Wisconsin engineer. Vol. 75, No. 2 November 1970

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

VOL. 75, NO. 2

35 CENTS NOVEMBER, 1970

wisconsin engineer

Westinghouse the teacher?
the medic?
the builder?
the crime fighter?
the urban planner?
the ecologist?

Westinghouse Learning Corporation has launched a computerized teaching system that lets each child learn at his own rate.

Our studies for the Defense Department will lead to the "hospital of the '70s," and a level of efficiency and economy unknown today.

Houses? We're not talking about the thousands of units completed or under construction. We're talking about the new plant we're building to mass-produce modular houses.

Our computer-based information systems improve police efficiency, speed up court administration. We're marketing electronic security systems for homes and plants.

We've developed waste-disposal units for neighborhoods, sewage treatment plants for cities, a smokeless refuse plant that reclaims rather than destroys.

We're transforming 16 square miles of Florida into a new city. It's the bellwether for hundreds of thousands of acres, bought or leased, here and abroad.

The list goes on. Everything electrical, of course—from nuclear power plants to light bulbs. And aerospace, oceanography, broadcasting, rapid transit.

It all means that Westinghouse has openings for skilled engineers—electrical, mechanical, chemical, industrial. And we also offer job training for the unskilled as another step toward increasing productive employment for the disadvantaged people of our country. An equal opportunity employer.

You can be sure...if it's Westinghouse

The *lampyridae* beetle family. Delight of small boys. Biological light bulb. And prime source of raw material for another Du Pont innovation.

Luciferase, an enzymatic protein with intriguing properties, obtainable only from fireflies. *Luciferin,* an organic molecule also found in fireflies, but synthesizable. *Adenosine triphosphate* (ATP), a common energy-yielding substance found in all living cells.

Those are the three main ingredients in *lampyridae's* love light. And because ATP is common to all living cells, university researchers discovered they could produce an artificial glow by mixing luciferin and luciferase wherever life is present.

Noting that phenomenon, Du Pont scientists and engineers went on to develop it into a practical analytical system. Correlating the intensity of the artificial "glow" with the amount of ATP present in bacteria, they designed a means of measuring the reaction.

The result is the luminescence biometer—the first really basic improvement in bacteria-counting methods since the days of Louis Pasteur. Rather than waiting days for a culture to demonstrate growth density, a doctor or technician can now get a digital readout of bacteria concentration in a matter of minutes.

Other potentially lifesaving uses for the biometer are being suggested every day—such as diagnosing metabolic rates, enzyme deficiencies and nerve damage.

Innovation—applying the known to discover the unknown, inventing new materials and putting them to work, using research and engineering to create the ideas and products of the future—this is the venture Du Pont people are engaged in.

For a variety of career opportunities, and the chance to advance through many fields, talk to your Du Pont recruiter. Or send the coupon.

Venture: Use a love call to count bacteria.

Du Pont Company, Room 7890, Wilmington, DE 19898

Please send me the booklets checked below.

- ☐ Chemical Engineers at Du Pont
- ☐ Mechanical Engineers at Du Pont
- ☐ Engineers at Du Pont
- ☐ Accounting, Data Systems, Marketing, Production

Name__________

University__________

Degree__________ Graduation Date__________

Address__________

City__________ State______ Zip______

An Equal Opportunity Employer (M/F)

DU PONT

REG. U.S. PAT. OFF.

Ventures for better living.

To a man with emphysema, a flight of stairs is Mt. Everest.

If you have emphysema or other chronic lung problems, you know what it's like to climb a flight of stairs. And you probably don't know what it's like to play a round of golf or even take a walk.

Union Carbide's Linde Division has developed a portable liquid oxygen system which many doctors prescribe for their patients.

It weighs less than 9 pounds full. Set the oxygen at the flow your doctor tells you to. And you can do many of the things you did before.

Sure, we've oversimplified the whole thing. We're not going to go on and on about all the Union Carbide technology that makes the Oxygen Walker possible. It's just one of the things we're doing with air.

We separate and purify nitrogen, argon, neon and krypton for industry. We make liquid nitrogen systems for everything from refrigeration to surgery. We make mixtures for underwater divers.

It makes sense that if we can help a diver dive to 1000 feet, we can give a man with emphysema the air to get to the top of the stairs.

UNION CARBIDE
THE DISCOVERY COMPANY
270 Park Ave., New York, N.Y. 10017

For additional information on our activities, write to Union Carbide Corporation, Department of University Relations, 270 Park Avenue, New York, New York 10017. An equal opportunity employer.

"We are drifting toward a catastrophe beyond comparison. We shall require a substantially new manner of thinking if mankind is to survive." – **(Albert Einstein)**

CONTENTS:

wisconsin engineer

MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: DANIEL L. GRIFFEN, JR., Iowa State University, Ames, Iowa.
Publishers Representatives: LITTLE-MURRAY-BARNHALL, INC., 369 Lexington Avenue, New York, New York 10017.

* * * * * * * * * * * *

Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

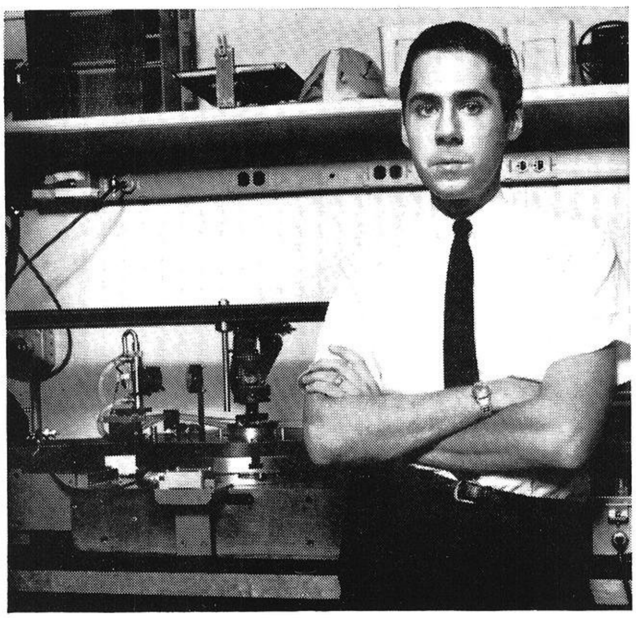
Published monthly from October to May inclusive by the Wisconsin Engineering Journal Assn., Subscriptions: one year – \$2.00; two years – \$3.75; three years – \$5.25; four years – \$6.50. Single copies are 35 cents per copy. 308 Mechanical Engineering Bldg., Madison, Wis. 53706. Office Phone (608) 262-3494.

"There's a little more freedom here to direct my own research than at most company labs."

Bob Pfahl, Western Electric

Thermal energy is his field. And since 1968, Bob Pfahl has been doing research and development in radiant heat transfer on the staff of Western Electric's Engineering Research Center.

Well-backgrounded, Bob holds three degrees from Cornell University—a bachelor's in mechanical engineering, and a master's and doctorate (received in 1965) in heat transfer.



"My job is self-motivating," said Bob. "I have to look ahead to see where I think research should be done."

And one such area was the design of heating equipment. Western Electric uses radiant heating in a variety of manufacturing processes because it's quick and inexpensive, and because it can be applied at a distance.

However, because of the limitations of existing reflectors, radiant heating has been limited to small areas. Bob has developed a reflector shape which uniformly distributes energy from a compact mercury arc lamp over larger circular areas.

"Many projects grow out of previous or existing work," Bob said. He explained that in order to calculate the reflector shape, he had to first design an instrument to measure reflectance of the reflector material.

"But we're well supported here at Western Electric," said Bob. "We have very fine lab equipment—and can obtain the equipment we need."

So Bob designed and built his "spectral bi-directional reflectometer." It provides data for a computer program he created that calculates reflector shape by numerically integrating a set of differential equations.

Bob is currently working on the development of an even newer type reflector which will distribute energy from line type filament lamps over a large rectangular area. An array of these reflectors will allow the uniform heating of almost any size workpiece.

"We're free to look around for our own projects," said Bob. "I like that—that's why I'm here."

Western Electric

An Equal Opportunity Employer

Editorial —

Who Cares?

In a recent *Wisconsin Engineer Journal* Assoc. board meeting, the editors and directors agreed on a policy statement. There had been suggestions on content and editorial sentiment but never a commitment to a formal and specific policy.

This meeting was called as a result of the offer of resignation of Prof. C. A. Ranous from the board of directors of the *Wisconsin Engineer.* He expressed the feeling that he had "let down" his contemporaries, his students, his profession and the faculty of the College of Engineering as well as the University of Wisconsin by not taking a more active part in directing magazine content.

During the past year, the *Wisconsin Engineer* gained a good deal of notoriety for its liberal editorial policy. Although this editor shares the opinion of many of his peers that the past eight issues were excellently conceived and successfully edited while presenting many contemporary issues, Prof. Ranous, a few other faculty and many alumni felt that their own interests and sentiments were being misrepresented.

Their feelings became clearly justified when they learned that the majority of staff people were not engineers and a few were not even enrolled at the University of Wisconsin. This of course violated the principal premise of the *Wisconsin Engineer Journal* Assoc., Inc. which intends that the magazine be edited and published specifically by engineering students at the University of Wisconsin. The editors may have been slightly negligent in not fully recognizing that the readership extends far beyond the campus community to many high schools in Wisconsin and to universities and alumni scattered throughout the world.

There were a few benefits reaped from last year's production. There has been a resurgence of requests for information and editorial opinion for campus newspapers and organizations. The *Wisconsin Engineer* has also been quoted as a source for articles on eutrophication, solid waste and Sanguine. And finally, the *Wisconsin Engineer* provided some meat for the bland diets of academic engineers. Coincidentally, one of the best paying stands and perhaps the attentive readership was in Bascom Hall. It appears that last year's editors conveyed the message of achievement and frustration in engineering in a manner and language meaningful to non-engineers and often directed specifically at campus activists.

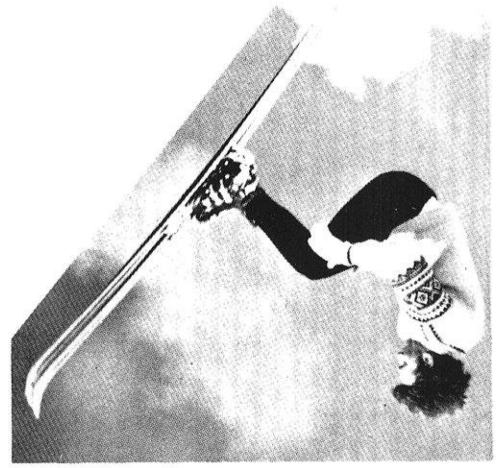
For a particular reason, I would give Roy Johnson, Susan O'Toole and Jerry Gottsacker a gold star: they injected some stimulating potion into the old and withering body of the *Wisconsin Engineer* and have stimulated it into a lust for life. Plus, it was an antidote for the disease that had affected much of the College of Engineering and is most despised by writers and editors – apathy.

Consequently, Prof. Ranous inspired the entire board to call for a review of the *Wisconsin Engineer.* He showed himself to be one of the most active and concerned board members and we thank him for his efforts and especially for not resigning.

DANA YARGER.

[***]

Ski Designs



R. J. BERNER

Remember back oh six years ago when a person with a pair of $148 HEAD COMPETITION skis could command some envious stares on the slopes? Well maybe you don't remember but that's how it was; kids would do anything to be seen strapped to a pair of metal skis, preferably those wondrous COMPS. Today, however, a fella with such a six-year-old rig would go unnoticed. In fact, he would probably apologize to his young friends, "Yeh, well, I left my good pair home." The superskis blew in about three years ago, sired by material innovations and high-powered racing at places like Innsbruck, Grenoble, and Portillo. Most of them are laminations of exotic woods and FRP (fiber-reinforced plastic) but the newest, and hottest skis are a curious blend of FRP and high tensile aircraft alluminum alloys.

HISTORICALLY SPEAKING. . .

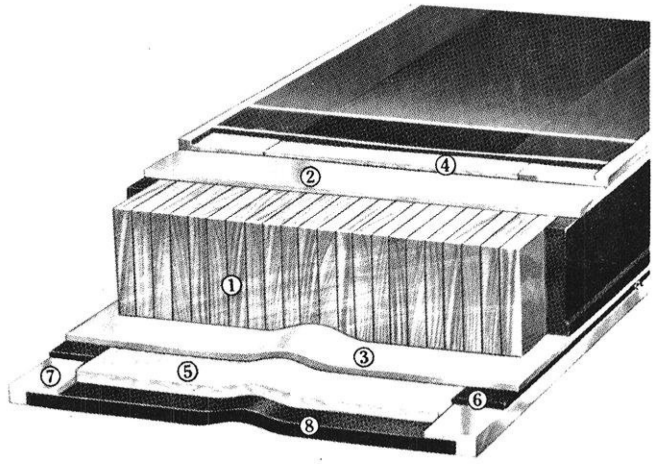
Fifty years ago skis meant two ash boards with points slightly upturned and a shallow running groove on the bottom. With the advent of rope tows, the lightweight, one-piece ash skis faltered under increased strain and abrasion. Hickory skis then captured the fancy of a sporting few because its density provided a good, tough running surface. But hickory was expensive and European ski pioneers like Josef Fischer in Austria decided to combine the lightness of ash with the durability of hickory by laminating the two woods together. Long strips of ash and hickory were laminated alternately into a unit which was then shaped. Aberations in grain tended to cancel giving the new ski more uniform and predictable flex while increasing the torsional rigidity of the ski. Ski technology was born.

As the sport continued to blossom, particularly after WWII, serious skiers trebled and quadrupled the number of miles put on their skis. Durability became an important design consideration as ski designers, notably Howard Head of the USA, dreamt of metal skis that would surpass the performance of the best laminated wood skis while introducing the more consistent engineering properties of metals. The first metal skis were nothing more than laminated cores of marine plywood sandwiched between aluminum sheets and topped with hard rubber. Segmented steel edges were screwed or riveted flush with a soft polyethylene base. The '50's became a decade of development of the metal ski with such innovations as one-piece steel edges, hardened steel edges (as high as 52C on the Rockwell scale), and neoprene lamina to dampen the metal ski's greatest drawback, high-speed vibration (chatter).

One-piece steel edges were a particularly knotty engineering problem for designers. Their feasibility was never questioned because they were to reduce tear-outs common with segmented edges and virtually eliminate water intrusion through nonexistent screw holes. However, because of their continuity, steel edges would tend to stiffen the action of the ski. Some designers particularly HEAD chose to use softer steel in the edges while other, notably Fischer, bonded very hard steel edges to a layer of neoprene which in turn was bonded under heat and pressure to the ski body. The neoprene was to restore the flexural response and, inadvertantly, dampen annoying high-speed chatter.

Fiberglass skis were inevitable what with the explosion of plastics technology in the sixties. Fiberglass skis differ fundamentally in that the high tensil aluminum sandwich evolved in the metals is replaced by a sandwich of carefully laid glass cloths and resins. In some models the core is wrapped with cloths, impregnated heavily with resin, and baked evenly under pressure. Fiberglass skis of one model or another incorporated all of the design innovations of metal skis including one-piece edges and neoprene layers. There were two distinct advantages to the new fiberglass ski; (1) they damped vibrations better, (2) they were torsionally more resilient. But they possesed one huge disadvantage which kept them from initially impregnating the recreational market: their fatigue strength was far below that of the metal skis. Back in '67, one would hear of the French racers using a pair of Dynamis VR7 for two or three races and then discarding them because they had lost their resilience and camber. Designers have greatly improved on this problem with the development of FRP (fiber-reinforced plastic) in which glass roving and bias cloths are laid specially to reinforce the action of the ski. In addition, some models use an aluminum top edge ro reinforce ski action and provide abrasional protection.

This season marks the advent of skiing's hottest board – a marriage of FRP and metal. The intent is to dominate the action of a metal-glass ski with the quick response and resilience of fiberglass while providing the fatigue strength and torsional rigidity of metal. In a sense, glass-metal skis sums all of the lessons learned in fifty years of ski design. To illustrate, Fischer's new glass-metal, the IMPERATOR, uses a lightweight, elastic core of African Okoume wood sandwiched between Perradur S aluminum alloy sheets which are in turn surrounded by FRP layers. One-piece hardened steel edges are bonded to neoprene strips.



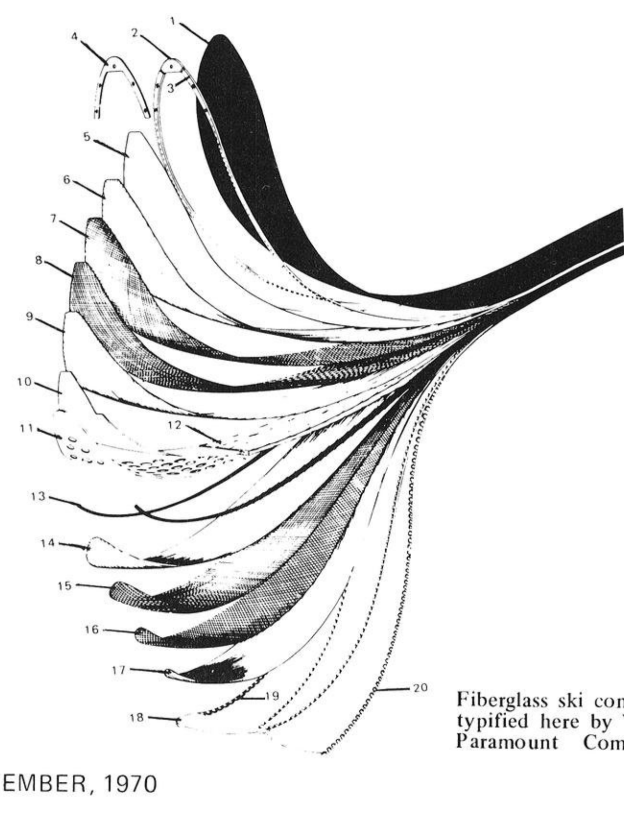
Fischer Imperator, metal-glass combination. (1) Okoume wood. (2) (3) Perradur S aluminum. (4) (5) FRP layers. (6) Neoprene layer. (7) One-piece edges. (8) P-Tex base.

THE MEASURE OF A SKI. . .

It might be said that materials engineering outstripped performance engineering in ski design until the last 3-5 years. Dozens of ski manufacturers flocked to Grenoble and Portillo to find out why their brands were resolutely rejected by the world's best skiers even though, materially, comparable models were all the same. HEAD lond ago resigned itself to the recreational market, especially after the fiberglass boom, because nobody was racing HEAD skis (with the Downhill model being a waning exception). And yet, names like Fischer, Rossignol, and Dynamic were taking home the bacon. Manufacturers wanted new empircal information about traditional as well as exciting new design parameters so that they too could enter the era of the superski.

Measurements best defining the important design parameters are now being coorrelated with empirical performance opinions of armies of expert, professional skiers. SKI and SKIING magazines have become the MOTOR TRENDS of the ski industry by publishing their own exhaustive performance tests and measurements. Some of the design parameters used, their measurement, and their relation to performance characteristics follow.

(Continued on Page 20)



Fiberglass ski construction typified here by Yamaha's Paramount Combination.

PARAMOUNT COMBINATION

1. ABS top sheet
2. Aluminum tip
3. 75S-T_6 aluminum top edge
4. Inlaid 18-8 stainless steel tip protector
5. Epoxi sheet
6. Glass roving with Epoxi
7. Glass bias cloth with Epoxi
8. Glass plain cloth with Epoxi — FRP
9. Glass roving with Epoxi
10. Veneer
11. 52S aluminum plate
12. Selected laminated wood core
13. Side ABS resin wall
14. Glass roving with Epoxi
15. Glass plain cloth with Epoxi
16. Glass bias cloth with Epoxi — FRP
17. Glass roving with Epoxi
18. 52S aluminum packing
19. 17-7PH YAMAHA special stainless steel one-piece edge
20. HIZEX polyethylene base

EXPO '71

BY CHRIS PAPE

The College of Engineering of the University of Wisconsin is once again sponsoring the Engineering Exposition. The exposition is scheduled for the March 26-28 weekend and will be located in the buildings of the engineering campus. But what really is Expo 71?

Strictly speaking the exposition is an opportunity for U.W. engineering students to demonstrate their technical abilities by displaying projects related in nature to any of the many branches of engineering. It is also a chance for industry to present exhibits that show some aspects of their work which have relevance to the broad fields of engineering.

The exposition is continually seeking exhibits from numerous industries. To balance the industrial exhibits, Expo 71 encourages any student or group of students interested in some technological field to devise and construct projects for display at the exposition. This is an excellent opportunity for any enterprizing student to display his technical prowess and understanding.

An added attraction to students will be the opportunity to assist the participating industries in the formation and display of their exhibits. This will further the "closeness" between industry and the student which is a fundamental purpose of Expo 71.

The creation of the Engineering Exposition resulted from the termination of another old tradition. St. Pat's day was always celebrated by a parade here at U.W. but the bickering between the lawyers and the engineers reached such a spirited point, that the 1938 parade ended in a rotten-egg throwing war.

The engineers with the aid of the engineering faculty decided to celebrate St. Pat's day without a parade, and focus attention on events of a more constructive nature – an Engineering Exposition.

Two expositions, in 1940 and 1941, were held. Sixty-five student displays, thirty industrial exhibits and nearly 8000 spectators visited each one. Industries exhibited their latest products, such as the fluid drive and the florescent tube, and students made everything from a working model of the Panama Canal to a "kissometer."

December of 1941 saw the bombing of Pearl Harbor, and an end to the expositions.

In 1953, Polygon Board, the governing body of the student engineering organizations on campus, decided to resume the exposition. The emphasis was on student exhibits and the purpose was to show what the university engineers were doing.

The exposition is now held every two years. This year's chairmen are: Ray Kacvinsky, General Chairman; Al Vanderpoel, Building & Organization; Dennis Mitchell, Finance; Al Musser, General Exhibits; Tom Halvorson, Program; and Denis Landry, Publicity.

The chairmen are searching for more people to work either on organization and operation of the Exposition, or through entering projects. Those who do enter projects may earn from 1-3 credits toward graduation with approval of their department chairman. Society and student exhibits may also win financial awards. Check with your advisor.

As in the past, Expo 71 is going to be an exciting event. This exposition will give the engineering student, and students of other fields, an inside view of the engineer's world. [***]

WANTED – ENGINEERS TO WORK ON THE WISCONSIN ENGINEER. SPECIFIC POSITIONS INCLUDE: DEPARTMENTS EDITOR, ARTICLE EDITOR, COPY EDITOR, WRITERS, TECHNICAL HELP. ALSO NEEDED IS A PERSON TO BECOME EDITOR-IN-CHIEF NEXT YEAR.

Snowmobiles and the Environment

DENNIS SUSTARE
Ecology Students Association

Listen to the woods in winter. The first thing a person often notices when he enters a woods after a snow is the muffled quiet, seemingly only broken by the crunch of his boots or shuffle of snowshoes. When he stops walking, he can hear the soft swish of snow sliding off the branches of the pines and dropping to the forest floor. Tiny noises often seem to carry for great distances, however. The clicks and ticks of a squirrel shelling an acorn, the hammering of a woodpecker, or the sudden, bursting flight of a ruffed grouse out of the snow may all be quite distinct to the ear. If the person is patient, he may see other animals which seem to move with no sound whatsoever, such as the fox or the weasel. The mood is incredible. For one who is used to the turmoil of a city, the uproar of a factory, or the clatter of a business office, the silence of the woods is truly amazing. It induces a deep sense of peace and well-being, and the feeling of being at one with the trees and animals.

Suddenly there is a roar which shatters the air; the birds take wing and the mammals go bounding off through the snow. All of the peace of the forest is broken, as three snowmobiles pass single-file between the trees. The noise is louder than within an office, louder than auto traffic, even louder than within many factories. The life of the forest is disrupted, with the animals fleeing this intrusion; but sound travels far, and the disturbance is wide-ranging. What does the snowmobile do to the environment? What does it do to man?

COMMON SOUNDS AND THEIR SOUND PRESSURE LEVEL

Decibel Level	Common Sounds of that level
1	Softest audible sound
30	Inside a bedroom, tick of a watch
60	Conversation, face to face
70	Auto at 30 mph
80	Motorcycle, average factory noise, auto at 70 mph
110	Rock band
140	Threshold of pain, jet takeoff
170	Rocket launch
180	Kills mice

MISUSE OF THE SNOWMOBILE:

A small number of snowmobilers use their machines in such a way as to cause severe direct damage. They may directly destroy property on private lands, by cutting fences or by vandalism. They may leave litter along the trails or at temporary resting places. They may chase animals for "sport," either domestic animals or wildlife. There are reports of snowmobilers running down and killing coyotes which are helpless to get away in the deep snow.

Although actions of this type are not too common, they may get a good bit of publicity. They are probably most effectively dealt with by a combination of pressure through snowmobile associations with strict enforcement of regulations by conservation wardens. If control is not attained by these means, there is a possibility that farmers may take matters into their own hands (by taking a rifle into their own hands). There may be more serious problems than these, however, which derive from a normal use of the snowmobile.

DAMAGE TO VEGETATION OR STREAM BANKS:

When the snow is deep, there is probably little direct breakdown of slopes or banks when snowmobiles pass over them. When the snow is low, however, either early in the season, after a thaw, or late in the spring, there is a possibility that the constant passage of snowmobiles may cause a loosening of soil and vegetation under the snow, so that it will be washed away with the spring thaw. Bank destruction along trout streams at particularly destructive to the life in the streams at a later date. Erosion problems are often accentuated by the fact that snowmobiles often run on existing tracks, and the compaction of the snow may be such that a layer of ice presses down deeply into the underlying soil. When the snow melts, a channel has been created so that the runoff is concentrated along one line, forming deep gullies. Since some of the modern snowmobiles may weigh up to 700 pounds unloaded, their compacting effect may be considerable.

COMPACTION OF SNOW ON LAKES:

A related problem comes when snowmobiles are run on shallow lakes. Lakes are increasingly being used for rallies or similar activities by snowmobilers. The compaction of the snow on the lake may decrease its light transmission, so that less sunlight is able to reach the water below the ice. The aquatic plants under the ice are therefore producing much less oxygen for the life in the water. In addition, many of the plants themselves may die due to lack of light; their decay will cause a further depletion of oxygen. At the same time, the aquatic animals are consuming oxygen. The oxygen depletion may become so great that a massive fish kill may occur. The Wisconsin Department of Natural Resources feels that this chain of events may have been responsible for a fish kill which occurred in Coon Lake in Wisconsin.

(Continued on Page 22)

If you are a senior...

1971

could be the most important year of your life.

As you contemplate one of the most important decisions of your life, you will want to remember this: it is not just "a job" you are seeking—it should be the beginning of a career. And if it is to be successful, both you and your employer must need and want each other.

To help you with your decision, we invite you to consider the opportunities at Pratt & Whitney Aircraft. Currently, our engineers and scientists are exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future.

We select our engineers and scientists carefully. Motivate them well. Give them the equipment and facilities only a leader can provide. Offer them company-paid, graduate-education opportunities. Encourage them to push into fields that have not been explored before. Keep them reaching for a little bit more responsibility than they can manage. Reward them well when they *do* manage it.

Your degree can be a B.S., M.S., or Ph.D. in: MECHANICAL ENGINEERING • AERONAUTICAL ENGINEERING • ENGINEERING SCIENCE • ENGINEERING MECHANICS.

If your degree is in another field, consult your college placement officer—or write Mr. Len Black, Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

Pratt & Whitney Aircraft

ST HARTFORD AND MIDDLETOWN, CONNECTICUT

DIVISION OF UNITED AIRCRAFT CORPORATION

An Equal Opportunity Employer

MOUNTAINS OF TRASH

ROBERT K. HAM
Assistant Professor of Civil Engineering,
University of Wisconsin
Madison, Wisconsin

THE PROBLEMS associated with solid waste disposal have led to consideration of modifying present practices. One such concept is that of large elevation landfilling or building hills of refuse.

Many of the modern problems of refuse disposal are due to increasing amounts of refuse generated per person plus a general population increase; migration of people to urban areas; and decreasing availability of landfill sites. Although the costs of disposal are high, they will continue to increase as citizens become more concerned with the effect of disposal on the environment, the wastefulness of many disposal practices and the possibility of having a disposal operation located near them.

By concentrating refuse disposal into one area over a fairly long period of time, large elevation landfilling makes it economically possible to provide a well engineered operation, to lower nuisance levels, to reduce insults to the environment and to transform the city dump from a detriment to a potentially useful attraction for the community. The proposed method involved the construction of large hills with refuse – a concept which is not new, for it has been used and is being used at several locations around the world. The method offered herein is somewhat different than those used elsewhere, however, in that special site preparations and operating procedures are proposed. It is suggested that the best final use of the hill would be a public recreation area where skiing, tobogganing and sledding might take place during the winter, and picnicking, hiking and the viewing of flower gardens and the surrounding area could occur during the rest of the year. It is certainly possible that other final uses may be more appropriate in some localities.

How would you like to race Jean-Claude Killy or Corky Fowler or Suzy Chaffee? You'd jump at the chance, right? Wouldn't you like to find out just how fast they are without going to St. Moritz or Val Gardena? Well, here's the idea: build a mountain here, near Madison, and one in Minnesota, and one in Vermont, and one in Europe. Scatter them throughout the world but with one demand, that each is identical. Then all we have to do is get Killy to ski his Mont d'Ordures in France or Müllhaufen in Germany and then ski yours in Madison.

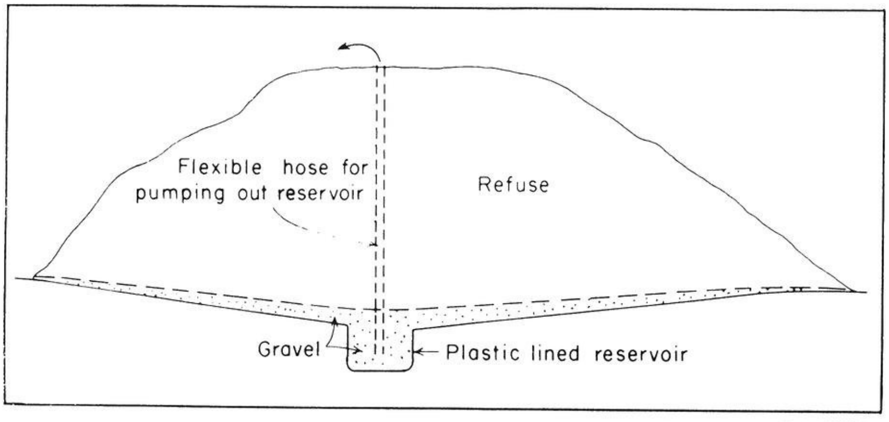
In this article, Professor Ham explains how to build our not too far-fetched dream.

Site Selection and Preparation

Proper site preparation can greatly diminish one of the major areas of concern brought about by concentrating such large amounts of refuse – the potential water pollution problem. It is suggested that the provision of a water-carrying layer of sand or gravel under the hill, properly sloped to carry water from the refuse, would collect water flowing downward from the refuse, as well as water flowing upward if the site should be one of ground water discharge. These waters would intercept the "aquifer" layer and flow laterally in it to a collection system for controlled discharge and/or treatment.

An estimate of the flow rate from ground water discharge may be obtained by drilling several wells of different depths and measuring the pressure acting on the water at each depth. If the pressure above datum increases with depth, there is a net ground water flow upward which, even though the surface may be dry before landfilling, may result in discharge into the refuse and the buildup of a water mound. Knowing the pressure gradient, standard hydrogeological methods can be use to calculate the rate of ground water discharge. An estimate of the maximum probable amount of leachate is next obtained to give the total amount of water the aquifer must

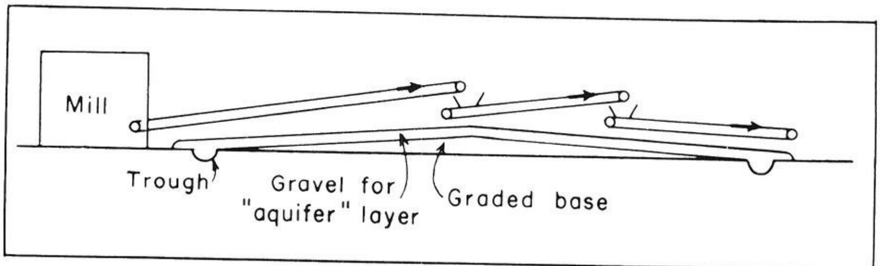
■ FIGURE 1. Profile of a refuse hill designed for use on an unstable foundation. Subsequent settling would increase the slope of the drainage system to the reservoir.



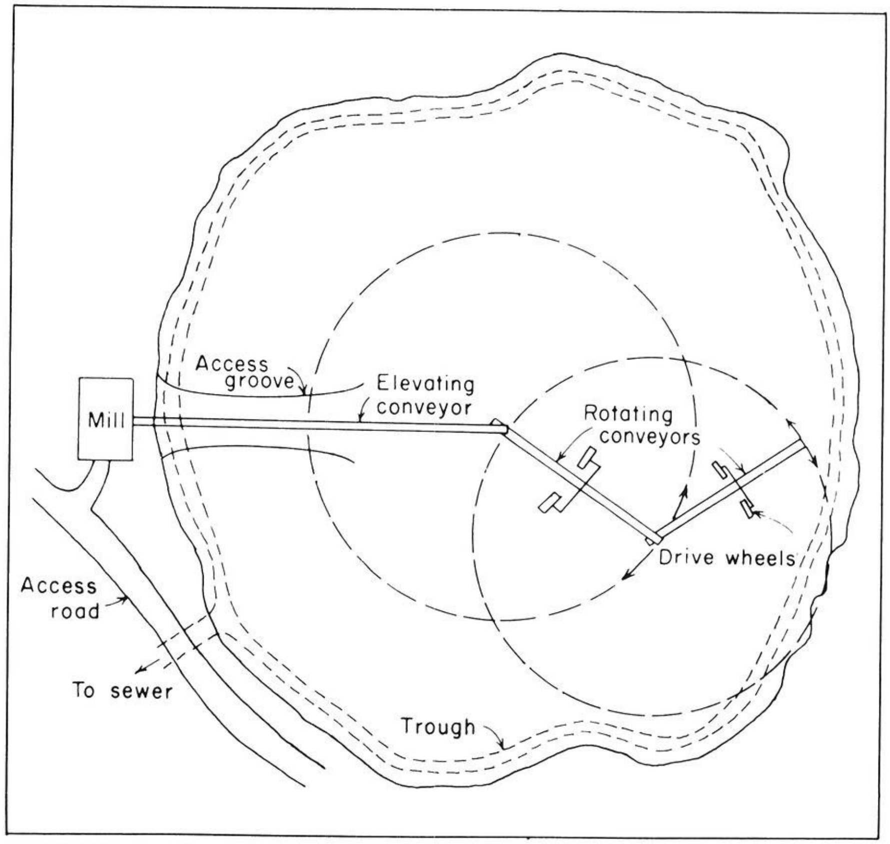
carry. Knowing the permeability of the aquifer layer, the required thickness and the slope of the layer necessary to provide adequate flow rates can be calculated readily. It is suggested that a sizable margin for error be allowed by providing excess aquifer thickness. This would assure adequate capacity even if part of the water carrying ability of the aquifer were removed due to clogging by extraneous matter or to aging processes.

The prepared site is shown schematically as Figure 2. It is prepared by first contouring the ground to the slope required for aquifer drainage. A trough is placed around the periphery of the site and then a layer of water--carrying sand or gravel is placed over the entire area, possibly varying in thickness from 6 inches near the center (when the flow capacity is less critical) to 2 feet near the periphery.

Load bearing measurements should be made to indicate whether the site is sufficiently strong to support the hill without settling. If settling is likely to occur, it may be useful to have the sand-gravel layer slope towards the center of the hill as shown on Figure 1. Settling, in this case, would simply add to the slope, causing increased flow rates to occur. The collection reservoir at the center of the hill could be filled with gravel and lined with heavy plastic sheets to avoid leakage. Pumping could be done through flexible plastic tubes which run through the hill itself in such a manner that settling of the hill will cause the least chance of tube blockage or breakage. For safety reasons, several such tubes should be installed.



■ **FIGURE 2. Where foundation conditions are suitable, a permanent drainage system would collect water and allow it to flow through a gravel layer to a peripheral trough. Conveyors transport refuse from the mill to all areas of the disposal site.**



■ **FIGURE 3. Plan view shows initial layout for construction of a hill of refuse.**

Equipment Requirements

The major pieces of equipment are the mill and the conveyor system. It is felt that milling is particularly useful for hill construction because, relative to nonmilled refuse, milled material is easier to handle, does not require periodic cover, attains higher densities, reduces nuisances such as blowing paper and has a relatively unobnoxious appearance and odor. Additional comments on these points will be presented later. It is suggested that a conveyor system be used to transport milled refuse up the hill for disposal. This process will result in an apparent low level of activity at the site, a definite all-weather operation, a reasonable cost for a system of the site discussed herein, and it should be acceptable to the public and to concerned officials.

The mill is located next to the base of the hill. Well built, all-weather roads should be porvided from the nearest main road to the mill. The roads are flanked by the access area, which should be provided from the nearest main road to the mill. The roads are flanked by the access area, which should be designed such that it will has been completed. The access area should be planted with grass, shrubs and trees to bring about a park-like atmosphere and to conceal the milling and construction operation. The mill and an adequate dumping area should both be enclosed in a building of pleasing appearance. This will mean that nonmilled refuse will not be observed at the site; in fact, the only clue to the presence of refuse will be the trucks which frequent the mill. Milled refuse looks much like shredded paper and should not present an offensive sight during conveyance and disposal.

The conveyor system carries the milled refuse from the mill to the disposal site. One possible configuration for the system is shown in Figures 2 and 3. This system allows all portions of the hill to be reached quickly and with a minimum of effort. The use of conveyors to transport and distribute the refuse rather than trucks or tractors, for example, avoids any problems associated with road building and trucking up steep inclines, reduces labor requirements and greatly reduces the apparent level of activity during hill construction. The non-rotating elevating conveyors should have provision for elevation adjustment as the hill

(Continued on Page 23)

Photography by W. Eugene Smith.

Hockey

at

Wisconsin

Stellar defenseman and author: Jeff Rotsch

"Lake Placid here we come!," were the cries from the Badger fans and players after the Wisconsin hockey team had defeated last year's NCCA Champion Denver, 3-2. With this win, and a great showing in the national tournament at Lake Placid, Wisconsin's hockey team has become a permanent fixture in the school's collegiate sports complex. How did such a sport, little known less than five years ago, suddenly become an "attendance drawer" and make Wisconsin into a college hockey power? The answer to this came last year at Denver, Colorado. The Badgers were there to prove to others they were more than just a good hockey team by winning the WCHA playoff. Sure, during the year they had finished fourth in the WCHA (the only team not to finish last in their first year), they had won the Big Ten Tournament and the St. Louis Tournament, they beat WCHA champ Minnesota 10-1 along with many other accomplishments but, all along the players knew they had a winning team. It was the fans as well as the other teams they had to convince.

And convince them they did. After winning the first playoff game against Michigan 2-1, the Badgers were placed in the playoff finals against Denver. Led by the great goaltending of Wayne Thomas and scoring of Murry Heatley, the Badgers knocked off Denver to advance to the National tournament in Lake Placid, New York. This was what Coach Bob Johnson called the "big win."

With fans crowding the airport, the team left for Lake Placid the following week. Expecting to see "bright lights and big city" in New York, the team, and the loyal fans who came along, found nothing but a small country town hidden away in the woods. Compared to the arena, the town looked 'great'. The rink, which was built in 1932 for the Olympics, had been left untouched since then. Even as Wisconsin took the ice for the first game against Cornell the workman were still repairing the boards on the rink and many old seats.

Cornell, who was rated the Top Team in the country on the basis of their 27 wins and no losses during the season, were the first game favorites. But Wisconsin, led again by the inspired goaltending of Wayne Thomas took a 1-0 lead after two periods. However, the rest is history as the Badgers succumbed to two third period goals by Cornells "Big Red" and some tenacious forechecking to drop a 2-1 decision. The following game was for third place against Michigan Tech. With the team having nothing to gain except a little larger trophy and some pride, the Badgers played sluggish but took a 6-5 decision. In that game, Bob Poffenroth set a tournament record with one goal and four assists and he was named to the All-Tournament Team for his play.

1970-71 HOCKEY SCHEDULE

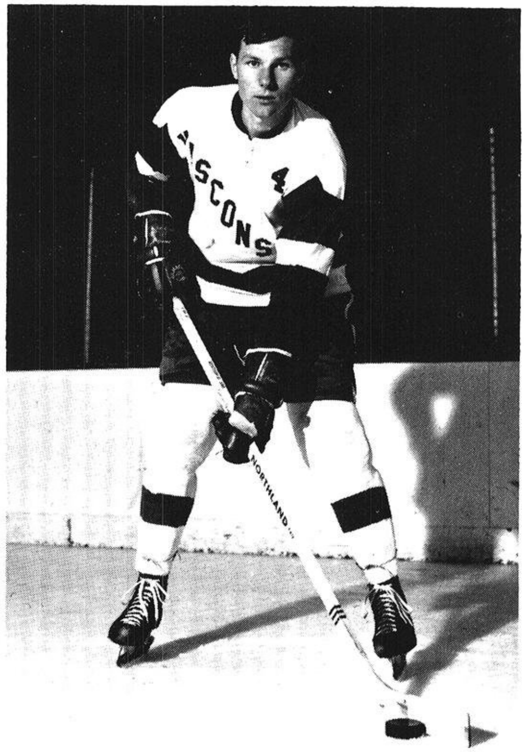
Fri., Nov. 13, At Michigan Tech
Sat., Nov. 14, At Michigan Tech
Sun., Nov. 15, At WSU-Superior
Fri., Nov. 20, BROWN UNIVERSITY
Sat., Nov. 21, BROWN UNIVERSITY
Fri., Nov. 27, At Denver
Sat., Nov. 28, At Denver
Fri., Dec. 4, UNIV. OF MINN.-DULUTH
Sat., Dec. 5, UNIV. OF MINN.-DULUTH
Fri., Dec. 11, At Michigan
Sat., Dec. 12, At Michigan
Sat., Dec. 19, At Notre Dame
Sun., Dec. 20, At Notre Dame
Sun., Dec. 27, St. Louis Tournament
Mon., Dec. 28, St. Louis Tournament
Sat., Jan. 2, RPI Tournament
Sun., Jan. 3, RPI Tournament
Mon., Jan. 4, RPI Tournament
Fri., Jan. 8, COLORADO COLLEGE
Sat., Jan. 9, COLORADO COLLEGE
Fri., Jan. 15, MICHIGAN STATE
Sat., Jan. 16, MICHIGAN STATE
Sat., Jan. 30, U.S. NATIONALS
Fri., Feb. 5, At Minnesota
Sat., Feb. 6, At Minnesota
Fri., Feb. 12, MICHIGAN
Sat., Feb. 13, MICHIGAN
Fri., Feb. 19, MINNESOTA
Sat., Feb. 20, MINNESOTA
Fri., Feb. 26, At Michigan State
Sat., Feb. 27, At Michigan State
Sat., Mar. 6, NORTH DAKOTA
Sun., Mar. 7, NORTH DAKOTA at 2:00 p.m.
Thu., Mar. 11, WCHA PLAY-OFFS (Dane County Coliseum)
Fri., Mar. 12, WCHA PLAY-OFFS (Dane County Coliseum)
Sat., Mar. 13, WCHA PLAY-OFFS (Dane County Coliseum)
Thu., Mar. 18, NCAA Tournament at Boston, Mass.
Fri., Mar. 19, NCAA Tournament at Boston, Mass.
Sat., Mar. 20, NCAA Tournament at Boston, Mass.

However, all this took place last year. What about this year's team? Will they once again be a winning team? Gone are such stars as Wayne Thomas, Bob Poffenroth, Doug McFadyen, Bert Dehate, etc. Still, Coach Bob Johnson and assistants Jeff Sauer and Barry McPherson are very optimistic.

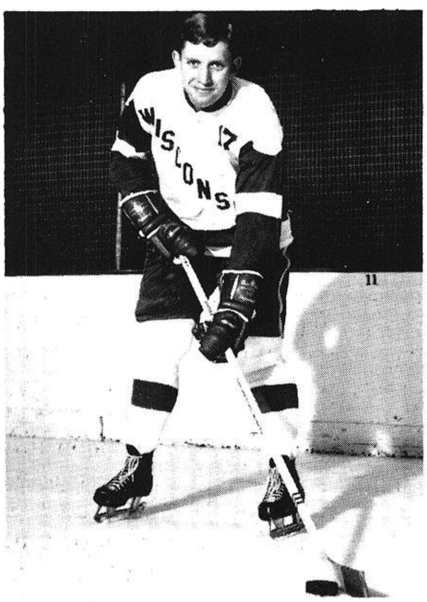
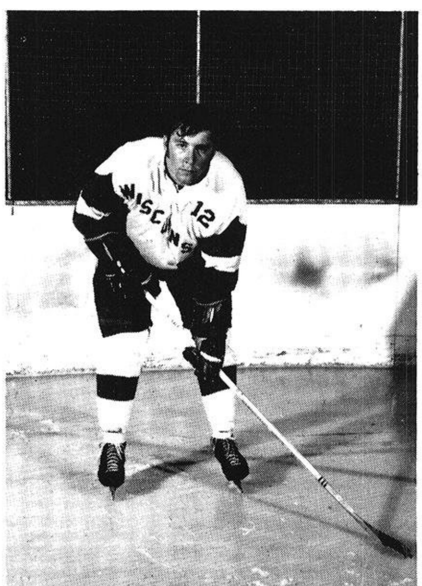
Returning from last year's strong contingent of forwards are Captain Jim Boyd and last years leading scorer Murry Heatley, both seniors. These two along with Phil Uehlein, a junior, and a sensational surprise, will be one of the strongest lines in the WCHA this year. Also returning is the "freshmen line" of Tim Dool, Norm Cherrey, and Lyold Bentley, now all sophomores. It was this line that gave Wisconsin a big lift in leading them to the third place NCCA finish. The other starting line look like veterans, Jim Johnston, a sophomore, and Jim Young, a junior, at the wing, with newcomer Gary Winschester, another Calgary product, at center. Vying for the final two spots at forward are Tom Chuckel, Gary Kukelenski, Tochtermann. Pat Larnam, who had looked good in early scrimmages, tore a tendon in a finger so he will be out until mid-November. Other new faces at forward are Stan Hinckley, Bill Reay, and Bob Shaughnessy, all freshman.

Defense, once again looks like a strong point in the Badger attack with three of last year's starting four defensemen returning. Led by Wisconsins first All-American John Jaeger, the tandems should be Dan Gilchrist pairing with Jeff Rotsch and Jaeger with junior Brian Erickson. Other defensmen looking to take over the other two spots or even taking a veterans place are Al Folk, Brian Wright, Ernie Blackburn, and freshmen Dave Arundel.

The position hardest hit by graduation was goaltender, where both Wayne Thomas and Boby Vroman have gone. Vying for the job will be both of last years J.V. goalies, Chris Nelson and Gary Engberg, along with two highly recruited freshmen, Doug Spitzig and Jim Mackey. These four along with John Anderson, a senior, could be fighting it out until the day of the first game at Michigan Tech. None of the five have distinguished themselves although freshman Jim Mackey seems to be leading the way.


Wisconsin's first hockey All-American: John Jagger

So, with a little experience for the new lines and some stout goaltending and defense, the Badgers could have another successful season. How successful? Only time and hard work will tell. [***]


The first line. Highly touted Jim Boyd; welcome surprise Phil Uihlein; high scorer Murray Heatley.

SKI DESIGNS – (From page 9)

(i) RUNNING LENGTH (RL) – Running length denotes the portion of the sole of a ski that has direct contact with the snow in a straight, downhill run. Naturally it varies with the flexural action of a ski and the weight of the skier, but a standardized measurement is shown in figure 1. Generally, RL is considered long when it exceded 90% of the chord length of the ski. It is considered short when it is less than 85% of the chord length. The performance characteristics affected by RL are:

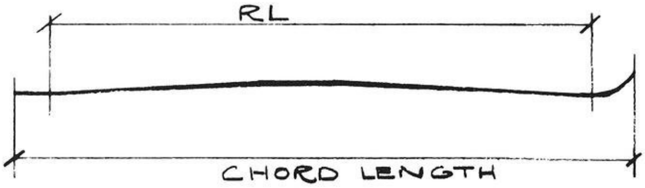
(1) ease with which skis can be turned into the fall line (line perpendicular to hill contours)

(2) tracking (straight running ability)

(3) shocking (over bumps)

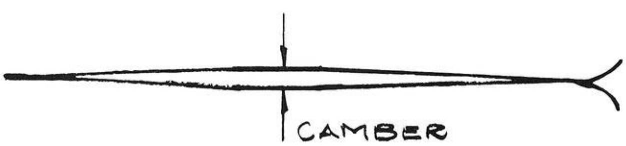
(4) turns away from the fall line In general, skis with shorter RL's per equal chords start turns better, take bumps smoother, but track poorer than skis with longer RL's.

FIGURE 1 –



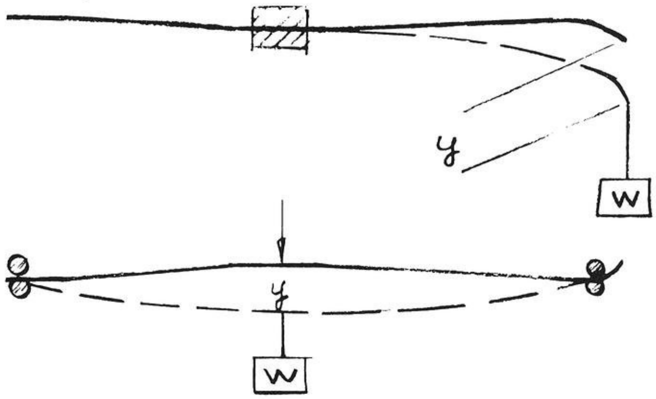
(ii) CAMBER – Camber is the arching of a ski off of a flat surface. It's like a leaf-spring effect to the skier and its measurement is shown in figure 2. Too much camber reduces the effective length of edges on the snow. Because edges carve turns, excessive camber causes erratic turning. On the other hand, too little camber causes a marked reduction in pressure transferred from the tip and heel areas to the snow, causing slide and yaw in traverses. The latest measurements compiled by SKIING magazine (Nov. issue) show that the hottest French skis have a very nominal camber of around 1 inch.

FIGURE 2 –



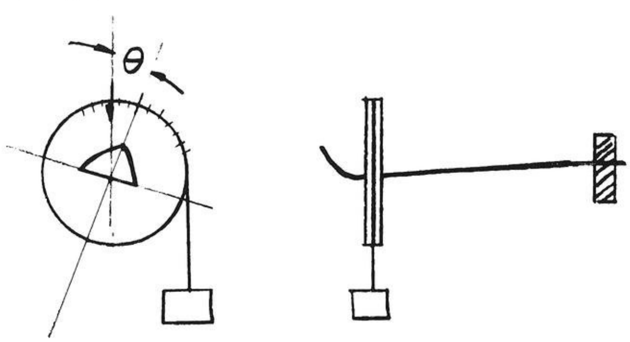
(iii) BENDING FLEX – Bending flex implies a resistance to bending forces and typical measurements are shown in figure 3. Assuming flex is directly proportional to y, let k–w/y or load per unit deflection. For decades ski designers have thought that a perfect design would have k be a constant throughout the length of the ski (YAMAHA still does). However, skiing experts testing for SKIING magazine seem to enjoy tails stiffer than the fronts of their skis by about 25%!

FIGURE 3 –



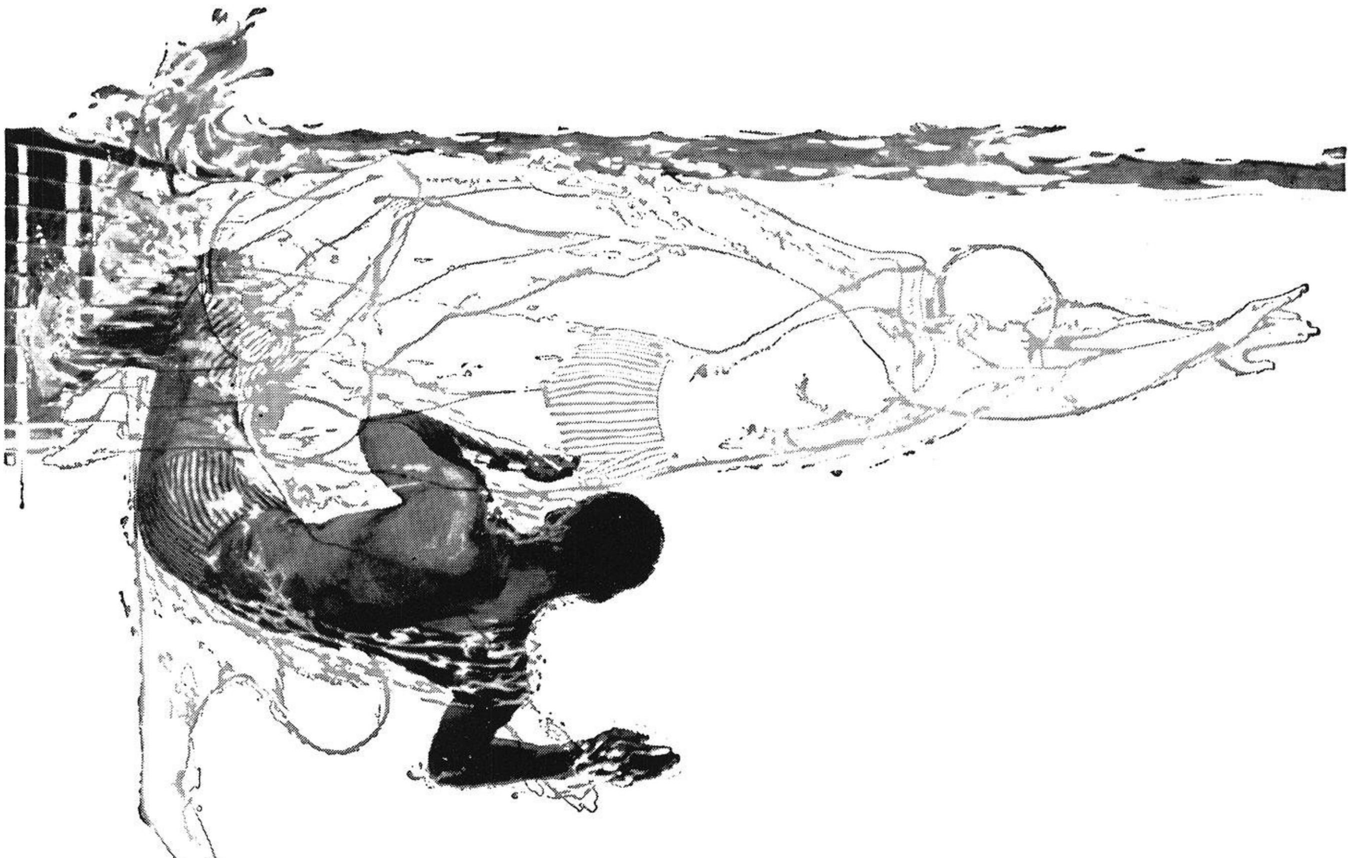
(iiii) TORSIONAL RESISTANCE – A ski's resistance to rotation about its longtitudinal axis, caused by torquing, can be measured as shown in figure 4. Torsional resistance affects the turning performance of a ski. If a ski has weak resistance to torsion (i. e. large O), its edges won't bite into the snow on a traverse. If a ski has excessive torsional resistance (small O), initiating a turn or swinging out of a traverse is difficult. Torsionally rigid skis are more apt to chatter at high speeds because a torque is transmitted along the entire length of the ski; the ski is less likely to forgive the terrain by localized torquing along its length.

FIGURE 4 –



CONCLUSION

Ski designing is an art, no question about it. Structural strength and beauty mean nothing to an aggressive skier if the performance of his or her skis can't match his skills. Performance parameters are directly related to the structural and dimensional configurations of a ski. Manipulation of, say, the flex distribution of a ski changes the camber which changes the running length which affects the turning performance of the ski. It is concievable that someday, soon probably, somebody is going to shoot down off of a hill on Teflon II coated, titanium space-age steel skis with a monocoque body of "blown" plastic, costing $2000 a pair. Meanwhile, those old? $148 HEAD skis will still be getting someone else down a mountain. [***]



SNOWMOBILES – (from page 11)

NOISE:

The most far-reaching problems with snowmobiles may be due to the noise which they generate. This noise may disturb or endanger wildlife, may severely annoy homeowners or farmers, and may even cause hearing loss in the snowmobilers themselves. We might first ask what level of noise is generated by a snowmobile.

The decibel is the standard unit used to describe noise level, and is based on the pressure (or power) of the sound itself. Human sensitivity to sound is based on frequency and duration, as well as the volume. Thus the decibel level alone is not sufficient information to predict a human response to a sound. Normally, the decibels are measured with a frequency weighting applied, the "A-weighting network," which not only accounts for the frequency spectrum of the common noise meters, but also reflects the equal loudness contour of the human ear. Human hearing is most sensitive to sounds at around 4000 Hz, and sounds of equal pressure will seem louder to a human at that frequency than at 100 Hz or 15 KHz, for example. If the threshold of hearing is defined to be O dB (A) (that is, decibels on the A scale), then every increase of 3 dB will represent a doubling of apparent loudness to the human ear, and comparative noise levels may be examined. Table 1 lists several common sounds and their noise level in dB(A).

The noise levels of snowmobiles often are in the 90-100 dB(A) range, and may even reach 110 dB(A). One of the quieter new models is now down to a level of 80 db(A). Noises of this intensity may have both physiological and psychological effects on man. One study has indicated that while noise levels below 85 dB(A) are unlikely to result in impaired hearing, levels above 85 dB(A), and particularly those above 95 dB(A), may cause temporary or even permanent hearing loss or impairment. There is apparently much individual difference in senstivity to noise damage, with some people more susceptible to noise induced hearing loss than others. Even at lower noise levels with long exposures, hearing impairment may occur. A study in the area of the Upper Nile showed that people at age 75 had hearing as acute as those of 25, whereas in our society a deterioration of hearing with age is taken as being normal. Dr. Samuel Ruser felt that this difference was due to the effect of normal high noise backgrounds in most of American society.

Studies with animals have shown that high noise levels may induce epileptic seizures, aberrations in sexual behavior and even death. Exposure of humans to noise has also resulted in changes in circulatory activity and heart rate, glandular discharges, and actions of involuntary muscles. Noise can also increase fatigue, either through direct disturbance of sleep, or indirectly when awake. When one considers that many animals in winter are close to the limit for survival, it is evident that recurrent disturbances by noise, leading to excessive movement, higher metabolic activity and fatigue, may lead to death for many of these animals. The effects on man may lead to higher accident rates while on the snowmobile or on the road afterwards.

The psychological effects of noise may be significant and long-lasting. Some of these effects may include headaches, anomie, anxiety, frustration, rage, and other forms of distress. Prolonged fatigue or sleep loss may give rise to delusions or psychotic behavior. With all the pressures and anxieties present in our cities today, it seems criminal to increase these pressures in the fields and forests far from the urban areas.

Some of the steps which are being taken to reduce the noise level of snowmobiles include the use of crossover pipes and elongated baffle chambers, opposed can-type mufflers, and tuned exhausts. Much more progress needs to be made, however. One problem apparently seems to be that people relate noise to power, and feel that a noiser snowmobile must be a more powerful snowmobile (and presumably thereby be more desireable). If the same effort were devoted to noise control that has gone into styling, the snowmobiles would undoubtedly be much quieter than they now are.

THE OUTLOOK:

Regulations on the use of the snowmobile in Wisconsin were passed in the last legislative session. Amendments to these rules will probably be forthcoming in the next session. Many new trails are being made for snowmobiles in the state, and there will probably be further restrictions on areas, that snowmobiles can and cannot enter. The Casper Snowmobile Association has proposed that snowmobiles should be restricted to use on highways, roads and trails in parklands which are used by vehicles in the summer. This might solve some of the problems mentioned above, although the appearance of all-terrain vehicles (ATV's) may make such a regulation meaningless.

The most needed change is probably a strict noise abatement ruling by the state. This would force manufacturers to produce quieter machines if they wished them to be sold or used in Wisconsin. The potential disturbance and damage to people and wildlife from snowmobile noise calls for action along these lines as rapidly as possible, as the sport of snowmobiling is expanding greatly every year.

[***]

REFERENCES:

1 Conservation News 34(3):10-11. Feb. 1, 1969.
2 Environment 12(5):S-4. June, 1970.
3 Toward a Quieter City, 1970. A Report of the Mayor's Task Force on Noise Control; New York City.

MOUNTAINS – (From page 15)

grows and depending on the final contour of the hill, they may or may not be extensible. The rotating or distribution conveyors should be provided with a mechanism for easy rotation from one dumping area to the next.

Construction of the Hill

To make the disposal operation as unobvious as possible, the following method of construction, as illustrated in Figures 4, is proposed. As each new layer or rise of the hill is begun, a pile of refuse should be placed around the periphery of that layer, thereby screening the operation from view until the next layer is begun. As soon as the outer slope of each layer is completed it should be covered with earth, and vegetation should be planted. Note that the earth may be placed by the conveyor system, but that some machinery for compaction and contouring the surface will probably be necessary at this point. Note also that as people get closer to the hill, where the operation could be seen more clearly, more of the operation will be hidden from view. No fences or other eyesores would be necessary. The elevating conveyors are located in an area called the access groove. The groove screens the elevating conveyor from side views and has utility as access to the hill during and after construction, as will be discussed later. Prompt planting of trees and shrubs will further shield the conveyor from view.

There are several matters of concern as the hill nears completion. It is expected that the top of the hill will be skewed and/or relatively flat. A skewed hill not only provides a more interesting and imaginative profile, but requires less conveyor adjustment during the latter phases of construction. It is not necessary to fill the access groove, for the relatively low and uniform slope would, for example, make an ideal tobaggan run in the winter and provide access to the summit throughout the year. Another advantage of leaving the access groove is that it would provide a means for relatively simple removal of the conveyors from the site. If, however, it is desired to fill in the access groove, incorporation of this fact into the design of the conveyor system will be necessary.

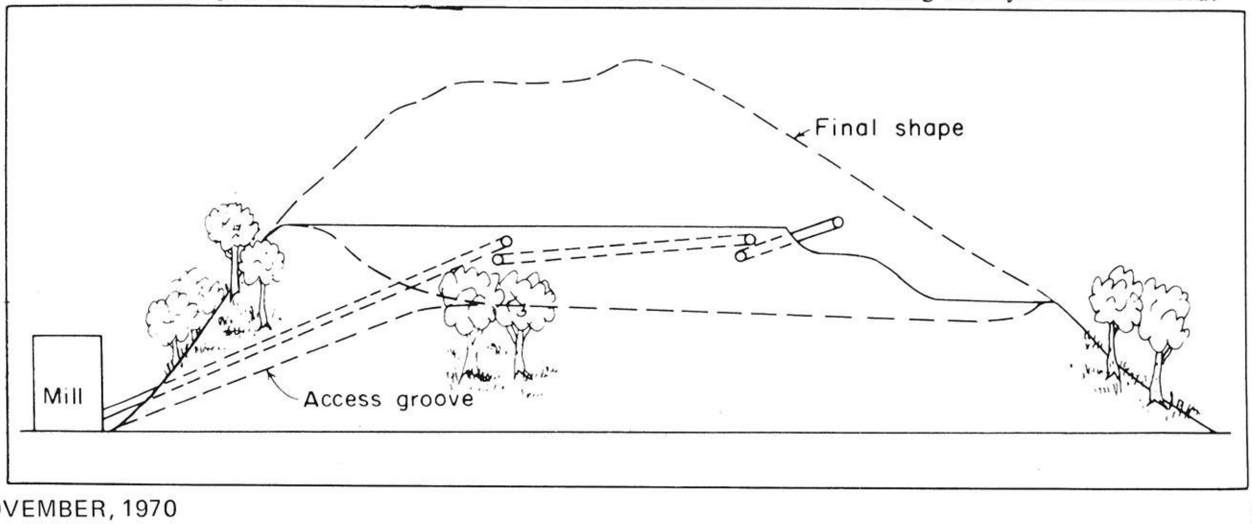
A potential problem during construction is the disposal of large objects. Anything which can be transported by conveyor to disposal will offer no problem, as it will be quickly covered with milled refuse. Large bulky objects which cannot be milled or readily conveyed must be handled separately. Depending on the number of such objects, it is suggested that they can be trucked on a road in the access groove (note that it is relatively easy to make good all-weather roads with milled refuse, as shown by experience in Europe and experiments in Madison and placed on the hill at such locations that they can be readily covered with milled refuse. When the hill is sufficiently large that trucking becomes difficult, such materials can be placed in a specific location at the foot of the hill, next to the mill, where proper fencing and periodic covering with milled refuse will make disposal as unobnoxious as possible. Note that if large amounts of bulky refuse are received, rather than have many trucks going up and down the hill it may be useful to provide a special process for grinding such objects for disposal, or to provide an auxiliary conveyor system to transport milled refuse cover to a special disposal site for these objects adjacent to the main hill.

Discussion

As has been emphasized throughout this article, the construction of a large elevation landfill must be done in such a manner that at no time will the public find the process obnoxious, nor will health and safety considerations be jeopardized. It is felt that the milling process is particularly useful to meet these criteria, and to provide a sound long-term, low-cost operation. This opinion is based on experience gained during the Heil-Gondard, City of Madison demonstration project, in which the feasibility of landfill construction with milled refuse but without daily cover was studied. Items of special interest include the following:

- Results from the demonstration project have suggested that daily cover is not necessary; the milled material provides its own cover. The costs, noise levels, and amount of activity associated with bringing in huge quantities of cover material, elevating it to the active area of the hill, spreading it, and compacting it are thereby avoided.
- Milled refuse piles, not covered, have resulted in no more, and probably less, fly or rodent problems than non-milled refuse piles covered with 1 to 2 feet of dirt. Vector problems appear unlikely even for a large-scale operation. (Public Works, July, 1969).
- It has not been found necessary to cover milled refuse due to odor problems; odor levels have been well below those normally associated with sanitary landfill operations.
- Blowing papers are not a problem with milled refuse; probably usable paper is ground and then mixed with the other matter to form a matrix which restrains any blowing.

FIGURE 4. Middle phases of construction and the final profile. Note that the elevating conveyor has been raised.



- Milled refuse can be handled easily on a continuous basis; therefore, conveyors can be used, resulting in less gross activity at the site, lower labor requirements, and smoother all-weather operation.
- Milled refuse compacts easily and uniformly to densities of 1000 lbs. per cu. yd. (based on a six foot rise compacted with a Caterpillar 10-7 tractor) or more. This means that less landfill volume is required than would be necessary for a conventional non-milled operation where daily cover is applied.
- Milled refuse is significantly less obnoxious in appearance than is raw refuse.
- Milled refuse settles more uniformly than does non-milled refuse.
- Milled refuse does not burn as readily as raw refuse; however, to ensure safe operation, it is suggested that the site be provided with appropriate fire-fighting equipment until more experience has been acquired with milled refuse. Note that the milling process itself will tend to dissipate hot ashes or other similar fire hazards.

Water Contamination and Gas Production

It is obvious that the accumulation of large amounts of refuse represents a major potential source of water contamination. For a large-elevation landfill, with elevations of 100-300 feet or more, it is doubtful that any leachate will pass through the refuse to the base in many parts of the country. For cells constructed of milled refuse up to one year old, not covered with dirt, and six feet deep, data collected under the Heil-Gondard project at Madison indicated that a maximum of 0.18 percent of rainfall reached the bottom. This amounted to 0.073 liter per square foot for a seven-month period, over which 17.31 inches of precipitation was received. The maximum amount of leachate collected in any 30 day period was about 0.028 liter per square foot. It should be emphasized that these cells were not covered and were level; therefore, there was essentially no surface run-off and the water soaked in readily. These amounts are expected to be far in excess of the actual amounts of leachate which would be collected from a refuse hill of depths much greater than six feet and with sides that are sloped, covered with dirt, and planted with vegetation. In addition to direct leaching, the formation of a water mound over a period of time would provide a transfer mechanism to carry contaminants to ground or surface waters. In order to avoid such contamination problems, whether due to leaching or the formation of a water mound, provision for drainage of the hill, such as the aquifer layer described previously, may be used.

The water that is collected by the aquifer may be highly polluted. That collected from milled refuse cells during the Heil-Gondard project has reached more than once a BOD of 14,000 mg/L, COD of 30,000 mg/L. total nitrogen of 600 mg/L. The pH ranged from 5.1 to 7.8. Using these concentrations and assuming a leachate flow rate of 0.021 gallon per square foot per 30 days, the pollutional load from a hill with base dimensions ½ mile by ¼ mile (or approximately 1,000 feet in radius for a conical hill) would be approximately 100 pounds of BOD and 4.4 pounds of nitrogen in a flow of 870 gallons per day. It is expected that the amounts of pollutants-produced in an actual hill would be considerably less than these estimates. It is likely, therefore, that the leachate will have no effect on a sewage treatment plant of reasonable size, and that disposal in a sewer, if available, would be desirable. Work is underway at the University of Wisconsin, and additional work is being planned, to estimate more accurately the amounts, composition, and treatability of leachate. Note that runoff from the surface of the hill will run harmlessly down the slope and will not enter the collection system.

Little is known about gas production within a large landfill. Since gas production is known to be very dependent on moisture content, the provision for adequate drainage of the refuse hill should lower the rate of production markedly; nevertheless, studies are planned at the University of Wisconsin to determine more accurately whether special precautions for gas discharge should be taken.

Some Additional Benefits

To the public official who is finding site aquisition more and more difficult, the main benefit brought about by a large-elevation landfill may be the extended period of time a relatively small site can be used. For example, assuming a cone shaped hill with a base radius of 1000 feet and a height of 850 feet, and assuming that the ratio of refuse generation is 4.5 pounds per person per day and the density of refuse in the hall is 1000 pounds per cubic yard (this is a conservative figure), approximately 7.8 X 10 man-years of refuse will be required to complete the hilll. For a municipality of 500,000 population equivalents, this would take 15.6 years. In a day when many cities are hard-pressed to acquire sufficient land to assure operation two years hence, the use of a small site for over 15 years is a most desirable prospect. Aside from needing fewer sites, another aid to new site acquistion may be the increased number of potential sites available and because one need not be as concerned with proper drainage and possible water contamination problems.

An important benefit to the municipality, and to future site acquisition should arise from increased public acceptance. This would be due to nuisance-free construction methods, such as those described previously, and a carefully developed master plan for ultimate use of the bill which takes the needs of the community into account. It is suggested that the hill be designed and constructed in collaboration with the Parks Department or some similar agency, if it is to be used for recreational purposes. By careful planning, the hill could have ski slopes of various degrees of difficulty and toboggan runs for winter use. During the summer a well designed system of paths, along with imaginative planting of vegetation, can provide the municipality with a major scenic and recreational attraction. It is not difficult to imagine that parts of the hill could be used for flower gardens. picnicking, scenic views, etc. Research is underway at the University of Wisconsin to determine the suitability of milled refuse for supporting various types of vegetation. Goals of this effort include the identification of species both suitable and not suitable for growth on refuse, methods for improving the ability of refuse to support growth (if necessary), and any peculiar characteristics of milled refuse which might be used to advantage by planting distinctive vegetation.

It is felt that proper design of a large elevation landfill operation can gain public acceptance, be reasonable in cost, enhance rather than detract from the environment, and turn one of the most offensive aspects of modern living – the dump – into a major municipal attraction. [***]

An engineer can cut crime as well as any cop. Maybe better.

Last year, murder was up 7%. Rape was up 17%. Robbery was up 14%.

It's getting to the point where a woman can't show her face on a dark street. And grown men are running scared. Sadly, crime has become a part of our everyday lives.

Where do we turn for help? To police, of course. But why not also to engineers?

Engineers at General Electric set out to develop a more efficient streetlight. And they came up with one of the most efficient crime fighters ever invented.

It's called the Lucalox® lamp. It puts twice as much light on a street as any other lamp without any extra operating cost. And wherever Lucalox has gone up, crime has gone down. By 50% or more in city after city.

But that's not all an engineer can do. He might design communications equipment that enables one patrolman to do the job of two. Or a complex of traffic monitors that puts twenty cops back on the beat. Or even a patrol car to do its special jobs in a better way.

It's sometimes hard for people to realize that engineers, with their technology, can solve social problems. But, in fact, some social problems can't be solved any other way.

So if you're an engineer who's bothered by social problems, you're in a unique position to help.

General Electric could use your help. We see more problems around us than we know how to solve. So what we need is more engineers.

GENERAL ELECTRIC

An equal opportunity employer