THE NORTHERN ENGINEER

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Research in Cold Regions Engineering— Which Direction?

Cold regions engineering technology can be viewed as a huge, intricately made lace tablecloth. A network of flimsy theory fastens together islands of specific knowledge. Each island of knowledge, when magnified, appears to be a scaled down duplicate of the whole; again we see threads connecting small, seemingly dense regions. When an engineering project is undertaken in the North, the preliminary study will usually demonstrate that necessary data, or even a specific theory upon which to base a design, is unknown. Eventually the design engineer must undertake a research project, thus creating a new island of knowledge. This method of developing knowledge is, by-in-large, a random process based on an immediate need for information. The drawback to such a hit-and-miss approach is obvious: general theory does not develop until a huge amount of randomly gathered supporting information is acquired.

Research that is directed by the National Research Council of Canada's Building Division is, to a degree, planned. The committees representing industry, the universities and the NRC plan the general direction of investigations. In the United States, however, work is generally underwritten by agencies interested in a narrow field of technology. This system generally leads to the funding of projects of confined scope. The responsibility of creating knowledge of a general nature is left to the individual. One reason that the United States space program has been successful is that realistic objectives and time tables were made and research was coordinated among the several interested groups.

In the tremendous job of developing the northern areas of the world, there is no such long range planning. Thus each investigator, engineer and agency concerned with northern problems must examine the overall state of knowledge in his field and formulate a program which will not only satisfy the short range goals of the job at hand but will also aid in the development of more universal theory. Only by achieving some balance between short and long range studies will the Northland be economically and intelligently exploited.

Agencies that underwrite research and planning work in cold regions engineering should ask of their engineer "How does the proposed work fit into the overall fabric of cold regions technology?" — "Can the study now under consideration be designed to help in the development of a more general understanding of the natural phenomena that govern our environment?"

THE NORTHERN ENGINEER

is a quarterly publication of the College of Mathematics, Physical Sciences and Engineering of the University of Alaska.

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We will consider manuscripts of any length, whether short descriptions of current projects relating to Arctic Science and Engineering, or fully developed research reports. While our focus is on technology, we view it broadly, thus are interested in the social, natural and political aspects related to cold regions engineering.

All correspondence should be addressed to THE NORTHERN ENGINEER, University of Alaska, College, Alaska 99701. Subscription rates are $6.00 per year, $10.00 for two years, $20.00 for five years. Single and back issues may be obtained for $2.00 each.

Looking Forward

The **Northern Engineer** grew from an idea over a beer to a pile of short articles collected from friends working on problems throughout the North. The articles and news gathered over the past months appear in Volume One, Number One and Two of **The Northern Engineer.** Volume One, Number One was a test to determine the interest level. The test was positive; Volume One, Number Two was compiled. Even with the "shot gun" approach to these first issues, response to the magazine is extremely heartening.

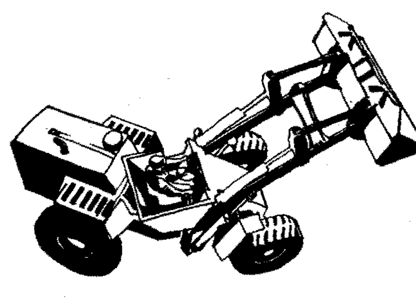
Planning for future issues is in progress now. The highlighted subjects of the next three **Northern Engineer's** are listed here so that readers may make critical comment or literary contribution.

— Volume One, Number Three — Northern Transportation: The staff of **The Northern Engineer** is working with Professor F. L. Bennett of the department of Engineering Management, University of Alaska, in producing this issue.

— Volume One, Number Four — Northern Architecture: This issue will feature an article by Ralph Erskin of Drottingholm, Sweden.

— Volume One, Number Five — Environmental Health Engineering in the Arctic and sub-Arctic: R. Sage Murphy, director of the Institute of Water Resources and head of the department of Environmental Health Engineering, in cooperation with the Alaska Water Laboratory, is assisting in the publication of this issue.

—Editor



National Estuarine Pollution Study

The Institute of Water Resources, at the University of Alaska, has undertaken a contract with Federal Water Pollution Control Administration (FWPCA) to provide data for the National Estuarine Inventory for the Alaska Coastline.

The National Estuarine Inventory, being conducted as part of the National Estuarine Pollution Study, was authorized under the Clean Waters Restoration Act of 1966. The purpose is a compilation of the available information on the coastal zones of the United States. This will be the first time that a large scale attempt has been made to gather water pollution oriented information on the entire coastline of Alaska.

On a nationwide scale, the Department of the Interior is cooperating with the Secretary of the Army, the Secretary of Agriculture, the Water Resources Council and with other federal, state and local public bodies.

In Alaska, the Institute of Water Resources (IWR) is supplying most of the information required, although certain federal agencies are researching particular areas. The information being collected by the IWR includes managing entities and political divisions, water quality conditions in estuarine waters, sediments and sediment transport, habitat uses and damages—including shipping, fishing, recreation, boating and hunting. Mining along coastlines affecting water quality in nearby estuaries will also be considered. All sources of pollution are being documented as a part of the study.

On February 14, 1968, Congress passed H.R. 25, which authorized the Secretary of the Interior to conduct an inventory and study of the nation's estuaries. Under the terms of this act, which compliments the earlier legislation, the wildlife and recreation potential, ecology, value to marine, andromous, and shell fisheries of the nation's estuaries shall be considered. In addition, the importance of estuaries to navigation, flood, hurricane and erosion control will be evaluated. The mineral value of submerged lands will be studied as will possibilities of more intensive development of estuaries for economic use as part of urban, commercial and industrial developments. Under the terms of this act the Bureau of Sport Fish and Wildlife of the Fish and Wildlife Service will be responsible for information and data collection nationwide. The Bureau of Commercial Fisheries is the agency responsible for the Alaskan estuary study under this act. The Institute of Water Resources is coordinating with the Bureau of Commercial Fisheries to reduce the duplication of effort in collecting data for both studies.

—Dave Wagner

The Department of Mechanical Engineering, University of Calgary, is offering a Spring Seminar (May 5-9) on **STRIBLING CYCLE MACHINES.**

Dr. G. Walker, University of Calgary, and Dr. T. Finkelstein, Consulting Engineer, Los Angeles, California, will be lecturing.

The course will cover the following topics:

- Basic Thermodynamics of Regenerative Machines
- Types of Machine:
  - Valve controlled open cycle
  - Piston controlled closed cycle
  - Heat operated prime movers
  - Pressure generators
  - Refrigerators and heat pumps
- Detailed Design Analysis:
  - Mechanisms
  - Heat exchangers
  - Regenerators
- Computer Simulation
- Experimental Methods
- Future Development Potential

Further information can be obtained by writing to: Dean, Faculty of Engineering (Attention: Dr. G. Walker), The University of Calgary, Calgary 44, Alberta, Canada.

The Heat Transfer Study Facility at the University of Alaska

Thermal analysis plays a major role in the design of civil engineering structures for cold regions. Because of the significance of thermal analysis in the design of utilities, earth structures and architectural detail, a facility for the study of heat transfer and the thermal behavior of materials was created at the University of Alaska. The facility, operated under the direction of the Arctic Environmental Engineering Laboratory (AEEL), obtained initial funding for laboratory equipment and environmental chambers under a research grant from the National Institute of Health, who has also underwritten a four year research project to study heat transfer process in soils.

Accurate temperature measurement is, of course, of primary importance to the study of heat flow. This being the case, a temperature standards room was incorporated into the facility. Two large, walk-in environmental chambers provide research engineers with atmospheric temperature as low as -70°F. Digital Data Acquisition equipment provides a fast, error-free method of collecting temperature information from experiments that are in progress.

Research now under way in the laboratory is related to the thermal properties of soils, specifically the entropy of freezing silts and salt water intruded soils, the thermal conductivity of ice laden soils and a study of measuring techniques.

The AEEL's heat transfer staff works closely with the University of Alaska's departments of Civil, Mechanical and Electrical Engineering, Physics, Geophysics and various research institutes. Projects now utilizing the heat transfer facility are concerned with sea ice, river ice, ice in soil material, ice fog materials testing and natural convective heat transfer systems.

Dream Projects

Ed. Note: Dr. E. F. Rice, Head of Department of Civil Engineering at the University occupied the role of keynote speaker at the joint meeting of the Alaskan Society of Professional Engineers (ASPE), National Society of Professional Engineers (NSPE), American Society of Civil Engineers (ASCE) and American Society of Mechancal Engineers (ASME) held on Engineer's Day February 14, 1968 in Anchorage. Dr. Rice is currently president of the Alaskan Society of Professional Engineers.

Dr. Rice enumerated three challenges or "Dream Projects," projects that he felt were exciting to the cold regions engineer in that they require cooperation between the engineer and his environment.

The following are excerpts from that speech:

". . . The first challenge is power from the sea. There are two dramatic possibilities . . . One of these is in Cook Inlet, where the two arms, Turnagain and Knik, exhibit some of the highest tides in the world. There is a possibility that tidal power from a two-basin system here could result in a block of power which, in conjunction with the use of the two necessary dams as causeways, could turn out to be feasible and economically attractive. Benefits in addition to power and transportation may include control of difficult and destructive tidal currents as well as improvement of facilities for marine shipping. The dams, as causeways, could provide for both rail and highway access by "the direct routes" both to the north and to the south of Anchorage.

". . . The other promising power-from-the-sea scheme is based on the temperature difference between seawater and air in the Arctic. Sea water stays at around 2° or 3°C below zero, whereas, in the winter months, air temperatures average about 15 degrees lower still. This isn't much difference, as power engineers would be quick to point out, but there is a lot of water in the Arctic Ocean, and a lot of air above it. Whenever a temperature difference exists, it is theoretically possible to extract some mechanical energy, or even to produce electrical energy directly.

". . . The second of the three special dreams is the building of northern harbors and platforms. In lower latitudes, one can pick a natural basin or construct breakwaters and jettys of stone and concrete to form a harbor. This could be done in the north, too, and doubtless will. Recently, people in the Arctic Environmental Engineering Laboratory (Peyton, Johnson, et al.) have demonstrated dramatically that . . . an ice island can be built. And with a little ingenuity, it can be moved around a bit and placed where needed. What better way is there to construct a pier? An ice pier would allow ships to unload without the lightering which now doubles the cost of sea transport to our coastal cities from Nome to Barrow. What other way exists at all for constructing an offshore platform in 100 feet of water – a platform which must withstand wind, currents, waves, and the grinding attack of the sea ice?

". . . The last of the 'big-three' of my 'Dreams for Engineers,' I support as a long-time conservationist who tries to maintain a world-wide perspective. If we define 'conservation' as the 'wise use of resources' certainly the Rampart project must be prominent in our plans. It is large: the largest potential hydraulic power project in the western hemisphere . . . The Rampart project on the Yukon River must be built and it will yield benefits far exceeding costs. Surely, with wisdom and compassion, we can improve the quality of life in Alaska through this project—and not merely the economic quality, either.

". . . These three: power from the sea, ice structures, and the Rampart project, are only a sample of the many dreams an engineer may have for the preservation and enhancement of the qualities of Alaska. Dreams must precede vision, and vision should guide and sponsor action. The Alaskan engineer is where the action is . . ."

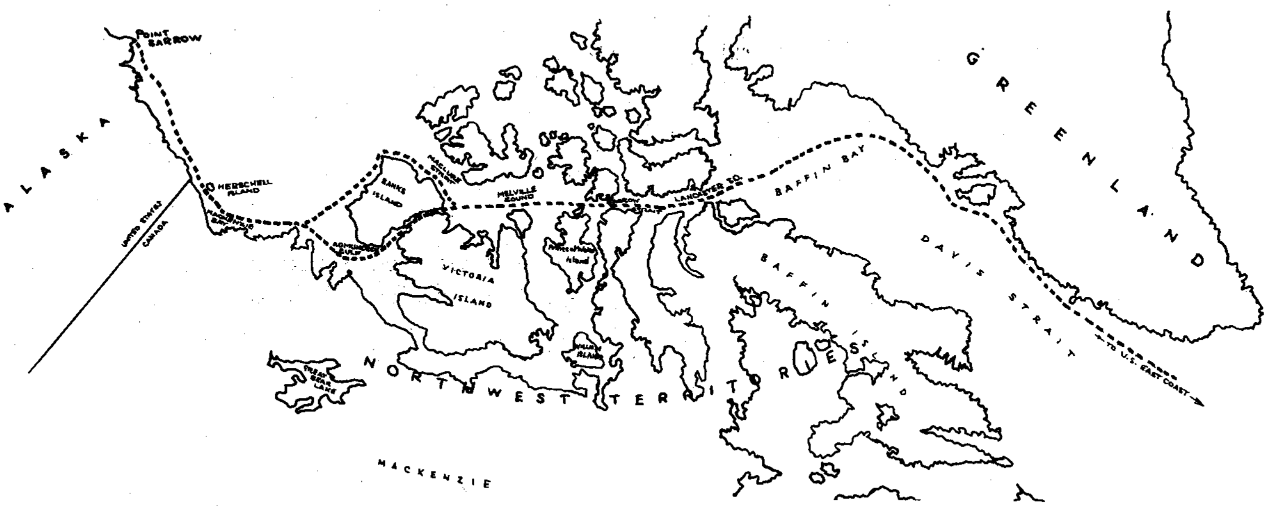
—E. F. Rice

Report on the Permafrost Conference University of Calgary

The third Canadian Conference on Permafrost was held the 14th and 15th of January at the University of Calgary, Calgary, Alberta. A total of 16 papers were presented and the number of delegates exceeded 370 with a large representation from the United States.

Papers presented at the conference generally fell into two categories. Firstly, those dealing with the technical aspects of permafrost in which actual experimental data and calculation techniques were given and secondly, those which were descriptive in content. This latter group, which was amply supported by slides, gave a vivid verbal description of construction and actual experience in permafrost regions. Of particular interest was an English translation of a Soviet Union film outlining permafrost construction methods as applied in the Siberian cities of Norilsk and Yakutsk.

The timing of the Conference was most appropriate, arriving at a time when considerable attention is being focused on the north as a result of the recent oil discovery on the north slope of Alaska. Dr. R. J. E. Brown of the Division of Building Research, National Research Council, Ottawa, is to be commended for the able way in which he convened the Conference as well as for the choice of papers. The Conference afforded an excellent introduction to northern conditions for those delegates who have had little or no previous northern experience.



Short Way to the Indies

The recent announcement by three oil companies drilling on Alaska's north slope, Humble, Atlantic Richfield and British Petroleum, of plans to send a tanker through the northwest passage, evidences the immensity of the whole oil activity. It also suggests the rapid pace at which Arctic development is underway. If a sea passage to the Arctic can be opened and maintained, the impact on the entire north, its people and resources, is incalculable. Certainly there will be a knowledge explosion as dramatic as the commercial expansion. The motivation for scientific study of the Arctic has been lacking in the past; support for research projects has been sporadic. Now there is an urgent necessity to know the answers to problems that once interested only a few devotees.

Briefly stated, plans are to equip a 115,000 ton tanker, the **Manhattan,** with an ice-breaker bow of conventional design. Her hull will be strengthened and some protection for her screw and rudder will be provided. Then, in late May, the 4,500 mile voyage from the East Coast to Prudhoe Bay will commence. If successful in reaching Prudhoe Bay, the ship will continue into the Pacific, call at Seattle, then return to the east, testing the northern passage once more.

No one concerned expects the voyage to be easy. Helicopters will scout ahead for channels free of heavy pressure ridges, while scientists, including Dr. Charles E. Behlke, director of the University of Alaska's Arctic Environmental Engineering Laboratory and Dr. Harold R. Payton, the University's ice expert, will assist in determining the route and study the effect of the ship's passage on the ice it passes through.

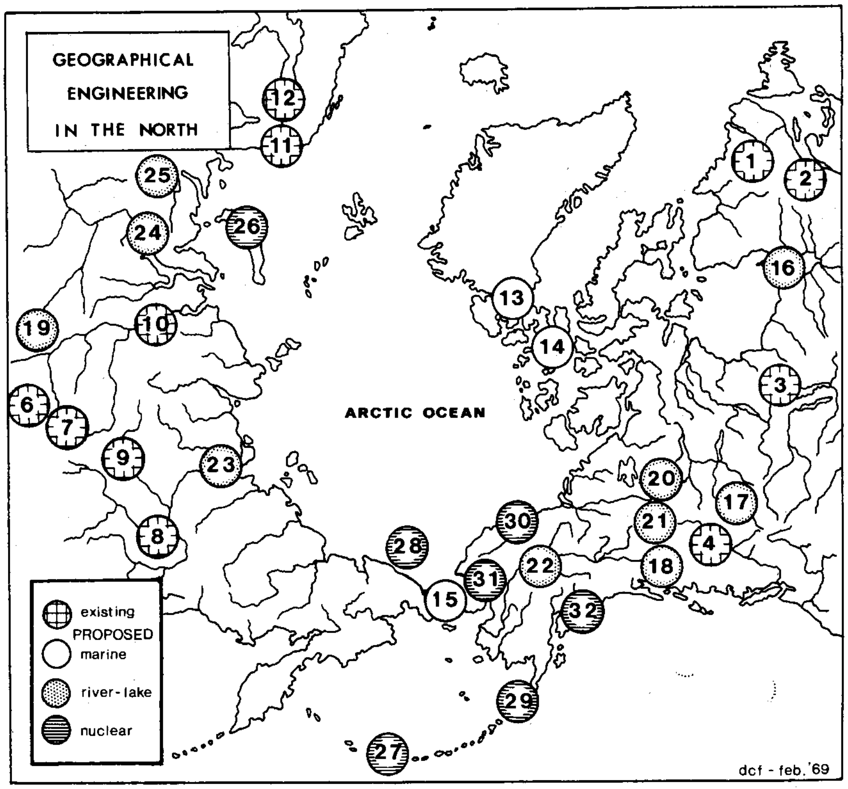
For 400 years men have attempted to force their way through America's northern passage in the hope of establishing a short trading route to the Orient. These efforts have produced our great Arctic saga, the fascinating story of dauntless men in egg shell ships measuring their courage and determination against the formidable obstacles of ice-choked seas and hostile climate. It is one of our most stirring romances and, like all romances, abounds with elements of heroism (Bylot, Parry), endurance (Ross, Back, MacClintock) and disaster (Hudson, Franklin). Success must crown romances and there have been a few. MacClintock made it through in 1850-54, but only by using sledges after his ship was trapped by ice. Amundsen got his **Goja** through in 1903-06, and in 1944 the Canadian Mounted Police ship, **St. Roch** made it also.

The only surface vessel to complete the passage since Superintendent Larsen in the **St. Roch** was the **H.M.C.S. Labrador** in 1954.

But for all the practical achievement resulting from this age-long quest, it was just as if the goal had not been attained. After all, the searching, agony, hardship and loss of lives were stimulated by hope of finding a commercial passage; one that could be utilized in the way the Russians have exploited their Northeast passage. Such a passage is no closer to existence today than it was with the **Gjoa's** success in 1904. Some may have been lulled into a false sense of security concerning our ability to overcome Arctic environmental conditions when the atomic submarine **Nautilus** passed under the ice pack with ease in 1958. Since then the feat has been repeated by another similar vessel, but for all the news value of such a voyage, the practical value compares roughly to our immediate prospects of developing trade with the moon. Atomic cargo carrying submarines are not looming on the horizon, so we are left with the necessity of solving an ancient problem with more conventional equipment.

Perhaps this spring, man's age-old ambitions will have some realization. Although the world's discovery and exploration owes much to the energy and aggressiveness of individual men, there has always been another factor making his bold effort possible — the economic stimulus. The cost of bringing oil by tanker to the East Coast will be less than by pipeline. Other factors, including that of technological advances, the greatest motivation is present. Gentlemen, place your bets!

—**William R. Hunt**



Geographical Engineering In the North

"Man . . . extends his action over vast spaces, his revolutions are swift and radical, and his devastations are, for an almost incalculable time after he has withdrawn the arm that gave the blow, irreparable."

G. P. Marsh, 1882.

The great north polar environment, nearly eight million square miles of land, fresh water, boreal forests, tundra and ice caps and an almost equal area of arctic and subarctic oceanic waters, is often thought to be a vast, pristine wilderness because its resident human population numbers less than eight million. In part this is true. Perkins Marsh would find in the north that, so far, man has struck most heavily at selected animal species. As we approach the last quarter of the century, however, the north embarks on a new and probably its last great historical period of human impact.

Viewed in global perspective the region has a geological and climatological history representing a wide, perhaps the widest variety of physical environmental types possible. But biologically and in terms of human occupation it is still young and uncomplicated.

Man's use of the north follows a classical sequence from palaeolithic to mesolithic hunter and on to neolithic herder in most parts. The region then underwent exploration and invasion by the European, and suffered from his colonialization and ignorant use of many biological resources. In its last historical phase, high-grade minerals, easily exploited by relatively primitive technology were utilized and the limits of national sovereignty on land were fixed and defended in the north by, and because of, the technology of the time. A new and final historical phase has now begun brought about by the world-wide phenomena of modern technological change, the disappearance of colonialism and an ever increasing human population.

This new historical period is the last because it is now clearly evident that the surface character of the earth, in the next century, shall result directly from the conscious decisions of men. Earth shall be a giant mirror reflecting into space the idea of what man wants earth to be. Wilderness areas, river systems, lakes, mountains, even seas of the 21st century shall exist only because man wills them to exist. We, who now embark on this new phase of history in the north, shall strike the last irreparable blow.

The term "geographical engineering" can be applied to two types of large scale engineering projects; those which modify or control relatively small portions of the environment but which have an accumulative effect on the total environmental system (hydroelectric projects, canals, nuclear reactors, cloud seeding, water evaporation prevention, etc.) and those which attempt to modify whole sub-systems of an environment (ocean current change, river system redirection, climate modification, etc.).* Fig-

*Also called "Planetary Engineering."

ure I shows a sample of projects completed, in progress and proposed in the north whose magnitude qualify them as geographical engineering events. A brief description of the projects should serve to illustrate the degree to which modern man has and could change the northern environment.

In the past decade a number of large scale hydroelectric projects have been started or completed in the north. These include stream diversion and damming at Churchill Falls [1]*, a development of seven power sites on the Outardes and Manicouagan Rivers [2], the Nelson River program requiring division of the Churchill River near Thompson [3], the Portage Mountain dam on the upper Peace River [4], the Angara River program** with dams at Bratsk [6] and Ust Ilim [7], the dams at Yakutsk [8], the upper Vilyui [9] and Khantaika River [10], the Pasvik River complex [11] and on the Kemi River [12].

While these projects include the largest hydroelectric sites in the world (Bratsk 4.5 mill. kw., Ust Ilim 4.0 mill. kw., Churchill Falls 3.9 mill. kw., Portage Mountain 2.3 mill. kw.) their immediate impact on the environment is relatively local. Planned or proposed projects, however, could or certainly would influence change in a large area, in some cases probably the entire earth.

The first group of proposals deal with modification of the northern marine environment. For example it has been suggested that a conventional or ice dam across Kennedy Channel between Ellesmere Island and Greenland [13] would prevent sea ice from moving south and thereby increase the probability of open water in the so-called "north-water" area of Baffin Bay. This, in turn, might lead to a gradual decline in the Baffin Bay and Davis Strait sea ice cover. Another suggestion has involved a dam or dams in the eastern Queen Elizabeth Island [14] which would inhibit the outflow of arctic surface water and perhaps lead to increased marine productivity and amelioration of the climate in the eastern arctic. The most ambitious plan for changing the northern environment is to build a dam across Bering Strait [15]. Several versions of the plan exist. The first is to pump slightly warm Bering Sea water north, the second to pump cold arctic water south and the third, simply to build a dam with no pumps. Given the technical means, to pump water north appears to be impractical, the removal of the arctic water layer from the Arctic Ocean would lead to massive environmental change, and to simply dam the strait would probably result in a slight climatic change, especially in the eastern arctic.

Removal of the Arctic Ocean ice pack has been suggested by other means than the Bering Strait dam. Two ideas to reduce infrared radiation loss over the ocean ice without greatly reducing incoming solar radiation have been put forward. One proposal was to detonate a series of submerged nuclear devices (hydrogen bombs) in late summer and thereby create a massive vapor cloud above the ocean. The second proposal was to inject aerosols into the stratosphere from aircraft. It is assumed that the trapped longwave radiation would prolong summer melting and inhibit the growth of thick winter ice. Once the ocean is ice free normal solar radiation would melt the ice cover each summer. Somewhat similar thoughts such as widespread artificial reduction in albedo in order to accelerate surface melting, have also been put forward.

The second group of proposals deals with massive rearrangements of stream flow. It has been suggested that damming James Bay [16] would create an inland fresh water lake 20,000 square miles in area. Reversal of the Hurricanaw River and appropriate pumping stations could bring the northern water to the Great Lakes system. In central and western Canada, the P.R.I.M.E. (Prairie Rivers Improvement, Management and Evaluation) plan involves diversion of arctic drainage southward. For example, the Peace River could be diverted to the Athabasca via Lesser Slave Lake [17] and then further south to the North Saskatchewan. One of the most impressive water control schemes, N.A.W.P.A. (North American Water and Power Alliance) requires diversion and water storage systems from the Yukon River [18] and other northern streams southward into the Rockies and to Mexico. Water diversion plans in Siberia have been equally large involving dams on the upper Yenisei and Ob Rivers [19] and canals to the southwest.

To these river diversion schemes should be added dams whose impact could be widespread. Among them might be proposed dams on the Mackenzie drainage [20] and South Nahanni River [21], the Yukon River dam at Rampart [22] and the large dams planned for the lower Lena [23], lower Ob [24] and the Pechora-Vychegda dams and diversion to the Vologda system [25].

The third group of large scale engineering projects relate to nuclear explosives. Nuclear tests for military purposes have been conducted on Novaya Zemlya [26] and Amchitka Islands [27] and perhaps Wrangel Island [28]. Excavations by nuclear devices for peaceful purposes have been proposed for canal building in Siberia [19?] and Alaska [29] and for harbors in Alaska in the north [30], the northwest near Point Hope and Kotzebue [31] and at Katalla [32]. Although their impact on the surface environment should be minimal, underground nuclear explosions have been proposed for retrieval of oil from tar sands (Project Oil Sand) and for underground oil storage. Both uses have possible application in the north.

For the engineer the challenge of the new north is unique. With the technological means at his disposal he can design projects of hitherto unknown proportions. And for this rea-

(Continued on Page 8, Col. 1)

*Numbers refer to Figure 1.

**To include the dams near Irkutsk [5] (not shown).

Geographical Engineering

(Continued from Page 7)

son he must work with a consortium of physical, biological and social scientists, politicians and diplomats. Engineering in the new north must be ecological in its approach. We have now started into an historical period where projects in one nation may change the environment of another state and therefore become an international issue. Moreover, the large scale projects usually relate to resources or geographical regions which are international but, like sovereign rights over some northern marine areas and continental shelves, have hitherto not created problems requiring international cooperation. Certainly Alaska, located between two rich and technologically powerful northern nations, will face such questions.

One last word should be said about geographical engineering in the north. Undoubtedly many of the proposed projects mentioned here and others not touched upon will be started in the near future. Some projects may never be attempted. Regardless of how far fetched the ideas may seem, they are technically possible, but presently require prohibitively large amounts of public investment. Worldwide disarmament, therefore, will accelerate the final historical phase of man's impact on the north.

—Don Charles Foote

We regret to report that as this issue goes to press Dr. Don Charles Foote was killed in an automobile accident.

Photo-Instrumentation In Cold Regions

The use of photographs as supplemental coverage or as prime data provide a valuable record for instruction and analysis, but in extreme low temperatures there are particular difficulties to be overcome by the photographer. Significantly, normal cameras are designed and lubricated for use in temperate climates. Thus, even when manufacturers boast about their cameras' operation at cold temperatures, it must be realized that the extreme they have in mind is no lower than -10°F. In the Arctic and sub-Arctic equipment must often function at temperatures between -40° and -60°F.

Some camera repair houses offer a winterization of the lubricants but even this probably will not permit operation at temperatures of -40°F because the differential contraction of the many parts is likely to cause binding. Then, too, because the camera must be completely disassembled, this service is expensive.

Film is another problem. Film becomes brittle at low temperatures because of the desiccated air at -40°F and lower. Furthermore, in this dry air, static electrical discharges occur and these can produce exposed areas on the film at sporadic intervals.

Besides lubrication and film concerns, the camera must also be protected from precipitation and from frost formation.

The obvious solution to these problems is to heat the camera. Many camera manufacturers can supply heating elements installed in the camera body to keep the drive mechanism and the film warm. This works if the lens, too, is kept warm because if a sharp heat gradient is produced in the lens differential contraction or a separated lens can result.

The Geophysical Institute of the University of Alaska has been dealing with these problems in its operation of recording cameras in the Antarctic and Arctic to monitor auroral activity, ice fog patterns and other cold land phenomena. It has discovered that the most practical solution to these problems is to enclose the camera completely in an insulated box containing a heating element. Function is assured by providing a transparent plate or dome which covers the lens. Another method, which eliminates the necessity for a transparent plate, is to direct a stream of warm air past the lens at the point where it looks through a hole in the camera box.

If a transparent plate or dome is used, one of good quality must be selected, otherwise the negative will be affected. For the same reason, it must be kept clean. The transparent plate must also be kept free of frost and snow by periodic cleaning or by keeping it hot enough to sublimate any precipitation.

There may be a static discharge problem in the use of a heated camera box. This can be eliminated by placing a wet sponge in the camera box. The moisture will raise the humidity enough to reduce the static discharge.

Film may be kept fresh for years past its normal expiration date if stored at -10°F or colder, but caution must be exercised in the use after such storage. It should be thawed, while still sealed in its can, for a day or so before use so that any moisture which has left the film base during freezing may be reabsorbed. If frozen or quickly thawed film is used while frozen or even directly after thawing, it may break or shrink during use due to desiccation. A roll of film can shrink enough to prevent the matching of sprocket holes with the printing stock, or the shrinkage could cause tearing of the film in the processing machinery.

Photographing snow fields or objects against a snow background makes it difficult to get the proper exposure setting on an exposure meter. Exposure readings should be taken by measuring the light reflected from a standard photographic grey card held in the camera field of view. In a pinch, readings may be taken by measuring the light reflected from your hand. Once readings have been taken, consideration of the exposure and processing must be made to produce proper contrast. Winter light requires an exposure and processing combination which will produce more contrast than the same exposure reading during the summer.

The experimenter will acquire good quality data under extreme cold conditions if the problems outlined above are considered and dealt with.

—Merritt R. Helfferich

Test Flight of the Airscat

In early December 1968, three University of Alaska engineers and a reporter for The Northern Engineer were invited to test drive and evaluate the AIRSCAT 240—a ground effects machine owned by Marvin Greenlee of M and M Enterprises, Fairbanks, Alaska. A concise description of the AIRSCAT as found in the owners manual is as follows: "The Model 240 AIRSCAT" is a ground effects machine "intended for operation with no more than 400 lbs. load . . . over relatively smooth and level terrain." Its design incorporates flotation devices "so that over-water operation can be accomplished in several different modes including raft flotation, semi-cushion borne planing and fully-cushion borne cruising. The AIRSCAT is provided with a bristle-like structure along each side that can be lowered or raised . . . retracted (for operation over water), or fully-cushion borne flight over land or in shallows with the bristles lowered.

"The AIRSCAT is provided with two propellor fans driven by a single 40hp Volkswagen type engine. Both fans operate at the same speed but vary in design. The lift fan is buried in the deep duct at the forward end of the vehicle – the propulsion fan, located in the aft end of the vehicle, has controllable blade pitch and is intended to produce a variable and reversible thrust. The blade pitch is controlled by a cable which runs to the control stick in the cockpit. Situated directly behind the aft fan is a row of airfoils, called steering vanes. They are 'moved' in unison and are connected to the control stick in the cockpit by a special cable. The vanes produce a steering force by deflecting the air stream from the thrusting fan."

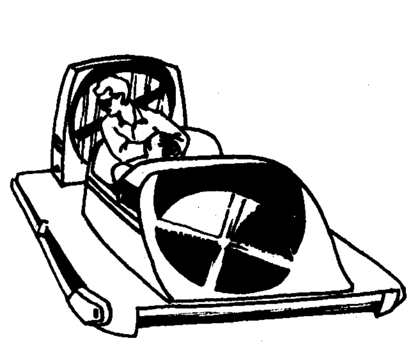
Harding Lake, south of Fairbanks, was chosen as the test site. The snow on the lake was from 4-8 inches deep (with drifts to 18 inches) with the temperature at -10°F. After soloing the AIRSCAT twice, each of the now veteran "Hovernauts" made several observations of the craft.

The test group agreed that control and maneuverability of the vehicle presented a problem. Some modification of the steering system seemed desirable. It was also found that the system of bristles tended to malfunction. Leaks developed at the junction of the bristles and the raising and lowering mechanism. These leaks caused a partial loss of floatation thereby reducing the payload of the machine. To remedy this a complete redesign would probably not be necessary but some improvement on the connection system would prevent vent leakage.

It must be remembered that the AIRSCAT was not specifically designed for either snow or -10°F conditions. These adverse environmental conditions encountered during testing probably affected from the machine's performance.

The future of ground effects machines in Alaska appears especially promising as a pleasure craft vehicle. It is not difficult to forsee a large market for a new and improved AIRSCAT designed especially for Alaskan conditions. A machine capable of handling a ½ ton payload should find great acceptance among duck hunters and fishermen as a mode of transportation to remote areas. Along frozen as well as ice free waterways and on the North Arctic Coastal Plain a vehicle that could economically negotiate both the summer muskeg and winter tundra would prove a valuable asset. Hopefully, the present technological and economic obstacles will soon be overcome so that more Alaskans can enjoy the adventure of riding on air.

—James Knapp



Report on the Highway Research Board 48th Annual Meeting

Washington, D.C., Jan. 16, 1969

From the view point of cold regions engineering, this year's annual meeting of the Highway Research Board proved to be of outstanding interest.

Among the papers presented at the regular meeting were two of special appeal to engineers who work in the North. Lyle Moulten and James H. Schaub presented "A Rational Approach to the Design of Flexible Pavements to Resist Detrimental Effects of Frost Action," an engineering approach to pavement design that is deserving of attention. Although their study dealt particularly with West Virginia's seasonal frost problems, the approach of developing the "Exact-modified Berggen Equation" seems to have merit.

Arthur Straub, Paul Dudden and Frank Moorhead did work on the surface radiation effects as applied to moisture migration in highway subgrades. Their paper "Frost Penetration and Moisture Change Related to Pavement Shoulder Color" points up the need for intensive investigation into the radiation component of heat transfer problems in highway design.

The most outstanding feature of the HRB meeting was the International Conference on "The Effects of Temperature and Heat on the Engineering Behavior of Soils." The conference was dedicated to Dr. Hans F. Winterkorn of Princeton University who chaired the committee on Physico-Chemical Phenomena in Soils for 30 years.

Twenty-two papers were accepted for discussion during the conference (see list Page 10, Col. 1). The growing significance of the field of cold regions engineering is reflected in the quality, as well as the quantity, of the papers discussed during the conference.

(Coninued from Page 9)

The Effects of Heating on the Swelling of Clay Minerals—L. A. G. Aylmore, J. P. Quirk, and I. D. Sills, University of Western Australia.

Thermal Transfer of Liquid in Porous Media—A. M. Globus and B. M. Mogilevsky, Agrophysical Institute, Leningrad.

Relationships Between the Daily Temperature Wave and the Development of the Natural Soil Profile—R. Goetz, German Research Association; and S. Mueller, State Geological Survey of Baden-Würtemberg.

Thermo-Osmotic and Thermoelectric Coupling in Saturated Soils—D. H. Gray, University of Michigan.

The Physics and Chemistry of Frozen Soils—Pieter Hoekstra, U. S. Army Cold Regions Research and Engineering Laboratory.

Thermodynamics of Granular Systems—Alfred Holl, United Asphalt and Tar Manufacturing Company, West Germany.

Heat Conduction in Saturated Granular Materials — Richard McGaw, U. S. Army Cold Regions Research and Engineering Laboratory.

Temperature Effect on Water Retention and Swelling Pressure of Clay Soils—R. N. Yong and R. K. Chang, McGill University, Canada; and B. P. Warkentin, MacDonald College of McGill University, Canada.

Effect of Heating on Bearing Capacity of Highway Subgrades—Fernando Emmanuel Barata, Federal University of Rio de Janeiro and Highway Department of Guanabara State, Brazil.

Expansion of Soils Containing Sodium Sulfate Caused by Drop in Ambient Temperature — Harold D. Blaser, Federal Housing Administration; and Oscar J. Scherer, Nevada Testing Laboratory.

Influence of Heat Treatment on the Pulverization and Stabilization Characteristics of Typical Tropical Soils — E. C. Chandrasekharan, S. Boominathan, E. Sadayan, and K. R. Narayanaswamy Setty, College of Engineering, Madras.

Influence of Temperature and Other Climatic Factors on the Performance of Soil-Pavement Systems—H. Y. Fang, Lehigh University.

Effect of Temperature on Some Engineering Properties of Clay Soils—Joakim G. Laguros, University of Oklahoma.

Effect of Temperature on the Elasticity of Clay—Sakuro Murayama, Kyoto University, Kyoto, Japan.

Effect of Temperature on Strength Behavior of Cohesive Soil—Calvin A. Noble, Memorial University of Newfoundland; and Turgut Demirel, Iowa State University.

Transient Temperature Influences on Soil Behavior—Robert E. Paaswell, State University of New York at Buffalo.

Some Temperature Effects on Soil Compressibility and Pore Water Pressure—Robert L. Plum, Goldberg-Zoino and Associates, Cambridge Massachusetts; and Melvin I. Esrig, Cornell University and Dames and Moore, New York, New York.

Soil Stabilization by Incipient Fusion — James L. Post and Joseph A. Paduana, Sacramento State College.

Pavement Temperatures and Their Engineering Significance in Australia—B. G. Richards, Commonwealth Scientific and Industrial Research Organization, Victoria.

Temperature Effects on the Unconfined Shear Strength of Saturated, Cohesive Soil — Mehmet A. Sherif and Chester M. Burrous, University of Washington.

Influence of Seepage Stream on the Joining of Frozen Soil Zones in Artificial Soil Freezing—Tsutomu Takashi, Seiken-Reiki Company, Osaka, Japan.

Effect of Preliminary Heat Treatment on the Shear Strength of Kaolinite Clay—Herbert Wöhlbier and Dieter Henning, Technical University, Clausthal, Germany.

Terrestrial Sciences Center

Cold Regions Research In Progress

Trafficability Over Snow and Muskeg: New and improved concepts of transportation in snow and muskeg are being investigated with specific reference to Army air mobility by solving problems associated with permanent and temporary landing areas and with all-season access routes.

Mechanics of Ice Bridging: Studies are being made of the bearing capacity of sea and lake ice for bridging, the mechanics of floating ice sheets in relation to specific uses including landing air vehicles, and the mechanics of ice jams for their causes, elimination, and prevention.

Route Selection Terrain Studies: Integrated hydrological, geomorphological, physical geographical, rheological, pedological, geochemical, dendrochronological and ecological studies are being made to determine the unique features of the terrain and environment in cold regions and to obtain data on land forms, streams and river locations and soil movements useful in selecting overland routes and construction sites. The thaw depths and runoff characteristics on the Arctic coastal plain have been correlated with climatic conditions. The hydrology and morphology of selected sub-Arctic streams and drainage basins have been characterized in relation to vehicular mobility.

Seasonal and Areal Variations of Earth Materials: Determinations are being made of the physical characteristics of snow and ice at various elevations and terrains. Field work was done at elevation 19,500 feet on the slopes of Mt. Logan in Canada. Two automatic weather stations were installed. A computer program to forecast the first freeze on lakes and rivers was developed as part of the investigation.

Cold Regions Waste Disposal Study: Investigations are being made of the criteria, materials, techniques for the design, construction, and maintenance of temporary and permanent utilities for waste disposal in cold regions. Prototype systems will be designed and installed and evaluations will be made of existing facilities.

Current Publications

The Terrestrial Sciences Center (TSC) U.S. Army Material Command, Hanover, New Hampshire

Research Report RR262 **Diffusion law for the dispersion of hard particles in an ice matrix that undergoes simple shear deformation,** by J. Weertman.

Technical Report TR213 **Effect of solar radiation on processed snow in engineering construction,** by Austin Kovacs and Rene O. Ramseier.

Special Report SR111 **Investigation of subsurface drainage at the BMEWS Facility, Thule, Greenland,** by J. M. McAnerney.

(Available in photocopy or microform for cost of reproduction from the Clearinghouse for Federal Scientific and Technical Information (CFSTI) 5285 Port Royal Road, Springfield, Virginia 22151.)

National Research Council (NRC), Division of Building Research, Ottawa, Canada

NRC 9762 Permafrost Investigations in British Columbia and Yukon Territory by R. J. E. Brown, January 1968, 43 p., 41 figs. (DBR Technical Paper No. 253). The distribution of permafrost and the climatic and terrain factors affecting its occurence in northern British Columbia and southern Yukon Territory are described and discussed in detail.

NRC 9769 Permafrost Map of Canada. (A joint production of the Geological Survey of Canada and DBR/NRC), Aug. 1967. See also Canadian Geographical Journal, February 1968. This map is a joint publication of the Division of Building Research and the Geological Survey of Canada. It is printed in color at a scale of 120 miles: 1 inch and the single sheet measures 40 inches by 30 inches. Explanatory notes on the definition of permafrost, distribution and occurrence, physical factors influencing permafrost and a bibliography of source information are printed on the map.

TT 1298 Instructions for Designing Bearing Media and Foundations in the Southern Zone of the Permafrost Region. Research Institute of Foundations and Underground Structures, Academy of Construction and Architecture, USSR Moscow, 1962, 77 p. This translation of the Soviet Building Code dealing with the design of foundations for the southern zone of the permafrost region is of particular interest to the Division of Building Research in its investigations of permafrost and building problems in northern Canada. A similar document dealing with the design of foundations for the entire permafrost region was translated in 1962—"Technical Considerations in Designing Foundations in Permafrost" (NRC Technical Translation 1033). The Russians have been involved in construction on permafrost for many years in Siberia and their experiences are of great interest to those who are involved in this activity in northern Canada. A building code for northern Canada is currently being prepared.

Film Russian film on **"Construction on Permafrost"** — January 1968. In July 1966, the Ambassador of the USSR presented a 35 millimeter black and white film entitled "Construction on Permafrost" to DBR/NRC. A 16 millimeter version with English commentary has been produced by the National Film Board for the Division and is available for loan. The film depicts graphically early building failures and their causes. Solutions to these problems and successful construction of large multi-story masonry buildings on permafrost are shown both by drawings and by actual photographs taken mainly at the Siberian cities of Nor'ilsk and Yakutsk.

United States Geological Survey Denver, Colorado 80901

1) **ANTARCTIC MAPS**
Reconnaissance Series 1:250,000
(1 inch=about 4 miles)

Shaded-relief maps prepared by the U.S. Geological Survey in cooperation with the National Science Foundation from aerial photographs taken by the U.S. Navy, Basic contour interval is 200 meters. Sheet 33 by 26 inches. 75c per sheet.

SHEET NAME	SO. LAT.	E. LAT.
Mount Joyce (1962)	75°-76°	157°30'-162°
Relief Inlet (1960)	75°-76°	162°-166°30'
Reeves Neve	74°-75°	157°30'-162°

2) **REVISED MAP OF ALASKA:**
Date revised—August 1968

Research projects in Scandinavia. Semiannual list No. 1/1968 edited by Nordforsk (Scandinavian Council for Applied Research) Lönnrotinkatu 37, Helsinki 18, Finland.

Gunnar Kärrholm, prof., Lars-Erik Larsson, prof., Anders Losberg, prof., and Roman Malinowski, prof. Programme of research in pre-fabricated building units at the Chalmers Univ. of Technology. (BFR).

Lars-Erik Larsson, prof. and Rolf Tellstedt, civ. ing. Problems of heat and moisture, construction with pre-fabricated units, and general construction technique. Conditions of moisture and temperatures in heated service space. (BFR)

Karl J. Leander, övering. and Ove Pettersson, prof. Deformations and transmissions of heat and moisture in outer walls covered with an outer layer of glazed ceramic tiles (BFR)

O. A. Taivainen, prof. Temperature in the road bed and strengthening of road ground. (TTT)

Technical University of Norway, Department of Building Engineering. Coordination of modules, sandwich elements, pre-fabricated elements, and cost analyses. (NTNF)