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LAKEHEAD UNIVERSITY SCIENCE REVIEW

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JANUARY 1973

A LAKEHEAD UNIVERSITY SCIENCE REVIEW
incorporating
LAKEHEAD UNIVERSITY MATHEMATICS GAZETTE

> CARET (*kar'at*) *n.* A sign (∧ or λ) placed below a line to indicate where something should be inserted.

What is missing? Well – a title, for one thing, and a magazine without a title is unthinkable!

We, the editors, are not at all sure what you would like us to do, but we do know one thing – there is a disastrous communications gap between High Schools and Universities: the bridge across it is missing and we will hope to span the void if only with a gossamer thread.

Let us know what kind of articles you would like to see. *Write an article yourself and send it in.* Push your science teachers into sending us stories about their scientific and personal interests, or write about them yourselves (what an opportunity!). Above all, *don't think that what you have to say will not be of any interest to us:* let *us* be the judge of that. And, please don't assume that university scientists are somehow not quite human; we experience the same emotions of fear and hope, love and hate as the majority of human kind.

Oh, about the title. The 1378–page, four volume *Harper Encyclopaedia of Science* for the best title. Why not fill in the form on the back page and send it to us TODAY?

> **The encyclopaedia is really worth having.**

The views expressed in *Caret* do not necessarily reflect the opinions of the Editor, the Faculty or the University.

Caret is published by the Faculty of Science of Lakehead University. Thunder Bay "P", Ontario, Canada.

LETTERS TO THE EDITOR

Thank you for your letter of August 15. As you have probably guessed from my return address, I am teaching with the Canadian Armed Forces here in Germany for the next two years. Mr. W.A. (Bill) Luft has taken over as Head of Science at Lakeview.

Naturally, I am still extremely interested in any publication that may come forth. Would it be possible to be placed on your mailing list? Once I get my head above water around here, I'd be glad to send you an article on teaching Canadian students some science in a German environment. Let me know if I can be of some assistance! – E.F. Dojack, Lahr Senior School, Canadian Forces Base, Europe. C.F.P.O. 5000. *We'll be very pleased to hear from you from time to time, and we hope you will send us an article when you have settled down a bit. – Ed.*

CONGRATULATIONS!

This is the first edition of the Lakehead University Science Review, "CARET". It was conceived by the Faculty of Science as a logical extension of the Lakehead University Mathematics Gazette into a wider area of subjects. We hope that it will be as successful as the "Gazette" and create active interest in the many aspects of Science.

Our editor, Dr. John Hart, deserves our thanks for the initiative and vigour he has shown in collecting such varied articles from many eminent authors. We hope that each will contribute again to later editions.

Good reading to you all.

R. A. Ross,
Dean, Faculty of Science

Dear Professor Hart:
Thank you very much for your recent letter. May I take this opportunity of conveying my good wishes for the success of your Journal. Science is everybody's business.

Kindest regards.

Yours sincerely,

Alastair Gillespie, M.P.,
Etobicoke

A SCIENTIST LOOKS AT SOCIETY

By Andrew D. Booth

ARE WE HEADING FOR DOOMSDAY?

Thinking and reading members of our community at the present time are bombarded with information about "ecological catastrophe". On the other hand, the voices of industry and government assure us that many of the warnings of the more frenetic environmentalists are without foundation. It may, therefore, be interesting to consider the sort of hard information which the scientist can give about problems of this type, and to do this, I shall explain briefly three approaches to the problem.

593 YEARS TO GO

The first approach is what one might call the worst case geometric one. Here, one assumes that the surface of the earth is drained of water in some way which is yet to be discovered, that humanity goes on increasing in numbers at its present rate of approximately 1.9% per annum, and that the limit is attained when the surface of the earth is covered solidly with people standing shoulder to shoulder and back to back. This situation is covered by the simple compound interest law learned at school and by the formula known to the Greeks for the area of spherical surfaces. Inserting the relative parameters, it turns out that at this rate of population increase, the earth's surface will be covered in only 593 years from now. Remembering that this is just about the period since the renaissance, and that no assumptions have been made about the way in which society operates, the way in which wars may reduce population and so on, this is a far from reassuring figure.

The second argument which can be used is what one might describe as the thermodynamic one. In this, we assume that the surface of the earth is covered not only with a single layer but with people stacked shoulder to shoulder, back to back, and feet to head. In other words, they are accommodated in multi-storey skyscrapers. The problem involved here is one of great interest to the physicist since, in the last analysis, it resolves itself into one of energy dissipation. When the population of the world reaches about 10^{17} people, the skin temperature of the outside of the structure required to dissipate the human energy into space, would have to run at a temperature of something like 5,000° C which is precisely the temperature of the outer layers of the sun. One need hardly say that this is not a terribly practicable solution. Even so, the time involved is still quite short, about 900 years, in fact.

Yet another solution which has been proposed to cope with the population increase is to export population to adjacent planets. As things appear at the present time, the only possible candidate would seem to be Mars, although, assuming a high degree of technological competence, one might include Venus in the argument. However, it should be noted that a 1.9% increase per annum in population involves a doubling in 37 years for Mars and a very much smaller time then to cover Venus.

ZERO POPULATION GROWTH NOW

Finally, one can consider the so-called M. I. T. model. This relates the future to the socio-economic variables of the present. Such models are extremely complex and their study has only been possible since the advent of large electronic computers. Whilst some of the details of the M. I. T. model are open to question, the main structure is sound. The model shows that, unless radical steps are taken to ensure zero population growth **now**, only about 100 years remain until the world population is reduced to about ¼ of its present value by an eco-catastrophe. This neglects the very real possibility of a major war and points up the urgent need for an in-depth application of the **hard** physical and mathematical sciences to the soft area of sociology. †



SCIENCE IN SOCIETY

By C. K. McLellan

THE ROLE OF SCIENTISTS

Of late, people have begun to consider more carefully the role of science in society. This unexpected turn of events has caught many scientists unprepared, for they grew accustomed to the attitudes prevailing in our technological society in the 1950's – an attitude which seemed almost to hold science and its devotees in awe for their considerable contributions to recent world developments.

SCIENCE IS A TOOL

Prior to this century, the dominant role of science was the discovery of new knowledge. Beginning early in the 1900's, however, the trend to urbanization and industrialization of the western world translated much of this knowledge into new products and services. As a corollary, the role of science was altered to emphasize these goals of the industrial society. The transformation was highly successful. Science became an essential tool in our production - and consumption-oriented economy. The role of science assumed two important aspects: the continuation of this line of economic and social development through product improvement; and, the evaluation of new ideas. Science's "experts" became highly respected as important parts of a system which provided the good life for many. This, in turn, produced in our educational systems a great emphasis on training more scientists in the "practical" fields where their skills could be applied to immediate problems.

The economic system which uses technology, and the people who welcome its benefits, must share some responsibility for the problems it has created: scientists must accept a large portion of the responsibility, but it seems that scientists have often divorced their role as scientists from their role as citizens.

FREEDOM AND RESPONSIBILITY

A scientist must be given the freedom to speak out on matters touching his field of expertise and he must accept the responsibility. He should shun the pose of the expert and should function, rather, as a "resource person" whose knowledge should be shared by others, for it is the entire society which must evaluate the information and choose courses of action.

A first approach to this goal may be made through the professional associations of scientists. Information must be presented so that it is easily understood by non-scientists. It does no good to attempt to dazzle people with unintelligible jargon. [*Amen! – Ed*]

The second approach lies in more direct action on several political levels. The scientist should be involved in political and community action groups where he has direct contact with other citizens.

As the traditional training grounds for highly professional scientists, universities should have an important part in developing a social responsibility for science. The two dominant functions of universities have always been education and research and the current problem is how best to execute these functions in scientific fields for the benefit of society. The system provides some students with a broad general background of knowledge, but often with few specific work skills. Such a graduate frequently fails to impress an industrial employer, who notes with dismay the considerable practical training this person will require in order to become a productive employee. On the other hand, industries must bear in mind that in the long run, it is more to their advantage to have employees whose wide background knowledge allows them to be flexible in their work, than to have only narrow specialists.

CANADIAN BASIC RESEARCH IN DILEMMA

The research function of a university arises quite naturally. University researchers seek approval from their peer group – other researchers. Hence in order to be respected, a university must produce high-quality research results through its graduate school. The amount of research done this way is valuable, particularly in Canada. In our so-called branch plant economy, industries tend to emphasize research in the narrow areas of product and process improvement, and the "basic" research for which there may be no immediate application is left to the foreign parent company. If a significant amount of basic research is to be done in Canada it appears that universities must do much of it.

The dilemma arises in the choice of topics for investigation, for the benefits of research should accrue both to the scientific community and to the larger community of Canadian people. This implies that a significant proportion of such work must be

tailored to the foreseeable needs of our nation. Considerable emphasis should be placed on these needs in choosing research topics, and as responsible citizens, scientists should be doing this themselves. The abdication of such responsibility invites forced direction of research from the governments which supply a significant portion of funding for research.

University education should be broad enough to create a search for alternate approaches to the solution of socio-technogical problems. For example; in the problem of energy shortages currently plaguing parts of North America, the conventional solution is to seek technical means of meeting the increased demand for energy. The success of such solutions has led producers to invite increased demand which in turn raises consumption. It would be better to find a way of cutting back on the rate of increase in demand for energy.

SCIENTISTS ARE CITIZENS

Alternate approaches to large problems often range beyond the fields of expertise of the specialist. No grouping of experts alone can make the decisions, for the implications may be so broad that only society as a whole can decide. That may well be where the major role for science lies in the future — not in product development and production, but as an information resource for a society which we can but hope will be pursuaded to develop rationally. The relative importance of science will be diminished as scientists de-emphasize their roles as experts in favour of their roles as citizens. †

GEOLOGICAL TIME

By: M. Kehlenbeck

MAN HAS LIVED FOR A FEW MINUTES

Geological time spans are among the most difficult concepts to comprehend. It is common for us to think in terms of years, generations, and centuries. However beyond this, time becomes, for most of us, merely a number of many zeros without any real meaning. Yet the geologist speaks constantly in these terms.

At present we believe the age of the earth to be about 4.5 billion years and the existence of life on earth to be of approximately 2 billion years duration. Do these figures really signify anything to you? Perhaps an analogy can serve to make these time spans more meaningful.

Let us use one of our years to represent the entire history of earth. Our planet then was forming at the beginning of this year. Gradually it solidified; mountains were formed and eroded and formed again; the ocean basins and continents began to take shape. For perhaps half of this year the earth was barren and lifeless. Then at some indeterminate point in August, life in the form of single-celled organisms appeared in the seas. It was not until late November that life forms emerged from the waters and were able to survive on land. The age of the great dinosaurs was as recent as mid-December. And modern man did not evolve until the last few minutes of our year.

Now the question must arise as to what evidence there is to substantiate these divisions of time. Fossils of course give us the clues to the last 600 million years, but what about the more than half of earth's history when there was no life present or organisms were soft-bodied and could not leave fossil evidence? By what means do we divide this immense span of time into more concise parts?

The answer to this question lies in the field of geochronology. Using radioactive elements and their known rate of decay into stable end products, it is possible to calculate the time required to produce a certain quantity of the stable substance and hence the age of the original radioactive element.

Several methods of radioactive dating are employed. The uranium-lead method can give us the absolute age of a rock but is useful only when there are lead-bearing minerals present. Far more abundant are potassium-bearing minerals, and for dating these we use the potassium-argon "clock". However this method does not give us the absolute age of a rock, rather the date of the most recent orogenic (mountain-building) event to which it was subjected.

For example, prior to the application of this method of geological dating, much of the Canadian Shield was simply regarded as Precambrian (older than 600 million years or before November in our analogous year). Now we know more specifically that the rocks of the eastern Shield underwent their most recent metamorphic event about one billion years ago, whereas those of the western regions were last metamorphosed about 2.5 billion years ago. Thus we can now subdivide the Precambrian of Canada into periods of orogeny.

By such methods of dating we not only learn the ages of rocks and events, but can divide huge eras of time such as the Precambrian into more specific and meaningful periods, making geological time and evolution that much easier to comprehend. †

SO YOU WANT TO BE AN ATHLETE?

By J. Widdop

A KNOWLEDGE OF SCIENCE MIGHT HELP!

It is difficult for many people to accept or even recognize the relationship which exists between Mathematics and Athletics. The purpose of this article is to indicate a few of the various aspects of that relationship.

Many students who excel in mathematics are excellent athletes, a well-known example being Frank Ryan who was quarterback for the Cleveland Browns and has a Ph.D. in mathematics.

APPLICATION OF SCIENTIFIC PRINCIPLES

Three fairly simple formulae are shown below. See if you can identify them:

a)

$$R + R_2 = \frac{v^2 \sin\theta \cos\theta + V \cos\theta \, V^2 \sin^2\theta + 2gh}{g}^{\frac{1}{2}}$$

b)

$$R_1 + R_2 + R_3 = \frac{V^2 \sin\theta \cos\theta + V \cos\theta \, V^2 \sin^2\theta + 2g\,(h - C\sin\theta)}{g + c \sin \alpha + c \cos\theta}^{\frac{1}{2}}$$

c)

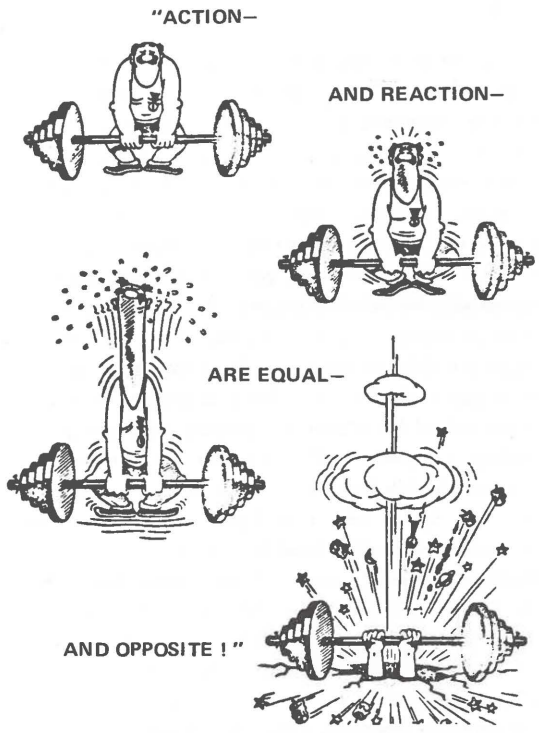
$$V_1 = \frac{(m_1 - em_2)\, U_1 + (1 + e)\, m_2 U_2}{m_1 + m_2}$$

I am certain (?) that you will recognize that a) and b) are derived from the basic laws governing the path of a projectile which describes a parabola and show the formulae for the flight of a shot and the distance covered by a long jumper respectively. c) may be used to calculate how much further a fast ball may be hit than a slow ball, assuming all other pertinent data are equal (U_1 = velocity of ball before meeting bat).

These three examples constitute only a sample of the plethora of similar formulae which are applied everyday – whether by chance or design – in the realms of physical activity.

THE BODY IS A MACHINE

The human body contains many examples of **levers** with the bone itself constituting the rigid bar, the joint being the fulcrum and the contracting muscle the force. Most body movements are produced through third-class levers where the force point lies between the fulcrum and the resistance point. Examples are when one flexes the forearm with the elbow acting as the fulcrum, the force being applied at the insertion point of the biceps and brachialis and the resistance being the forearm itself whether or not a weight is being held in the hand. Normally, when considering levers the force is assumed to be acting at right-angles but with muscle action this is rarely observed. Using the



flexing of the forearm again as an example the usual formula needs to be modified. Let us suppose we are holding a 5 lb. weight in the hand with the forearm fully extended and wish to know what force need be exerted to start the flexion of the forearm. We may assume that the weight arm (from weight the force point) is 12" and that the force arm (muscle insertion to fulcrum – elbow point) is 2". Normally the formula would read:

Force x Force Arm = Weight x Weight Arm

or in our case

$$F \times 2 = 5 \times 12$$

$$F = \frac{60}{2} = 30 \text{ lbs.}$$

However, the applied force in this case is not at right angles but at an angle of approximately 5° with the lever. Therefore a more realistic calculation of the force exerted by the biceps would, in our example, be

$$F = \frac{30}{\sin 5^\circ} = \frac{30}{.0872} = 344 \text{ lbs.}$$

If we started at 30° angle the force required would be:

$$F = \frac{30}{.5} = 60 \text{ lbs.}$$

It can be seen that to exert great force the force arm should be as long as possible while for greater speed the force arm should be relatively short. In the movement of body parts we have no real control over these factors as the muscle attachments which are the source of the exerted force are fixed. Wrestling however shows how the lever principle can be used outside the body. To prevent an opponent from turning by holding his arm on the mat it will be most effective to grasp the arm as close to the hand as possible with the arm fully extended at right angles to the body. This guarantees the greatest moment of force and the greatest mechanical advantage. Conversely if one wishes to turn an opponent quickly then a short force arm is required, an example being the use of a half-nelson where the force is applied at the shoulder.

Kinesiology (the science of movement) helps the student – athlete to better understand the scientific principles which will enable him to train and perform at a higher level than before. These same principles can then be passed on to his own students when he becomes a qualified teacher/coach.

ALLOW FOR THE WIND

Aerodynamics play a major role in such activities as the discus and in the kicking or throwing of a football. The equation

$$R = \frac{CPSV^2}{2}$$

expresses the reaction resulting from the diversion of the air stream about a moving airborne body.

- R = the resulting reaction.
- C = a numerical non-dimensional coefficient dependent upon the shape of the object and its attitude to the air stream.
- P = air pressure (15 lb./sq. in. at sea level).
- S = the active surface area of the object over which the air stream flows.
- V = the velocity of the air stream with respect to the object.

The Y component of R creates lift while the X component has a retarding effect and is called drag.

Most coaches encourage their charges to kick or throw at a lower angle than usual into a head wind or higher with a tail wind. The Russian discus throwers are informed of the precise wind conditions prior to throwing and adjust the angle of release accordingly, which may vary from as low as 22° to above the "ideal" 45°. As a matter of interest the best results were obtained with the discus inclined at 35° and a head wind not exceeding 14 m.p.h.

Spin or **gyration** is also applied in many sports and has either a stablizing effect that holds an object on course, or resists a change in the direction of the axis of the object. If the spin on a football is too little, the ball will float or travel end over end, while too much spin will tend to cause the ball to swerve from its intended path. All baseball pitchers know that a spinning ball will tend to move in the direction in which it is spinning; a top spin will cause the ball to drop while a ball spinning counterclockwise (viewed from above) will curve away to the pitcher's left. This is caused by the increased air resistance met by the ball on the side which is spinning into the created head wind. In such games as basketball, tennis, table-tennis, handball, cricket and billiards, spin is used to change the direction of the ball – by use of the relevant surface area rather than through the air, although certain top class bowlers in cricket are capable of causing the ball to curve through the air one way and then – upon striking the ground – spin back sharply in the opposite direction. This would be one example of applying both air resistance and gyration effects, while a tennis serve could be another.

CROSSING THE BAR

The body's **centre of gravity** is considered in many sports activities: it can be located at about the height of the hips midway between the front and back of an individual who is standing erect or lying flat with arms at the side. If the attitude of the body or parts is changed then the c. of g. is changed. It is possible for the c. of g. to be located outside the body when performing such activities as vaulting or somersaults in gymnastics or diving. The modern styles of the High Jump have evolved because of a better knowledge and understanding of kinesiological principles. Research has shown that in the vertical jump some of the world's greatest jumpers – with their arms at their sides – have been able to raise their c. of g. only about two feet. This emphasizes the necessity of the application of sound mechanics principles and the perfecting of jumping techniques to achieve heights that exceed seven feet. If we take

a pole about 6 feet long and hold it vertically then let it drop so that it bounces straight back up, it will probably bounce only a few inches from the ground. If we **throw** it down it will bounce considerably higher. Let us repeat this experiment but, at the high point of the bounce, grab the pole at its mid-point (c. of g.) and turn it horizontally so that it is now parallel to the floor and is now four to five feet from the ground. Here we have indicated (very crudely) the essential differences between the Scissors style of high jumping and the lay-out styles currently used. In the Scissors style the jumper's c. of g. passes over the bar and is quite a considerable height above the bar because the jumper is almost in a sitting position at the peak of the jump. If, however, we lay-out as we cross the bar our c. of g. still passes above the bar but is much closer to it. In essence, for the same amount of force and energy expended, we should achieve a greater height. In the Western Roll, however, the whole of the body is – at some point – lying on its side above the bar. If we go a step further and use the Straddle style, or "flop" popularized by Fosbury or Debbie Brill we find that the body **rotates** around the bar and at no time are **all** parts of the body above the bar. This then gives the effect of the c. of g. passing **under** the bar thus again giving the capacity for achieving even greater heights.

Other mechanics included in the well-executed high jump include:

a) a vigorous stamping of the take-off foot hard against the ground (Newton's third law) and
b) the forceful swinging up of the free leg and the arms to increase the lifting force of the body, showing the principle of transfer of momentum from part to whole. This principle can easily be experienced by trying to do a sit up from a back lying position, i) first with the arms to the side then, ii) starting with the arms stretched overhead with the backs of the hands touching the floor and initiating the movement by a vigorous upward and forward swing of the arms.

FRICTION HELPS OR HINDERS

Principles of **friction** are put to good use in athletics in two different ways. The first and more obvious application concerns the problem of slipping and how to provide a higher coefficient of friction. Sometimes this is achieved by artificial means such as spiked shoes or specially located floor surfaces. Adverse conditions can, however, also be overcome by a sound knowledge of equilibrium and the use of appropriate body lean, examples of which could be the angle of inclination of a 100 yard sprinter, or running on a sharply banked indoor track, or a basketball player dribbling down court.

The second application is deduced from the normal principles of friction. Since the friciton is the same whether the force which presses the two surfaces together is at one point or spread over a wide area it logically follows that if the total force is spread over a wide area then the force will not be as great at any one point as it would if it were concentrated at that particular point or a small area. Again, some of the problems can be alleviated by articial means and we find equipment constructed to "spread" the force of a blow. A catcher's mitt – compared with other player's gloves – is an example of the recognition of this principle. The "armour" worn by footballers and hockey players is designed to spread the force of an impact and also to transfer it from one part of the body to another. Shoulder pads are based on the cantilever principle with the intention of transferring the impact from the point of the shoulder to the flat less vulnerable surface areas. Over-weight boxing gloves used in training are not – as many people think – a training device to make the boxer's arms stronger or so the regular gloves will feel lighter in real combat but are designed to spread the force of a punch over a wider area thus lessening the chances of injury during sessions, a fact for which managers (and sparring partners), no doubt, are truly grateful!

The same fundamental principles may be applied to the body itself without artificial aids. Learning to land correctly in Judo after being thrown is a good example of how to protect a particular part of the body from injury by absorbing the effects of the impact over as wide an area as possible. The fundamental movements of a layout should be employed when sliding into a base when as much as possible of the leg, hip and back should hit the ground simultaneously.

POWER IS IMPORTANT

In 1932 McCloy pointed out that the **power** used for performance varies with the cube of the **velocity**. Using the formula

$P = FV$ when P = power
F = force in lbs. in the direction of the motion
V = velocity of the body in the direction of the force

McCloy demonstrated the difference in power units used in running the mile at a constant rate of speed and varying rates of speed. Using hypothetical

times and rates of speeds, two tables were produced showing the amount of energy expended when
a) a constant rate of speed was maintained and,
b) where a varying pace was used.
In each case the distance was covered in four minutes 24 seconds. The power was found by calculating the cube of the velocity for each 220 yards.

TABLE BASED ON CONSTANT RATE

	Time for 220 yards	Speed in Ft. / Sec.	Velocity Cubed or Power Used
1	33	20	8000
2	33	20	8000
3	33	20	8000
4	33	20	8000
5	33	20	8000
6	33	20	8000
7	33	20	8000
8	33	20	8000
	264 secs.	Average = 20	64000 power units used

TABLE BASED ON VARYING RATES

	Time for 220 yards	Speed in Ft. / Sec.	Velocity Cubed or Power Used
1	29	22.7	11697
2	30	22.0	10648
3	32	20.6	8742
4	34	19.4	7301
5	36	18.3	6128
6	38	17.4	5268
7	37	17.8	5640
8	28	23.6	13146
	264 secs.	Average = 20	68568 power units used

The significance of the study is the fact that, although both runners had the same time for the mile, the one who ran at a constant speed used approximately 7% less power. At least two advantages can be noted: first, that a runner can, by "pacing" himself, match the time of a stronger runner who does not pace himself and, second, a runner can achieve a better time using the same energy if he masters the technique of pacing. As the famous Australian coach Lydiard, has said regarding the four-minute mile, "Most runners can do 440 yards in 60 seconds; with stamina added they can keep up that pace for four times 440 yards." Try to run 110 yards in 15 seconds – not a difficult task. Thirty seconds for a 220 yard canter? – quite easy. However, if you could maintain this pace for a mile you would cover the distance in four minutes. Great runners such as Bannister and Ryun utilized pacing methods to achieve their great performances and always had some energy left for that last 100 yards dash to the line.

LIGHT LINEMEN CAN BE EFFECTIVE

There are numerous other examples that could be cited where the knowledge and application of scientific principles play a vital role. Among them are the popular circuit training programmes where an athlete performs to his maximum. He then prepares a training "Circuit" of several activities, each one calculated from his maximum performance in each activity, the whole circuit to be achieved within a certain time limit. He can then make the circuit progressively more demanding by gradually increasing the number of repetitions of each activity, or by cutting down the time factor for the full circuit. Periodically he will re-test himself to determine a new training circuit based upon his improved maximum level.

The famous "Crimson Tide" football team of the University of Alabama are noted for usually having a smaller line than the teams against which they play. They counter this by training their players to get off their marks more quickly than their opponents and – where possible – to hit them at an angle.

Work it out. If you are a lineman in football and weigh 175 lbs. while your immediate opponent weighs 200 lbs., how much faster must you be moving – if you meet head-on – to be able to hold him for those vital split seconds after the ball is snapped? At what angle should you hit him to best deflect his forward progress. Theoretical? Perhaps, why not try it out?

Whether we are counting the number of push-ups a student can perform, keeping the statistics of a game, or utilizing extremely sophisticated analytical techniques in research or coaching, the importance of the relationship between the sciences in general (and mathematics in particular) and athletics cannot be too strongly stressed.

May the "jocks" and the "egg-heads" long continue and expand their joint ventures. Each group has much to offer the other.

†



INTERVIEW WITH THE LAKEHEAD UNIVERSITY GLASSBLOWER

Ken Sumpter

IS EDUCATION ROULETTE?

Ken: What are you actually going to do in in this magazine?

Us: Well, I'm not sure. The idea is not to try to professionalize it, but to write articles for the "ordinary" students in Grade 12 and 13. Our problem always is that we tend to make things too professional. I still think YOU could write one!

Ken: I've got my own view about education as such, you know, particularly at this moment. It's a difficult job to promote a University to high school students. It's a fact that there are NO JOBS at this moment in time. It's like a game of roulette to pick a subject where you are going to find work because what looks good now . . . .

Us: . . . . may look very different in ten years' time.

Ken: Right! If I was going to do something, I'd probably do Physics because . . . .

Us: . . . . nobody's doing it.

Ken: No . . . .

Us: . . . . But, if nothing else, there's an energy crisis and it's going to be solved by the Physicists.

Ken: The universities now have got to completely alter their old way of thinking from a pure academic point of view. Education has DEFINITELY got to be pertinent to what's needed. For example, there's no good in teaching a guy pure Physics alone. A student has to mke up his mind EARLY. Some people should have a wide variety of subjects, but a FEW should specialize early.

Us: We need both kinds . . . .

Ken: Yes, we need a balanced program.

Us: Is what we want to get across in this magazine, the fact that they've got to be thinking about what they're going to be doing much earlier than they are now?

NOT EVERYBODY CAN BE AT THE TOP

Ken: One of the problems is, I think, that we've got an overspecialized society. Society does not truly recognize the fact that you need broader-based people who know things, but at a lower level. Everybody THINKS as specialists do when they start off. Somewhere along the way, you want an enlightened person who is not working at a very high level, but at a good level of their own competence. It's like the sort of thing that happens on a factory floor. You get a first class charge hand and the place runs like a clock. And they think, "Gee, he's a good fellow – we must get him up", and so they promote him into management and he comes up to a level of incompetence and he's stumbling about up there and he can't manage it. That's the sort of thing that happens.

Us: I'd rather talk about YOU, though. You really won't write an article? You know, people are always turned on by glassblowing.

Ken: Yes, but you know it's only because it's something like action painting . . .

Us: Sure, and what's wrong with that? And, by the way, the magazine is **NOT** *to sell Lakehead University.*

Ken: A sort of "Science and Technology Gallops On", I suppose. "Everything is being produced but people haven't learned to live with it."

Us: I'm sure the readers would be happy to know how you got into glassblowing.

Ken: Yes, well, I worked in a research lab and I used to go watch the glassblower at lunch time and he allowed to me practice. He said, "Do you want to do it permanently?", and the boss took me on: 23 years ago!

Us: Did you apprentice?

Ken: Well – not really. They CALLED me "apprentice" but I didn't have any indenture papers. The glassblower, he was working two days a week for Reading University, and one of the guys he was working with took the Chair at Hobart, in Tasmania: he asked the glassblower to go with him and I took over.

Us: Did you have to go through the business of six months making the centrifuge tubes?

IT'S A SLOW PROCESS

Ken: Oh, yeah! yeah! But the thing that was REALLY difficult was pulling concentric

spears* out of bits of tubing, and I remember one time when I had been at it for about six months, I used to go home and worry about it. At one time, I would think I was getting pretty good, and then I would think, look at this stuff that I was going to have to make like diffusion pumps, and I'd think I'd NEVER get it. —"Look at the trouble I get into with a little 10 millimetre spear!". Slowly and surely the mistakes and breakages got fewer until in the end it came to be automatic. It's interesting, but at the same time, you can get yourself in a terrible emotional state over it.

Us: *Is it true that ALL glassblowers are emotional?*

Ken: Well, let's say a little edgy.

Us: *They're real artists, aren't they? Prima donnas.*

Ken: Yes, I know some temperamental glassblowers who ARE difficult. But when a guy comes into your shop and wants something, it's not fair that you should rip into him because you just had a bad time with the piece of glass! You can be right on the last joint of a piece of work and you made a decision about ten moves before that which left you no way out. You thought you were going to sneak through without putting a proper asbestos bung in place and you found the cork you used instead burnt away and you can't blow into the system and you can't put your finger on it because it's too hot, and you watch the molten glass dripping away in front of your eyes and you get angry with yourself because, YOU, . . . YOU. ., YOU'RE SO STUPID, THAT, . . . THAT . . . , THAT YOU KNOW IT WAS GOING TO HAPPEN. But you took a chance because you were rushing, when you should have disciplined yourself and said "No, let's do it properly and take your time." They say, "IT'S A GOOD GUY THAT CAN GET HIMSELF OUT OF TROUBLE BUT IT'S A BETTER GUY THAT DIDN'T GET HIMSELF INTO IT IN THE FIRST PLACE." No, it's interesting and it's fulfilling, but it can be awful shattering. One of the worst things is when you've got a lot of work banked up and people are waiting for it and you've got some intricate work that needs all your attention. You've got this lot waiting for you to do and it's PRESSING.

IT COSTS NOTHING TO APOLOGIZE

Us: *Can't you lock the door?*

Ken: Well, you CAN, but the mere fact that you've got a lot backed up means that you worry about it, because nobody likes to wait and people are reasonable if you're reasonable with them. I think sometimes I get a little niggled, though I try not to be. But I found the trick is, if I get a guy occasionally is being a bit unthinking or something like that or he's in a hurry for his own job, he'll bring a job in that's DIRTY. That's the thing that REALLY annoys me when I get a greasy job. I clean it when he's left it dirty; it's quicker for me to clean it than chase after him. But, I found the trick is, if I DO blast anybody, I've got to then think about it afterwards, and if I come out and very often I'm not being fair, half the time I say, "I'm wrong, I'm sorry." It makes him feel better. It makes me feel better, and it doesn't cost anything.

Us: *Is it increasing in volume, or is it just about steady?*

Ken: Well, work here, oh yes, it gallops ahead. We've got some more graduate students coming in which means more racks and gadgets.

Us: *What's your major job at the moment?*

Ken: Well, I would think catalytic systems. There are a lot of people working in Catalysis. And each one has got a different system. Now Dr. Hawton has just got back from N.R.C. full of ideas and there's a real big rack going up for him.

Us: *You mean N.R.C.? In Ottawa?*

Ken: Yes, I went down to see them and get some idea of what kind of work I had to do on those systems. They get bigger and bigger. They grow like Topsy and occasionally you have to cut the lot off and start again. They get so many new pieces added that it looks like ivy on the wall

L.U. HAS TO BE RELEVANT

Us: *As somebody who sees the Faculty from outside, what do you think is the future of the University in this district?*

Ken: Well, I would think that it's going to alter to some extent. I think probably work that's going on in Chemistry is pertinent to the clean-up of automobile exhaust fumes, for instance. I think the University will not survive as a University without research, but I think at the same time it's got to be appropriate to the needs of the area or the province or the country.

Us: *Which brings us back to what we said at the beginning. The problem of specialization,*

Continued on next page at bottom right.

* **Concentric spears are drawn-out** thin spikes of glass tubing, — *Ed.*

INDUSTRY AND THE TECHNICAL GRADUATE OF THE 70'S

By R. G. Lightfoot, — Dryden Paper Co. Ltd.

A MEMBER OF MANAGEMENT POINTS UP A PROBLEM

Today's Canadian technical school or university graduate is more knowledgeable and better trained than ever before. And indeed he should be since much of the knowledge he has gained in his technical training has only been known for 10 to 20 years and he has had the benefit of some of the best technical facilities available in the world.

Industry not only is aware of the quality of these graduates, but very much requires their talents in order to survive in the highly competitive business world of the 70's. The future would thus appear to be assured for the technical youth preparing to enter industry. Such, however, is not the case. Three obstacles stand in the way: the supply and demand interrelationship, technical competence and technical obsolescence.

During the 50's and 60's, the vast majority of technical graduates in Canada found ready employment. Engineers in particular were in demand. It was not uncommon for each graduate to have five or more job offers, with the recruiting companies having to really court the graduate. The net result was skyrocketing starting salaries, a great influx of students into the university science courses and the large scale entry of technicians and technologists onto the Canadian job scene. Not surprisingly, the supply of technically trained people soon outstripped demand, to the point where today's university or technical school graduate not only does not have a wide job choice, but is considered fortunate to be employed in this field at all! The business slowdown in Canada in the 70's certainly hasn't helped; however, even with business running full out, there are not enough openings to provide jobs for all the technical personnel available.

INDUSTRY MORE SELECTIVE

The fact that the supply of technical graduates exceeds the demand also means that industry can be more selective in its hiring and personnel retaining policies. In other words, the graduates with the most to offer regarding knowledge, personality, appearance and promotability will still be very much in demand. The bottom half of the class and those judged not able to contribute effectively will not be so fortunate.

The third career obstacle facing the technical graduate is knowledge obsolescence. Two factors are involved — the rapid outdating of the knowledge learned in the academic halls, and the ability or perhaps desire of a person who is no longer in his or her early twenties to stay abreast of rapidly changing technology. The consequences of these two factors are very interesting. Consider, for example, industry's feeling that the performance of most technical people peaks in their early thirties and declines thereafter. This is reflected by the fact that companies are generally forced to decrease the complexity of job assignments of technical personnel after the age of thirty. The effect is also felt in salaries, with the purely technical people peaking before the age of forty.

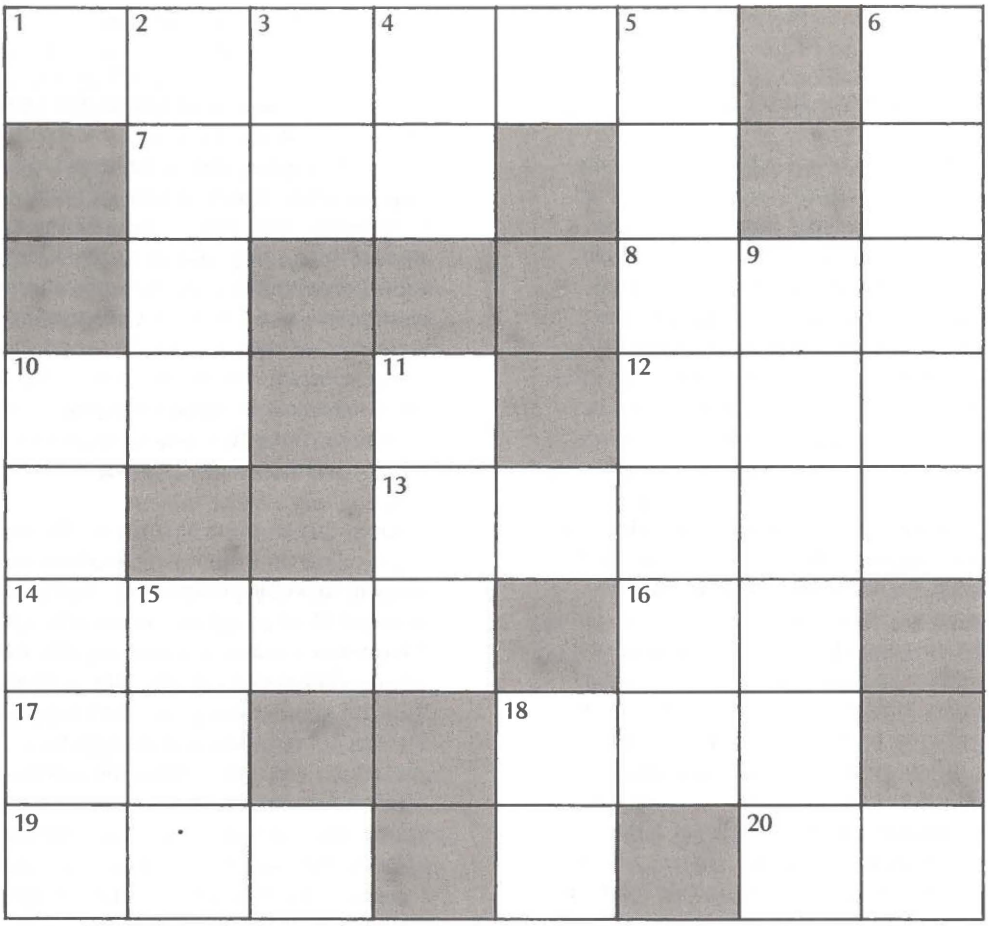
Does this all mean that young people choosing a technical career in industry are doomed to thirty years of downhill sliding after the initial challenging and rewarding ten years? Definitely not! What it does mean is that a technical person must recognize what will happen early and take appropriate action. This can consist of constant knowledge updating through formal classes or reading, or the person can embark on a second career. The latter approach often means moving into the supervisory and managerial areas and provides a much needed reservoir of talent for industry. The technical person must recognize that whichever road he chooses, a great deal of self development will be required. It is not easy to stay technically up to date, nor is it easy to suddenly become a manager of people, money and machines. For those who make the grade, the rewards both financially and from a self-satisfaction point of view are well worthwhile. †

Interview with the glassblower, Ken Sumpter Continued

not just the problem of specialization of Faculty, but people who sit on money-granting committees, that sort of thing.

Ken: One of the problems is, I think, that there are so many other things in University that deny the freedom of people being able to look more constructively at things, such as the political atmosphere in the University. Producing research papers is an important thing, but at the same time they've got to be of some relevance: **we have to do things that matter.**

TWENTY–MINUTE PUZZLE



ACROSS

1. Does his law indicate he was partial to pressure? *[6]*
7. The place for experiments (abbreviation) *[3]*
8. The first "T" in T.N.T. *[3]*
10. Abbreviation for a one molar solution! *[2]*
12. A unit of radiation or the place to put anti-freeze in your car (abbreviation) *[3]*
13. In the electrolysis of sodium chloride, this is where you can collect chlorine. *[5]*
14. One of the noble gases. *[4]*
17. Abbreviation for a type of radiation of wavelength greater than 8000 Å approx. *[2]*
18. A unit of electrostatics (abbreviation) *[3]*
19. A system of units (abbreviation) based on metric system. *[3]*
20. Symbol for manganese. *[2]*

DOWN

2. Common name of the double salt of potassium sulphate and aluminium sulphate. *[4]*
3. Symbol for the first of the rare earths. *[2]*
4. Serious disease (abbreviation) or symbol for a rare earth element *[2]*
5. and
6. The gas for comedians? *[7, 5]*
9. Madame Curie first isolated this element. *[6]*
10. The bonding type in sodium chloride. *[5]*
11. An early method for the extraction of native gold. *[3]*
15. A unit of energy. *[3]*
18. Symbol for an element named after a continent. *[2]*

A prize for the best clue to 16!

SOLUTION IN NEXT ISSUE . . . . . .

REFLECTION ON LAKEHEAD UNIVERSITY

By Gary Human

TEACHER MEETS PROFESSORS

This summer I had occasion to attend Lakehead University and enroll in the Chemical Instrumentation Course offered by the Science Department. This was a rather unique experience in that it was the first science course I had taken since graduating with a BSc in 1964. Some pertinent objective observations are herewith enclosed.

The course left nothing to be desired, in that it included both the theory and practical application of the Mass Spectrometer, I.R., Spectrophotometer, N.M.R., and X-ray Diffraction. I believe that the key of the course was the emphasis on learning how to operate all the above mentioned instruments, then how to interpret the data included in the resulting graphs and films.

So much for the course . . . . now to discuss the two intended points of this article: how does the Lakehead University Science Department approach learning processes of its students, and how can a course of this nature eventually assist the science teacher?

Suffice to say that L.U.'s Science Department surrounds itself with an excellent facility and, I should imagine, a fairly substantial budget. The more important aspect of this department, however, is the staff, who for the most part are some of the finest people I have occasion to work with. Speaking from a completely personal point of view it was noted that once a student's desire to learn has been established, then there was no end to the assistance that made itself available, not only in terms of the immediate assigned instructor or assistants but also from the specialists thoughout the department who tended to show a genuine concern for the students. At this point allow me to make mention to one Dr. Tom Griffiths. On first meeting this gentleman you may be inclined to consider him to be a rather blunt, academic and extremely practical individual. However, after thoroughly enjoying a six week course with him you will realize that he is, in fact, a blunt, academic and extremely practical individual – who will stay by you for hours on end until you have satisfied yourself that you have grasped the situation! Dr. Griffiths surrounds himself with two excellent lab assistants who will bend over backwards to help you gain a full working knowledge of the instrument under study.

UNIVERSITY HELPFUL

Let me now suggest to you the assistance I have found available to the teacher from the staff of L.U. Specifically, the staff of the Chemical Instrumentation Lab have offered to supply my grade 13 chemistry class with all the necessary graphs and films to enhance the Instrumentation section of Chapter 20 of Toon and Ellis's *"Foundation of Chemistry"*. Further to this, the inorganic lab under the direction of Dr. Holah has offered to run grade 13 labs dealing with experiments on pollution. Other professors have indicated an interest in assisting when and where requested.

Although this article may tend to be brief in words it is intended to be rather long in praise of an excellent summer course. I thank you for your attention and consideration given to this one student's opinion. †

WHISKY

By George Anderson

A SCOTTISH TECHNICIAN LOOKS AT SCOTCH

The art of whisky distillation is practiced in several countries, notably Canada, the United States, Ireland and Scotland. However, the Scottish product has probably achieved the highest standing internationally, exports of Scotch being world wide.

The name whisky (the alternative spelling of "whiskey" is used for the Irish product) is an anglicized version of the Gaelic *uisge beatha*, which means "water of life" and this expression is believed to have originated from the Latin, *aqua vitae.*

In the production of Scotch whisky, two somewhat different methods are employed, resulting in two types of whiskies which are known as *Grain Whiskies* and *Malt Whiskies.*

For malt whisky, barley is soaked in water for two or three days, then it is spread out and kept moist and warm for a further period of eight to twelve days. The water used for the fermentation of the grain is taken from springs which have risen through granite or peat and distilleries are located close to reliable sources of such water. Under these conditions, the barley germ-

(Continued on page 23)

AN OPINION OF SCIENCE AT L.U.

By our old friend, Anonymous
[He is NOT a member of the Establishment – far from it! – Ed.]

L.U. SCIENTISTS AND TECHNICIANS "GOOD" ON THE WHOLE

The general concensus is that one must allot a certain quota of one's time and energy to the earnings of one's living. The alternatives are very grim; being perhaps prison, drug addiction, or maybe politics! With that in mind, most citizens spend a portion of their day at the corporation or institution of their choice. I had developed a keen interest in science on the day I got 92% in physics without studying, so when my day of decision came I took the path of least resistance.

Having been a member of Lakehead University's science community for approximately three years now, I have had time to consider, both qualitativley and quantitatively, the relative importance of Lakehead University's Science Faculty. Hereforth lie some of my impressions.

Lakehead U., like all other institutions, has a book of rules that is necessary for its operation in the manner it does. The constitution seems to imply a form of democracy, but as usual the principles work for the principals. The University is divided into three or four camps, being termed Faculties in this case, with the President as supreme commander. And of course there is the beaureaucracy to keep everything businesslike.

Since L.U. evolved from a technical school, it is not surprising that science has played an integral part in the development of the university. With the addition of the Centennial Building in 1969, the Science Departments gained full laboratory facilities for research and student instruction. Science now had some excellent research apparatus and a skilled technical support staff to complement the highly qualified teaching staff.

TECHNICAL STAFF ARE AS IMPORTANT AS FACULTY MEMBERS

A look at the credentials of members of the science faculty shows them to be an impressive group. They have long lists of degrees from MIT, Glasgow, London, Toronto and Iowa. Some of these scientists have come from as far as Texas, from Ireland and London, from Vienna and Geneva and from Newfoundland to join the Faculty of Science at Lakehead U. All of these men and women (women seem to be in the minority, with only approximately 1.88% of the faculty being female) bring years of experience with them to the university. Unlike some other faculties at Lakehead U., Science has a large number of Canadians in its ranks. With well over 20% of the full professors native Canadians,* the Science Faculty is relatively abundant in Canadian content. [*and many other naturalized – Ed.]

The backbones of the science departments are undoubtedly the technical support staff. It is the technicians who do the unspectacular chores that are so necessary for operation of the department. Technicians clean glassware, align spectrometers, tune r-f receivers, prepare instruction laboratories and sweep floors. They have an important role in research, assisting faculty members in the preparation and operation of laboratory apparatus.

The technicians at L.U. are almost as cosmopolitan as the faculty. Although most of the technicians originate from the British Isles; Finland, Woodstock Nation and Canada are well represented. L.U. is most fortunate to have such highly skilled individuals choose Thunder Bay as their home.

A university may have highly rated professors and technicians but without the proper facilities, quality science instruction and research cannot be obtained. Lakehead U. is slowly acquiring the best of modern research tools available as well as a full complement of student labware. The Science Department is now located in the recently completed Centennial Building. With its well lit interiors, conveniently arranged laboratories and spacious hallways, the Centennial Building has proved to be a tribute to its designers.

The amount of scientific equipment at Lakehead U. is enormous. There are many varieties of spectrometers, including a mass spectrometer. As well as the usual large numbers of conventional light microscopes, there is a Phillips High Resolution Electron Microscope. Large numbers and forms of vacuum systems can be found throughout the building, many capable of reaching 10^{-10} Torr. Chemistry has excellent chromatagraph setups. Important support facilities such as the glass blowing lab, Intrumentation's electronic diagnostic equipment, a competent machine shop, as well as various photographic darkrooms are dispersed throughout the building. For its size, Lakehead University's Science Department is quite sufficiently stocked with the required apparatus needed in modern science.

RESEARCH IS LOCALLY ORIENTED

A multitude of research projects are being conducted on these machines at L.U. The chemistry department currently is conducting a co-ordinated study of catalysts from which industrialists may benefit greatly. This project involves a large number research tools including the mass spectrometer, the electron microscope and a number of chromatographs. An interesting study is being staged by Lakehead University biologists on mineral uptake in the leafs of vegetation located near mining areas. Information gathered here may be of significant interest to prospectors in their efforts to develop Northern Ontario. Geology, working closely with the local mining business, is slowly obtaining information on the structure of the bottom of Lake Superior, using machines such as rock crushers and x-ray spectrometer. Solid state research is conducted by some members of the physics department, requiring sophisticated electronic apparatus. The electronic industry has a constant need for new discoveries in this field. Modern business is using complex mathematical methods increasingly everyday. Mathematicians at L.U. have a large I.B.M. computer at their disposal for their formulations.

Last but not least are the students which actually are the reason for the existence of Lakehead University. Students come to L.U. from as far west as Hong Kong; from Nova Scotia, Texas and Kenora. Hundreds of undergraduates are processed by the Science Department annually. Once processed, science graduates then enter the fields of opportunity that are available to science graduates in Canada.

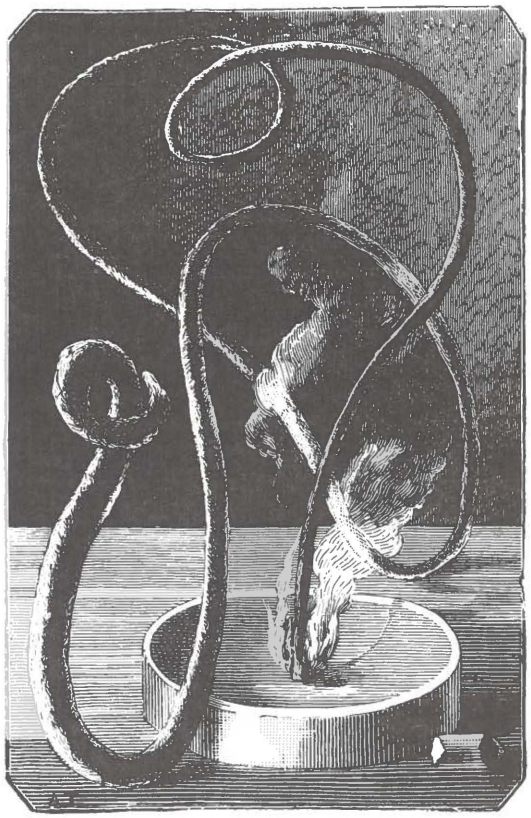
A few of the more competent graduates are absorbed into one of the master programs at Lakehead University. For the next few years they are initiated into the field of scientific research as they work in the labs till late at night, tutor students and assist professors in their paper production.

SMALL UNIVERSITY ADVANTAGEOUS

One of the advantages of a small university like L.U. is the accessability of expensive science apparatus, the use of which is so necessary to modern research. Undergraduates become acquainted with such instruments as the electron microscope as early as the third year. The use of spectrometers such as the Infra-Red Spectrophotometer are important in chemistry instruction from the second year on. Graduate students have almost free access to most research apparatus as well as the skills of countless technicians.

This is the environment that I enter at nine and leave at five. I am positioned rather low in the structure. My job requires a bit of skill and is quite satisfying at times. The impression that L.U. has made on me so far is that with its feudal power structure it compares quite favorably with other institutions of its size and rank. The Science Departments, I feel, especially chemistry, are of excellent quality. Chemistry graduates have done well at other universities. Faculty members that I am acquainted with are pretty good people, most work fairly hard, some are conducting some interesting research. The technicians are almost totally a good lot.

Lakehead University is entering a new period under the leadership of newly appointed president Dr. Booth. Since Dr. Booth is a respected practicing scientist, Lakehead University's Science Department can look forward to a bright future. I personally am of the opinion that if one must have a science degree then one might as well take it at L.U. †



HIGH SCHOOL STUDENTS ASSESS BLEACHES

Students from Northwestern Ontario High Schools have been doing their own consumer research in the University's chemistry department. Under the expert guidance of Dr. Holah, they have been checking up on the manufacturers of laundry bleach. The active bleaching agent, as the bottle labels state, is sodium hypochlorite (NaOCl), usually in the form of a 5% solution. The strength of a bleaching solution may also be expressed as the amount of "available chlorine", which is the amount of chlorine which can be "liberated" from the solution by simple chemical processes. It's the chlorine that does the job.

The students are provided with bottles of Javex, White Magic, French Maid, A & P and so on. They find three things: – –

1) The percentage of NaOCl, which is compared with the manufacturer's figure on the bottle;
2) The percentage of "available chlorine", which is also compared with the manufacturer's figure;
3) What every housewife is interested in – the "Best Buy." From the volume of the bottle, the price and the percentages, the student evaluates the order of bleaching value for dollar spent.

The answer? Most students agree that _____ is the best. We deliberately leave you guessing – if you want to know the answer, ask somebody who has done it! (Or ask Dr. Holah to let you do it for yourself).

For the chemistry buffs, here is the prescription prepared by Dr. Holah.

THE ASSESSMENT OF BLEACHES

By Dave Holah

The basic chemistry involved is the fact that the hypochlorite ion is a good oxidizing agent in dilute acid solutions, and will oxidize iodide ion to iodine.

$$OCl^- + 2H^+ \rightarrow Cl^- + H_2O$$
$$2I^- \rightarrow I_2$$
$$OCl^- + 2H^+ + 2I^- \rightarrow I_2 + Cl^- + H_2O$$

The student begins by pipetting 10 ml of bleach (usually directly into his mouth at the first attempt)* and diluting to 250 ml with distilled water. He then has a stock solution from which he can take a number of 25 ml portions for titration until consistent results are obtained. To each portion is added about 10 ml of dilute acetic acid and an excess of about 1 - 2 gm of potassium iodide. Most of the students recognize the brown colour of iodine. (I_2) as it is formed. The quantity of I_2 that has been oxidized from the iodide ion is proportional to the amount of available chlorine.

The last step in the analysis is to measure the amount of I_2 by reducing it back to I^- using a suitable reducing agent of accurably known strength, such as 0.1 molar sodium thiosulfate.

$$2S_2O_3^= \rightarrow S_4O_6^=$$
$$I_2 \rightarrow 2I^-$$
$$2S_2O_3^= + I_2 \rightarrow S_4O_6^= + 2I^-$$

BLUE COLOUR IS THE KEY

He therefore can titrate the iodine solution with thiosulfate and watch the brown I_2 colour slowly fade. Most of the students are familiar with the intense blue colour formed by the interaction of I_2 and starch, and this is used to mark the end point of the titration. Thus, when most of the brown I_2 has been reduced and the solution is a pale yellow colour, a few drops of starch solution are added to give the deep blue colour. The thiosulfate addition is continued slowly until very suddenly, within one drop, the blue colour (and hence the I_2) is discharged and the solution becomes perfectly clear.

One of the problems is that the students are often confused about which solutions must be pipetted accurately and which can be handled in a much more casual manner with a crude measuring cylinder, and it is not until the student understands the chemical reactions that this point is made clear.

The experiment is popular with the students, since it relates some of their school chemistry (I_2-starch) with consumer products, and ends with a result that may be of use to them (or their parents) in terms of deciding which bleach to purchase. It also lets them use analytical equipment which most of them have not touched in the school.

* *It's not dangerous – just unpleasant.*

THE MYSTICAL WOLF

By George Ozburn

OZBURN KNOWS HIS WOLVES

Have you ever seen a wolf? Perhaps if you have travelled the Algonquin Park trails, the Temogami Lake or Quetico area, you have heard one. My first experience with them was near Bear Island on Temogami Lake while camping. During two consecutive nights they howled outside our lean-to. In the early morning we looked carefully trying to establish where they really were, but they didn't even leave a track.

My next contact was some years later — with their tracks — fresh on new fallen snow. I have often thought back to those first wolf tracks which my companion assured me were those of the terrible wolf. We own huskies and after a few years of mushing, one sees many foot prints of various shapes, any of them could be those of a wolf.

Finally while winter fishing on a lonely lake, I saw my first live wolf in the wild. We spent a glorious half hour observing these graceful creatures playing, romping after one another, chasing their tails; but are they shy! They caught wind of us as we cautiously stalked them along the shoreline and suddenly were gone like ghosts.

From the air in the winter they are very easy to spot. Flying just at dawn on a clear frosty morning it's easy to spot a set of tracks and follow. Often they are returning along the edge of a frozen waterway after a night's foraging. Frequently they are even found quite close to town.

They are often quite defenseless. The snow in the bush is deep and soft so they try to outrun the plane on the hard pack of the lake. It's no wonder so many people take advantage of them and hunt them this way. These people really aren't hunters.

The late Jack Miner for all his wonderful work with bird conservation was very short sighted about nature's wonderful biological selection force, the wolf. He reportedly sighted them as cold blooded killers, destroying deer herds. Granted in some parts of the country where snows are frequently very heavy, the depth of snow serves the same function.

When deer hunting falls off, we need a scrapegoat. Since the average city dweller never sees the great outdoors in the mid winter and doesn't realize the other hardships, he promptly blames the wolf. The result? These predators are called "varmint". Yet, predators cannot become too abundant. They can never increase beyond the limits set by availability of food. If they are very abundant. then so must be their food supply. To cry wolf then would suggest that the mighty deer stalker has spent too much time in the concrete jungle and lost his ability to read the nature's sign boards.

A recent study of the Isle Royale wolf suggests that the wolves appear to keep the moose herd within its food supply, cull undesirable individuals such as the old and the parasitized; and also, to stimulate reproduction. On this island ecosystem, the wolves will probably remain in a very dynamic equilibrium due to little intervention by man.

The city dweller should be overjoyed if in some outward bound movement, country is reached where the eerie howl of a wolf may be heard in the stillness of the night. There might then still be a hope of your seeing one of these beautifully graceful creatures. †



THE FIFTH WHEEL

By Charles Mallard

GIRLS OR CARS?

Last year the second year students taking Dr. Hart's mechanical physics course 2e4 were allowed to conduct an experiment of their own choice. The nature of the experiment was entirely up to the students and materials needed would be provided, on condition that the students construct the necessary equipment themselves if it were not readily available. Unfortunately, the experiment had to be designed with some basic physics involved, so I had to rule out the plan to interview every beautiful woman in Thunder Bay and compile a very comprehensive black book for myself. I still can't understand why Dr. Hart couldn't see the physical aspects of such an experiment, but be that as it may, I elected to change the concept of the experiment entirely and construct a "fifth wheel" for my car.

The fifth wheel is literally, as its name implies, a fifth wheel which is towed at the rear of a vehicle. It is, in essence, an electric speedometer from which a record of the vehicle's speed may be recorded. It is electronic in nature and does not have the errors common to mechanical devices such as a car speedometer. However, the most advantageous aspect of such an instrument is that the car's speed may be recorded as a function of time by feeding the data into a portable casette tape recorder. There is no need to use a stop watch and comments can be recorded directly onto the same tape.

The basic idea to construct such an instrument arose from my keen interest in the technical aspects of automobiles and my desire to evaluate the performance of my 1971 Plymouth Cricket. Fifth wheels are used extensively for road testing cars (acceleration and braking capabilities) and the results are published in numerous car magazines. However, to my knowledge, no such test has been carried out on this particular car. I could therefore obtain this data first hand with such an instrument. It is also possible, by making use of a few simple laws of physics and elementary mathematics to obtain more useful data such as drag (wind and rolling resistance) **versus** car speed, and rear wheel brake horsepower and torque as a function of engine rpm. Such data would enable the calculation of theoretical top speed and optimum rpm shift point in each gear. A graph could be constructed which indicates the rear wheel horsepower required to maintain the car at any given speed and it could be extrapolated or an equation devised to show how much of an increase in HP is required to produce an increase in top speed and/or acceleration.

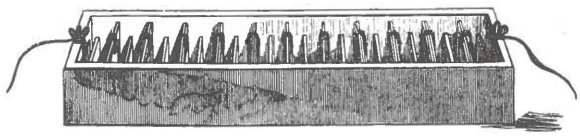
ENGINE OUTPUT COMPARED WITH FACTORY RATING

The Plymouth Cricket, an English built import, when introduced to the North American continent, was assigned a very optimistic horsepower rating. The 1972 models have since been defactored to a more realistic power rating and a more powerful motor has been added as an option. It was my intent to calculate the engine output of my car and make a comparison between the factory ratings. The motor could then have been modified and more comparisons made.

The construction of the fifth wheel was simple, although time consuming. It consisted essentially of an aluminum Y shaped frame and a 26" bicycle wheel upon which three magnets were attached. As the wheel rotates, the magnets pass a reed switch mounted on the frame. The switch opens and closes sending pulses (supplied by a flashlight battery) to the tape recorder. The number of pulses per second is proportional to the car's speed, e.g., 30 pulse/sec = 40 mph. The frequency of the pulses is obtained from the tape recording which is fed into a pulse counter. The graph is then plotted by hand.

NOT ALL UNDERGRADUATES EXPERIMENTS BORING

Unfortunately, because of poor magnet alignment and improper tire balance, we were unable to obtain consistent readings above 50 mph. The arrangement of the magnets was changed so that we could use two magnets and two reed switches and allow more precise alignment of the magnet. This setup has not yet been tested and therefore the desired data have not been obtained. However, the fifth wheel does work (hopefully above 50 mph now) and with a fair degree of accuracy (+ 1 mph). The entire project cost very little and although the aims of the experiment have not been fulfilled completely the results thus far are very rewarding. It just goes to prove that not all experiments are boring.



LIBERAL SCIENCE PROGRAM

It is impossible to over-estimate the importance of science in today's careening technological world. Science is the only branch of human enquiry which applies itself to the systematic observation and interpretation of our physical environment. As such, science provides a fountain of well-defined data upon which to base important judgements which must be made now if we are to survive.

The influence of science and technology upon modern man staggers the imagination. And yet, there have been very few systematic attempts to bring this home to future teachers, legislators and decision-makers. The Liberal Science Program aims at giving such people a broad view of science, rather than producing professional scientists. The program brings science out of the confines of the laboratory in order to explain its effects upon man and his environment, and also to explore ways in which science can influence our daily lives for the better.

Students entering the Liberal Science Program must have successfully completed Grade 13. But science and mathematics are not prerequisite, as they are for other programs in the Faculty of Science. Requirements include a mature mind and a desire to understand the role of science.

Liberal Science students may concentrate on any Arts subjects to meet the requirements of the program. Indeed, it is essentially designed to provide a broad background in science study for students specializing in the social sciences, humanities, or education. It is extremely flexible, allowing easy transfer in and out of the program from other Arts and Science programs. In addition to at least three subjects from the Faculty of Science and up to seven from the Faculty of Arts, the three-year Liberal Science Degree Program requires at least five of the following courses:

L.S. 100 Science and Man – The profound influence of science on the individual and society is the central focus of this course. The effects of great experiments and theories on the development of civilization are studied in detail. The relationships between science, technology, philosophy and politics are identified and discussed. Also, the role of science in determining the way we think and act is probed as far as possible.

L.S. 101 Science in an Age of Machines – The explosive development of technology has led to qualitative changes in the nature of the Earth. This course studies the effects of manipulative techniques on man's environment.

L.S. 102 Natural Science – This course aims at a unified understanding of the basic principals of nature. A brief treatment of the physical features of the Earth is followed by an examination of the interrelations among organisms and between organisms and their environment. Questions of conservation, pollution, and the future of man are discussed at length.

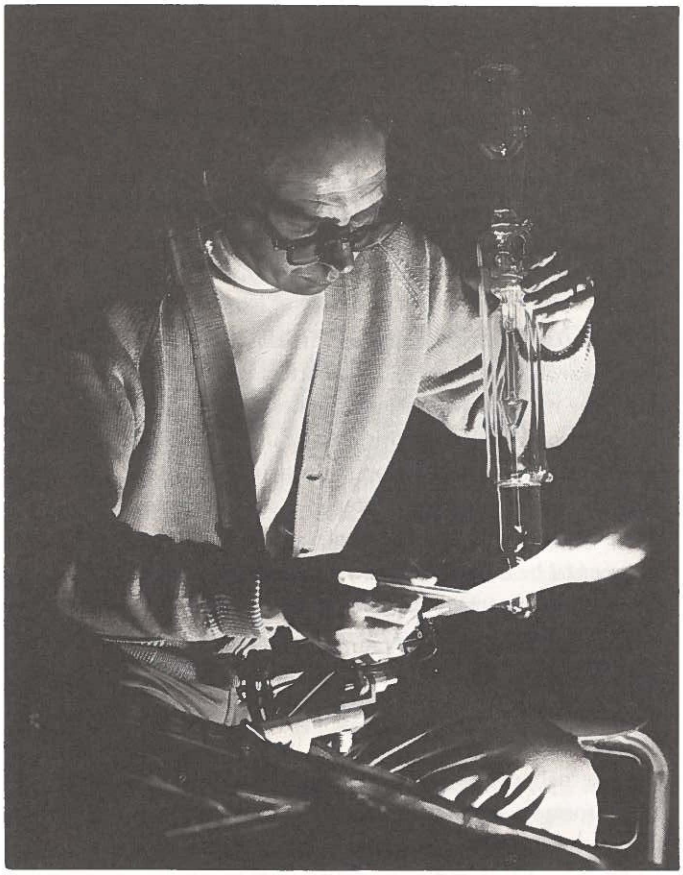
L.S. 103 Chemistry and Man – This is a survey of those aspects of chemistry which affect our lives every day. The material will include a general historical introduction. Following this, a basic understanding will be provided for such popular activities as photography, wine-making and pottery. Also, such topics as the energy crisis, birth control, pollution, physical and mental health, the use and misuse of drugs will be discussed from a chemical viewpoint.

L.S. 104 The Physical Nature of the Earth – The general physical and chemical principles relating to the origin and development of the Earth are the main focus of this course. Particular concerns include the external and internal processes which are constantly forming and deforming the Earth's crust, laboratory work in the mineralogy and petrography of the principal rock types, the identification and use of fossils as indicators of relative time, and the interpretation of geological maps.

L.S. 105 Contemporary Physical Thought – Important scientific literature is often ignored because its language is too technical or mathematical for the general reader. This course purposes to interpret such writings to promote understanding in the theories of the Universe and its creation, in the laws of physical science, and in recent scientific thought. Proficiency in mathematics is not required.

L.S. 107 Mathematics – the Analytical Tool of Science – Mathematics has always been indispensable in the formulation of theories and the solution of problems, both in the traditional disciplines and in the newer social sciences. This course outlines the way in which the "mathematical method" has influenced the study and application of science throughout its history.

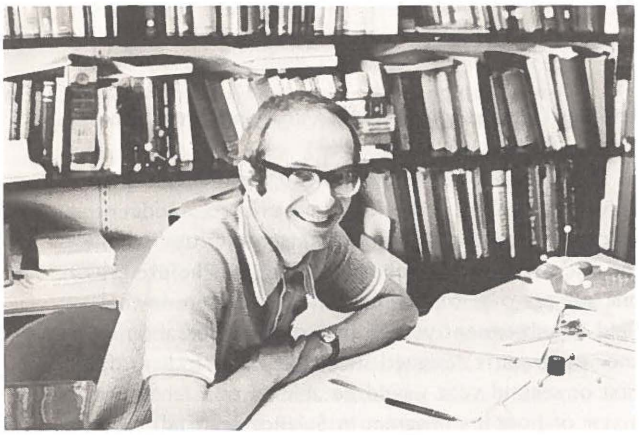
L.S. 108 Astronomy – This course is designed to acquaint the student with the principal features of the Solar system, our Galaxy, and the known Universe. The student will make observations of the moon, planets and stars, plot their movements and deduce some of their properties. Photographs from observatories will supplement the student's observations. No previous background in physics or mathematics is required.



KEN SUMPTER "Education has DEFINITELY got to be pertinent"



"By such methods of dating . . . . !"





DR. HOLAH . . . . AND FRIENDS

"Ask him . . . . to let you do it for yourself!"



DR. OZBURN "when deer hunting falls off, we need a scapegoat"

A STUDENT'S VIEW OF THE LIBERAL SCIENCE PROGRAM

By Gloria McNeill

A UNIQUE OPPORTUNITY?

The Liberal Science program offers a unique opportunity for different sectors of the community. It gives teachers, politicians, housewives, and generally all persons interested in taking university courses for enjoyment, the chance to experience fields of study they would normally not come in contact with (or *desire* to come in contact with!)

Teachers who have indulged in Liberal Science courses have a greatly enriched reservoir of knowledge to draw upon when dealing with their students. This aspect is most important to the public school teacher for he, by himself, must deliver to a group of thirty or more youngsters a general education. Spelling, literature, grammar, arithmetic and reading do not suffice, for these will equip the students with only the essentials of an education. Children must know more about this world in which they live, grow, work and play; and it is up to their teachers to make sure that they do. Thus, it is wise for the teacher who is in pursuit of his university degree to major in Liberal Science rather than narrow his spectrum of knowledge by majoring in a specific subject. By choosing the Liberal Science program as his area of study, he will acquire a general education in the realm of both arts and science. Not only he, himself, but all his students will benefit.

POLITICIANS AND VOTING PUBLIC SHOULD UNDERSTAND SCIENCE

Politicians and the voting public, too, will benefit if they choose to study within the Liberal Science program. It is the politicians who decide what laws might aid the community and it is the voting public– that is, the residents of the community – who decide whether or not these proposed laws are relevant. Such contemporary problems as drug and alcohol abuse, air land and water pollution, the necessity for and goals of space probes, improper use of our land and natural resources, and many others must be dealt with. But how can men who in actual fact know nothing of the causes and consequences of these problems propose laws which will solve them? And, how can the public vote intelligently on these issues when they, too, know just as little? It is most necessary for politicians and the voters to acquire a general knowledge about these contemporary issues and this is what Liberal Science courses such as Science and Man, Natural Science, Chemistry and Man, Astronomy and Problems in Pollution will do.

The Liberal Science programs offers the freshman university student a chance to experience a wide spectrum of courses without being committed to one specific discipline. If upon deciding that he prefers one subject over others, he may concentrate in that field in subsequent years. In fact, the Liberal Science program is designed such that "the student after first or second year would be able to transfer into a major or honours program in Science or Arts", as stated on page 139 in the 1972-1973 Lakehead University Calendar. This eliminates the problem of choosing a specific discipline for the uncertain first-year student.

THERE ARE SOME SNAGS

Despite its apparent benefits, the Liberal Science program contains a number of drawbacks as well. Of the nine courses calendared as Liberal Science courses, five are in actuality courses which have been drawn from other departments and renamed as Liberal Science courses! Hence, these courses do not cater to the Liberal Science student (as for instance, an English course would cater to a student who is an English major). Rather, these courses are geared towards those students who intend to major in the related discipline. For example, LS104 – The Physical Nature of the Earth – is merely Geology 1a6 which is the first-year geology course for specialist students who wish to continue in the field of Geology. The Liberal Science student, however, would mistakenly think this course to be geared towards himself, since it is calendared as LS104.

No separate Liberal Science Department exists. Therefore a lack of continuity is to be expected within the "non-department". The professors who teach Liberal Science courses have been drawn from other departments, and they do not relate to themselves as Liberal Science professors, but rather they see themselves as professors from their respective areas of study. To be efficient and therefore beneficial to the student, it would be desirable if all Liberal Science professors were to be located in adjoining offices. This would help to remove the amorphous identity of Liberal Science and would allow for easy student-faculty contact.

The Liberal Science program as it stands now is a program without an identity but, on the other

hand, a program with much potential. Perhaps, once more courses are developed which are truly and only Liberal Science courses, and once its professors establish themselves as belonging to a new Department, then students will be able to acknowledge its existence. At present a great number of Lakehead Unviersity students do not even know that such a department and program exists, while even those that are aware know nothing about it.

CONTENT IS VERY GOOD

However, the program content is very good, for it ensures that students will attain a general education that has a strong base in science. The science-orientated Liberal Science courses, both those unique to the Liberal Science program and those borrowed from other departments, teach us more about the nature of our universe, our world and life itself. Meanwhile the arts-orientated Liberal Science courses further our knowledge of ourselves.

There should be more courses like LS109 – Problems in Pollution – which deal with contemporary problems. These courses could be instructed by using social science and scientific principles to explain the causes and the impact the problems are having. Many guest lecturers are available in Thunder Bay who could supplement the courses. For example, spokesmen from the Ontario Water Resources Commission could speak on water pollution; spokesmen from the Lands and Forests could speak on problems in our timberlands and forest mammals; spokesmen from the Health and Community Information Centre could speak on social problems. These guest lecturers would thus be able to link the information that a student receives in his courses to situations in the real world outside. *We must ensure, however, that any new Liberal Science courses developed are developed for the needs of the Liberal Science students.*

Apart from its deficiencies, the Liberal Science program would become a highly valuable department within the university and the community at large. †

[Many of Gloria's criticisms have been acted upon, and we are grateful to her for making them – Ed.]

WHISKY – *Continued from page 13.*

inates and the starches are converted by the action of enzymes into fermentable sugars. When the sprouts on the barley are about three-quarters of an inch long, this stage is complete and the grain is collected and spread out on screens over a peat fire to dry. The peat smoke can make direct contact with the malted barley, a method of drying unique to Scotch whisky.

The dried barley is next infused with hot water, cooled, fermented with yeast for several days and then distilled twice in large copper stills. Part of the second distillation is collected and matured.

SMOKE AND WATER PRODUCE FLAVOUR

Two factors are generally regarded as being responsible for the distinctive flavour of Scotch whisky – the peat smoke and the water.

Grain whisky is produced by a similar process to that described for malt whisky, except that a mixture of barley and corn is used and the distillation is a continuous one. Other whiskies also use a mixture of grains.

Most brands of Scotch sold are blends of grain and malt whiskies, some blenders say they use "upwards of 40" whiskies from different areas of Scotland to achieve their desired end.

Scotch is matured in oak casts (which used to be old sherry casks) for a minimum period of three years, although some whiskies may be left to mature for more than ten years. In the cask, changes take place in the minor constituents of the liquor. Some of the acids and alcohols present will combine to increase the ester content while, because of the porous nature of the cask, air can reach the liquor and combine with certain alcohols to form aldehydes. Tannin and furfural (another aldehyde) may be extracted from the wood of the cask. Although these substances are present in only small quantities, they nevertheless determine to a significant degree the final flavour of all distilled liquors.

The predominant constituents of all whiskies are of course ethyl alcohol and water, but the differences found in the important minor components are interesting to compare. These figures are of course approximate and vary with brand.

Grams / 100 litres at 100 proof	Canadian Blended	Scotch Blended	Straight Bourbon
*Fusel Oils	60	150	200
Acids	20	15	70
Ester	10	20	60
Aldehydes	3	5	7
Furfural	10	10	50
Tannin	20	10	50
Total Solids	100	130	200

*Fusel oils are liquids produced during fermentation and are mainly composed of amyl alcohols along with some lower alcohols.

(Editor's note: Whisky is, of course, an intoxicant. The word "intoxicant" comes from the Greek toxican, *meaning poison (especially for arrow tips!) It's insidious stuff, and those fusel oils can play the very devil with the brain.)*

THE REPRODUCTIVE BEHAVIOUR OF THE BLUE GOURAMI

By John H. Kelleher

LOVING FISH PROVIDE CHI-SQUARE ANALYSIS LESSON

Ethology, which is the biological study of animal behaviour, offers a wide variety of research activities. Included in this research is the study of the reproductive behaviour of fish. Such a study should capture the imagination and enthusiasm of many students from the elementary to the college level. Some students may find themselves capable of not only reading the current research literature in Ethology but also of contributing to it. While most ethological studies take place outdoors, there is some work that can be done indoors. In the latter case, the reproductive behaviour of fish could easily be studied as most schools have the required equipment. The blue gourami were chosen for this investigation because they are available locally, are inexpensive, easy to keep, and have been reported in the literature

REPRODUCTIVE BEHAVIOUR COMPARED

The purpose of this study was to find out if there was any significant difference between my observations of blue gourami reporductive behaviour and similar observations reported by Miller (1964)[1]. The latter observations served as the basis for calculating the expected results *(See Appendix on page 26)*

Two large blue gouramis were placed in a 20 gallon (U.S.) tank. In addition, the aquarium had a gravel bottom, a few mystery snails, assorted aquatic plants and a cup. The cup was left in one corner of the tank in order to provide a hiding place for the female during reproduction. The fish were fed a varied diet twice a day. The water temperature was kept at 80° ± 2° F. Room and aquarium lighting automatically turned on and off providing a 15 hour photo-period.

In order to avoid ambiguity, I chose only three clearly defined stages of reproductive behaviour: rubbing, clasping, and spawning. For pictures of each of these stages the reader is referred to the research reported by Miller.

1 Miller, R.S.
Studies on the social behavior of the blue gourami, **Trichogaster trichopterus** (Pisces, Belontiidae), 1964, Copeia, No. 3, 469–496.

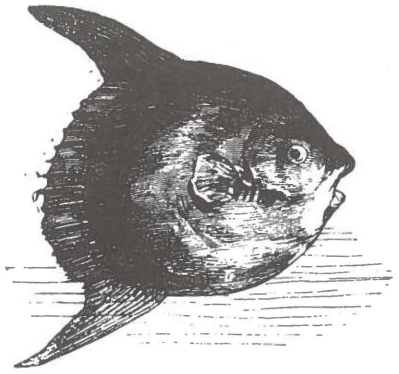
RESULTS MORE STIMULATING TO STUDENTS

	Rubbing	Clasping	Spawning	TOTAL
Observed	13	10	12	35
Miller	42	50	46	138
Expected (see App)	11	13	12	36

On the basis of the above data, for 2 df and a chi-square value of 1.05 (see Appendix), the differences between observed and expected are not significant at the .05 level. That is, there are more than 5 chances in 100 that the above differences could be accounted for by chance alone. The 35 observations that I made were reported during one mating session, so I assumed the 138 observations of Miller were based on at least three mating sessions. Therefore, it would appear that the observations of more than one mating session did not yield results that were significantly different.

In a chi-square analysis the researcher compares the observed results to the expected or chance results. For example, in the present study the chi-square is generally illustrated by reference to one of Mendel's experiments on the colour and shape of pea seeds. However, it was my experience that most students were not impressed with the application of the chi-square test to the results of Mendel's experiments. Therefore, the present study might help, but is not limited to, the instructor who is looking for supplementary material on the topic of chi-square.

(Continued on page 28)



FROM HIGH SCHOOL ON: A CASE FOR BIOLOGY

By Claude Garton

LIFE CAN BE ENJOYABLE

All living is a challenge. Nature has no room for losers: sooner or later the unfit are discarded – what about you? Man, a social animal, has created a complicated pattern for living: where will you fit in? How can you have a happy, rewarding future as an essential part of humanity, working with those forces that lead us forward and, we hope, upward?

Too often we blame the past generations for errors, but no one can undo the events of yesterday. Some mistakes are irreparable and all we can do is make today better so that tomorrow will give us fewer regrets. Nor can we escape from the technical society. No longer can one get away into the wilderness and live his own life cut off from other people, as we sometimes wish to. The more one learns about life and living, the more one can enjoy it, and as we explore the biological sciences doors are opened that give a deeper meaning to our everyday life. Biology, the study of life and living, does not have all the answers, and it never will. But it can help you, an individual, fit into living, so that in the fifty-odd years ahead, you become cognizant of self, and in sympathy with people and the living world around you.

A young gas station attendant, a senior high school student, remarked to me this past summer. "I wish I had the chance to learn about plants and animals. I'd like to go into biology." I pointed out to him although Biology is not particularly recommended as a career it does open the way to a deeper, fuller understanding of one's environment, for an appreciation of how natural things live and react can help us to live better in the natural environment we too are part of.

One obvious aspect of the immediacy of Biology is the concern for plants that produce a major part of our food supply. Farmers, gardeners, nursery men need to "know about plants".

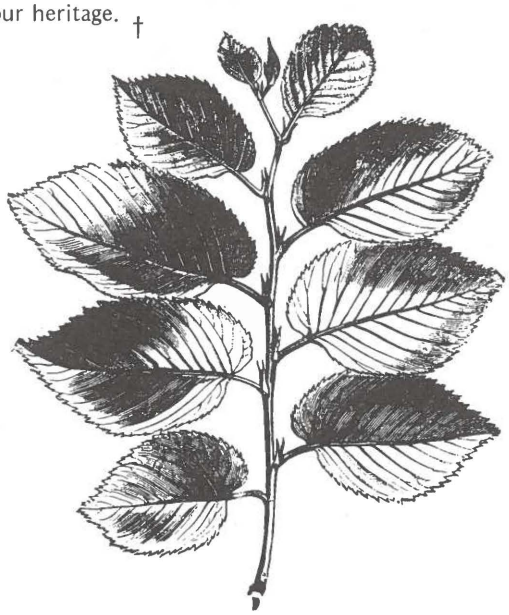
BIOLOGY HAS MANY BRANCHES

Zoology, the science of animal study, gives us an insight into the animal world, our world too: man may be divine, but he is also an animal. Birds, their songs, their migrations, the many facets of their lives are fascinating subjects. When a moth bumps against a lighted window of a late evening, when a butterfly sips nectar from a flower, our interest is aroused. Entomology, the study of insects, is a broad one and full of wonder. Whatever the animal, if we get to know more about it, we feel a fellowship that is part of a good life.

Genetics is a science that has a special appeal to many. It is the study of inheritance. No two individuals of any species are exactly alike. Why so many similarities? In the past century, great advances have been made in this field. We even read that we are on the way to being able to create life. If you wish to specialize there are many subfields in Biology: ornithology, entomology, morphology, and enough -ologies to fill several pages. It is hoped you will delve into some of these in your studies, in school or out.

Applied biology is a growing field. For example, a real problem today is pollution. Its correction and prevention can come about only if all of us know and observe the basic laws of ecology. Sociology, people living together, is only a part of ecology, all things living and thriving together. Whether we become a doctor, salesman, a factory worker or whatever, we can become a better, happier person if we know the living things around us.

For those who are about to go on to further studies, Biology should be part of them. No matter what your chosen field, it can help you if only as an escape, a hobby. And do remember reading about living things, hearing about them, seeing them in pictures **is no substitute for the real thing.** To get out and live with them is to make them truly a part of your life. People, animals, plants, they are our heritage. †



CLUES

Across

1. *(12,5)* The distance from earth to sun is one of these
9. *(3)* See 2 down
10. *(5)* Quadratic solutions useful to plants
12. *(3)* An unknown angle – the 21st Greek letter
13. *(5)* Einstein . . . a unified field theory just before he died
14. *(5)* The reflectivity of a fabric
16. *(5)* Viscera and other bits
18. *(5)* When fruits do so, there is a synthesis of fructose
19. *(7)* The father of sterilization
21. *(5)* A high-pressure man
22. *(5)* Interference used by a piano tuner
24. *(4)* Gas for a sign at no. 10
25. *(3)* A current measure
27. *(4)* 15 over 30
28. *(4)* A leading actor in the night sky
29. *(4)* A bitter liliaceous genus
30. *(4)* *Phragmites communis* in a clarinet
32. *(3)* The cry of the genus *Corvus*
34. *(4)* Acid magnesium silicate
35. *(4)* The useless male of a hymenopterous or human species
37. *(4)* A usually fast ungulate
38. *(7)* What the fruit does to the pip
39. *(5)* Rough points of lands
41. *(5)* A mechanical man
44. *(5)* A chair carried on two poles which had a great influence on 19 across
45. *(3)* A charge-carrier
47. *(5)* A large ungulate with a short elephant-like trunk
48. *(3)* Archimedes lived long this
49. *(7, 10)* The powers of **e** that equal the numbers in question

42. *[5]* # !

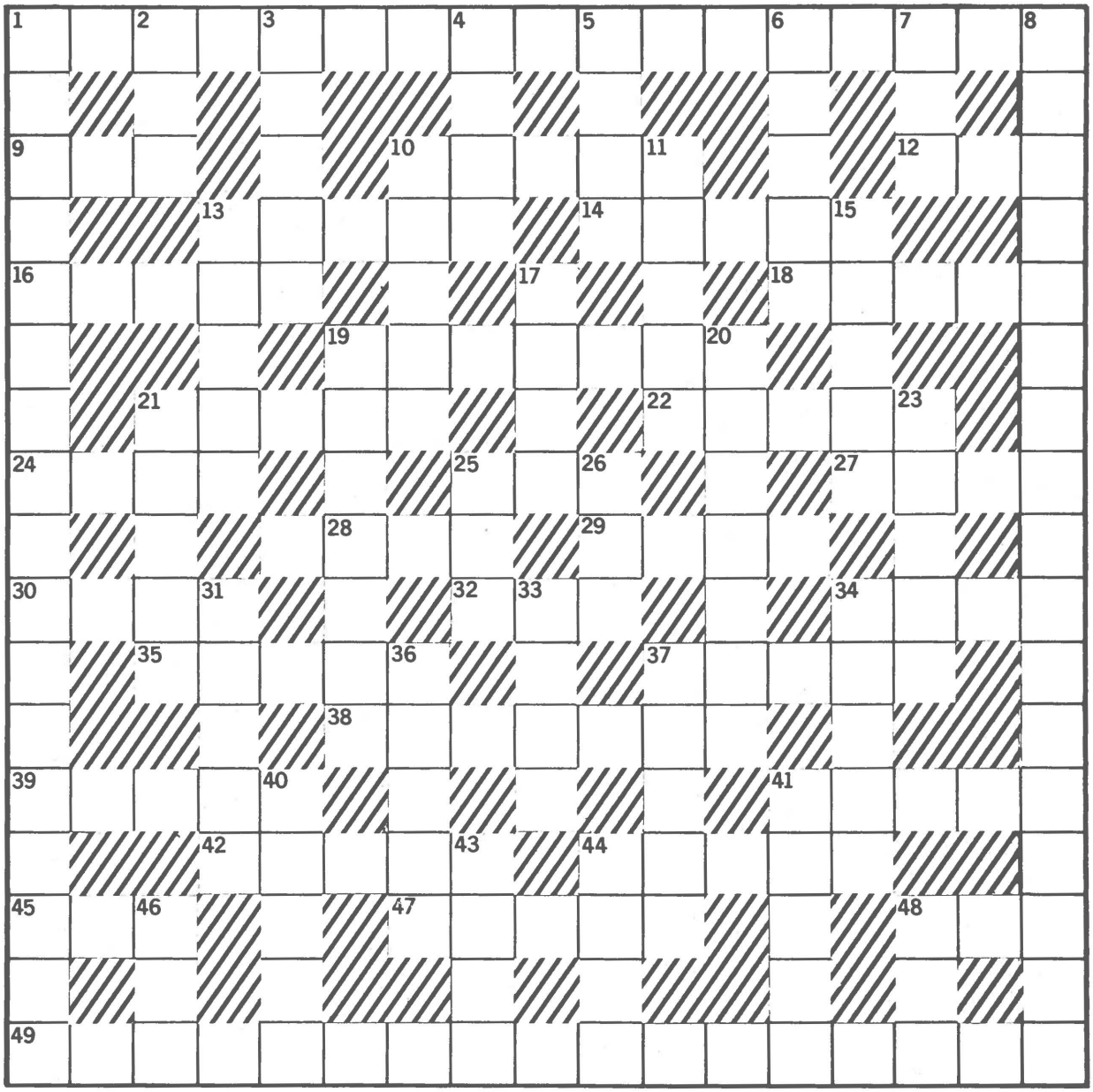
Down

1. *(6,3,8)* Equal mechanical concepts that are always mutually contrary
2. *(3)* If 2 across were to run down, it would begin to 2 down sideways **(viz: precession)!**
3. *(5)* An auricular window
4. *(4)* When new, I am nearly black, but the older I get, the more I shine until I'm full
5. *(4)* More than one *Felis*
6. *(5)* Kelp is a plant found here, relative to the surface
7. *(3)* Not exactly Maxwell's daemon, but a close relative
8. *(10, 7)* Elementary laboratories provide basic skills in their use
10. *(5)* A palindromic electronic device
11. *(5)* A low woody plant (or a drink)
13. *(5)* The area drained by a river and its tributaries
15. *(5)* The position of fluorine in the table of elements
17. *(4)* The leaf-bearing axis of a plant
19. *(7)* The fifth member of the methane series
20. *(7)* Do chemists use them to answer back?
21. *(5)* A geological structure associated with salt and oil is sometimes this
23. *(5)* *Lactuca sativa* often forms the main part of this green dish
25. *(3)* A spark between carbons
26. *(3)* A foot of one 5 down
31. *(5)* Chemicals of current controversy
33. *(4)* Jelly for growing "bugs"
34. *(5)* A projection that fits a mortice
36. *(5)* Parliament has power to make laws, e.g., about 31 down
37. *(5)* To cut off
40. *(5)* The track of four 26 downs
41. *(5)* In a circle, we all measure the same
43. *(4)* The rank of Bertrand Russell (he was third)
44. *(4)* To produce related frequencies with the vocal chords
46. *(3)* A hard dry indehiscent fruit formed from a syncarpous gynaeceum; and an eccentric
48. *(3)* *Fraxinus excelsior;* and what is left after it is burnt

Solution in next issue (or in desperation, Phone: 807 - 345-2121, Extension 529)

CRYPTIC CROSSWORD

NO TRICKS, NO ANAGRAMS. AN ADVANCED CLASS PROJECT MAYBE?



COMPUTER CENTRE TOURS

Academic use of the computer slows down during April, May and June – this is convenient for the many groups of visitors who come at this time. Computer Centre tours are given to high school, public school and any other groups who wish to come. In addition, for the last two years a typewriter terminal has been circulated through a number of Thunder Bay High Schools – spending a week or two weeks in each. Connected to the Computer by telephone this terminal gives students an opportunity to use the university APL system in the school environment. Their teachers have been making good instructional use of the system.

ACADEMIC COMPUTER SERVICES

ACADEMIC USER'S GUIDE

The Academic User's Guide has been updated. Last year due to budget restrictions one copy only was sent to each department. This proved unsatisfactory in that many of these copies got lost and never surfaced again. This year all academic users will get a copy.

CONSULTATION SERVICE

Users (or non-users) requiring advice or information related to academic usage of the computer should contact the manager of Academic Computer Services (Mr. Watson, Ext. 383, Room MB1040) between the hours of 9:00 a.m. – 12:00 noon, 1:00 p.m. – 5:00 p.m. Mr. Davis (Ext. 316, Room MB1039) is also available for consultation during the same times.

A DOCUMENT FOUND IN A COPPER CYLINDER

PHYSICS
RULES FOR MARKERS

1. It is necessary that the solution to a problem contain *all* connecting steps, written in more or less complete English. No problem without these steps can receive more than 60%.

2. A diagram must appear in all problems. No problem without a diagram can receive more than 60% of the marks remaining after (1).

3. Watch that there is a symbolic solution followed by the tabulation of data. A problem without symbolic solution can receive no more than 60% of the marks remaining after (1) and (2).

4. Watch the numerical solution for powers of 10, irrational numbers, and wrong units. An answer like 18,000,000 is *not* acceptable, because it does not specify the number of significant figures. An answer like 18,000,000 $\pm$ 2% *is* acceptable.

5. Never deduct a mark without making a comment. However brief, make a comment. DO NOT USE! or ? on their own.

THE BLUE GOURAMI

(Continued from page 24)

APPENDIX

A. **Expected**

1. Rubbing $= \frac{42}{138} \times 35 = 11$
2. Clasping $= \frac{50}{138} \times 35 = 13$
3. Spawning $= \frac{46}{138} \times 35 = 12$

B. **Chi Square** $= \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$

1. Rubbing $= \frac{(13 - 11)^2}{11} = 0.36$
2. Clasping $= \frac{(10 - 13)^2}{13} = 0.69$
3. Spawning $= \frac{(12 - 12)^2}{12} = 0.00$

$X^2 = .36 + .69 + .00 = 1.05$

C. d f $=$ degrees of freedom
$=$ (Rows - 1) X (Columns - 1)
$=$ (2 - 1) X (3 - 1)
$=$ 2

The End.

LAKEHEAD UNIVERSITY
MATHEMATICS GAZETTE
serving Northwestern Ontario

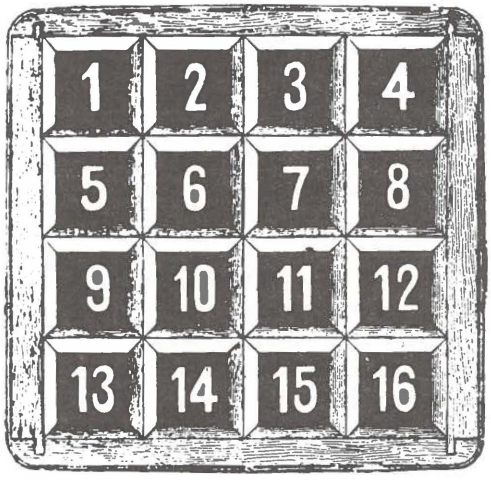
Vol. II No. 2

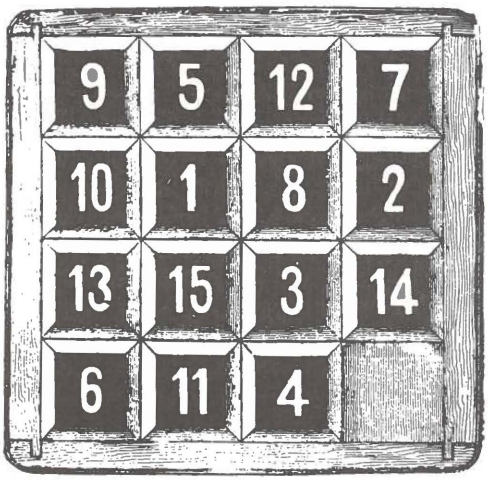
EDITORIAL

It is in one sense a sad occasion to see the *Lakehead University Mathematics Gazette* (serving Northwestern Ontario)swallowed up in a more comprehensive publication. On the other hand, it has truly been a pleasure to see the demand for it grow, and to hear expressions of gratitude from those who have been kind enough to call it useful.

We will continue to be available to assist your new editor, Dr. Hart, in every way possible, and we should like to take this opportunity to exhort our readers to continue sending in articles just as before. Our thanks go out to those who have generously contributed their articles, and time, in past issues.

L. Dale Black





HINTS FOR BEGINNING TEACHERS

By W. Eames

When Professor Black told me that I would be expected to offer you suggestions – helpful hints he calls them – on the teaching of Mathematics, my first impulse was to leave town. I had no suggestions whatsoever, other than the obvious ones like *"don't assign any problems you can't do"* and *"when you haven't had time to prepare a lesson, give a test"*. But you are as familiar with these strategems as I am, so I asked my first year class here to help me. I asked them for any suggestions they might have regarding the teaching of Mathematics in High School; in my article I will simply pass these suggestions on and comment on them.

Several students mentioned the *"different terminology"* used here; we really should get together and decide on a common nomenclature, but it shouldn't be necessary. Most of Mathematics is, or will be, couched in the terms of N. Bourbaki, and these are what we use here. Many of you are familiar with the work of L. Felix in bringing Bourbaki to the schools – indeed, she is required reading for most Mathematics teachers in Europe and undoubtedly had great influence here. Difficulties over terminology are absurd, but can involve a student in real difficulty.

Many students mentioned that their teachers had used tutorial and seminar methods with great success, that their teachers had encouraged them to use the school library, to actively participate in learning, and to study well outside the syllabus. But most students appear to have had an arid time of it; *"more watching than doing"* is a phrase one of them used that sums it up for the majority.

Many students were quite bitter about the lack of enthusiasm of their teachers, but I should think this is not a problem with younger teachers. I merely suggest that you consider breaking the class into small groups which would discuss problems, with the teacher intervening only if asked. (Several students mentioned that this is done at Lakeview and is a great success.) I suggest teacher-aided discovery, more library projects (one of our better students informed me that she had never seen the inside of her school library!) and more willingness to go off the beaten track. Why not have them consider some

simple game theory (does your library have a copy of the **"Compleat Strategyst"**?), give them topics like *"the groups generated by various wallpaper patterns", "modern geometries", "the relations between simple switching circuits and logic".* Even number theory can provide interesting and elementary topics – Davenport's book **The Higher Arithmetic** is a good source here. Perhaps your library subscribes to the **Mathematical Gazette** – if not, it should, and there is a very interesting book published by Unesco in 1966 – **New Trends in Mathematics Teaching.**

Another minor suggestion: students here often have trouble taking notes in lectures; they have no practice in this. It might be worthwhile to give informal talks during which the students are expected to take notes. It will be hard in the beginning. Some students will find it impossible (you may be surprised – some very good students just cannot absorb oral information), but it will be rewarding, even for those who do not continue on to University.

Now, let me come to the major suggestion. Nearly all my students found this fault in their previous schooling; there was not enough theory, there was too much emphasis on numerical working, type problems and unthinking manipulation. One mentioned that *"Math in school is arithmetic".* I hope this was an exaggeration. When it came to a proof, quote, *"Math teachers told us to memorize"* again ' *teachers ask, "do you understand this proof", then laugh and say – "if you don't understand it, don't worry about it"* '.

This is unforgivable. Mathematics is thought, proof and deduction, not blind manipulation of meaningless squiggles, and all of us here know that. Tell your students – if you don't understand a proof, **do** worry about it. As teachers, you must help them in analyzing proofs. Point out the common guideposts in a proof. Why does the proof proceed this way? Can you think of any other way it could go?

Point out the various options which are open at each stage of a proof: is the next step in the proof inexorable? is it the only reasonable path to follow? Try a few blind alleys. Point out where each of the given conditions is used. Are any of the hypotheses used twice? Are some never used at all? (I aways feel a **proof** is unsatisfactory if any condition is used more than once – it is certainly not a pleasing proof if it is not economical – and certainly the **statement** of the theorem is unsatisfactory if some condition is never used.) Suppose, in some theorem, we have the condition that a certain number, say, **a**, is not 0. How do we use such a condition? The obvious answer is we must divide by **a**. This is our reflex action when confronted by a non-0 number. (As an aside, if it's a calculus problem, we use $|a|$ as the ε in a continuity or convergence argument. Perhaps this is the only difference between algebra and calculus – the way we use non-0 numbers.) Thus, we look around at the surrounding facts to find something to divide *a* into. It is by the continual repetition of points like this that develop a student's intuition and powers of analysis.

So, your students must be given a feeling for the mechanics of a proof; it is not enough for them merely to be able to reproduce a proof. And, most important, they must realize that Mathematics is proving; it is not manipulating numbers and substituting for x and comparing with the answers in the back of the book. It is a game you play with abstract concepts which you bend to your will; it is a game they must enjoy. †

COMMENTS ON THE SNOW PLOW PROBLEMS

The article on snow plow problems contributed by Professor Mathimaki to "The Gazette, volume 3 has aroused some favourable fan mail but not, regrettably, a simple solution to the second problem as requested. The learned professor would still like to obtain such a solution so please, if you have any thoughts on the subject send them to the editor.

As far as we know, the second problem – the one involving two snow plows – has never been published before. The first problem appeared in "Ingenious Mathematical Problems and Methods" by L.A. Graham (Dover Books), and as E275 in the American Mathematical Monthly, the solution being in the December 1937 issue; we are indebted to Mr. L.J. Upton of Mississauga for these references. Professor Mathimaki first encountered the problem in a pub, in Kingston. It seemed to be fairly well-known to calculus students at Queens in the fifties.

(We would like to know where Mathemaki bought his second plough, which appears to have the capability of travelling faster than light! – Ed.)

WHO NEEDS A COMPUTER!

The success of APL/360 as a computer system, while effectively spreading the use of the language, has considerably obscured its purpose. APL was intended originally to simplify communication between human beings, both as a publication and a teaching notation. Common features of problems being solved by computer were represented by powerful new primitive functions, enabling concise and elegant descriptions of algorithms to be produced.

Iverson, the author of APL, also demonstrated that his notation could be used to describe the computer itself. In 1962 he published the paper, *"A Common Language for Hardware, Software and Applications"*, and in 1964, together with Falkoff and Sussenguth published *"A Formal Description of System/360"*. This latter paper concisely described the hardware operation of the IBM System/360 computer.

APL was therefore being used as a publication and teaching notation before any computer implementation. In fact the language was called *"A Programming Language"* and **not** *"A Computer Programming Language"*.

Iverson also intended that his notation should have an impact upon Mathematics as well as Computer Sceince. The language is a development of the notation of Algebra. Ambiguities have been removed, useful functions added and a more unified approach to the manipulation of arrays provided. Iverson has successfully used his notation in the teaching of Mathematics – again without necessarily using a computer. He has also published texts in both Elementary Algebra and Calculus using APL notation.

One might expect to find others using APL as a useful notation in Computer Science, Mathematics and mathematically based disciplines. So far, however the use of APL as a notation has been small. Without the dramatic success of APL as a computer programming language, the notation might have been ignored for a good many more years.

The first computer implementations of APL were produced as an experimental aid to the development of the notation. From that point APL also became a means for a human to communicate with a computer, rather than another human. APL/360 in particular very quickly had great success as a computer programming language and system. Users became enthusiastic over their interactions with the computer to such an extent that they lost interest in communicating with each other. It is unfortunate that all present APL implementations execute programs faster when the program is made more difficult to read. This has further obscured the real purpose of APL.

If clearly written APL notation can be a help in communicating mathematical ideas – why does one need a computer at all when using APL as a teaching aid? Dr. Paul Penfield of M.I.T. in a recent paper on his use of APL as a notation in an Electrical Engineering course reported that his students felt they learned little from going to the computer. They learned most from clarifying their thoughts into APL before they reached the computer. Of course, the same fact is true for a student writing in FORTRAN – he learns most while writing his program not while running it – even though it is more difficult clearly to express one's thoughts in FORTRAN.

The computer really serves two purpose here; firstly it motivates the student to write his program since he can make use of it; secondly it tirelessly tests his work, isolating mistakes and correcting misconceptions.

The computer is still a glamorous creature to many students who are eager to use it. Many thoroughly enjoy using APL. It is, however, only a tool. What matters most is not the machine, but the thought behind what it is used for. †

INTRODUCING THE NEW COSTING SYSTEM

Users will find their output contains some new statistics including a dollar cost. These statistics refer to the new charging system which will be run concurrently with the old system for a trial period.

An extensive study has been made to obtain realistic and accurate charging for every aspect of computer usage. Use of the fast core will cost more than use of slow core. Usage during peak periods of the day will be more expensive than overnight runs. APL users will be charged half the previous rates per connect hour – but charges will be made for CPU time and workspace storage. Overall, the computer centre expects that charges for computer centre services will not change substantially.

If the costs are similar – why have a new costing system? We need as realistic and fair charging scheme as possible for the benefit of external users– whose use of facilities is expanding.

The new scale of charges is contained in the Academic User's Guide section 2.4.

COMPUTER SCIENCE IN THE SCHOOLS

By J. S. Griffith

I feel that all children should know something about the nature and uses of computers in our present day world. Rather than start by a general discussion of computers or a history of their evolution, I consider the first step in such a program should be to get the class to run programs on a "**real live**" computer, either individually or in groups.

These programs can be devised by the teacher, but should demonstrate something of the speed and storage capabilities of modern computers. Let me assume for the rest of this article that access to the Lakehead University Computer Centre (either by the physical presence of students at APL terminals or by preparing punched cards and FORTRAN programs) is possible.

INTRODUCTORY PROGRAMS

```
C     WHAT IS HAPPENING?
      A=1
      B=2
      C=3
      D=A+B+C

8     PRINT, A,B,C,D
      D=B/C
      PRINT, A,B,C,D
      STOP
      END

C     SEPARATION OF 100 NUMBERS INTO
      TENS AND UNITS
      I=0

1     READ, KA
      PRINT, KA
      I=I+1

C     FINDING THE TENS DIGIT
      IA=KA/10
      PRINT, IA

C     FINDING THE UNITS DIGIT
      JA=KA-IA*10
      PRINT, JA
      IF(I.LT.100)  GØ TØ 1
      STOP
      END
```

Try your own program for addition using tens and units – remember to test for carry of one.

```
C     SIMPLE LØØP
      I=D

1     I=I+1
      IF (I.EQ.11) GØ  TØ 2
      PRINT, I
      GØ TØ 1

2     STØP
      END

C     G.C.F. OF 75 AND 120
      I=0
10    J=25-I
      IF(120/J*J. EQ. 120. AND.75/J*J.EQ.75)
      PRINT, J
      I=I+1
      IF (I.LT.75) GØ TØ 10
      STØP
      END

C     FIRST 20 MULTIPLES OF 2,3,4,5,6,9,10
      PRINT, 'MULTIPLES OF 2--OF 3--OF 4--
      OF 5--OF 6--OF 9--OF 10'
      N=1

5     N2=2*N
      N3=3*N
      N4=4*N
      N5=5*N
      N6=6*N
      N9=9*N
      N10=10*N
```

(Continued on next page)

```
PRINT, N2,N3,N4,N5,N6,N9,N10
IF (N.LE.20) TØ TØ 5
STOP
END
```

Once they have used the computer, there should be sufficient material available to demonstrate, from their programs, the organization of arithmetical operations, branches, loops, flow charts. Then one can look at non numerical applications e.g. flow charts for biological development, getting to school in the morning, dancing, setting up a tent, using timetables, dictionaries, literary card indices.

This may be followed by work on the social impact of computers e.g. data manipulation (payroll, accounting), data banks and information retrieval (medical records, criminal records, license plate records, libraries, stock control), real-time and on-line control (seat reservations, banking, machine control of production processes), problem solving and models of physical situations (nuclear reactors— safer to test models numerically than physically; stellar models — impossible to build in a laboratory or wait a billion years to **observe** evolution, weather forecasting), future possibilities. Ask the class to try to find a large company or manufacturing concern that does **not** use computers. Look at family bills for evidence of computer activity.

Other topics include:

The sort of jobs associated with computers (operational staff, data preparation, data control, tape librarian, computer operator, programmers, systems analysts and designers, and engineers).

History of computers, (abacus, addition and multiplication tables, slide rule, desk calculator, accounting (Hollerith) machines, digital and analogue computers. Values, transistors . . .)

Numerical analysis (how do errors propagate in various operations, linear equations, numerical integration, (f(x) =0), statistics.

How computers work — logical principles (Boolean algebra and Turing machines via functional matrices), construction of simple circuits.

Data processing (Systems analysis, fast finding, form designs, design of data collection, report writing, systems flow charts, decision tables, programming, coding, testing, documentation, implementation. File handling, editing, relating, up-dating on magnetic tape, cards or disc. Sorting and collating files, information retrieval, data banks, terminals. Data transmission, invoicing with sales analysis, payroll, medical records).

Many other programs may be obtained from the following references (try giving the child a program, asking him to figure out what it does, then run it:— discovery by experimentation).

References include:

Computers and high school teaching,
J.S. Griffith, Lakehead University

Fortran IV with WATFOR and WATIV,
Cress, Dirksen, Graham, Prentice-Hall

Ten Statement FORTRAN plus FORTRAN IV,
Kennedy and Solomon, Prentice-Hall

and, of course, any other books you can find. The pages of the **"Gazette"** seem to be an appropriate place for the interchange of ideas and programs. A reference for the future impact is C.S. Wallia "Toward Century 21" Basic Books. †

SQUARE PROBLEM

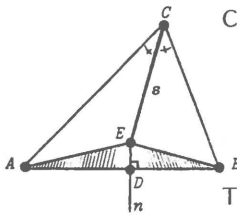
Suppose that you have a square room and that you wish to tile it with square tiles, not necessarily all of the same size. How many tiles could you buy to do the job and not have an excess? For example, could you tile the room with 6 tiles? 9 tiles? 5 tiles? Certainly you can always tile the room with 1 tile.

Determine for which positive integers n you can tile the room with **n** square tiles.

— J.H.M. Whitfield

WHAT'S WRONG HERE?

Below, a "proof" is given that all triangles are isosceles. Take a triangle ABC. Let s be the bisector of $\sphericalangle ACB$ and n the perpendicular bisector of AB. Let E be the intersection of s and n.



Consider ΔADE and ΔBDE.

We have

AD = BD
$\sphericalangle$ ADE = $\sphericalangle$ BDE
DE = DE

Therefore $\Delta ADE \equiv \Delta BDE$.

Consider now ΔAEC and ΔBCE.

From (1), we obtain AE = BE.

Furthermore, CE = CE,

$\sphericalangle ACE = \sphericalangle BCE$.

Since both $\sphericalangle CAE$ and $\sphericalangle CBE$ are acute, we conclude that $\Delta AEC \equiv ABCE$, and therefore AC = BC.
This means ΔABC is isosceles. Of course, we know that not every triangle is isosceles, so something in this "proof" must be wrong.
Can you find out what?

EXPERIMENTAL GEOMETRY

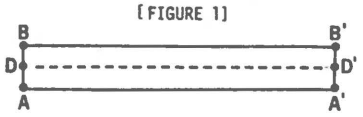
Take a rectangular paper strip, **A A' B B'** (Fig. 1). Draw a center line **D D'** ∥ **A A'**. Now twist it once, as in Fig. 2.

Without a further twist, put the edges **A B** and **B' A'** together, such that **A** and **B'** coincide, and **A'** and **B** (Fig. 3).

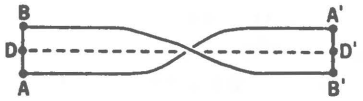
Glue it along **A B**. Then cut it through along **D D'**.

What happens? What happens if, before gluing, you twist it once more (Fig. 4)?

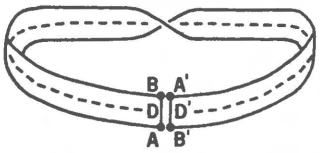
[FIGURE 1]



[FIGURE 2]



[FIGURE 3]



[FIGURE 4]

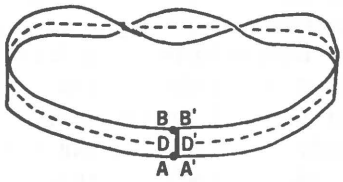


FIGURE 1

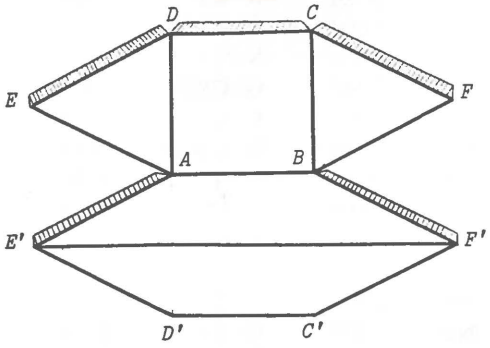


FIGURE 2

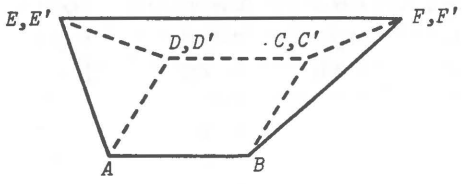
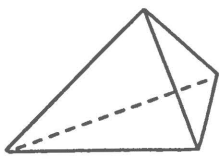


FIGURE 3



Draw Fig. 1, where **ABCD** and **ABC'D'** are squares, **ADE, AD'E', BCF, BC'F'** equilateral triangles. Add the shaded pieces for later gluing. Cut the figure out and fold it along the thick lines. Then glue it together such that **D** and **D'**, **C** and **C'**, **E** and **E'**, **F** and **F'** coincide (Fig. 2). Do the same thing once more, so you get two congruent solids. Can you put them together to form a regular tetrahedon (a pyramid whose faces are four congruent equilateral triangles, Fig. 3)?

COMPUTERS PLAY CHESS: CAN YOU DO BETTER?

United States Computer Chess Championship

Boston, Massachusetts

August 13–15, 1972

WHITE: Northwestern University
(Larry Atkin, Keith Gorlen, David Slate)

Computer: CDC 6400

Location: Evanston, Ill.

BLACK: Columbia University
(Monty Newborn, George Arnold)

Computer: Data General Nova 800

Location: Sheraton-Boston Hotel

	White	Time (sec.)	Black	Time (sec.)
1.	P–K4	(1)	P–QB4	(1)
2.	N–KB3	(1)	N–QB3	(1)
3.	P–Q4	(1)	PxP	(1)
4.	NxP	(1)	P–K4	(1)
5.	N–KB3	(235)	Q–N3	(1)
6.	N–B3	(140)	B–B4	(269)
7.	Q–Q2	(199)	P–Q3	(227)
8.	N–Q5	(181)	Q–Q1	(144)
9.	P–QN4	(74)	B–Q5	(143)
10.	P–B3	(64)	B–N3	(147)
11.	NxB	(49)	PxN	(44)
12.	B–B4	(99)	B–K3	(207)
13.	BxB	(69)	PxB	(39)
14.	N–N5	(92)	Q–Q2	(87)
15.	O–O	(115)	P–KR3	(58)
16.	N–B3	(56)	O–O–O	(220)
17.	R–Q1	(56)	N–B3	(245)
18.	Q–K2	(115)	Q–QB2	(230)
19.	B–N2	(108)	N–K2	(195)
20.	N–Q2	(135)	P–Q4	(67)
21.	P–QB4	(95)	P–Q5	(246)
22.	Q–Q3	(91)	N–N3	(154)
23.	P–N3	(119)	Q–K2	(162)
24.	B–R3	(70)	K–B2	(90)
25.	R(R1)-N1	(122)	R–R2	(257)
26.	R–K1	(88)	R–Q2	(89)
27.	K–N2	(75)	Q–Q1	(69)
28.	P–R3	(80)	N–N1	(257)
29.	R–N3	(94)	Q–N4	(63)
30.	K–R2	(115)	R–B2	(249)
31.	Q–K2	(101)	N–B3	(94)
32.	R–KB3	(130)	P–R4	(63)
33.	P–R4	(80)	N–N5	(249)
34.	K–R1	(88)	Q–K2	(78)
35.	K–N2	(110)	RxR	(216)
36.	NxR	(65)	Q–B3	(52)
37.	B–B1	(108)	K–Q3	(251)
38.	B–N5	(106)	Q–B2	(63)
39.	B–Q8	(176)	R–R1	(286)
40.	BxP	(157)	K–K2	(63)
41.	N–N5	(97)	Q–K1	(241)
42.	P–N5	(185)	Q–QB1	(111)
43.	R–QN1	(195)	R–KB1	(82)
44.	R–KB1	(94)	R–K1	(335)
45.	Q–B3	(173)	R–B1	(135)
46.	Q–R3	(78)	K–Q2	(82)
47.	B–B5	(135)	R–R1	(94)
48.	N–B7	(146)	R–R2	(104)
49.	R–B1	(155)	N–R3	(88)
50.	N–Q6	(26)	Q–B2	(234)
51.	P–N6	(110)	Q–B3	(69)
52.	R–K1	(149)	R–R1	(126)
53.	K–N1	(36)	N–N5	(116)
54.	R–KB1	(110)	R–R3	(299)
55.	N–B7	(99)	QxP (K4)	(151)
56.	NxR	(106)	NxN	(75)
57.	P–B3	(56)	Q–QB3	(102)
58.	K–B2	(67)	K–Q1	(128)
59.	R–QN1	(96)	Q–Q2	(119)
60.	K–N2	(109)	N–B4	(75)
61.	K–B2	(100)	Q–B1	(232)
62.	R–N5	(88)	K–Q2	(99)
63.	R–N2	(78)	K–B3	(288)
64.	Q–N4	(234)	K–Q2	(80)
65.	Q–N5	(80)	Q–B3	(39)
66.	R–Q2	(85)	QxQ	(227)
67.	PxQ	(39)	K–Q1	(60)
68.	R–Q3	(74)	N(N3)–K2	(165)
69.	P–R4	(129)	P–N3	(66)
70.	P–R5	(79)	K–Q2	(211)
71.	P–R6	(50)	PxP	(57)
72.	PxP	(138)	K–B1	(231)
73.	P–R7	(105)	K–N2	(129)
74.	R–R3	(52)	K–R1	(85)
75.	P–N7	(27)	KxP	(1)
76.	P–R8=Q	(32)	K–B2	(1)
77.	R–R7 Mate	(33)		

AN EXPERIMENTAL STUDY OF MATHEMATICS LEARNING

Pub. 1963 – Hutchinson & Co. Ltd., London.

Z.P. Dienes

This book would be suitable for students specializing in mathematics for elementary teachers. It would also be a good reference book for students of child psychology.

Dienes's treatment of mathematical concepts learned as a function of play is fascinating, but rather too intricate for the general student.

The book is certainly thought-provoking although one who has little background in mathematics might find it difficult to follow.

The chapter on educational implications is significant and would be worth-while reading for any teacher.

D. Botly

HOW CHILDREN LEARN MATHEMATICS

Pub. 1970 – The Macmillan Co. New York

Richard W. Copeland

Copeland's stress on the **learning** of mathematics rather than on the **teaching** is directly in line with the type of programme advocated by an increasing number of educators and classroom teachers.

"How Children Learn Mathematics" would make excellent preparatory reading for any course for teachers of elementary mathematics.

Although the works of Piaget are very detailed, Copeland has developed Piaget's approach clearly and concisely and applied it to the teacher's role in a way which is sure to help any teacher who reads this book. Copeland achieves a fine balance of theory and practicality.

This book should be available for all Education students in the elementary field.

D. Botly

A COURSE OF GEOMETRY FOR COLLEGES AND UNIVERSITIES

Pub. 1970 – Cambridge University Press.

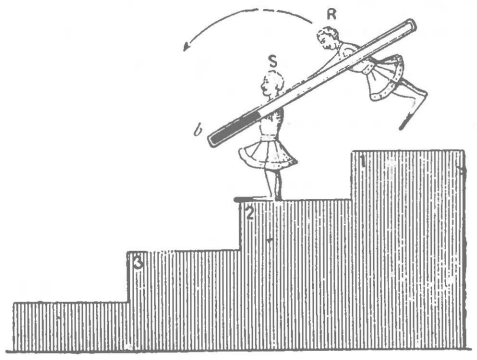
D. Pedoe

Many of us, having studied under graduate mathematicians at a time when geometry was at a low ebb, find ourselves short of examples, intuition, and a sense of direction about how high school geometry can be developed and directed. This book was written as a text for the undergraduate course we should have taken and can assist us in picking up some of the ideas which are at the heart of geometry.

The book is a large collection of elementary geometry in its many forms. Though the author concentrates on analytic geometry, including some use of vectors and a prelude to algebraic geometry, he uses a variety of approaches in proofs of the basic theorems, including pretty synthetic constructions when these are appropriate. The various chapters tend to be a bit disconnected, which makes it hard to see the material as a unified whole. However this situation does make it possible to dip into the middle sections on mappings of the plane, without extensive reading of the preceeding sections on coaxial systems etc. All of the essentials of euclidlean goemetry and projective geomentry are presented in some detail and there are regular, if somewhat difficult, exercises. Several sections, such as the nine point circle, or a pretty section on reflections, could even be read by high school students as they stand.

This book is a fine reference and source book at a time when we need all the geometric intuition we can get, in order to digest the abstractions which are piling up around us.

Walter Whiteley



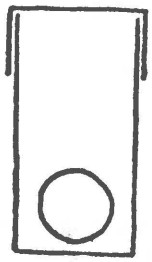


Figure 1

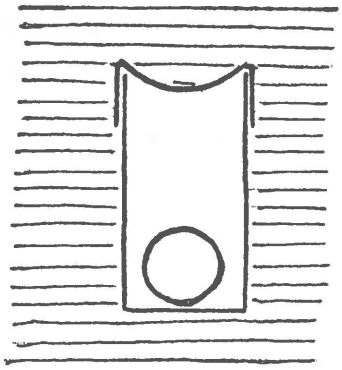


Figure 2a

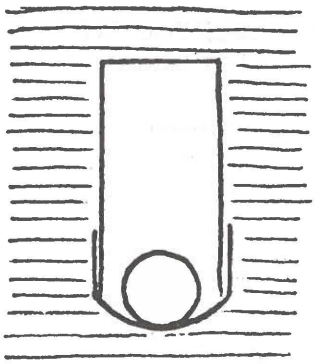


Figure 2b

A PERPETUAL PROBLEM

Every common mechanic has something to say in his craft about good and evil, useful and useless, but these practical considerations never enter into the purview of the mathematician.[1]

With the above in mind, one may be enticed to join Jean Bernoulli, Sr., and Leonardo da Vinci for a few minutes and enter the realm of the perpetual-motion-mongers. [2]

Though it is an unpromising venture from a physical point of view it can be entertaining mathematics.

Consider a U-shaped vessel made of a non-flexible material, such as a tin can, with a heavy steel ball inside and covered on top with an elastic, watertight lid as shown in figure 1. Observe that when this container is placed under water the amount of the water displaced – and hence the buoyancy – is dependent on its position; when upright as in figure 2a the lid is pressed inward by the water pressure, while when the container is upside down as in 2b, the weight of the ball stretches the cover outward thus increasing the buoyancy. Attach an even number of these containers to an endless belt on two pulleys as shown in figure 3 and submerge the entire system under water.

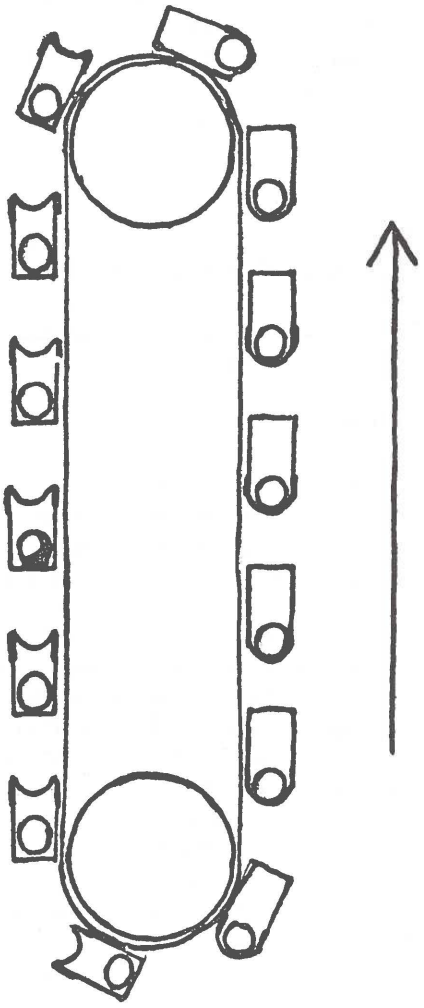


Figure 3

1 Aristippus of Cyrene, quoted by HICKS, R.D. "Stoic and Epicurean"; (New York, Charles Schribner's Sons, 1910) p. 210

2 Encyclopaedia Britannica, 1967, Vol. 17, p. 639-41

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