the Thai calendar. The outer rim shows the twelve year cycle in which each year of the cycle is represented by an animal.

LAKEHEAD UNIVERSITY FACULTY OF SCIENCE

ACADEMIC NEWS

MASTER'S PROGRAMME IN BIOLOGY

It is anticipated that the M.Sc. (Biology) will commence in July of this year. This is contingent upon the arrival of Dr. Walter T. Momot, an aquatics biologist who is expected to join the staff of the department.

The Ontario Council of Graduate Studies have approved the programme but have specified that only 8 students can be admitted initially. The areas of specialization are also to be somewhat restricted in the early stages with the provision of expansion in the future.

Inquiries should be directed to the Chairman, Department of Biology, Lakehead University.

GEOGRAPHY

The Department of Geography has revised its B.Sc. and Honours B.Sc. programs and has made a series of changes in its course offerings, aimed at providing greater choice for third and fourth year students. A copy of the new programs, with course descriptions, is posted on the Department notice board, and can also be obtained from the Department chairman.

Science students should also note that there is now an Honours B.Sc. program in Geography with Geology minor: this replaces the old B.A. Geography-Geology program.

GEOLOGY

"If you wish to become a geologist you should know that you may combine geological studies with four other disciplines:

- with Chemistry — the most popular and generally most useful combination
 - with Physics — as the basis for a career as a geophysicist
 - with Biology — for careers in the vitally important field of environmental studies
 - with Economics — for careers in the management of non-renewable resources."
-

LETTERS TO THE EDITOR

April 9, 1975.

In Volume 1 no. 3 (p.37) and Volume 1 no. 4 (p.2) of your journal the name of the late Dr. L.S.B. Leakey is misspelled (as Leaky). As a fellow-member of Dr. Leakey's college (St. John's, Cambridge) I owe it to him to set this right.

I would also like to note that his best-known discovery, *Zinjanthropus boisei*, is usually so spelled (not *Zinganthropus*). However, *Z. boisei* was not, as far as I know, also a member of my college. Such an old fossil was probably an Oxford man.

Yours sincerely,
Robert S. Dilley
Lakehead University
Thunder Bay

* * * * *

I am delighted that *Caret* is read, and even scrutinized. Thank you for pointing out our errors to us. On the basis of this information, should the specific name be *leakei* or *leakeyi*, or ...? (May I add that scientific names of organisms are always in a different type from that of the rest of the text, most commonly *italics*).

— Editor

March 12, 1975

I was horrified by the mistatements in the recent article by Dr. Richard Reis.

i) He claims the most *conservative* estimate of the fraction of stars with planetary systems ~ 1 , and that a similar conservative estimate for the fraction of such planets on which life does develop ~ 1 . Most authorities would regard these 'conservative' figures most liberal!

ii) There is still controversy surrounding the existence of planets around Banard's star — and I would hesitate to use this example to give "strong support to the statistical estimation that there may be at least fifty million planets in our galaxy."

iii) He states "it is just as likely that we would be in a position to teach them much more than they can teach us about science

& technology Bolderdash. The human race has been industrialized for about 2000 years — and has around 4×10^9 years before the sun novas. The probability of another civilization capable of communicating with the electromagnetic spectrum (which we have been using for about 50 years) learning from us is incredibly small. In short this article is erroneous and dull.

Surely the editors of *Caret* are capable of instituting a system of referees so that similar misleading articles are caught before they appear in print.

Dr. J.S. Griffith
Lakehead University
Thunder Bay

* * * * *

I am disappointed that Dr. Griffith did not like Dr. Reis' article, but I hope that this difference of opinions will produce some enlightening comments. I would certainly like to hear from Dr. Reis again, but, alas, my attempts to get in touch with him have so far failed. I very much hope that, in the meantime, other readers will send in their comments.

Caret is definitely NOT intended to be a referred scientific journal. I like to read in Dr. Griffith's letter, an offer to review articles for us. I would be delighted to call upon him in future. Meanwhile, I think this sort of controversy adds some spice to life. I like it.

— Editor

True or False?

cataract: a cataract is a waterfall, a cascade. It is better known as an eye condition where the lens or the cornea becomes opaque. It is also a downpour of rain, a rush of water, a steam-engine governor acting by flow of water.

How about

carotid: yellowish or orange pigment associated with chlorophylls in all green plants.

carob: the measure of weight for precious jewels and metals.

goatsucker: a dairy woodpecker.

WHO SAYS PEOPLE DON'T GET INVOLVED?

by: Lynn Hamilton and Audrey Saxberg
Lakehead University, Thunder Bay.

On the face of it the assignment seemed quite simple. Our public-spirited Physics professor, Dr. Hart, asked each class member to check the accuracy of two parking meters in town.

As working mothers, who are part-time students, time is limited, and Wednesday evening at seven o'clock seemed best. We decided that at this time no one would be around to interfere with our work, and we could carry on unnoticed.

Having made our decision as to time and date, we began settling things at home, discussing the assignment with our husbands in a matter-of-fact fashion. It was their reactions that gave us our first inkling that we were doing something extraordinary. "Are you kidding?" "You're not really going downtown to do that!" "You CAN'T put money in a parking meter after six o'clock!" "You really are going, aren't you?" Yes, we were.

We met on Arthur Street and picked out a likely parking meter, found our change and got out the stopwatch and notebook. These unobtrusive preparations created a reaction. A man, 'sauced to the eyeballs' suddenly appeared from nowhere shouting "Hey lady, are you from out of town? You don't have to put money in the meters after six o'clock."

"We're working on an assignment," we said, trying to sound nonchalant.

"For the city?" he asked in a booming voice.

"No, for our Physics class."

"I'll bet you're really doing a secret report for the city," he shouted. (A crowd was gathering).

"No, we're not," we said, and put the nickel in the meter, but before we had a moment to check the stopwatch, he had turned the dial and ruined our first timing.

The crowd was getting larger. "These here ladies are doing a secret report for the city," our man said ceremoniously.

"If you magnetize the nickel before you put it in, it will gum up the works," one man told us helpfully. "I've heard if you cover a penny with aluminum foil, you can use it as a nickel," someone else said.

"What kind of secret report are you doing?" someone else asked.

"None," we said. Disgusted and embarrassed, and writing off the loss of the nickel to experience, we slunk away leaving them to their discussions as to just who we were and how to 'put one over' on the City Parking Authority.

Finding another parking meter, this one with two meters attached, we decided to use it for our next two efforts. A car was parked by it, but we didn't feel that this was something to worry about. Out came the notebooks, in went the nickel. One of us held the lever while the other checked the stopwatch. We were intent on getting everything right this time.

"Three, two, one — now!" and the lever was released triumphantly. The exact time was recorded — and we looked up into the startled faces of the car's owners. This respectable middle-aged couple apparently made an initial decision that it would be prudent to ignore us, but this proved to be too much for the lady. With one foot in her car, and the other still on the sidewalk, she paused, mouth opening and closing with no sound being emitted, eyes wide with questions. She stood like that for several seconds before her husband, anxious to get away from us, started to drive off, with the lady still half in and half out of the car.

By this time we were beginning to feel slightly conspicuous. We were cold too, and decided to wait out most of the twenty minutes we had bought in a nearby restaurant. After sixteen minutes had passed we gulped down the rest of our coffee and darted out across the street to the meter. Good! We had caught it in time. The minutes ticked by and we stood poised with the stopwarch, waiting. The time was clocked. Half of the assignment was now

done. We looked up this time to find five men waving wildly in the restaurant window across the street. One came running over without his coat in sub-zero weather to tell us that we didn't need to put money in the meters after six o'clock.

"We know," we said. "Thank you," and left him there on the sidewalk staring at us and shivering.

"Crazy women," he muttered.

Up the street we went, and found another meter with two heads which would suffice for the last two timings. Out came the notebooks, in went the nickel. Zooming out the blackness came three boys on bicycles.

"You don't have to put money in the meters after six o'clock," one said.

Trying a different approach we answered, "Oh, really?"

"I don't even drive and I'm not stupid enough to put money in a meter after six o'clock. What's wrong with you anyway?" (Not only had we met with opposition this time, but we had met it in angelic-looking, but nasty little boys).

Using her 'mother-voice' my friend said, "Why aren't you boys at home? It's after nine o'clock."

Using his 'brat-voice' one of the angels said, "Why aren't you in a rubber room, stupid ladies?", and with that they zoomed off leaving us quite mortified.

All-in-all the whole experience was becoming quite trying. We sat on the curb, this time quite oblivious to passers-by who probably thought we had just come out of the hotel and were sobering up on the sidewalk.

We took our last timing as the meter clicked off. Two couples passed by, and each said, "You don't have to put money in the meters after six o'clock."

"We know," we said, "thank you."

With our times recorded, our teeth chattering, our price at a new low we left downtown Port Arthur never to return again after six o'clock.

Next time you think people on the street refuse to get involved in other people's problems, don't bet your parking meter money on it.

EDITOR'S NOTE

Over many centuries much has been written about spring and its effects on the lives of individuals and on society in general. We, in this part of Canada, are well aware of these effects, and I need not say much more on the subject. It is also that time of the year when old interests are renewed, new ones are born, and future activities are looked into more firmly. In the past, this has also been the time when we have had many inquiries from high-school students contemplating a university education. Particularly for the benefit of those students, we are printing some information on some of the facilities available at Lakehead University. (We would like to hear if it is helpful or not.)

This is also the time when many teachers, students and nature lovers in general will find themselves spending more time in our "great outdoors". **There is much biological activity in our North Western Ontario, but, alas, we are short of people to collect and analyse the data.** So, when YOU are out there on a picnic, a fishing or other similar trip, why not 'mix business with pleasure', and contribute to our better understanding of our area? **Study your flora. Collect some plants. Start a herb-arium** (at home or in your school).

To help you, amateur or 'professional', Professor Claude Garton has kindly prepared some handy hints. (Professor Garton has contributed and is still contributing actively to our knowledge of our local flora, and he needs no introduction to plant taxonomists in this country). Now YOU TOO can benefit from his vast experience! Furthermore, he is always ready to help, and he may even lend you a plant press until you get your own! **Why not make this a school project and start now?**

If pressing plants does not turn you on, **you can still contribute** through drawings, paintings, photographs, etc., and in many other ways.

STUDENT SERVICES

The Canada Department of Manpower & Immigration maintains a **Student Placement Office** on the campus of Lakehead University. The aim of the Student Placement Office is to provide assistance to students who are seeking either **part-time, summer or permanent employment**.

The assistance takes the form of a wide variety of **services to students of all years and disciplines**. An opportunity is offered to participate in the on-campus recruitment program whereby **employers from the private and public sectors from all across Canada visit the University to recruit recent University graduates**. The Office also has up-to-date career literature, brochures, employment statistics, and information about re-employment trends, salaries and Manpower programs such as student Mobility, Mobility Grants and Relocation Grants. Another form of assistance is direct referral to part-time and summer jobs.

In order to take the fullest advantages of the services offered, students seeking employment should register with the Student Placement Office as early in the year as possible. Should you want to find out more about Manpower programs and services call 345-2121 extension 254 or visit the Student Placement Office located on the second floor of the University Centre Building.

The Student Placement Office also serves High School students who are seeking summer part-time employment.

The University provides new students with many opportunities for intellectual and personal growth. Personal problems often interfere with student's academic and social development. **It is the concern of the Dean of Students and his staff to maintain in all students such a sense of well-being** that they are able to take advantage of all the opportunities for full development. The Dean of Students and the University physician are especially qualified to help stu-

dents resolve their personal difficulties. The **Dean of Students** is also available to help students resolve problems connected with their choice of a course of study or a vocation.

The **Dean of Students Office** is also responsible for various forms of financial assistance to students. In addition to providing information and application forms for the Government programs, **the office administers a number of scholarships, bursaries and awards**. A summary of financial assistance available to entering students and continuing students in the faculty of science follows. Interested students requiring more information should contact the Dean of Students Office.

ENTRANCE SCHOLARSHIPS

C.J. SANDERS SCHOLARSHIP — \$1500.

This scholarship was established from the proceeds of a generous grant made by Mr. Sanders to Lakehead University. To be awarded to an outstanding student enrolling in a course leading to a university degree at Lakehead University under the following conditions:

- (a) \$500 payable at registration, provided a first class average in the grade 13 papers required for admission is obtained, and financial need is known;
- (b) \$500 payable in the second and third years respectively, provided that at least second class average has been obtained in the previous year of the student's course at Lakehead University.

THE BORA LASKIN SCHOLARSHIP —

Five scholarships of \$1000 each will be awarded on the basis of academic standing to students entering the Energy and Fuel Science programme. The scholarships are renewable for a maximum of three years depending on academic progress.

KATHLEEN BOOTH SCHOLARSHIP — Value totals \$2000. This scholarship is open to all Mathematics Majors and will be awarded at the discretion of the Department of Mathematical Sciences.

C.A.P. ONTARIO UNIVERSITIES' PHYSICS TEST SCHOLARSHIP — Full tuition costs. To be awarded on the recommendation of the Physics Department to a student from Northwestern Ontario who achieves high marks in the C.A.P. Ontario Universities' Physics Test.

LAKEHEAD UNIVERSITY ENTRANCE SCHOLARSHIP — \$300. All students entering Lakehead University with a standing of 80% or over are eligible for a Lakehead University Scholarship. No application is necessary for those scholarships awarded by the University since all students with an overall average of 80% will be considered.

NORMAN S. GRACE SCHOLARSHIP — \$80. To be awarded on the recommendation of the Department of Chemistry to a first year student of high academic standing who registers as a Chemistry Major.

AUXILIARY TO ST. JOSEPH'S GENERAL HOSPITAL SCHOLARSHIP — \$150. To be awarded to a student preferably from Northwestern Ontario, who is entering the Bachelor of Science Nursing Degree Programme. The scholarship will be awarded on the basis of need and academic excellence.

ENTRANCE BURSARIES AND AWARDS

MARION E. TOMLINSON MEMORIAL BURSARY — \$1000. To be awarded to a deserving student entering the degree or diploma programme at Lakehead University. \$400 at registration, \$300 at the beginning of the second year, \$300 at the beginning of the third year, provided second class average is maintained.

JOSEPH MARIEN MEMORIAL BURSARIES — \$500. Two bursaries of \$500 each will be awarded to provide assistance to worthy and needy students seeking higher education in a degree programme.

IBM THOMAS J. WATSON MEMORIAL BURSARIES — up to \$200. To provide financial assistance to one or more needy students in good standing entering any faculty at Lakehead University. In addition, the donor provides an annual grant-in-aid of \$500 to the University.

GREAT LAKES PAPER COMPANY FORESTRY BURSARY — \$150. To be awarded to a deserving student entering the Forestry Diploma Programme at Lakehead University with the intention of proceeding to the degree programme.

LOGOZZO AWARD — \$150. To be awarded to a student entering the first year of a degree or diploma programme. The student should have a good scholastic record and excel at some athletic sport.

Application forms for Entrance Scholarships and Bursaries are available from the Dean of Students Office.

ONTARIO STUDENT ASSISTANCE PROGRAMME CANADA STUDENT LOAN PLAN

These programmes are administered by the Ministry of Colleges and Universities of the Province of Ontario. They offer Canada student loans and provincial grants to provide awards for university and other post-secondary students.

To be eligible to apply through the Ontario programme a student must be a Canadian citizen or a landed immigrant with at least twelve months residency in Ontario.

An award is made after the student's loan and possibly a provincial grant is apportioned according to a formula established by the government.

8.

Application forms and further details about these programmes may be obtained by contacting the Dean of Students Office. **It is strongly recommended that interested students apply early to these programmes.** Entrance students may apply for assistance before they receive their letters of acceptance from the university.

INCOURSE SCHOLARSHIPS AND BURSARIES

A number of scholarships and bursaries are offered exclusively to 2nd to 4th year Science students. The following is a brief summary of those available.

J.P. BICKELL FOUNDATION SCHOLARSHIP — \$1500. (to be paid at a rate of \$500 a year for three years provided the student maintains first class standing in the course). To be awarded to a student who obtains 80% in a science or applied science course at the end of the first year, who plans to take a degree in mining, metallurgy, geology or chemical engineering.

ALLIED CHEMICAL CANADA, LIMITED, SCHOLARSHIP IN THE CHEMICAL SCIENCES — \$750 and silver tray. The Allied Chemical Company of Canada, Limited offers a scholarship of \$750 and a silver tray to be awarded to a student, not otherwise holding a scholarship, entering the final year of undergraduate studies in a chemistry programme. The award will be based on high academic achievement in previous undergraduate years and leadership qualities as demonstrated by participation in extra-curricular activities.

PETER MCKELLAR SPENCE MEMORIAL SCHOLARSHIP — \$200. To be awarded to a student who is continuing his education at Lakehead University. Those going on in Science, particularly Medicine or Nursing will be given preference.

CHEMICAL INSTITUTE OF CANADA, LAKEHEAD UNIVERSITY SCHOLARSHIP — \$50. To be awarded to an outstanding student entering the third year chemistry at Lakehead University. The grade of the student receiving this scholarship must not be less than 80%.

THUNDER BAY MEDICAL ASSOCIATION BURSARY — \$500. To be awarded annually to a student or students who plan to continue their education in medicine, nursing or pure science.

J.P. BICKELL FOUNDATION BURSARIES — Total award \$750. To be awarded on the basis of financial need to students registered in geology, mining, metallurgy or chemical engineering.

ABITIBI PAPER COMPANY LIMITED BURSARY — \$250. To be awarded on the basis of financial need, to a student showing general proficiency in his study of science or forestry who has demonstrated his intention to pursue further his studies in science or forestry at Lakehead University.

PRINCESS BEATRICE CHAPTER I.O.D.E. BURSARY — \$100. To assist a student in science at the end of first or second year. Awarded annually on the basis of scholastic standing and financial need with preference being given to a son or daughter of a war veteran.

INTERPROVINCIAL PIPE LINE COMPANY BURSARIES — Total value \$2500. Up to ten \$250 bursaries will be awarded to deserving students, depending on need, who are continuing their education at Lakehead University; minimum of 50% of the bursaries will be awarded to students in the applied sciences. Awarded to Canadian and United States residents.

Application forms are available from the Dean of Students Office and must be submitted by August 8th, 1975.

ABOUT PRESSING PLANTS

by: Professor C. Garton,
Lakehead University, Thunder Bay.

WHY PRESS PLANTS?

If living material is available this at first does not seem necessary. But our weather here is seasonal, and even in the tropics plants are subject to flushes of growth and fruiting. Through drying and pressing you can have plants at various stages of their development, all available at the same time for study.

Besides, in the field you cannot easily examine a plant or its parts under a microscope. It may not even be possible to get it back to a laboratory to do so while it is fresh. So, press it and examine it at your leisure or convenience.

A further advantage of dried specimens is that you can compare plants at different stages of their development or the same species from different localities. Individual and geographic differences are as much a feature of plants as of animals.

Another important point, particularly in the naming and description of species: you can examine the same plant even after many years, for well-prepared and well-preserved herbarium specimens will last for centuries.

HOW DO I GO ABOUT PRESSING PLANTS?

Exact instructions can be secured from the herbarium or from books. There are several more general points to be noted.

1. **Get good representative material**, neither too fat, too thin, too short, too tall. When plants are averaging one metre tall, it is foolish to select a 10 cm. dwarf simply because it will go into your press.
2. When plants are smaller than your press get **several** as **different** as possible to show variation.
3. Whatever the pressed plant does not show must be given in notes. If it is a tree, how tall is it, what kind of branching it demonstrates, what its bark is like (a sample if possible). Many trees bear fruits which, like those of many other

plants, are large and inconvenient for a press — save these separately. With most larger plants only fragments can be taken; so notes must be made about the whole plants.

4. Pressing does not usually retain the exact colour of a living plant. Notes again must record this.
5. **All plant parts are three dimensional.** The pressed plant has only two dimensions. A careful collector will provide for depth by such devices as splitting and flattening, for example, the corollas of tubular flowers, the leaves of the pitcher plant. A few extra flower heads pressed with the specimen can be included on the sheet in small easily opened envelopes. This is particularly necessary with grasses, sedges and all plants where seed attachment such as in the Crucifers is critical in determining the species.
6. Unless a pressed plant is well supported with critical data it is worthless for future study. Date of collection, collector, place (and this must be exact enough so that a reader can locate the site), association (other plants growing with this particular one) amount of light, soil, moisture, habit of growth are some of the necessary items.

It is wise to have **in the field a pad with duplicate sheets** so that notes can be made on the spot. The original is put with the specimen at the time. The duplicate provides a ready reference.

7. As to the actual mechanics of pressing and mounting the specimen you will get instructions and then develop your own techniques. That will give you specimens that will be **a joy to behold and a pleasure to study.**

HINTS TO COLLECTORS

1. Latitude and longitude exact to the minute.
2. Distance from nearest post office.
3. Other data as exact as possible: township, concession and lot number, river, lake, stream etc.

10.

4. All data not shown by specimen:

- (a) Shrub or tree: height, type of growth, bark characteristics.
- (b) Herbs: type of growth — prostrate, erect, climbing, submersed (give depth of water), floating.
- (c) Type of substrata: mud, silts, clay, loams, sand, gravel etc.
- (d) Plant associations: other dominant plants growing with this species.
- (e) Colour of foliage and inflorescence, etc.
- (f) Name of collector.
- (g) Date of collection.

SPECIMENS:

1. Average specimens as available. Smaller or larger than average specimens should be avoided.
2. Use newspaper folders which are smaller than 12" x 18" (News Chronicle and Times Journal excellent. Toronto, Globe & Mail, Star etc. are too large).
3. Bend and crisscross specimens to fit sheet. Make sure there are no protruding parts.
4. Arrange specimens so that leaves show both dorsal and ventral surfaces.
5. Arrange floral parts to show all floral structures. It may be necessary to split tubular corollas etc.
6. Extra floral parts should be gathered where available.
7. For grasses, sedges, rushes, etc. extra heads should be gathered.
8. If available, be sure to collect enough specimens to completely fill 2 full sheets.
9. **If a plant is rare, as with orchids, one specimen as a record is sufficient in the interests of conservation.**
10. Be sure to collect all parts of the plant, including underground portions.
11. Roots etc. should be washed and dried off before pressing.
12. Flaccid plants, particularly water plants need to be floated in water over a screen and lifted out on the screen to prevent matting. If these are allowed to dry for a few minutes the plants can then be transferred to the newspaper folder with ease.

13. Gather mature seeds if available. These can be put in small envelopes to prevent loss.

14. If the plant is parasitic, as dodder, recognizable portions of the host plant are desirable.

15. Plants should be put in the press for a few hours to relax. Then leaves, stems and floral parts can be straightened and rearranged.

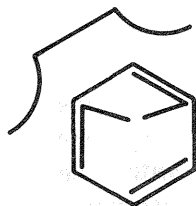
SPECIFIC DATA FOR FAMILIES AND GENERA:

1. Crucifers must be gathered with some mature fruit.
2. Sedges, grasses and rushes must have mature seeds but the heads must not be disintegrating.
3. Violets must have roots and rhizomes for determinations. Also, the late summer flowers or cleistogenes should be gathered.
4. Hawthorns require collection of flowers and, later, mature fruits.
5. Ferns must show the type of indusium
6. Pond weeds must show mature fruiting heads along with underground rhizomes
7. Composites must show type of florets and the involucre.
8. Orchids are usually covered with a heavy waxy epidermis. This prolongs drying time. In addition orchids have juices which are readily oxidised. Discolouring is almost inevitable unless gentle heat is used to hasten drying.
9. Mature fruits as in roses, currants etc. should be gathered and pressed. If possible these should be preserved in a suitable preservative in vials.
10. Cactus plants are extremely resistant to desiccation. These are usually split in half.
11. Mosses, lichens, and liverworts should be separated from substrata and pressed with gentle pressure as with other plants.
12. Most legumes must show both flowers and mature fruits for determination.

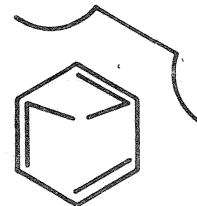
GENERAL:

1. Moderate pressure is essential. Extreme pressure produces brittle, deformed specimens.

(continued page 15)



A CHEMIST IN THAILAND



11.

by: Dr. A.N. Hughes

Lakehead University, Thunder Bay.

One of the great privileges of academic life (and, in my opinion, one which must be preserved at almost any cost) is sabbatical leave. This allows a professor who is somewhat ragged at the edges to go elsewhere and engage in scholarly activity of his choice for a year free from the daily cares of routine administration, University politics and student lynch mobs thirsting for his blood. If he so desires, he may not only change his location but he may also change to another culture. This is what I chose to do when after investigating various Universities active in my research field (organophosphorus chemistry) in Australia, Britain and Germany, I decided to spend my year at Mahidol University in Thailand.

The reasons for this were numerous. First, I had spent the years 1960-62 in Malaya (now Malaysia), and my wife and I had been very happy in South East Asia despite the Malayan emergency which finished shortly after our arrival. During our time in Malaya, we had visited Thailand as impoverished tourists and we were greatly impressed by the country, especially by the Thai culture and the easy acceptance of foreigners by the Thai people. We later returned to Thailand for a much longer stay (1964-1967) where I worked at the University of Medical Sciences (now Mahidol University) in Bangkok.

Our three years there had been very rewarding and academically successful, and we had made many Thai friends. We therefore decided to ask if we might go back for a further year, knowing how good the facilities for chemistry were there. We were accordingly delighted to hear from the Dean of Science, Dr. Kamchorn Manu-napichu, that not only were we welcome but that he had arranged for the required

Thai government approval of my visit, air-conditioned office space, full library and laboratory facilities and a car for my use — a treatment which few sabbaticants in the western world would receive! In return, the University asked me to set aside only two or three hours each week to lecture on my special research interests and to advise graduate students from time to time. These arrangements were ideal for sabbatical study and we therefore set off for Bangkok in 1973, via Singapore and Malaysia.

The day after our arrival we were able to find an excellent fully air-conditioned apartment in a block consisting of several low buildings grouped around a central court containing miniature Japanese gardens, shaded lawns, clumps of bamboo, fan palms and a swimming pool. These apartments were situated next to a beautifully landscaped small estate owned by a princess and were extremely well run by the Thai owner who ran them almost like a friendly club. All cleaning and laundry were done for us and we hired our own cook. There was the added bonus of an armed police guard on the gate at night to discourage burglars who are sometimes quite violent when caught in the act. These apartments were about **ten minutes walk** from the University **but about 45 minutes drive**. The Bangkok traffic is an unbelievable nightmare with **eight-lane highways completely jammed for miles** at rush hour (which seemed to be all hours except midnight to 6 a.m.).

Before describing our year in Thailand, a brief account of the country is in order. Formerly known as Siam (the name was changed about thirty years ago), **Thailand**, which means **the land of the free**, lies south of China and is bounded by the turbulent countries of Burma, Laos and Cambodia and the more tranquil Malaysia. **Alone of all South East Asian states, it was never a colony of a European power.** This

was in large part due to the high degree of skill in dealing with Europeans shown by the rulers of the country, principally King Mongkut (inaccurately portrayed in "*The King and I*") and his son Chulalongkorn, at the time of colonial expansion in this area. The absolute monarchy was overthrown very politely and gently in the Thai manner in 1932 and the country became a constitutional monarchy ruled by a variety of civilian and military governments ever since. Most changes of government have been effected by *coups d'état*, many of which, by the standards of the rest of the world, have been **very gentlemanly affairs** having no great effect upon the general population other than a few tense days. However, the revolution which occurred during our visit was somewhat different — more of this later. The present monarch is King Bhumibol Adulyadej, otherwise known as Rama IX, and the religion of the country is **Hinayana Buddhism**. This last **probably explains the gentle and tolerant nature of most Thais**. The capital is Krung Thep (**the City of Angels**) which is known in the West as **Bangkok**. It is a modern city of three million people and is situated on the central rice plain near the mouth of the Chao Phya river.

The University system in Thailand in some ways resembles a combination of European and North American systems but superimposed upon this is a strong Thai flavour. For example, in Bangkok there are five Universities but only one of these is the very broad based University of the type which one would see in Canada. This is Chulalongkorn University which was founded about seventy years ago and which has the usual faculties in Arts, Science, Engineering etc. which we associate with Western Universities. The other Universities are somewhat different in character. Thus, Thammasat University, **The University of Moral and Political Philosophy**, is almost exactly what its title implies and **has (very sensibly some would say) no faculties or departments of physical, biological, earth or applied sciences**. It produces many of the

nation's lawyers for example. The three other Bangkok Universities are very like large professional institutions with the emphasis on some aspect of professional activity, such as Mahidol University (the University of Medical Sciences), Kasetsart University (Agriculture) and Silapakorn University (Fine Arts).

Three regional Universities lie outside Bangkok. The oldest of these (1963) is beautifully situated at Chiangmai in the far north of Thailand with the other two at Haadyai (extreme south) and Khon Kaen (north east). These are building up to the conventional broad based structure of a Western University.

Virtually all instruction in Thai Universities is in Thai although most students have a working knowledge of English. Perhaps it should also be added that the Thai language sounds something like Chinese but in reality it is a mixture of **monosyllabic tonal** (five tones) words similar to Chinese together with many polysyllabic words derived from Sanskrit.

Mahidol University has a number of faculties such as Science (where I was), Medicine (two teaching hospitals), Dentistry, Tropical Medicine, Pharmacy and several others relating to the study of medicine scattered all over the city. The Faculty of Science was founded about fourteen years ago by a very able Thai chemist, Professor Stang Mongkolsuk, who was tragically murdered a few years ago. It consists of a giant complex of seven six-storey buildings, built over the last seven years, which are **extremely modern** and, on the whole, **very well equipped**. The funds for building such a complex came from the Thai government and the Rockefeller Foundation, and technical assistance in the way of small number of academic staff, technical workshops and certain pieces of advanced equipment have been provided by the Rockefeller Foundation, The Columbo Plan (Britain and Australia), M.I.T. and the German government. There is also an English Language Institute and a very good library (particularly for Chemists). The Faculty of Science is also well sited in

relation to other institutes of advanced study which have a variety of equipment and library facilities and the nearby **National Research Council of Thailand** has some excellent facilities.

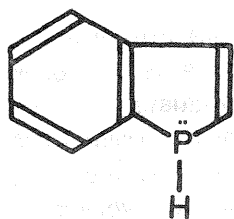
The Department of Chemistry is housed in one of the large modern six-storey buildings and is well staffed with very able Thais trained to the doctoral and post-doctoral level in a number of countries, such as Canada, Britain, Australia, New Zealand, the United States, Germany and Norway. The degree program is four years with the first two years fairly general in nature but with the last two years being an intensive treatment of Chemistry at a level comparable with that in Canada. The emphasis is upon organic chemistry and physical chemistry since there is a shortage of teachers highly trained in inorganic chemistry.

The research effort is relatively recent but already there are active research programs in physical and organic chemistry with the main research areas in liquid crystal studies, the nature of oscillating reactions, natural product characterizations and synthesis, the development of new organic synthetic methods, mechanistic investigations and now organophosphorus chemistry. The range of equipment available for these studies is impressive. For example, they have a Varian A60-D NMR spectrometer on the premises with access to two other NMR spectrometers in other institutions. In addition, there are the usual infrared and ultraviolet spectrophotometers, analytical and preparative gas chromatographs and facilities for C, H and N microanalysis. A further range of modern equipment is also available in the well-staffed Department of Biochemistry. There is as yet no mass spectrometer, but moves have been initiated to acquire one in the fairly near future. A small but modern glassblowing shop set up with the aid of the German Government completes the facilities. On top of this, the worldwide contacts of the staff makes most types of instrumental investigation available to the department.

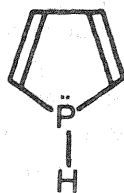
These research programs have been conducted by the academic staff but recently, a substantial number of students have been enrolled in the M.Sc. graduate program which has been running in its present form for three or four years. At the moment, there are about 35 students involved in physical and organic graduate work and, after about eight months of intensive course work, the students become actively engaged in research in cooperation with a staff member or a group of staff members. This year, the doctoral program in Chemistry started and the first students are now enrolled.

All of these research efforts are greatly aided by the fact that **Bangkok has a major international airport with most of the world's leading airlines calling there. There is therefore a steady flow of distinguished academics and technical experts from other countries through Bangkok** and the internal seminar program is reinforced by several guest lectures each year from visitors to Thailand. I should also add that I am not the first sabbatical visitor to the Department of Chemistry. There have been other such visitors from Britain and Australia, and when I left, another Canadian chemist was enquiring about the possibility of going to Thailand. Also, Dr. Hart of Lakehead University visited the Department of Physics a few years ago.

My own work there followed two main lines. The first of these was to write, in cooperation with Dr. Holah and Dr. Hui of Lakehead University, several research papers on results accumulated on various research projects in organic, organometallic, and inorganic chemistry over the previous eighteen months or so. Also a major review of the coordination chemistry of phosphorus heterocycles was prepared for publication. The second aspect of my work in Bangkok was to start a research program there in organophosphorus chemistry. In particular, I wished to start an investigation of the synthesis and reactions of a class of compounds called the benzophospholes which have the structure shown below.



benzophosphole



phosphole

These are of particular interest at the moment because they have as yet received virtually no attention and because they are closely related to the phospholes. The phospholes have provided a puzzle regarding their electronic structure which has still not been satisfactorily solved even after about fifteen years of study. In this connection the behaviour of the phosphorus non-bonding electron pair is of interest.

I was very fortunate to have two graduate students offer to do their research work under my supervision jointly with two Thai staff members. This work proved to be experimentally very difficult but has now begun to yield useful results. Thus, one of the students has been able to expand the five-membered ring in benzophospholes to a six-membered ring by two different methods involving the non-bonding electron pair and this provides valuable information regarding the electronic structure of the system. These results can be integrated with the work we are doing at Lakehead University which is to look at the coordinating ability of organophosphorus compounds towards various transition metal systems. It is possible that some of the resulting compounds will have catalytic activity in a variety of reactions and, indeed, we have prepared several such catalysts, two of which show excellent activity in homogeneous hydrogenation reactions.

In addition to my writing and research, I gave a course in organophosphorus chemistry to the graduate students. This was invaluable to me since it made me get up to date in a number of areas which, through pressure of work I had been forced

to neglect until then. I was also invited to give the same course on a crash basis (four hours a day for a week) to final-year undergraduate students at the new Prince of Songkhla University at Haadyai near the Malaysian border about 700 miles south of Bangkok.

This trip was a very nice change although it had its exciting moments since bandits and insurgents occupy a number of areas in the region which is mostly jungle-clad hills. Also, I was told that four people had been shot at the University in the two months preceding my visit. The University has two campuses separated by about 100 miles, and while driving from the main campus at Haadyai to the other one at Pattani, my Thai companion pointed out the sites of various armed bandit attacks and shoot-outs. On the return journey after dark, it was suggested that I should keep a look-out for roadblocks and for lights in the hills. I was told, however, that if we reached safely a particular point on the road, there should be no problem thereafter!

Apart from the academic success of the year, there are a number of other things upon which we can look back. Undoubtedly the highlight of the year was the revolution which occurred in mid-October 1973 about 3½ months after we had arrived. This had been simmering for a long time and probably only a Thai could give the real detailed reasons for it. However, it was clear that the people in general were dissatisfied with the authoritarian and apparently corrupt way in which the Prime Minister, (Field Marshall Thanom Kittikachorn) the Deputy Prime Minister, (General Prapas Charasutiara) and the Prime Minister's son (Narong Kittikachorn) were running the country. Accordingly, protests and demonstrations, led mainly by students, built up gradually over a period of several weeks and finally came to a head with troops, police and many helicopters firing upon huge crowds of demonstrators near Thammasat University and the old Grand Palace. This resulted in two or three days of heavy fighting, mainly in the city

centre, with about a thousand people being killed or wounded. Several government buildings were destroyed by fire and towards the end of the fighting, a large group of Engineering students laid siege to the main police headquarters. This was situated in such a fashion that the students had to cross a large expanse of open road to approach the building and over twenty students were shot down while storming the headquarters. Finally, the building was set on fire with the aid of a water truck containing gasoline.

These events resulted in Thanom, Prapas and Narong being ordered out of the country by the Army Commander who refused to fire on the demonstrators any more and, under the guidance of the King (a highly respected figure), an interim government was appointed and charged with formulating a new constitution leading to elections. These have now been held and Thailand is ruled by a representatively elected government.

During these events, we retired to our apartment compound and from the roof watched buildings burning in the distance and listened to the wail of ambulance sirens. We heard only one or two shots in our area. On the first day of fighting, I tried to get to work but the traffic lights were all smashed, the roads were littered with broken glass, debris and smouldering barricades and all police had fled the streets. It was therefore pointless in view of the choked roads to attempt the drive, and I returned to the apartment.

The remainder of the year was extremely pleasant. For example, we were able to visit the northern capital of Chiangmai which is a very old city, formerly the capital of an independent state, situated in a beautiful valley, surrounded by jungle-clad hills inhabited by various non-Thai hill tribes. It is as yet relatively uncontaminated by the West but, unfortunately, it is beginning to change its character with luxury tourist hotels being built. We were also able to feast regularly upon a tremendous variety of foods such as Thai,

Chinese (several styles), Korean, Indian, and Indonesian, as well as various Western styles. Some items on the menu may not appeal immediately to the Canadian palate. For example, among other things, at country restaurants I have eaten chopped cobra fried with red chili, deep fried tree lizard, fried frogs, chicken claw skin in chili vinegar and pigs duodenum together with less easily identified dishes, most of which were delicious. However, I decided to miss out on the bats blood soup.

The year was so rewarding that I could write on and on about up-country trips to make end-of-Buddhist-lent offerings to the monks at a country temple, the beauty and rhythm of Thai classical dancing, the calm of the Thai countryside, the superb National Theatre and Thai art in general (see front cover), and the colourful markets. Indeed, I often feel that the Thais have a lot more to offer us than we have to offer them. However, the year (and this article) finally came to an end and we managed to secure cheap (!) charter flights home via Moscow which seemed to us to be a very gloomy and rather bad-tempered city. It would, however, be wrong of me to close before thanking Drs. Kamchorn Manunapichu, Vichai Reutrakul, Siriporn Phisithkul, Kosan Kusamran and my other Thai colleagues for making my visit so academically and socially successful.

ABOUT PRESSING PLANTS *(from page 10)*

2. Ventilators and driers should, if possible, be changed every day and sun-dried. If weather does not permit, then spread in a heated room.
3. If extra sets of ventilators and driers are not available, several thicknesses of newspaper between each specimen sheet is helpful.
4. Counter cheque books make a good form of record. The original is put with the specimen and the duplicate forms a chronological diary of specimens.
5. Be sure to number your specimens either using numbers chronologically from year to year or prefixing as: 75-1, 75-2, 75-3 etc; 76-1, 76-2, etc.

16. ASBESTOS CONTAMINATION OF LAKE SUPERIOR

and

Dr. R.A.ROSS

The ready availability of sophisticated analytical equipment in the past two decades has caused experimental scientists to become increasingly aware of the pronounced physical & chemical effects that may arise through the presence of impurities and/or imperfections in inorganic or organic materials. Thus, for example, profound changes in the electrical conductivity of germanium or silicon can be effected by introducing into their lattices extremely small amounts of elements from adjacent columns of the periodic table. At liquid helium temperature, $\sim 4^\circ \text{K}$, the resistivity of germanium changes from 10^{10} to 5×10^{-3} ohm cm when the impurity concentration of antimony is increased from 5×10^{14} to 10^{18} atoms cc^{-1} . The contribution of Bardeen, Brattain and Shockley to the theory of such phenomena resulted in their receipt of a Nobel prize and we have all benefited tremendously in the application of these concepts to technology — transistor radios, time-pieces, miniature circuits and so on.

There are many further examples of scientific and medical phenomena of major import that can be initiated and sustained through the intervention of impurities within a reaction process or system. In research laboratories dealing with studies of reactions at interfaces results are often painfully distorted through the contamination of surfaces by traces of unknown species that have been unwittingly introduced to the system during a prior preparative stage. In this connection the possible presence of impurities in wash water presents a particular hazard.

Lakehead University takes its water from the Port Arthur ward system in Thunder Bay. This water is drawn from Lake Superior and is largely untreated. There are many 'tales' — old wives' and otherwise — regard-

ing the quality of this water and, among other suspected contaminants, asbestos may be present. There is sufficient responsible scientific and medical opinion regarding the possible health hazards of this material, that further motivation was added to the Lakehead quest to obtain an analysis of asbestos fibres in our water supply. For comparison, data were also obtained for the asbestos content in water taken from homes in the Fort William ward and in Duluth, Minnesota.

The results below were obtained by Allan MacKenzie, using the electron microscope of the Instrumentation Laboratory in the Faculty of Science, towards the end of January, 1975.

	Fibre count (fibres.litre ⁻¹)
Doubly Distilled Water	0.15×10^6
Tap Water:	
F.W. ward	0.17×10^6
P.A. ward	$0.45 \text{ to } 14.7 \times 10^6$
Duluth	12×10^6

(The high result for the Port Arthur ward has since been shown to lie within the range determined by scientists at McMaster University, $10 \text{ to } 20 \times 10^6$ fibres.litre⁻¹, on samples of Bare Point water — the source of the Port Arthur supply.)

A substantial amount of public concern regarding the quality of the drinking water supply in Port Arthur ward has been apparent for several years and this concern was increased by the publication of the Lakehead University results. Reports and interviews have been carried in print, sound and vision by all the local Thunder Bay outlets and in Duluth, Minnesota. We reprint below an interview with Dr. R.A. Ross, Dean, Faculty of Science, which first appeared in the "Biology Newsletter" of Lakehead University in March 1975.

ASBESTOS:

An Interview with Dr. Ross, Dean of Science

Q. (BIOLOGY CLUB NEWSLETTER). What was the asbestos content of the Port Arthur tap water which you sampled?

A. (DR. ROSS). We found 14.7×10^6 fibres/litre in the water.

Q. How does this value compare with the Government's findings?

A. Their values show less than 1×10^6 fibres/litre.

Q. Do you know why there is a discrepancy between these figures?

A. We are not sure. Their samples were taken last fall, presumably from the lake. We sampled the tap water somewhat later. The handling of the samples might influence the results. For example, asbestos is known to stick to the sides of glass containers, if stored for a period of time. Since the government samples are not tested here, but are sent away for analysis, we may speculate that they are stored for longer periods than our samples.

The government uses a different analytical technique; however, this should not produce discrepancies of this order of magnitude.

Q. Is a standard technique available?

A. No. Different laboratories use different methods. We plan to conduct a series of some fifty tests on water samples to examine the effect of the nature of the container and of the prior treatment of the container on the asbestos content of water over a period of weeks. We have also volunteered to test a sample, obtained by a neutral sampler, that the Government and McMaster University would also test, in order to compare results; but the Government does not have enough funds available at this time.

Q. Would the presence of asbestos in the air affect the asbestos content of your samples?

A. No. The samples are kept in sealed containers.

Q. Is there any way of identifying the

source of the asbestos fibres?

A. There are various types of asbestos. It occurs in two main forms: a chain type and a sheet type. Electron and x-ray diffraction techniques, in combination with electron microscopy, can distinguish between them. The type of fibre would depend on the source of the fibres.

Q. Do you have any idea where the asbestos is coming from?

A. At the moment we have no conclusive answer.

Q. What is the safe level for asbestos in water?

A. It is not known if asbestos is harmful if taken orally. The Government is doing some studies on rats concerning the oral ingestion of asbestos, but until these studies are completed, we can only speculate regarding the danger from the asbestos in the water.

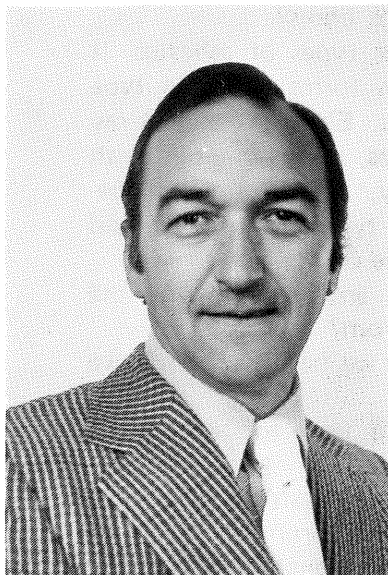
Q. Do you know if asbestos would have a synergistic effect in combination with other chemicals, which might be present in water.

A. No. An in-depth study of the biological properties of asbestos is needed. We have little idea, in fact, of the surface properties of asbestos. Dr. Murphy, who is working in my laboratory, is studying this aspect of asbestos. Synergism is possible. What we really need is a complete study that would identify every component of the water and examine the possible interactions of the substances present.

Q. What do you think should be the next step in research of this nature?

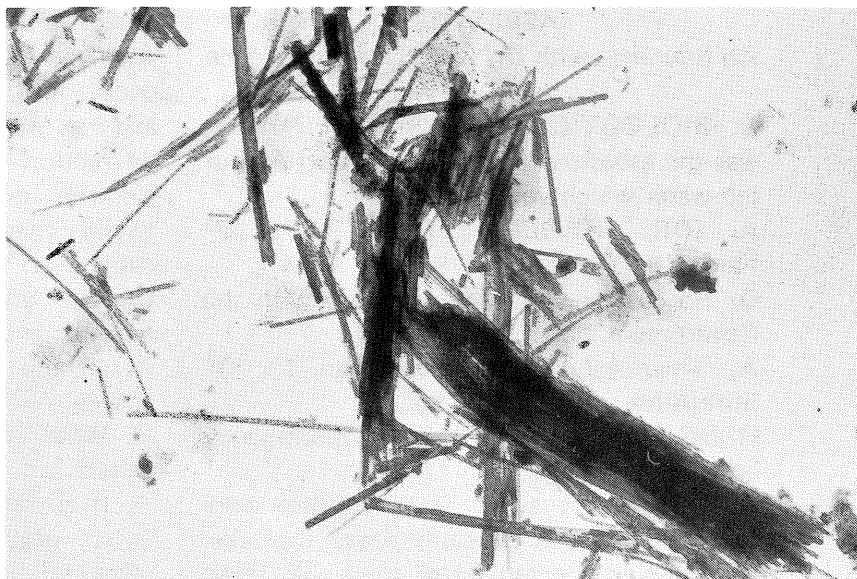
A. As I already mentioned, asbestos is not the only substance to be found in tap water. Until a complete study of the water is performed, to include both organic and inorganic substances, we cannot tell what dangers, if any, are present. It is possible that there are substances which should be of much greater concern than asbestos.

In terms of asbestos, we need to find the safe level, before we can take any action. Government controls of gaseous emissions are very stringent, but much more work is needed with liquid effluents.



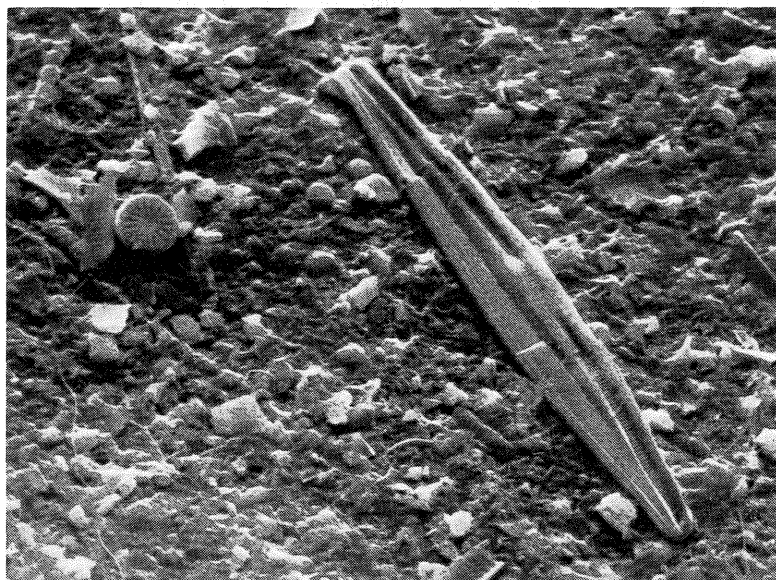
**Dr. R.A. Ross,
Dean, Faculty of Science**

One of the areas of research of Dr. Ross and his team relates to asbestos in our drinking water.



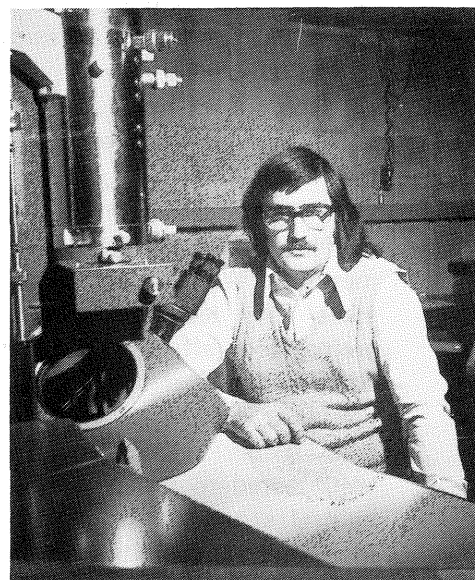
(14,300 X)

Transmission electron micrograph of asbestos fibres in our water samples. (Note tendency for fibres to clump into bundles).



(2,000 X)

Scanning electron micrograph of diatomaceous and other debris found in our water samples.



Mr. Allan MacKenzie examining water samples at Lakehead University with a transmission electron microscope.

AFFECTIVE CONTRAST: BEHAVIORAL CONTRAST OF LIKING

by: *Dr. S.R. Goldstein*

Lakehead University, Thunder Bay.

If psychologists were asked to identify the single most important adaptive mechanism adjusting organisms to their environment they would probably point to the ability to form discriminations as their first choice. The reason for this choice is fairly obvious; organisms must behave in different ways in different contexts if they are to survive. It is therefore, not surprising, that during the past 50 years a great deal of laboratory research has been directed at learning about how discriminations are formed.

One rather interesting recent finding is that the formation of a discrimination is frequently accompanied by certain behavioral "side effects". In what follows I describe a standard laboratory demonstration of a discrimination and a side effect called behavioral contrast as a means of introducing one aspect of my experimental extension of this area.

To demonstrate the formation of a discrimination, a hungry animal, say a pigeon, is placed into a small experimental space called a Skinner box. The box contains a circular target-striking device mounted at the bird's eye-level on one wall of the chamber. By the use of a control switch it is possible to illuminate this target with one of several colored lights. The Skinner box also contains a mechanism that delivers a small amount of grain to the pigeon if and when he strikes the target.

The pigeon is first taught to peck the target by rewarding or reinforcing, with food, only those responses that progressively resemble the appropriate response. When the bird is pecking at a substantial rate the response key is successively illuminated with a red and then a green light to determine whether the pigeon has a natural tendency to peck at different rates in the presence of the two lights. Since the bird is being equally rewarded in the presence of each light stimulus any preference will soon disappear.

To establish a discrimination, conditions are arranged so that responses made in the presence of, say, the green light continue to be reinforced while those responses occurring during the presence of the red light go unreinforced. Figure 1 shows the outcome of such an experiment. Section A of the figure shows that during pre-discrimination training the rate of response to the red and green lights are about equal. In section B we see the expected decline in response rate to the red stimulus signalling nonreinforcement. It is, however, the response rate to the reinforced green stimulus that is of special interest; for instead of maintaining the prediscrimination rate of response we now find that the rate has increased above baseline even though the reinforcing status of the green light has remained unchanged. The diverging response rates to the green and red lights are indicative of a discrimination and the increase rate of response above baseline level is indicative of behavioral contrast. Although we do not have a full explanation of behavioral contrast, in some way or another it is apparently related to the aversive or inhibiting consequences of non-reinforcement.

A criticism frequently directed at behavioral research with "lower" organisms is that such work is totally irrelevant to the complex functioning of the human mind. Of what possible significance is it to us, so the argument goes, that a rat or a pigeon shows behavioral contrast while learning to discriminate red from green lights in a highly artificial environment?

Consider then, the following more relevant situation. Our so called attitudes and feelings about one another are determined to a large extent by certain kinds of information we infer, experience directly, or have conveyed to us by certain others. For example, if a stranger is characterized to you as opportunistic, cunning and self-centred, your reaction to him on first meeting will be colored by this description and will probably be negative.

In the following experiment, introductory psychology students were presented a series of slides of two imaginary people called Person A and Person B. An adjective was placed on the bottom of each slide describing the person in question. The students' task was simply to rate, on a scale from 0 (Dislike) to 5 (Like), how much they liked the person in question after having seen the descriptive adjective. Two imaginary people were used in this experiment as a parallel to the red and green light conditions in the pigeon experiment. Thus during the first, prediscrimination phase of the study, the adjectives describing both Person A and Person B were selected which, previous research had shown, had a "likeableness" value in the 2.5 or neutral range. A total of 10 such slides for each "person" were presented. Immediately following this, the adjectives describing Person B were changed for the worse; in fact to levels which previous research had shown were in the 0 to 1 range. Again ten such slides were used. At the same time the quantitative value of the descriptive adjectives for Person A remained unchanged so that in all, a total of 20 slides of equal value were used to describe Person A.

Figure 2 shows the results of this study. Section a, the prediscrimination phase shows that both Person A and Person B were equally liked, according to the ratings. Section b shows that when negative attributes were used to characterize person B his rating dropped rapidly and approached zero. But most significantly for our purpose was the fact that although the likeableness content for Person A remained unchanged as Person B got worse, Person A's appeal increased significantly in the eyes or minds or behaviour of the students doing the rating.

The experiment, therefore, points to a continuity in the formation of discriminations across a wide range of species and situations. In addition the experiment suggests that behavioral contrast may be the mechanism behind various types of prejudice whereby one gains a better estimate of oneself by putting someone else down,

even though the new incoming information about oneself does not warrant the enhanced evaluation.

Finally on a more optimistic note, laboratory research has taught us a great deal about the nature of behavioral contrast, including several ways of preventing its formation. My students and I have extended these techniques to situations like the one described above and have obtained some promising results. At the same time we have begun to extend the idea of behavioral contrast to such diverse areas as population dynamics and marxian dialectics.

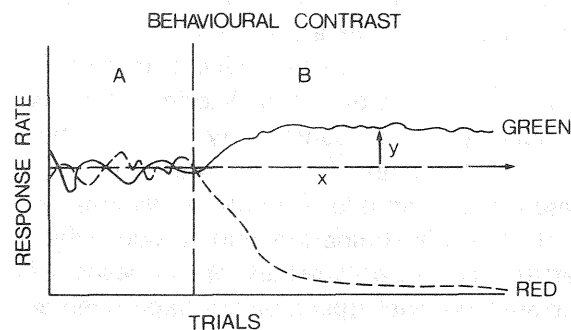


Figure 1: Rate of response to a green and a red light when both are equally reinforced (Section A) and when responses to red are not reinforced while responses to green continue to be reinforced (Section B). x is the expected projected rate of response to green, y shows the actual rate.

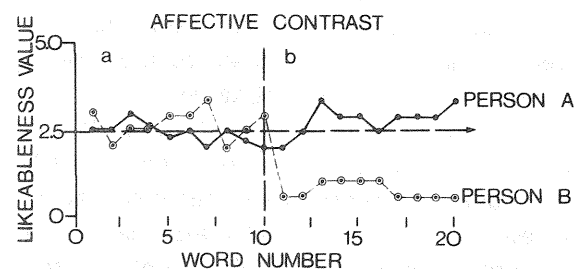


Figure 2: Behavioral contrast of "likeableness" ratings. In section a the information content for Person A and Person B was the same and so are the likeableness evaluations. In Section b the likeableness ratings for Person B go down as negative information is received while those for Person A go up even though the "likeableness" information remains unchanged.

METRICATION? SURELY YOU DON'T MEAN IT!

by: Professor John Hart,
Lakehead University, Thunder Bay.

Almost everything that could be said about the metric system has been said in the past hundred years or so, and despite the efforts of various commissions to inject some liveliness into the subject, it's a dead issue: in the contemporary jargon, SI units are here to stay. It is a pity that some of the terms we have to use reflect the stupidity of the scientists of international standards commissions and the recalcitrance of certain nations; but the fact is that to the world at large, metrication is pretty much a dead issue, and the amount of time and effort that is going into selling the system to North America is largely wasted. Why then, Mr. Editor (I think you were born in a metric country?) why then should I waste your readers' time with yet another article on metrication: why soil the pages of CARET with such pollution? My motivation, my dear friend, does not concern metrication as such. The decision as to which system of units a nation should use is largely a legalistic matter, and metric units have been legal in Canada for many more years than most readers of CARET have been living. The **real** issues concern, not metrication, but **standardization**, a matter which has intensely emotive, economic and political overtones.

By the time this issue of CARET is published, we shall have some idea as to whether the Celsius degree will be, perhaps grudgingly, accepted; and as for other common units, most of us can recognize a metre and its one-hundredth part, the centimetre (not meter, by the way); the kilogram is now moderately familiar to the purchaser of HIGHLINER fishcakes (the housepouse?); and, if he has the cash, the lush can buy a litre of wine, (the 'large' bottle), to slake his insatiable thirst. Electricity, of course, has always been billed in metric units.

No — it is not the **units** that constitute the problem, it is the **standards** that we have to worry about. In this context, I do **not** mean the kilogram of platinum-iridium kept in the basement of the Bureau International des Poids et Mesures at Sèvres in France. I mean the hundred grams of butter and the half-litre of lighter fluid; I also mean the screw that has one thread per millimetre and the cookie tray that is 25 by 50 centimetres.

Confused? You may well be. Yet, a shift in the units of measurement gives us a glorious chance to standardize, or to use a more appropriate word — **rationalize** all kinds of products. (Rationalize comes from the same root as ratio, meaning that human reasoning is at work, which is a nice put-down for manufacturers who do not rationalize!) **Metrication** and **rationalization**, though loosely connected are not entirely the same thing. To illustrate: take the time to look on the grocery shelves and see if you can spot **the rationalized sardine can**, as distinguished from the unrationalized one containing 127 grams. Why 127? Is it a coincidence that 127 is a prime number? What is the cost per unit weight (mass to the *cognoscente*) of 127 grams of sardines at 23¢? Get the point? Why not 125 (to divide by 125, multiply by 8 and divide by 1,000 — cost per kilogram, \$1.84); or better still, why not 200 grams?

To the everlasting credit of the manufacturers producing them, some consumer products are being rationalized on a voluntary basis. But there is in Canada, so far as I know, **no enforcing legislation** (except in certain special cases) specifying the normal sizes of packaged products; so that producers are free to pack whatever weight of, say, breakfast cereal they think will have the most cost-effective consumer impact, whatever that may mean! In Europe standard packages are the rule rather than the exception. **All who think that the voluntary standardization of consumer products**

will be adhered to in Canada by multinational corporations, stand in the corner.

There is another side to the question; and for products that manufacturers purchase (it is often forgotten that manufacturers are also consumers) the incentive for standardization is quite strong. Perhaps you service your own car? How many screwdrivers and wrenches do you need — how often do you have to make a new thread in an old hole (or use bailing wire, heaven help you) because you cannot get a screw to fit? You may be interested to know that the average vehicle uses about 3500 — yes, **three thousand five hundred fasteners**; and for a staggering statistic, how about the eleven to twelve thousand **different** fasteners used in the military hardware of the western world? By standardization, this huge inventory of nuts and bolts could be cut in half, with significant increase in the efficiency of the automotive trade.

The chances of a standardization scheme sticking in a manufacturing chain are about **fifty-fifty**. Some schemes that already exist are very successful; all 35 millimetre films fit virtually all 35 millimetre cameras: some schemes have never quite made it so that typewriter ribbons and video tapes come in almost as many specifications as there are machines.

Why are standardization schemes only moderately successful? I can identify three, though there are obviously many more than that. The first is what I call **"the foreman's elbow syndrome"**. (The foremen in dyeing plants long resisted the introduction of thermometers, because their elbows were quite sensitive to deviations from the required temperature.) In other words, **"let the others change — we've always done it our way, and our way is best"**. (That is why we had to throw out the perfectly sensible word Centigrade in favour of the misguided Mr. Celsius, a gentleman who got the freezing and boiling points of water inverted.) The second reason concerns the lack of perspicacity of design engineers, architects and suchlike who, faced with an intractable problem involving the fitting of one part to another

may prefer to take the easy way out and design a new part, rather than adapt the design to use existing standardized parts. Quite often, the new part does not work very well, and a piece of the product falls off. Third, there is the deliberate manufacture of a device **designed** to reject the product of a competitor. One classic example from World War I was the German rifle which accepted bullets of the other side, but not vice versa. Then, between the wars, there was a spate of razors with special ridges designed to reject all but one make of blade. Today, we have vacuum cleaners with special bags: other examples will come to mind.

There is one aspect of standardization to which my readers and their mentors might give some thought. It is this: **how far do we want to go?** Is standardization superceding reason? Is there a connection between the drab frenzy of our lives and the uniformity imposed upon us by our technological culture? Can we build a picturesque village from standard construction units, a poetic forest from standard trees, an exciting year from uniform days? Perhaps I push the argument too far. Here, for a contrasting viewpoint, is Walt Whitman:

*A vast similitude interlocks all
All spheres, grown, ungrown, small, large, suns,
moon, planets,
All distances of place, however wide,
All distances of time, all inanimate forms,
All souls, all living bodies though they be ever so
different, or in different worlds,
All gaseous, watery, vegetable, mineral processes, the
fishes, the brutes,
All nations, colors, barbarisms, civilizations, languages
All identities that have existed or may exist on this
globe, or any globe
All lives and deaths, all the past, present, future,
This vast similitude spans them, and has always
spann'd,
And shall forever span them and compactly hold and
enclose them.*

From "On the Beach at Night Alone"

an exercise in mathematical geography

by: Mr. Robert S. Dilley

Lakehead University, Thunder Bay.

A problem that frequently faces geographers is that of demonstrating relationships among a number of variables. It is sometimes possible to study geographical interactions under laboratory conditions: for example, glaciologists can use refrigerators to subject rocks to various kinds of freeze-thaw action. The human geographer has greater problems, in that he can observe people (though often with difficulty) but not experiment with them. A physical geographer who wants to know how flooding affects soil texture can pour water onto plots of land to his heart's content. A human geographer interested in the effect of flooding on rural communities will scarcely be popular if he opens the dikes to study the results.

Moreover, real-world geographical situations, especially those involving people, usually comprise a complex series of influences, each interacting with the others. To explain this in relatively simple terms, to show how changing one variable in a given system can have repercussions throughout the system, is difficult when one cannot demonstrate the actual processes at work. To overcome this, geographers have increasingly turned to mathematics to provide models of the real world with which they can experiment. Some of these models are complicated, requiring computers to work them out. Others are much simpler, but not necessarily less illuminating for that.

As an example, consider the problem of demonstrating the relationship between agricultural land, farming techniques and village size in primitive economies. **What limits the size of a simple agricultural village?** What happens if population grows, if new methods are introduced, if the climate changes? Anyone can see that population is likely to be higher on good land worked with advanced techniques; but how much higher? A simple model can help answer these questions by showing

how the various physical and cultural features interrelate.

Consider a simple, permanent agricultural village, operating as a closed system (i.e. no food is brought in from outside and none is sent elsewhere, the usual situation in undeveloped economies where local self-sufficiency is the rule. Assume, for convenience, that the villagers are entirely dependent on crop production for food. How big can that village grow?

First, we have to consider how much land the village has available. Even if it is the only settlement for a long way around, it cannot grow crops all over that area. The farmer has to walk out to his fields in the morning, perform a full day's work, and return at night to the village. If his land is too far away he will be spending too much precious daylight in travelling. In many societies (for example, among the Indians of North America before European colonisation) inter-village raiding was common, and field labourers were reluctant to work far from the stockade especially when cultivation was performed by the women. We can say, therefore, that the territory available to a village is roughly circular, with the radius a reasonable walking distance (D) from the settlement and an area πD^2 .

However, not all of this area will be suitable for agriculture. Parts may be too wet, other parts too dry. Some sections may be excessively stony, or too steep, or kept under trees for firewood. Part will be occupied by the village itself. We must therefore introduce the term U for usable fraction, such that if three-quarters of the territory is usable then $U = 0.75$. The actual cultivable area thus becomes $(\pi D^2) (U)$.

But under primitive conditions this area cannot be cultivated permanently. Simple agriculturalists are rarely familiar with the use of fertilisers or crop-rotation. Their practice is to grow crops on the same patch of land until, after a year or two or three, the soil is exhausted of its useful minerals and nutrients and the farmers have to go

on to another patch, leaving the first to rest and slowly rebuild its fertility. In time they can come back and cultivate it once more. Thus we have to introduce another factor, R , which stands for rotation, or the fraction of the total time that a given piece of land can be cultivated. Thus, if any one patch of land can be cultivated for one year in ten, or five years in fifty, then $R = 0.1$. The total possible area actually under crops in any one year is therefore $(\pi D^2) (U) (R)$.

To determine potential population we then need to know how much land is needed to support one person or, more conveniently, one family (it is easier to estimate the number of families in a village from the number of houses than to discover the average size of each family). If we call the area under crops necessary to feed one family A_f , then the maximum possible population for the village (remembering that no other food supply is available) is clearly the total possible area under crops in any one year, $(\pi D^2) (U) (R)$, divided by the area needed for each family, A_f . Denoting maximum population (in families) by P_f we can then express our model as

$$P_f = \frac{(\pi D^2) (U) (R)}{A_f} \quad (i)$$

This simple little formula then enables us to see how these factors interact with village size. Take, for example, a settlement where the maximum distance a farmer is prepared to walk to his fields is 2 km. (1¼ miles), where half the land is usable for agriculture, where crops are grown on each patch one year in ten and 2 ha. (5 acres) are needed to support one family: all reasonable figures. In that case

$$P_f = \frac{(\pi 2^2) (0.5) (0.1)}{0.02} = 31.4 \quad (ii)$$

The village could thus grow to a little over 30 families. (Note that the denominator has to be written as 0.02 square kilometers, rather than 2 hectares, to be in the same unit as D^2 . Try working that out with miles and acres and you become an instant convert to metrication).

The importance of travel-to-work can easily be illustrated. If the villagers become reluctant to move more than 1 km. from their homes, owing to frequent raids, hungry tigers or laziness, then the formula reads

$$P_f = \frac{(\pi 1^2) (0.5) (0.1)}{0.02} = 7.85 \quad (iii)$$

Halving the distance travelled thus reduces village size to less than 8 families. On the other hand, if the villagers in (ii) begin to use some fertiliser they may be able to cultivate their patches twice as long before moving on. This will increase R , and the formula will read

$$P_f = \frac{(\pi 2^2) (0.5) (0.2)}{0.02} = 62.8 \quad (iv)$$

allowing a doubling of population.

Alternatively, we can look at it another way and ask what happens to the village in (ii) if the population increases beyond 31 families? Obviously, if $P_f > 31.4$ then A_f must be reduced, giving everyone less to eat; or R must be increased, giving the soil insufficient time to recover and leading to disastrous soil exhaustion; or U or D must be increased, which may not be possible. Faced with population growth, therefore, village (ii) must starve, change its ways, or send the surplus population off to start a new village.

We can use this model to observe other factors than population. Take, in this instance, a village of 35 families, accustomed to travelling up to 1.75 km. to their fields, using three-fifths of the land and resting each patch seven years for each year of cultivation. How much land is available for each farmer? We know from (i) that

$$\frac{(\pi 1.75^2) (0.6) (0.125)}{A_f} = 35 \quad (v)$$

Therefore

$$A_f = \frac{(\pi 1.75^2) (0.6) (0.125)}{35} = 0.0206 \text{ km}^2 \text{ (vi)}$$

or fractionally over 2 hectares.

Further sophistication could be introduced. A_f could be varied to include food produced from pastoralism, which would probably involve modification of D , (people usually being willing to travel further to their stock than to their crops), of U , (land unsuitable for cropping may be grazed), and of R , (pasture needing a different resting cycle). If a number of villages occupy an area and claim all the land, then the territory of each may be calculated without reference to πD^2 , and so on.

The model is clearly too simple to be applied directly for research on the real world; it gives only potential and not actual populations. It can, however, be

(continued page 35)

QUALITY or QUANTITY: the modern dilemma

by: Dr. Paul Barclay-Estrup

Lakehead University, Thunder Bay.

(from an address given to the Calgary Teachers Convention in February 1974.)

Ten years ago, when someone said that our society and possibly our planet was heading for a serious crisis, the warning was either ignored or judged alarmist by most people. Five years ago, a similar pronouncement was taken into consideration, at least by more thoughtful people, but today perhaps even a majority of people are considering a crisis as a real prospect. **Considering** is the key word here, because far from a majority yet believe that there is a serious crisis; even fewer are proposing solutions, and virtually no preventative action is being taken. We are faced with a refusal of consciousness. Many intelligent people still pretend that "nine to five" is the real world, and that talk of disaster is a fad or fashion, idle chatter, the invention of TV, a communist plot, or a plot of vested interests.

It is possible that the doom and gloom statistics are all misleading, and some very qualified people are of this opinion. The doomsters draw lines on graphs and extend them into the future, a method which has produced some really frightening predictions. For example, if the present birth rate continues, by the year 6084 solid waves of people will be expanding away from earth into the universe at the speed of light.

It's true that doomsters have sometimes been proven wrong. One sceptic in Britain has pointed out that if the use of horses had continued to increase in Britain as much after 1870 as it did between 1800 and 1870, then **by 1970 the entire surface of the earth would have been six feet deep in horse manure.**

But sceptics aside, many people, especially professional ecologists, are firmly convinced that there is a potential catastrophe both for mankind and for most life on this planet, if changes are not instituted soon.

The root cause of this impending catastrophe is easy enough to identify: **Too Many People. Too Many People, in Too Little Space, with Too Few Resources.**

What is the present status of the world's population? This year, 1974, is World Population Year. At last, the United Nations has officially recognized that there is a population problem. "74 in '74" could be the slogan, for at the end of this year there will be 74 million more people than there were in the beginning of the year. That's over 200,000 more people each day of the year. China now has over 800,000,000 people and India almost 600,000,000, and half of this large number are children under 18. In 1975 the population of the earth will be four billion. When I graduated from high school in 1948, it was considerably less than three billion.

If the present rate of growth continues, by the year 2074 there will be 30 billion people. If somehow we could immediately reduce the increase to replacement level (two children per family), there would still be over six billion people by 2050. If somehow we could limit families to only **one** child, it would take another 30 years before the population of the earth would stop increasing!

Malthus made two predictions: one, that there would be world over-population, and two, that this would be followed by **mass deaths by starvation.** His first prediction has come true. We must do everything we can to ensure that the second prediction does not come true as well.

What can we do? The answer is simple enough: first, we stop the growth, and then we reduce the population to a level that can be maintained at a high standard of living and contentment without removing the capital resources of this planet.

The trouble with simple solutions is that they tend to be full of unknown variables. Is man a truly reasoning being, or is he

primarily controlled by basic biological instincts and reactions? What sort of situation makes man content? What is a "reasonable" standard of living?

There is no way in which the present world population of almost four billion can be brought even close to present Canadian living standards. Each Canadian uses over 20 times as much total resources per year as an average citizen of India. We use 30 times as much sugar and over 50 times as much energy. **It is not the poor, but the rich of this world who are threatening the survival of Spaceship Earth.**

So population must be reduced to a size which will suit the resources of our planet. What size is that? We do not know. This question must be answered by agriculturalists, foresters, geographers and ecologists. A worldwide study of resources and consumption trends is urgently required. (Some population proposals have already been made by ecologists. One estimate for maximum population in the U.S. is 30 to 50 million — less than $\frac{1}{4}$ of the present U.S. population — which if extended to Canada would mean a maximum of three to five million in this country!)

What happens if we continue uninterrupted growth? We luckier people in the "have" countries may be able to develop some kind of huge multi-storied cities. Perhaps our technology will provide space and food. What might the future hold, then, for us?

Food for us looks O.K., at least in quantity. Canada, New Zealand, Australia and Argentina are the last net food exporting countries (although in 1969, for the first time, low grain exports meant that even we in Canada imported more food in dollars than we exported). In Canada, we produce enough food to feed about 50 million people. So we have enough quantity for perhaps the next 50 years — assuming of course that other people who are in short supply don't take it away from us.

Quality? It doesn't look quite so good. Meat and fish supplies will continue to decrease, and prices will keep on rising. Many imported luxury foods will become scarce or very expensive as populations in tropical areas increase. For example, coffee, tea, spices, tropical fruit and even tomatoes are threatened. (Did you know that Canadians drink three times as much tea per capita as Americans, and that we import more fresh tomatoes per capita than any other nation? All tea and most tomatoes are imported.)

We may or may not like the North American car-culture, but we must live with it, anyway. A change in life-style here looks inevitable: smaller cars, fewer long trips, fewer week-ends away from the city, slower transport and more traffic problems.

What about interpersonal relationships? As people move frequently, from country to city or from city to city, many relationships are strained or broken. The result is galloping social instability and an alarming increase in, for example, the number of runaway children: 600,000 in the U.S. in 1973. The Canadian rate is likely to be substantially lower (perhaps 30,000), but still significant. In 1968, divorce rates in Canada were 60 per 100,000 of population and 300 per 100,000 in the U.S. Will we duplicate the U.S. rate, now five times our own, in the future?

At levels less basic than the family level — work, social, school levels — antagonism and stress are commonplace. Hierarchies and social systems are made unstable by deliberate policies of transferring individuals. Status and position are frequently ephemeral and insecure, driving the individual to greater efforts to achieve them.

There are plenty of other products of unrestricted growth — air pollution, lead, cadmium and mercury poisoning, alcoholism, cancer, crime and drug rates, the possibility of biological or nuclear war — to worry about, too. And what about natural

plant and animal communities? Hundreds of bird and mammal species are in danger of extinction. Whole ecosystems the world over are being threatened. It is quite certain that the destruction of plant systems alone will result in the extinction of at least 10,000 species in the next 20 to 30 years.

Who cares? Many people are concerned about the deteriorating quality of our lives, but too often they are not our leading politicians. Politicians did not arouse the world to the population and environmental crisis, and if left to themselves, they will not generate the necessary action.

It is up to you, the individual citizen. Write letters to your M.P. and M.L.A. Attend political meetings; organize all-party symposia with the aim of getting individual politicians to take a definite stand. Withdraw support from a politician who goes back on his word on the issues involved. Form a non-partisan pressure group — people interested in environmental quality are not limited to any one party — and take on one problem at a time. Try to avoid confrontations and hardened posi-

tions that lead to useless deadlocks. Even one or two persistent and dedicated individuals can be enough to bring and keep an issue before the general public.

Most of our problems can be solved. We can have both quantity and quality in our lives — but only if the major problem of over-population is treated. Treatment of symptoms such as fuel shortages and pollution are otherwise meaningless and perhaps even detrimental in the long term.

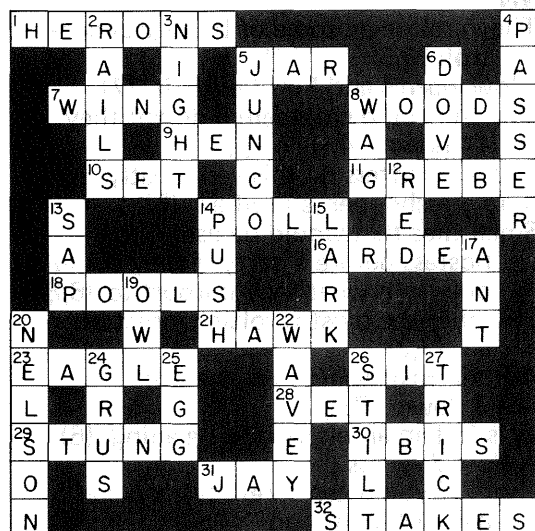
If our government will institute a rational population program — and years are involved — surely we will all do everything we can to save our resources and try to help those in great need. But I, for one, will do very little to support stop-gap policies that can only lead to greater shortages and less quality in the future.

Without such a new trend we might as well enjoy life to the full. Be daring: drive an eight cylinder, 450 horsepower car. Heat your house to 75 degrees. Burn your Christmas lights 12 months of the year. In the words of Paul Erlich,

"If you are sailing on the Titanic, you might as well go first class."

SOLUTIONS TO PREVIOUS PUZZLES:

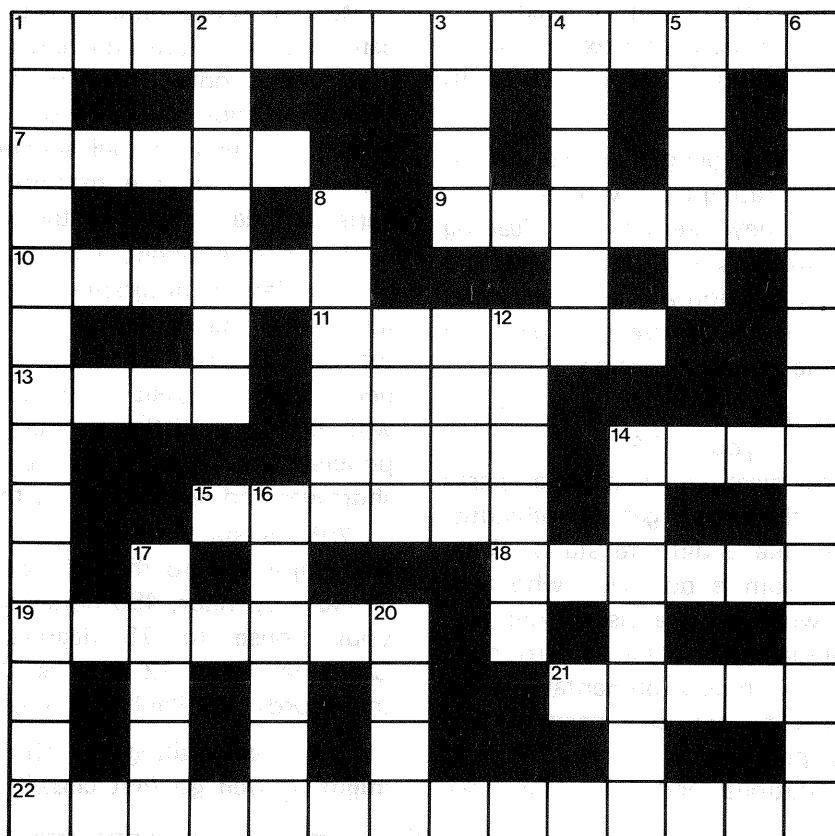
THE AVIARY



UNITS



FLIERS, STINGERS AND BITERS



ACROSS

1. Groups of fliers, stingers and biters (6,8)
7. The family of 17 down is nothing if not geometric (5)
9. The butterfly that commands a vessel (7)
10. A steady worker (6)
11. This wasp is not necessarily Australian, mate (6)
13. A small arachnid associated with widows (4)
14. A glimpse is a chirp (4)
15. If all insects survived, they would swiftly do this to our world (6)
18. A dull fellow, found somewhat disheveled in a laundry (6)
19. Ringlike (7)
21. A tiny primitive fly, larger than 13 (5)
22. Are these insects in Sergeant Pepper's Company? (7,7)

DOWN

1. They are the epitome of biological control (9,5)
2. Glow worms and Fireflies do it (7)
3. Nobody could call **them** 5 down: they 14 down (4)
4. The leaf-cutters do this very neatly (6)
5. The grasshopper is typified (5)
6. Small flies that would be useful to a hostess before a party if they could only spin what they purport to (6,8)
8. Probably the most revolting insect of all (3,3)
12. A biter, distressing to cattle (6)
14. See 3 down (7)
16. This Indian antelope may be ailing (6)
17. A slow 7 across
20. Hark! If you listen carefully, you can hear a Myrmeleon! (4)

WILL I NEED A CALCULATOR IN UNIVERSITY? 29.

by: Professor C. Kent,
Lakehead University, Thunder Bay.

This is a question more and more often directed to university profs these days by high school students, and also by students already in university. The space-age spin-off of micro-electronic circuits has placed high capacity calculators within the economic reach of a lot of people. Even students on limited budgets can strain to afford them, and the manufacturers haven't failed to notice the possibilities in the student market.

In the Thunder Bay Sears the other weekend, I was looking over the display of chained-down and otherwise guarded calculators when a proud parent and university-age son arrived to buy a calculator to replace the one he had bought the month before. **This month's model offered more functions than last month's. Herein lies a trap.** The price of these calculators has been dropping rapidly or, put another way, the capabilities of the calculators available at a fixed price have been rising rapidly. **But, they are still expensive toys** and keeping up with the Jones' latest hand-held calculator can be expensive.

I think the best answer for the university, or university-bound student, thinking of buying a calculator is that it is **not** necessary to have one to survive in university. University professors try not to impose arbitrary rules on their students, and they don't prevent students who have calculators from using them in class, but they try to devise test and exam problems so that the student with a calculator has no essential advantage over his poorer cousin without one.

Of course, if you are going to study engineering, or applied science, there will be a greater opportunity for you to use and profit from your own calculator than if you plan to study math, or physics. Even so, the ready availability of the large scale university computer to students, and the

increasing occurrence of mini-computers offer more than adequate opportunity for you to handle these big data processing assignments. At Lakehead University more and more of our first year students are getting heavily involved with the university computer and are learning, along the way, much more useful programming skills than how to punch the buttons on a 3x4 inch keyboard.

The *New Scientist* of February 27, 1975, contains a good article titled "*The electronic slide-rule comes of age*". The economics of the manufacture and marketing of the hand-held micro computers (or calculators) is surveyed, along with a list of the functions available in the various models. **That article is well worth reading** if you are thinking about buying a calculator, and can get your hands on *New Scientist*, which is an English magazine. If you can't, **here are some highlights.**

The Hewlett-Packard calculators are the Cadillacs of the species. HP got an early start and has kept ahead of the competition by offering increasingly sophisticated and capable calculators. These range from the (now old-fashioned) HP-21, at about \$200 through the super-Cadillac HP65 which sports 20 addressable registers, a 100 step programmable facility, magnetic tape read-in and read-out, user definable keys, and the sporty price of \$800-\$1000. Our Department owns a HP65 but I notice that it is used far less often than the much simpler Texas Instrument SR50, selling for about \$200. Sears sells an instrument virtually identical to the SR50, with full transcendental function complement, for a **little under \$100** when you catch a sale.

The *New Scientist* says that hand-held programmable calculators not unlike the super Cadillac HP65 will appear on the market in mid-1975 for a little over \$200. This is typical of the fierce competition now going on to capture the market, especially the student market.

As a guide for potential purchasers, *New Scientist* give a table of the expected costs of the various functions that can be purchased in a 'hand-held', as follows:

Functions	Price
$+, -, \times, \div$	\$20
$1/x$	5
x^2	5
$\sqrt{x}$	5
sin, cos, tan/Arc	20
Hyperbolic	12
Memory	12
$\ln x/e^x$	10
$\log x/10^x$	7
x^y	12
$x!$	5
Degrees/Radians	2.50
π	2.50

The typical cost breakdown for manufacturing and marketing a calculator selling for \$84 is interesting:

Integrated circuit	8.50
Semiconductors	1.20
Display	3.20
Keyboard	2.40
Case	.50
Misc.	.50
Rechargeable battery	3.20
Charger/A.C. adaptor	2.50
Total parts cost	22.00
Labour	2.00
Manufacturing cost	24.00
Overhead, marketing cost, man. profit	36.00
Factory selling price	60.00
Retail markup	24.00
Recommended retail price	84.00

The same issue of *New Scientist* contains ads for the Texas Instrument SR50 ranging in price from \$165 (from a "Discount House" in King's Cross, London) to just over \$200. It would appear that these calculators can be had for about 20% off suggested retail price, if you know where to look. (Our Department recently bought SR50's for \$150 from a Toronto firm). There is apparently still no wholesale "dumping" of the moderately sophisticated

scientific type calculators on the market, but the simplest types have recently dropped into the \$20 range, and a break in price of the others may not be far off.

One thing I find disturbingly missing in the published information about the hand-held calculators is information about their **reliability and durability**. An engineer friend recently told me that, if one of these baubles goes awry, forget it. His feeling is that **it would cost more to repair than to replace**. If his appraisal is correct, and the lifetime doesn't exceed the guarantee period (usually a year from a reliable vendor) then keeping yourself in calculators could be an expensive business. Another consideration for the Northwestern Ontarians could be the "down time" to send a calculator away for repairs if it goes bust, even in the guarantee period. I have been told that Sears' policy is simply to hand you a new calculator if something goes wrong during their guarantee period. That could be worth investigating but I wonder how often they go through the exercise on essentially new calculators.

All in all, your own hand-held calculator really isn't **necessary** in university, although it can be helpful in professional programs like engineering, or in upper year courses like statistics. Even in a program where a calculator would be handy, it probably isn't really too useful in the first year. It may be later, but the way prices are dropping and in view of the very limited experience people have had with their durability, I think **my \$200 will stay in the bank for a while yet**.

If, and when, you do decide to buy your own calculator you will face the decision on how much complexity to buy. The price very directly reflects the complexity and little else. *New Scientist* suggest that the cost premium you should be willing to pay for a "big name" manufacturer is not over \$25, while you can see from the figures above that \$25 is the cost of a very few additional functions.

Your planned use of the calculator dictates the complexity and price. If you are

going to use the device only for simple arithmetic of the balance sheet variety, you can get by with a \$20 calculator with $+$, $\times$, $-$, $\div$. The number of digits on the display should probably be greater than six, but **ten is an extravagance**. Eight should do nicely. "Floating point" decimal presentation is also unnecessary for simple arithmetic.

The next step up in complexity which will be usable will surely include a memory (one register will do) and "floating point". This extra capacity will allow you to cope with most of the calculations in statistics. Squaring, square-root and reciprocal keys would be convenient at this stage but are not really necessary. With a memory register there are simple "algorithms" in the user manuals which allow you to do your own thing with square-roots, cube-roots, etc. The increasing cost of dry cell batteries makes a rechargeable calculator battery a wise investment if you intend to make much use of your hand-held. You should easily get one of these calculators for \$50-60.

Only if you seriously intend to be an engineer, chemist, experimental physicist or econometrician would one of the "electronic slide rule" types with full scientific notation and transcendental functions be likely to be useful. The SR50, or comparable Sears or Eaton's models retail here for \$100-\$200.

The final step up to a programmable job, like the HP55/65, or comparable 'cheapies' to appear, is probably justified only for the serious practicing scientist or engineer. Some upper year students of these disciplines could find them useful, but only if they are "computer nuts" who develop their own procedures and programs for doing often repeated problems, or simply like to experiment with the procedures themselves. Here, however, these students are much better advised to use a mini-computer or large scale digital, and really get their teeth into a problem.

It may be strange to hear, but a math major in university probably will have less use for a hand-held calculator than almost any other type of student except history majors.

Finally, a personal prejudice or two. Special purpose calculators, for converting Fahrenheit to Celsius, or Acres to Hectares, are close to useless for the average human being. Unless you plan a career in the weights and measures business converting into and out of metric sizes, save your money. Even a percent key on an otherwise standard calculator is silly. **If you can't multiply by 100 you've got no business having that thing in your hand in the first place.**

BETTING GAMES THAT ARE A SURE BET

by: Dr. L.K. Roy,
Lakehead University, Thunder Bay.

There may not be a sucker born every minute but many people still find plenty of opportunity to lose money on what seems to be a fair bet. In the following examples bets are proposed by a smooth operator (call him the Artist) and accepted by a person who tricks himself into believing the bet is a fair one (call him the Mark).

1. The Gold Coin Gambit

Three boxes, identical in appearance, are placed on a table. One contains 2 gold coins, another contains 2 silver coins, and the last contains one silver coin and one gold coin.

Two	Two	One Gold
Gold	Silver	One
Coins	Coins	Silver

32.

A neutral person selects a box at random, opens it, and draws one coin from it. Suppose a gold coin was drawn. The Artist makes the following bet with the Mark: "I bet you even money that the other coin in the box is also gold."

The Mark thinks to himself: "The other coin could either be silver or gold. Also, it is obvious that this box is not the box with the 2 silver coins. So this box has an equal chance of either being the box with 2 gold coins or the box with one silver coin and one gold." He concludes that the bet is a fair one.

In fact there are two chances in three that the box being considered is the one with the two gold coins! Think of it this way: if the box is the one with a silver coin and a gold coin, there is one chance in two of drawing a gold coin. There are two chances in two of drawing a gold coin from the box with the two gold coins. So once we have the information that a gold coin was indeed drawn, the box with the two gold coins becomes twice as probable as the box with one silver and one gold coin.

2. The Birthday Booby-Trap

The Artist and the Mark attend a party at which a total of 40 people are present. The Artist bets that at least two people in the room will have the same birthday.

The Mark happily accepts the bet since there are only 40 people in the room and 365 possible birthdays.

Actually, the odds are not at all in the Mark's favour. Pick one person and determine his birthday. The next person selected has 364 other choices of birthday, so the probability that the two do not have the same birthday is 364/365. The third person selected still has 363 other choices of birthday so that the probability of the three having different birthdays is 364/365 times 363/365. For the forty people, the probability of none having the same birthday is a product of 39 fractions

$$\left(\frac{364}{365}\right) \left(\frac{363}{365}\right) \left(\frac{362}{365}\right) \dots \left(\frac{326}{365}\right) = 0.109$$

So the Mark has about one chance in 10 of winning. In fact the breakeven point occurs when there are only 23 people present in which case the Mark's probability of winning is 0.493.

3. The Odd-Numbered Dice

The Artist presents the Mark with 4 dice.

Blue	1 9 9 9 9 1	Green	7 7 7 7 7 7
Red	13 5 5 5 5 13	White	11 3 3 3 11 11

The Mark is invited to choose any one of the 4 dice, after which the Artist will choose one of the remaining 3 dice. Both persons will roll their dice and the person who rolls the highest number will win.

The Mark thinks to himself: "Obviously one of these dice is a better choice than the others. As soon as I determine which it is, I will begin to make some money."

Suppose the Mark chooses the red die since it has the highest number (13). The Artist would choose the green die and would have probability 2/3 of winning.

		Green				
		7	7	7	7	7
Red	5	x	x	x	x	x
	5	x	x	x	x	x
	5	x	x	x	x	x
	5	x	x	x	x	x
	13	--	--	--	--	--
	13	--	--	--	--	--

In the above table an X indicates a win for the Artist. Of the 36 possible combinations of green-red values, the Artist wins 24 of them.

After losing for a while the Mark may switch to the green die. As soon as he does, the Artist picks the blue die.

		Blue					
		1	1	9	9	9	9
Green	7	--	--	x	x	x	x
	7	--	--	x	x	x	x
	7	--	--	x	x	x	x
	7	--	--	x	x	x	x
	7	--	--	x	x	x	x

Again, 24 of 36 possible blue-green combinations mean a win for the Artist

When the Mark switches to blue, the Artist switches to white.

		White					
		3	3	3	11	11	11
Blue	1	x	x	x	x	x	x
	1	x	x	x	x	x	x
	9	--	--	--	x	x	x
	9	--	--	--	x	x	x
	9	--	--	--	x	x	x

Again, 24 of 36 white-blue combinations favour the Artist.

The Mark begins to reason as follows: "White beats blue, blue beats green, green beats red. So white beats everything. I'll choose white and eventually I'll make a fortune." The Artist chooses red.

		Red					
		5	5	5	5	13	13
White	3	x	x	x	x	x	x
	3	x	x	x	x	x	x
	3	x	x	x	x	x	x
	11	--	--	--	--	x	x
	11	--	--	--	--	x	x

Again, 24 of 36 red-white combinations mean a loss for the Mark.

The Mark's mistake is in choosing which die he wants to use **first**. Once the Mark has chosen, the Artist can make his choice so that he will win 2 tosses out of 3.

AN ANALYSIS OF THE GAME OF KENO

by: Dr. L.K. Roy,

Lakehead University, Thunder Bay.

The game of Keno is played in Las Vegas as follows:

The player chooses 8 of the numbers 1 through 80. Then 20 numbers are drawn at random from the number 1 through 80. If among these 20 numbers the player has chosen 5, 6, 7 or 8 correctly he wins \$5, \$50, \$1,100, \$12,500 respectively. The player pays \$1 to play.

There are $\binom{80}{20} = \frac{80!}{20! 60!}$ ways of randomly choosing the 20 numbers. There are $\binom{8}{x} = \frac{8!}{x! (8-x)!}$ ways of x of these 20 matching the player's 8 selections and $\binom{72}{20-x} = \frac{72!}{(20-x)! (52+x)!}$ ways of the remaining $(20-x)$ numbers not matching. So the probability of x matching numbers is

$$p(x) = \frac{\binom{8}{x} \binom{72}{20-x}}{\binom{80}{20}}$$

Thus the probability of winning \$5 is

$$p(5) = \frac{\binom{8}{5} \binom{72}{15}}{\binom{80}{20}} = .0183$$

of winning \$50 is

$$p(6) = \frac{\binom{8}{6} \binom{72}{14}}{\binom{80}{20}} = .0024$$

of winning \$1,100 is

$$p(7) = \frac{\binom{8}{7} \binom{72}{13}}{\binom{80}{20}} = .00016$$

and of winning \$12,500 is

$$p(8) = \frac{\binom{8}{8} \binom{72}{12}}{\binom{80}{20}} = .000004$$

The expected winnings of a player, each time he plays is

$$\begin{aligned} & 5 p(5) + 50 p(6) + 1100 p(7) + 1250 p(8) \\ &= 5(.0183) + 50(.0024) + 1100(.00016) \\ &\quad + 12500(.000004) \\ &= 0.4375 \text{ dollars.} \end{aligned}$$

34. IS THE MIND A MATERIAL OBJECT?

OR WHY DOES GLASS SHATTER?

by: Dr. J. Douglas Rabb,
Lakehead University, Thunder Bay.

Can dispositions be causes? This rather obscure question is, I believe, one of the most important unresolved issues in contemporary philosophy. Not only does the truth of two radically different accounts of mind and/or mental events depend on the answer to this question; but this problem is also at the basis of two quite different views of the nature of scientific explanation.

The two accounts of mind are represented on the one hand by Gilbert Ryle's behaviouristic analysis in *The Concept of Mind* and on the other hand by D.M. Armstrong's central-state materialism as presented in *A Materialist Theory of Mind*. The behaviourist claims that words which seem to refer to so called mental events do not in fact, refer to events at all. Rather they signify that the organism is liable or disposed to display certain sorts of behaviour. So, for example, to believe that it is raining is not to entertain the thought that it is raining, it is simply to have a tendency to wear a coat if one goes out, to have no inclination to wash the car or water the garden, to be disposed to answer in the affirmative if asked if it is raining — and so forth. The central state materialist on the other hand does not deny that there may well be events which we describe as mental. However, the materialist claims that these events are, in actual fact, events occurring in the brain or central nervous system. The materialist would argue against the behaviourist that there must be a state of the central nervous system which causes the organism to be disposed to behave in the way it does.

Ryle, the behaviourist, seems to hold a Phenomenalist or Operationalist position concerning scientific explanation whereas Armstrong is a proclaimed Realist. For example, Ryle states that:

When we describe glass as brittle or sugar as soluble, we are using dispositional concepts, the logical force of which is this. The brittleness of glass does not consist in the fact that it is at a given moment actually being shattered. It may be brittle without ever being shattered. To say that it is brittle is to say that if it ever is, or ever had been struck or strained, it would fly, or would have flown into fragments. To say that sugar is soluble is to say that it would dissolve, or would have dissolved if immersed in water.¹

On the other hand Armstrong argues that:

... in asserting that a certain piece of glass is brittle, for instance, we are ipso facto asserting that it is in a certain non-dispositional state which disposes it to shatter and fly apart in a wide variety of circumstances. ...

*The Realist view gains some support from ordinary language, where we often seem to identify a disposition and its 'categorical basis'. ('It has been found that brittleness is a certain sort of molecular pattern in the material.')*²

With crucial issues in both the Philosophy of Mind and the Philosophy of Science hanging in the balance, it is little wonder that the question 'Can dispositions be causes?' has generated such vigorous debate.³

In this paper I wish to propose a compromise which, I hope, will be acceptable to both sides of this important dispute. I begin with the following illustration.

An Enlightening Crash

Suppose I raise my glass of wine and propose a toast to Professors Armstrong, Ryle and their respective followers in appreciation of their valiant efforts to settle this important question. Suppose further that, as is the custom in proposing such toasts, after downing the wine I throw the glass with considerable force into the fireplace and the glass, as is its custom, shatters.

This very brief story allows me to generate a series of question which, I hope, will be illuminating. The first question is:

Q₁ Why did the glass break (shatter)?

The most obvious and straight-forward answer to question Q_1 is:

A_1 *Because it hit the hearth with considerable force.*

Answer A_1 , however, generates two further sorts of questions which I will class with obvious bias, as interesting and uninteresting. To state the uninteresting one first:

UQ_2 *Why did the glass hit the hearth with considerable force?*

It should be noted, of course, that UQ_2 is only uninteresting considering our present purposes. It might well, in other contexts, lead to some very interesting questions in the Philosophy of Action as well as to some intriguing sociological and psychological ones about certain drinking habits. Note also that the subscript '2' in these questions is intended only to indicate that they are in response to the answer to a previous question, viz., ' Q_1 '. The interesting question raised by A_1 is this:

IQ_2 *Why did the glass break when it hit the hearth with considerable force?*

The straight-forward answer to question IQ_2 is simply:

A_2 *Because it is fragile (brittle).*

However, answer A_2 also generates two further kinds of questions which I shall again class as interesting and uninteresting. First the uninteresting question:

UQ_3 *Why is it fragile? or What makes it fragile?*

Question UQ_3 is a question for the physicist and any answer to it would likely make reference to the molecular pattern of the glass etc., as Armstrong has noted in the quotation cited above. However the philosophically significant question raised by answer A_2 is of quite a different sort:

IQ_3 *Yes I know it was brittle but why did it break when it hit the hearth with considerable force? or*

Why do fragile things shatter when hit with considerable force?

Admittedly one way of interpreting question IQ_3 is simply as an oblique way of asking UQ_3 . But such an interpretation would be neither interesting nor instructive.

The sense in which IQ_3 is a different question from UQ_3 , and the sense in which I interpret it, is that in which it is a conceptual question. In most cases it would only be asked by someone who did not know the meaning of the English words "brittle" and "fragile". *The Oxford English Dictionary* defines "brittle", for example, as "liable to break", and once this definition has been understood, question IQ_3 has been answered and rendered pointless. Note that answering IQ_3 does not, of course, render UQ_3 pointless. It should be equally obvious that no answer to UQ_3 could possibly serve as an adequate answer to IQ_3 .

In conclusion it should be noted that we may well be tempted to raise question IQ_3 in response to some of the more technical answers to UQ_3 . However such a temptation should not be surprising for as has been wisely observed:

*The theoretically interesting category-mistakes are made by people who are perfectly competent to apply concepts, at least in situations with which they are familiar, but are still liable in their abstract thinking to allocate those concepts to logical types to which they do not belong.*⁴

Footnotes

1. G. Ryle, *The Concept of Mind*, (London, 1949), p.43
2. D.M. Armstrong, *A Materialist Theory of Mind*, (London, 1968), p.86.
3. See for example: R. Squires, "Are Dispositions Causes?", *Analysis*, Dec., 1968. D.M. Armstrong, "Dispositions Are Causes", *Analysis*, Oct., 1969. R. Squires, "Are Dispositions Lost Causes?" *Analysis*, Oct., 1970.
4. *Op. cit.* *The Concept of Mind*, p. 17.

HOW MANY VILLAGERS? (from p. 24)

used as a check on improbable claims for village sizes or food production, past or present. Best of all, it is a useful teaching device, showing clearly and simply the interrelatedness of the physical environment, human skills and population.

COLOURING-IN MAPS

by: Dr. Brian A.M. Phillips
Lakehead University, Thunder Bay.

Somewhere between the time of the historic voyages of discovery and the present, it has become firmly fixed in people's minds that Geography is all about longest rivers and highest mountains, and that geographers spend their time colouring-in maps. There is often a grain of truth in the most distorted views, and in the process of pursuing their long claimed interest in spatial correlations of criteria of, on, or above the earth's surface Geographers frequently use a variety of forms of visual display, collectively termed 'maps'.

Cartography is considered by most to be the science of the preparation of all types of maps, plans, charts and statistical diagrams. In its widest definition this would include every operation from the initial surveying to the design drafting and final printing. However, a more limited viewpoint tends to focus attention on the maps themselves, and examines them as useful devices for the display, comparison and analysis of spatially disposed data of all kinds. Any data which are arranged in space can be mapped whether they be 'solid' visible data such as elevation or population, or whether they be less tangible data, such as recreation potential or mental distance. Despite an enthusiastic but unfortunate student who once concluded an essay on the use of maps by stating that *"The Geographer has been blessed with a mighty tool which he should learn to use to its fullest extent"*, it is not only geographers who use maps, but also any persons whose interests involve spatial relationships. A biologist may map a single cell; an engineer may map the stress in a length of steel, a sociologist may map the pattern of crime in a city; a novelist may map the imaginary land in which his characters move. **So what are maps?**

One way of considering maps is to think of them as 'thematic' (an adjective derived from the noun "theme") displays. Whereas a conventional air photograph faithfully records every object visible within the field of view of the camera without selection, a map portrays a selection of criteria. As such it is emphasizing some criteria to the exclusion of others, and is therefore 'thematic'. Furthermore, within the scales in which maps are commonly drafted and reproduced, it is often not feasible to map every single item of a selected criterion. If one had the task of mapping individual political affiliation in a residential area, one would seek a representative sample of households from which to obtain data. Hence, a map is not only thematic, but is a visual transformation (by cartographic methods) of data which are a subset of the possible available data. Similarly, a map is itself a subset of a set or 'Supermap', which is all that can possibly be mapped.

While the map portrays data in pictorial form it serves, in effect, as a storage device for those data. Hence agricultural statistics may be stored both as tabulated figures and as a series of thematic maps. Since, in very many cases, the data sample is temporal, that is, representative of one moment in time, the map also serves the function of an historical document. Indeed, unless the delay between data collection and map production is very small, the very first copy of a new map may still be an 'historical document' if the criteria with which it is concerned are dynamic. A map of occupied dwellings in an urban area may only represent the real situation for less than a day. While this may seem to be a negative element, advantages are derived from the sequential nature of many maps. A series of maps of the distribution of the same criteria in the same area at specific points in time may be examined in sequence. The historical nature of each map

is the basis of comparative analysis, and the changing pattern of the dynamic variables can be discerned. A most dramatic visual display of urban growth may be obtained by examining a sequence of maps of five year intervals and filming each for a few seconds in turn. The resulting short film will demonstrate the 'amoeboid' growth of suburbia in a manner greatly more appealing and effective than the examination of tables of population or housing statistics. A map may serve as a data-storage device, as an historical document and as a part of a sequential series. To retrieve those data requires a further transformation, that of map interpretation.

Map interpretation might be described as an art, an ability gained by experience rather than by learning alone. However, though a map interpreter may be highly skilled, data will only be retrieved from a map if that map clearly and unambiguously portrays that which is intended. The pre-map decisions to be made by a cartographer are many and difficult, for they require a truly interdisciplinary understanding. Not only must he fully appreciate the business of mapping, but he must fully understand the spatial processes governing the criteria that are to be mapped, and the manner by which a map reader gains information from a map. Ideally, a well designed map will transfer to the interpreter all the data put into it, and also generate fresh ideas. Such a map is said to have a high 'map transfer function'. Problems often arise in the matter of map design. However attractive-looking and skilfully-drawn is a map, unless it rapidly and unambiguously transmits its data at an equivalent or greater rate than the initial form of the raw data would have done, its function is utterly lost. Our texts and news media are full of pretty maps which are far more difficult to understand than the original raw data which they purport to represent visually.

Designing maps involves an understanding of some psychophysical phenomena, and also involves one with the limitations

of cartographic language. For example, on this page the writer can control the order in which bits of information are transmitted to the reader, since it is known that the symbols used (the groups of letters or words) will be read in a particular and continuous manner (i.e. left to right, top to bottom in Canada). However, the map designer has very little control on the order in which the cartographic language (point, line and area symbols) will be read, since one cannot foretell at which point within the map boundary the reader will look first, nor which point might be viewed next, and so on.

The human eye scans a visual display in a series of foveal fixations. During any one fixation the brain receives data from the central part of the field of view (the fovea) which it appears to concentrate upon, but it also simultaneously receives data from the remaining part of the field of view (the extra-foveal area). Thus, a single item of information may be observed only once foveally, but may be reinforced extra-foveally several times during adjacent fixations. While the eye is capable of receiving about three million bits of information a second, the brain can only account consciously for about sixteen bits per second. **Our brains perform the incredible task of data reduction.** The efficiency with which this task is achieved is governed partly by the ability to class data and to link them to familiar knowledge, or by the ability to reject and ignore them. These processes take time, and depend ultimately upon the perceptual ability of the observer.

The processes of visual search are the subject of much research, but the application of such research to map design has only recently been recognized. For example, in tests in which subjects have been asked to locate a specific target within a display of a variety of unlike and similar-looking targets, the results indicate that some commonly used map techniques are ineffective. Results show, for example, that search time is least when the target is discriminated by colour, and greatest when

shape alone is the discriminating factor. Hence, it is found easier to locate a red target in a display of targets of several colours than to locate a circle in a display of targets of several shapes. It is also discovered that it takes longer for the brain to reject similar looking targets than to reject unlike targets. Suppose a map has one hundred and twenty black targets (e.g. symbols) one of which was the target to be located. Visual search time would be x seconds (case A). To find the same target in a display of sixty black targets predictably takes $\frac{1}{2}x$ seconds (case B). However, to find the same black target in a display of sixty red targets and sixty black targets (case C) will be found to take more than $\frac{1}{2}x$ seconds, but considerably less than x seconds, though the total number of targets was the same as in case A. The reason for this is that the brain rapidly rejects or filters out the non targets (red) and less rapidly matches and rejects the remaining fifty-nine similar targets. In view of the common use of differences in size and shape of symbols on maps rather than differences in colour, this type of research could herald some radical changes in future map design techniques. At this point it is seen that "colouring-in maps" is a far too simple view of the geographer's task. In the words of one eminent cartographer

"Whoever has a knowledge of cartography is convinced that it is more difficult to compile a good map than it is to write a good book. In the latter situation one does not need seriously to torment himself with precision because where ideas fail it is easy to shirk obstacles by the skilful use of words."

Raisz — 1962.

Problems of map design are by no means the only ones facing today's cartographer. We are in the midst of a quiet but rapid cartographic revolution, largely because our ability to collect data has outstripped conventional methods of storing, displaying, retrieving and analysing them. The long standing conventional topographic map, often printed about two to five years after initial survey and infrequently updated, is now simply insufficient for the planner concerned with the rapidly

changing situation in our major population areas. Quantities of data now being made available to those responsible for planning and managing our natural and urban environments can no longer be transformed into visual form by manual drafting at a rate sufficient to keep up with supply. Furthermore, people are increasingly concerned both with more complex and less directly derived data. Pre-map statistical processing of large volumes of data is best handled by computers, and **the 1970's are likely to be known as the decade of computer mapping.** Although the map draftsman is by no means obsolete, anyone claiming to be interested in dynamic patterns of spatially arranged data now uses computer generated maps.

Experimental maps of many kinds are now providing exciting and challenging new approaches to mapping, and the changing face of modern cartographic methods is so rapid that it is hard for an individual to keep pace with it. Discussion of specific map types and map related problems would be best reserved for further short papers. Meanwhile, where appropriate, the computer may be given the task of colouring-in and analysing some maps.

True or False?

genome: one complete set of chromosomes, a chromosome complement. Ordinarily, a gamete has one genome (is haploid), a zygote has two (is diploid).

gnome: in folklore, a tiny subterranean creature said to be guardian of hidden treasures.

One letter **does** make a lot of difference!

Which of these are used synonymously, and what is the preferable spelling: glycerine, glycerol, glycine, glycinol, glycol, xylene, xylo?

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