THE NORTHERN ENGINEER

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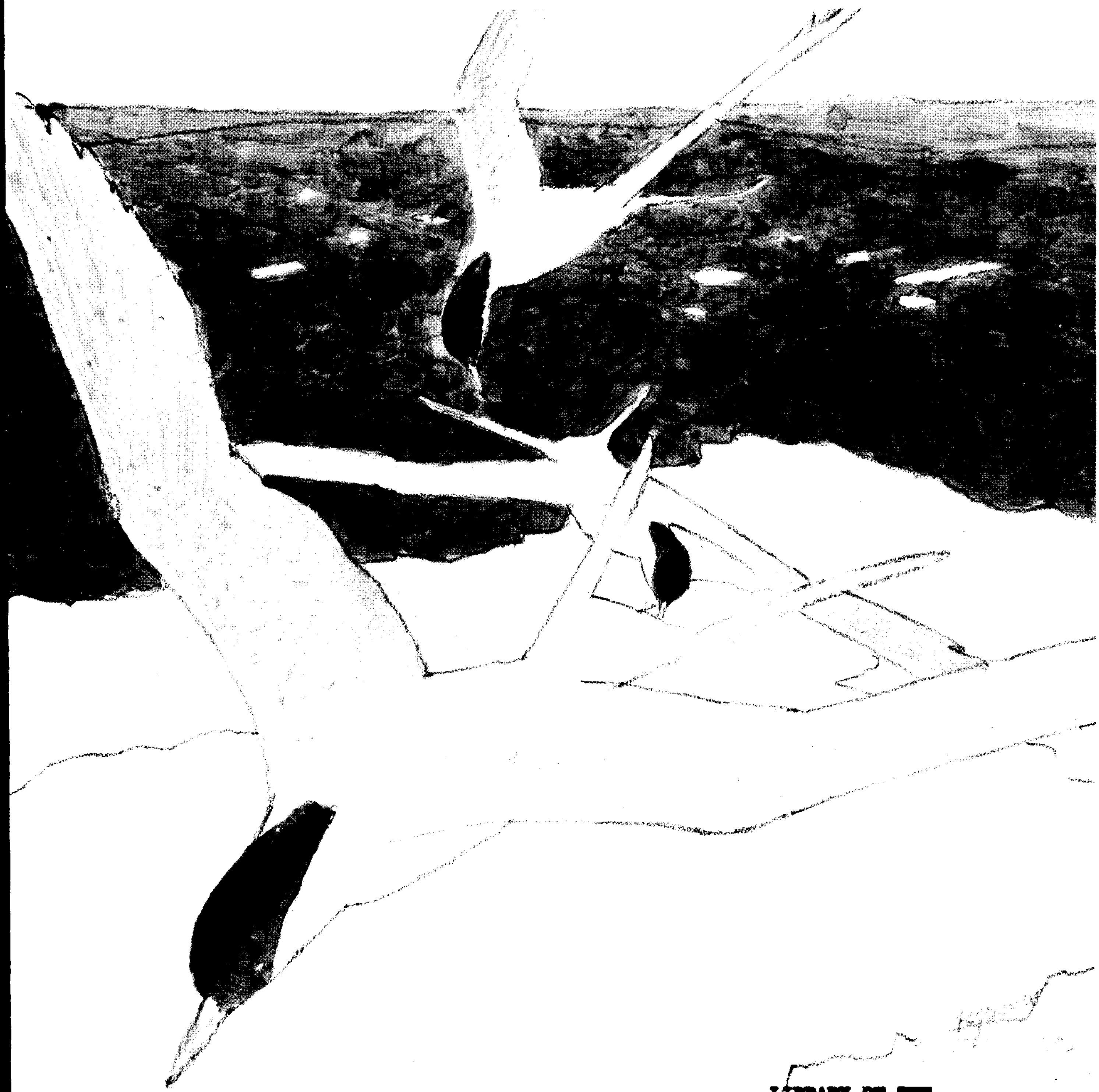

THE RESPONSIBILITY OF ENGINEERING LEADERSHIP

Charles Sargent is a phenomenon of the northland. He is an educator, planner and truly a northern engineer. This summer he is retiring from service to the University of Alaska and moving to the University of South Dakota (from the freezer to the ice box?) to build, for the second time, a program in engineering management. In 1962, as Dean of the College of Mathematics, Physical Sciences and Engineering he introduced an engineering management program to the University of Alaska. The engineering management program founded by Dean Sargent has, since its inception, awarded 101 Master of Science degrees. That figure speaks for itself, particularly when it is realized that the University of Alaska, state wide, has a total of just over 5000 students.

Chuck came to Alaska in 1942 as a surveyor on the trans-Canada and Alaska Railroad. After being Private Sargent, Sergeant Sargent and Lieutenant Sargent during World War II he returned to Idaho and obtained his B.S. degree. He returned in 1953 to join the University of Alaska.

The spark behind the engineering management program must have come in 1956 or so because in 1957, sponsored by the National Science Foundation, Chuck studied construction management at McGill University and Stanford University, where he was awarded his M.S. degree, and returned to his post as head of civil engineering at the University of Alaska.

As Dean of the College of Mathematics, Physical Sciences and Engineering, in 1961, he went to work setting up the engineering management program and later in 1965 managed to institute the Arctic Environmental Engineering Laboratory (the sponsor of THE NORTHERN ENGINEER).

THE NORTHERN ENGINEER visited with Charles Sargent concerning his impressions upon leaving the University of Alaska. His thoughts, presented below, are not directed to the community of engineering educators alone. They are directed to all northern engineers and are spoken in terms of education because education is a continuing process for all enlightened people.

A great need for bold new concepts in engineering systems for the Arctic is very evident. In every system of construction that I know of—in every field of engineering endeavor, transportation, communication, buildings, and sanitation—we are in need of innovation and creativity. The leaders in the search for the new Arctic technology must be trained at the University of Alaska where the proximity of the Arctic keeps one aware of the urgency and magnitude of the problems.

The engineering educational requirements for producing the engineers to solve the technical problems alluded to above are obvious; however, there is also a great need for engineers to become aware of the economic, environmental, and social implication of the work they produce and, most important, to become involved with the problems of people and society. Engineering educators must take the responsibility for including a socio-economic background in the program of education. But they must do more than simply require courses in economics, sociology, and psychology, etc., they must relate these disciplines to the practice of engineering as the students develop technically.

The traditional definitions of engineering usually contain the phrase ". . . for the betterment of mankind . . ."—yet every device for destruction and pollution now in existence is the result of engineering. If engineering is to produce and maintain a healthy environment then there must be a drastic metamorphosis in the education of the engineer. —Charles Sargent

THE NORTHERN ENGINEER

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THE NORTHERN ENGINEER

This Issue . . .

SHORT PAPERS AND REPORTS

OPINION

CURRENT PUBLICATIONS MEETING NOTICES, NEWS ITEMS AND CORRESPONDENCE

The Cover: Myriads of migratory birds arrive in the Arctic in the early summer to nest. Rich Grimes of the University of Alaska chose the Arctic Tern, one of the most graceful, as the subject for this issue's cover.

Next Issue . . .

Terence Armstrong of the Scott Polar Research Institute of Cambridge, will be guest editor for our next issue, which will focus on Siberia.

WHICH WAY IS NORTH?

WILLIAM W. MENDENHALL

Most of us have heard the old riddle — "A hunter left camp, traveled ten miles south, then ten miles east, then ten miles north, where he found himself back in camp. He saw a bear and shot it. What color was the bear?" The answer, of course, is white, since it must have been a polar bear. The idea is that the hunter's camp was right at the North Pole, and he started out south, then went east along a parallel of latitude, and then back north to the pole. (As a matter of interest, while the North Pole is one correct answer, and the most common one, there are many, many other answers, thousands of miles away, which are equally correct; their solution is left to the reader.)

The above problem serves to point out the fact that directions behave in rather curious fashion as you approach the poles. There is nothing basically different in surveying in the extreme north from surveying anywhere else, except that direction changes (convergence of meridians) are much more pronounced in high latitudes. There are many effects which can be ignored by the surveyor in Oklahoma, for example, with no great loss of accuracy; the ignoring of these same effects along the Alaska North Slope would cause horrible errors. For example, the angle between "east-west" section lines and "north-south" section lines is very close to 90 degrees in lower latitudes, but in northern Alaska, such an angle can be almost 15 minutes off from a right angle.

In the "lower forty-eight" states, geodetic control is reasonably dense, so that rarely does someone have to work in an area 10 miles or more from good first-order control. In northern Alaska, control is quite sparse, and often surveyors must work 25 miles or more from good control points. With electronic equipment, this should cause no great problems, but great care must be used in calculations to keep directions properly controlled. On lines which run true north-south there is no problem. No matter how far you go north, the extension of the line will still be heading north. But all other directions encounter the old convergence bugaboo. In fact, it is not always clear just what a line heading "east" means. There are two common approaches to this problem. (See Figure 1.) The Bureau of Land Management uses the "rhumb line" concept, where the bearing is indeed constant, but the line is a curved line. In our old polar bear problem, the "then ten miles east" is a curved line so that at any point a local tangent to the line runs east or west at that point. All BLM baselines, standard parallels, and east-west township lines are really curved lines, with monuments every half mile. All other east-west section lines make a jog every mile and the bearing of these one-mile-long lines is east-west at their midpoints. (This assumes perfect ground surveying.)

Although the rhumb-line method is used by the BLM, almost every other government and private organization uses the "geodetic line" or "geodesic" concept. This method uses what most people would call a straight line between two points, allowing for curvature of the Earth. If the Earth were a true sphere, such a line would be called the "great circle" between two points. Alaska and Canada use Clarke's 1866 Spheroid which causes minor variations from the great circle. This "straight" line has a different bearing or azimuth as you progress along the line. Thus, it is customary to give two bearings or azimuths for the line, one for each end of the line. Most private surveyors, and military agencies, give azimuths clockwise from the north; the U.S. Coast and Geodetic Survey and some others work clockwise from the south. Bearings always start at either north or south and may work either clockwise or counterclockwise, with the meaning made perfectly clear by letters. For example, starting at point A, you could go toward B by starting out at N 85° 32′ E. Keeping on a "straight" line until you get to B, if you were to then turn around and look straight back to A, the bearing (at B) from B to A might be S 86° 00′ W. There would be 28 minutes of convergence in this line. (A line 10 to 15 miles long, at latitudes 65 to 70° would have about that much convergence.)

People who do a lot of precise work usually use "geodetic" computations based on latitude and longitude. In the past this has been extremely inconvenient and time-consuming, and is not usually understood by the run-of-the-mill surveyor. Electronic computers have greatly simplified this approach. However, most surveyors prefer to work on a grid or coordinate system, where all norths are parallel to each other, where lines have constant bearings along their entire lengths, where X and Y, or east and north, coordinates have meaning, and where areas, errors of closure, etc. can easily be calculated. In short, some kind of plane coordinate system is preferred.

For small areas such as a city, a construction site, or small mining operation, the surface of a sphere does not depart very much from a true plane, or from some shape (cone or cylinder) which can be developed into a plane. As areas get bigger, "plane coordinate" systems depart more and more from a spherical earth, and errors (or corrections to eliminate these errors) become larger and larger. Thus there is a practical size limitation if a reasonable accuracy is to be obtained. The United States Coast and Geodetic Survey has adopted plane coordinate systems for each state so that, for normal use, errors will be less than one part in 10,000. The Universal Transverse Mercator system,

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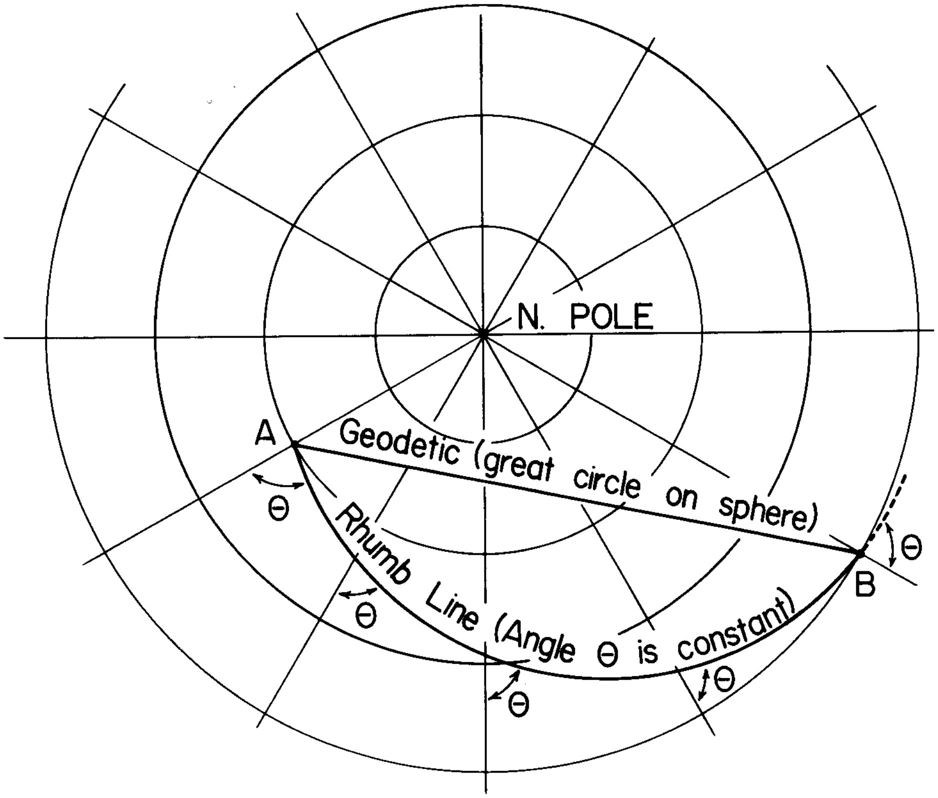
William W. Mendenhall, Professor of Civil Engineering, University of Alaska, College, Alaska 99701. B.C.E. and M.S. Cornell University. Registered professional engineer and land surveyor in Alaska; consulting photogrammetrist.



Geodetic Reference Systems

widely used by the military, has greater errors, unless special precautions are taken.

The title of this paper, "Which way is north?" brings up another question — just which north are we talking about? At any location in Alaska there are at least four norths which might be considered: true north; UTM grid north, used by the military; state plane coordinate grid north, used by the Alaska Department of Highways and many other agencies; and magnetic north, not used too much by surveyors, but widely used by the Federal Aviation Agency for all its runway directions and radio aids to navigation such as omni directions. In addition, there are many local grid norths such as those at most of the military bases, city grids, and grids of mining companies, University of Alaska campus, and others. For example, in the Fairbanks area there are at least six widely used norths. Magnetic north may be 25 to 30 degrees or even more away from most of the other norths, and these other north systems may vary up to about two and a half degrees from each other.

In addition to describing the location of a point by latitude and longitude, or by X and Y (or east and north) coordinates in any of the varying systems, the Bureau of Land Management system used to lay out public lands is a common descriptive method. Until very recently, this BLM system applied ONLY to those areas where actual on-the-ground surveys were run, and where physical monuments (pipe, usually) were set in the ground. By the mid-1950's only a minute fraction of Alaska had been so surveyed. Thus, about 99% of Alaska was not capable of being described under the BLM system. The stage was set for a truly confusing situation.

The mere mention of "Seaton's well" can cause many veteran BLM employees to turn pale. Mr. Seaton was a homesteader along the Alaska Highway near the Canadian border. Drilling for water, he hit gas. This started a huge rush of filing for oil and gas leases, and the Fairbanks Land Office was the scene of immense confusion. Some applicants put in descriptions such as "starting at the Fairbanks Initial Point, go S 70° E a distance of 260 miles, more or less, to the point of beginning . . ." Others said "starting at milepost 1260 of the Alaska Highway, go . . ." Others took maps and graphically extended the Fairbanks Meridian system and gave a township and section; still others did the same with the Copper River Meridian system. Since the gas leasing laws did not clearly define how the land was to be described, some people filed for their desired land in more than one way, just to make sure. If the gas had been in commercial quantities there would still be litigation to this day. However, the gas did not turn out to be commercially feasible, the "leases" became valueless, and the whole affair died down after a few months.

Many people saw that a very serious problem could easily arise so several steps were taken. The first was to mathematically extend the three basic systems in Alaska (Seward, Copper River, and Fairbanks) and to create two new initial points (Umiat and Kateel River) so that all of Alaska would be covered by these five BLM systems. Latitude and longitude, to the thousandth of a second, were calculated for every township and section corner in Alaska. Any point in Alaska could then be identified, and there were normal leasing blocks for any potential oil or gas strikes in Alaska. Next, the State Plane Coordinate System for Alaska was adopted, consisting of ten zones (eight transverse Mercator, one conic, and one oblique Mercator) and coordinates based on a mathematically exact protraction were calculated for every section corner. Also, coordinates were computed for every geodetic control point, so that the average surveyor could utilize the state plane system with ease.

The situation in Alaska now in 1970 is fairly well organized. For oil and gas leasing blocks, the protracted BLM system has worked out very well. For off-shore leasing a modified UTM system is being used, apparently with good results. The Department of Highways does most of its work based on the state plane coordinate system, and the state legislature has passed a bill which allows optional use of state plane coordinates for property description under certain conditions. More and more the private surveyors in the state are using state plane systems and the density of control is constantly increasing.

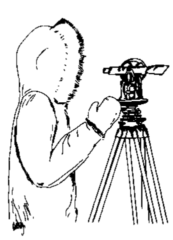
As was stated above, the state plane coordinate systems were originally set up so that for most local projects, the average surveyor would not be in error more than about one part in 10,000 if he used the basic system, without refinements, for small surveys. More and more surveyors are using microwave and light measuring devices which have accuracies of one part in 250,000 to 500,000. Unfortunately, there are many practicing surveyors who use a one-second theodolite and microwave system and feel that they are working to accuracies of one part in 100,000 or so, merely because the equipment is indeed capable of such work. Too often, usually because of ignorance, reductions to horizontal, reductions to sea level, and application of mean scale factor are ignored, with results often of the accuracy of one part in 2500. Thus, although excellent work is indeed possible, much work today is extremely sloppy, because of the long distances which much high latitude work requires.

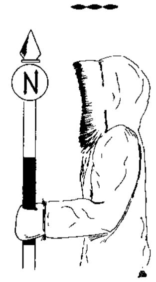
Aside from the convergence problem, the multi-zoned coordinate system, and the sparseness of control, there is another facet of high-latitude surveying which differs somewhat from usual procedures in more southerly latitudes. This is the problem of astronomical sightings. A surveyor usually takes such shots for only one purpose, that of azimuth determination; latitude and longitude determination is almost solely confined to USC&GS. Commonly, in lower latitudes, a shot is taken on Polaris. Unfortunately, the standard transit or theodolite cannot sight on Polaris in northern Alaska without special eyepiece prisms or other equipment. Also, during much of the year the sun is so low that refraction uncertainties are very serious, and the relationships of horizontal to vertical angles are very poor. Standard PZS triangle methods on any star will work, but this doesn't help the surveyor who has been trained to work solely with azimuth shots on Polaris at elongation.

Some gyroscopic equipment is coming into more common use of late, especially by the military. These instruments determine true north with a remarkable accuracy. Suffice it to say that their accuracy drops off as you go north, once again causing additional problems for the surveyor at high latitudes.

In conclusion, there is really no great difference between surveying in the north country and surveying at mid-latitudes, but problems which do occur everywhere are greatly magnified as one proceeds north. This means that those hardy souls who do operate in northern latitudes should be exceptionally well-trained.

This paper has stressed some of the problems encountered by surveyors in northern latitudes based solely on mathematical or geodetic considerations. There are many problems which are based on climate and remoteness which indeed play an immensely important part in surveying in Alaska. The extreme cold, darkness, necessity of helicopter support, difficulty of reading mosquito-stained notebooks, and many similar drawbacks make northern surveying something unique. The man who can overcome these drawbacks and who at the same time is truly competent in the geodetic considerations which high-latitude surveying requires is to be valued highly.





Radio Communication In the North

ROBERT P. MERRITT

High-frequency radio communication at high latitudes is subject to many difficulties. The term "high-frequency" designates the group of radio signals higher in frequency than the standard broadcast band (about 1,600 megacycles per second). A more scientific definition specifies the HF radio bands as extending from 3MHz to 30MHz. Long distance communication is facilitated by the selection of a frequency that will be reflected from the ionized regions of the upper atmosphere called the ionosphere.

When the radio wave penetrates the ionosphere to reach a high ionization density, it is reflected back toward the earth. If a sufficient ionization intensity at a given frequency is not encountered, the radio wave is not returned to the earth but is propagated out into space. The higher the radio frequency the less effect the ionosphere has on the propagation of the signal.

A measure of the ionization density is the highest frequency radio wave that will be returned to the earth at vertical incidence. If radio waves enter the ionosphere obliquely the signal encounters an extended region of ionization (secant function). The effect is the return of signals of higher frequency than would have returned by a transmittal perpendicular to the ionospheric layer. The lower portion of the ionosphere (about 80 km. above sea level) is in a region of higher neutral molecule density and a short mean free path for ions. This environment tends to absorb energy from a radio wave by collision between the ions and the neutral gas molecules. The amount of absorption in the lower ionosphere is approximately an in-

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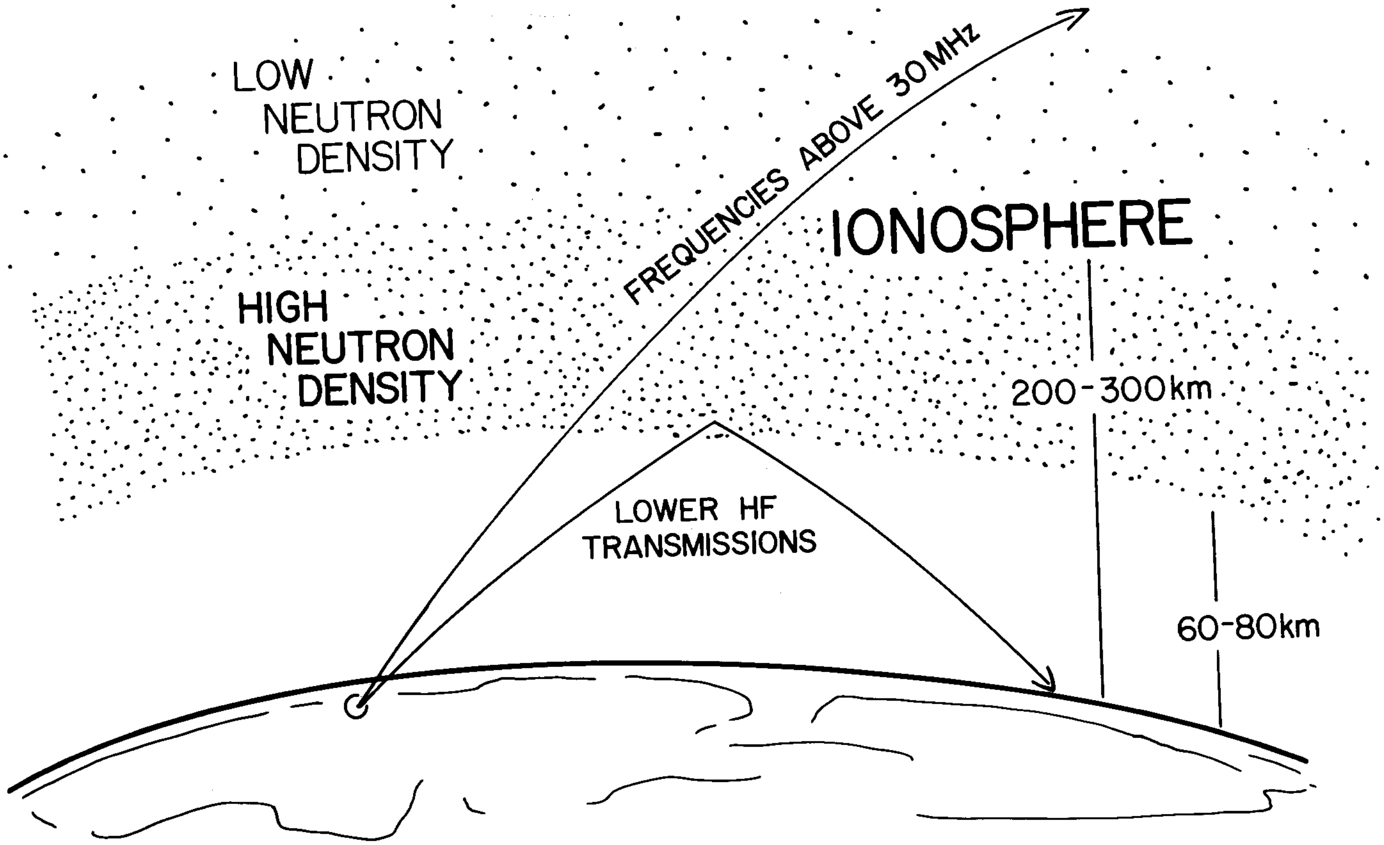


High frequency radio signals propagate through the ionosphere with ease, while low frequency radio signals are obsorbed and reflected in the ionospheric region.

verse frequency squared function. The ion density at these altitudes is dependent on a continuous source of ionization energy, such as solar radiation or particle bombardment. In the upper ionosphere (200 to 300 km. above sea level) ionization is lost more slowly than at lower altitudes and persists for several hours after initial perturbation.

In lower latitudes, where the ionosphere is relatively stable, a radio signal must be transmitted that will be high enough in frequency to be only slightly absorbed, yet low enough in frequency so that it will be reflected from the ionosphere back to earth at the distance required. The ability to change the frequency of the transmitter to adjust for the above requirements is essential to continuous communication. Even with this ability and extensive instrumentation along the radio path to measure the ionosphere, it is often impossible to sustain continuous communication over HF radio circuits.

The Auroral Zone

In an oval region roughly symmetrical with the earth's magnetic poles the ionosphere is often highly disturbed because of complex interactions between the earth's magnetic field and the particle flux continuously emitted by the sun. The solar particle flux, frequently called "solar wind", changes continuously depending upon the conditions on the sun's surface.

Ionosphere absorption events in the central and northern portion of Alaska are identified with three types of solar radiation. Explosions of tremendous energy occurring on the sun may project very high energy particles into space that reach the earth's orbit in about one and a half hours. These particles are deflected by the earth's magnetic field over the entire polar cap, even extending as far south as Fairbanks, Alaska. The particles penetrate to about 50 kilometers altitude and result in intense ionization in the lower ionosphere. This results in a strong absorption of radio waves that may persist for several days. The high energy but relatively low density particles are often followed by a much higher density, low energy cloud of particles that travel from the sun to the earth in about thirty-six hours. This slower particle radiation distorts the earth's magnetic field in space and gives rise to large magnetic disturbances and aurora.

Communication Anomolies—Water—Ice—and an Active Ionosphere

The ionosphere above Alaska between Fairbanks and the north Arctic coast is almost continually disturbed by solar-initiated radiation. To communicate one must wait for propagation conditions to reach a state where his assigned frequency will be returned to earth at the right distance without being highly absorbed or multi-reflected.

The radio energy transmitted from an HF antenna may be divided into two distinct radiations, a sky wave, which must depend on favorable ionospheric conditions for satisfactory utilization, and a ground wave, which travels along the surface of the earth and is usually quickly dissipated as heat in the conducting surface. Across a highly conductive surface, such as sea water, the radio wave suffers very little absorption. Similarly, with a non-conducting surface the absorption would be very low. However, a poor conductor such as the surface soils in northern and central Alaska will rapidly attenuate ground wave propagated radio waves in the high frequency bands. For example, a 5.0 MHz signal would typically be reduced by a factor of 100 in field strength in traveling from one to ten miles across the soil condition of interior Alaska. A standard broadcasting station on 1.000 MHz with a vertical antenna and 10,000 watts of power could be satisfactorily received for about one hundred miles. At 5.0 MHz the signal would be similarly received at thirty miles. Most HF communication antennas discriminate against the ground wave propagation and are therefore dependent on ionospheric conditions for satisfactory communication, even for very short distances.

Single Sideband Performance

Single sideband equipment does have several worthwhile advantages in HF communications. The older high frequency transmitters produced a signal consisting of a radio frequency carrier and a group of frequencies slightly above and below the carrier called the upper and lower side bands. This is the amplitude modulated (AM) mode of radio transmission. Any receiver that could be tuned to the carrier frequency could receive the signal and both transmitter and receiver were easy to maintain and operate.

The intelligence information contained in either sideband, under normal receiving conditions, and in the presence of random noise, improves the "signal to noise" relation by a factor of two. If the AM signal is transmitted through an ionized region the upper and lower signal band may propagate at different velocities (a dispersive medium) and arrive at the receiver out of phase in such a manner as to interfere with each other and partially or completely destroy the intelligibility of the transmission.

In a single sideband transmitter the carrier frequency sidebands are suppressed and one selects to transmit either the upper or lower sideband. The carrier frequency must be reinserted at the receiver in order to retrieve the information from the sideband signal. Since the carrier and one sideband are not transmitted the average power requirement for the transmitter is reduced by about a factor of four. This is an important advantage for a single sideband (SSB) over an amplitude modulated system. The complexity of the transmitter circuits and difficulty of maintaining the equipment in proper adjustment must be listed as a disadvantage for single sideband systems. The single sideband receiver must be more stable than required for AM reception and the frequency of the reinjected carrier must be accurate to within a few cycles per second in a million cycles per second. The single sideband transmitter and receiver are therefore more expensive even though a smaller power supply is required.

If a communication system was being selected for a remote, air supplied field site, single sideband equipment would offer perhaps a four-to-one advantage over a similar weight amplitude modulated system. This advantage might result in the ability to communicate when it would otherwise be impossible. Yet it may only extend a period of communication for a few seconds beyond what an amplitude modulated system would provide.

Even with the latest equipment and high-power communication in northern and central Alaska, the success of a high frequency band will be unpredictable and subject to extended periods of communication failure.

Hope for Tomorrow

The Electrical Engineering Department of the University of Alaska, under authorization obtained from the National Aeronautics and Space Administration (NASA) by Governor Keith Miller has been conducting some communication experiments, using the ATS-1 satellite. The satellite is in stationary orbit above the equator at 150° West Longitude. It has been demonstrated that a relatively inexpensive transmitter-receiver station can be utilized in a satellite relay system at 149.22 MHz to communicate almost anywhere in Alaska. Although the results of this experiment are not as yet conclusive, the indications at the present are very encouraging.

Tundra Biome Applies New Look To Ecological Problems in Alaska

JERRY BROWN

The fragile nature of the Arctic and sub-Arctic landscapes has received considerable notoriety in recent years, particularly in connection with efforts to extract and transport oil from the Alaskan North Slope. Scientific investigations of the tundra and taiga ecosystems over the past several decades have been many; however, few have evaluated the pressing question of how sensitive the tundra is to artificial changes and natural stresses. During the summer of 1970, a series of biologically related investigations is being conducted on the North Slope and interior Alaska under the direction and coordination of the Tundra Biome Program of the U.S. International Biological Program. Funding of the 1970 program is principally through the National Science Foundation, which initiated a $300,000 grant in May 1970 to seven academic institutions, including the University of Alaska. Other government agencies such as the Office of Naval Research and U.S. Army CRREL are providing considerable logistical and scientific contributions to the program.

The strategy of the coordinated research effort is to compare natural and disturbed ecosystems in such ways as to establish an early understanding of how sensitive they are to stresses and what mechanisms exist for recovery once damaged. Two sites at Barrow and College are under intensive investigation and a series of sites along the proposed pipeline route is being monitored on a comprehensive basis.

Two types of disturbance or perturbation experiments have been established at Barrow, artificial and natural. The artificial category consists of simulation of anticipated man-made disturbances on the temperature-sensitive permafrost terrain. These include 1) increased soil temperatures to simulate heat flow out of the tundra over a buried hot oil pipeline, 2) increased air temperature and reduction of wind speeds in the plant canopy to test the response of fauna and flora to more favorable growing conditions, 3) physical disturbance of the surface vegetation, and 4) oil spills of different intensities and time on both land and fresh water. Validation of a precision soil thaw model is being conducted on each treatment and on control sites.

The natural perturbations are experiments which simulate naturally-occurring phenomena that affect the rate of nutrient and energy flow through the ecosystem, i.e., soil-plant-air processes. These include 1) clipping of vegetation to simulate increased animal grazing, 2) mulching of natural plant litter to simulate accumulation of organic matter, and 3) fertilization of both terrestrial and aquatic systems.

On both categories of sites, projects are measuring plant and animal productivity, microbial activity, insect life cycles, soil and air temperature regimes and a variety of other physiological processes. Each treatment is being compared with undisturbed, controlled sites. Over 40 scientists and technicians were involved at Barrow in June.

The College site is located on the area adjacent to the buried hot pipeline experiment at the University of Alaska. Here the micro- and macroflora and fauna and micromet in the undisturbed forests adjacent to the pipeline are being monitored at regular intervals. Results from concurrent research sponsored by TAPS on the pipeline itself will be compared with findings from the undisturbed area. A similar strategy is being followed along the proposed pipeline route where a team of NSF-sponsored scientists will scrutinize the undisturbed vegetation adjacent to revegetation plots established by TAPS researchers. Other comparative studies between Barrow, Prudhoe Bay and Interior Alaska are included in the integrated program.

In order to analyze the immense amount of information emanating from these studies, a central data processing system is being established at the University of Alaska. Weekly data are being funneled into the system and individual researchers will receive weekly statistical reports of the preceding sample period. By summer's end, summarized data reports and initial interpretations will be available. Funding for the data processing is partly coming from the oil industry. Both ARCO and BP are making contributions to the Tundra Biome Program; these funds will be applied to central analytical and data processing services for the many projects.

This summer's research is not only an experiment in new techniques in ecological manipulations, but is also an experiment to determine the effectiveness of a large group of individual scientists and engineers working together as a multidisciplinary team. It is anticipated that this approach will help shorten the time required to answer the many pressing questions concerning Alaska's terrestrial environmental problems. Additional information on the program is available from Jerry Brown, Director, Tundra Biome, Box 1601, USA CRREL, Fairbanks, Alaska, or Dr. George C. West, University of Alaska, College, Alaska.

Jerry Brown, Ph.D., U.S Army Cold Regions Engineering Laboratory, Box 1601, Fairbanks, Alaska 99707. Director of IBP Tundra Biome, research soils scientist, associated with Earth Sciences branch of CRREL.

Arctic Research

PHIL JOHNSON

The Arctic is again becoming a land of mystery. In the days of Hudson and Cook the area was truly unknown. During succeeding centuries it was studied, often at relatively high cost, and much of the mystery dispelled. Then following World War II a new period of scientific and engineering studies was inaugurated and knowledge grew fairly rapidly. Suddenly, with the discovery of the Prudhoe oil, other people and resources moved into the area and Arctic studies grew at an accelerating rate.

Our new mystery is — what do we know about the Arctic? We have learned and are learning a great deal but the information is unorganized and fragmented and we are at a stage of Arctic anarchy and cold regions confusion. During the last two years the University of Alaska, like other centers of expertise in cold regions, has seen numerous visiting groups, particularly from the oil industry, who have been picking brains. They needed and wanted to know what was known and going on and could only find out by visiting those with knowledge in the field. Since the principal sources of knowledge are in Washington, D.C., Hanover, N.H., Port Hueneme and Menlo Park, Calif., Montreal and Ottawa, Canada, and College, Alaska, these orientation trips were extensive and expensive.

The rapidly growing Arctic knowledge has reached the point where it needs to be collected and organized. Currently there are two groups which are in the Arctic or cold regions area with information programs. The Cold Regions Research and Engineering Laboratory, U.S. Army, at Hanover, New Hampshire, publishes the **Bibliography on Cold Regions Science and Technology** with emphasis on engineering. It is designed primarily to meet the needs of the laboratory but is available to others. The Arctic Institute of North America publishes the **Arctic Bibliography** which deals with the earth, physical and life sciences and the arts and industries of the Arctic. Unfortunately, it is not current although AINA is working to bring it more up to date. There are other smaller programs but there are no good comprehensive information systems on the Arctic.

Several groups are considering the field of Arctic information. The U.S. government has assigned responsibility in this field to the National Science Foundation but no programs have been funded. The committee on Polar Research of the National Academy of Sciences is currently considering the general field. The most advanced program is that by the Federal Field Committee for Development in Alaska and the University of Alaska. To meet Alaskan needs they have solicited and are currently considering a proposal by Battelle Memorial Institute to develop an Arctic Environmental Information and Data Center (AEIDC) at the University of Alaska. This project would provide a complete and modern information program including interfacing with other programs such as the CRREL and AINA work; information acquisition, analysis and evaluation; and services such as response to inquiries, current awareness bulletins, technical notes, and reviews of recent developments. Battelle also proposes to seek up-to-date information such as progress or other interim reports and states that they can secure "proprietary information" from industry.

The current pattern of Arctic work makes an Arctic information center in Alaska of key importance. The federal research programs have been based either in Washington, D.C., or in laboratories in various places in the "lower 48." However, an increasing amount of work has been carried out at the University of Alaska in recent years. When the oil industry moved in following the Prudhoe discovery, this new effort immediately grew to exceed that of all others working in the area. The Arctic work cannot be pulled together in Texas or in Washington, D.C., and the logical point for the Arctic center is in Alaska, "where the action is" and where the facilities can be established. The Arctic Environmental Information and Data Center will probably be one of the most important tools for unravelling the new Arctic mystery.

IAEE Appointment

Dr. Tunis Wentink Jr., has been appointed Associate Director of the Institute of Arctic Environmental Engineering at the University of Alaska.

Professor Wentink is no stranger to Alaska, however, having served two years ago here as National Science Foundation Visiting Professor in Physics with the Geophysical Institute.

Prior to joining IAEE, Dr. Wentink headed the Experimental Physics Department of Panametrics, Inc., in Massachusetts. His research there included studies of application of advanced measurements technology to Arctic environments. He has also held posts as Senior Staff Scientist of the Space and Atmospheric Sciences Directorate, GCA Corporation; Senior Consulting Scientist of the Avco Corporation Missile and Space Systems Division; Principal Research Scientist at the Avco Everett Research Laboratory; and Physicist at the General Electric Advanced Electronics Center.

Dr. Wentink graduated from Rutgers University, did additional work at Princeton and Massachusetts Institute of Technology, and earned his doctorate at Cornell University.

A wide variety of research topics interests Dr. Wentink, who has published since 1947 over fifty papers on missile reentry, optics, infrared radiation, molecular spectroscopy, chemical kinetics, plastics behavior, and other subjects. In addition, he has had extensive field test experience with industry and the U.S. Navy.

South of The North

BILL HUNT

AN URGENT CALL TO ALL ALASKANS OF GOOD CONSCIENCE WITH SINCERE SENSE OF DUTY. This banner headline introduced a May 1 ad in the **Fairbanks Daily News-Miner** and injected a new note in the shrill struggle between the saviors and the developers of the North. The ad asks all Alaskans to contribute to the improvement of Southern California's ecology by supporting a suit to force closure of all freeways, refineries, etc. in Los Angeles County. This does seem a worthy and unselfish cause. As the ad points out, the beautiful Ponderosa pines in the San Bernardino National Forest are in danger and "those trees belong to us, too." Contributions can be addressed to Alaskans Concerned for Neglected Environments, Box 287, Yakutat, Alaska 99689.

* * *

Among the contemporary problems we should not be expected to worry about is the prevalence of permafrost in Mississippi. Yet an ad in a recent **Engineering News-Record** placed by Michael Baker, Jr., Inc., a consulting engineering firm of Jackson, Miss., calls for engineers experienced in Arctic conditions and permafrost. With a sense of relief we discover by a closer look at the ad that the positions will be in Alaska. Maybe, after all, permafrost doesn't plague Ole Miss, but where do they keep their permafrost experts?

* * *

Speaking of experts, the most illuminating report on the first MANHATTAN icebreaking voyage came from the much respected national newspaper, the **Christian Science Monitor.** One of the Boston-based journalists reflected on the voyage and the experiments undertaken by University of Alaska engineers concerned with utilization of grounded ice islands off the Arctic coast and described the engineers building ice islands "while taking part in the Northwest Passage of the MANHATTAN." What incredible energy the engineers must have had in order to jump from the tanker every time it halted and rush some thousands of miles to Prudhoe Bay, build a little ice, then hurry back! It got easier, of course, as the MANHATTAN got closer to Prudhoe, then harder again as the ship headed back to the east coast. One can only conclude that the Alaskans have boundless spring and that some reporter needs a lesson in geography.

* * *

If Eskimos ever attended cocktail parties in Houston or New York they might be rewarded with a lot of information on the Arctic. The country is rich in instant northern experts these days, those who easily dominate all social gatherings with their easy "just got back from the Slope" opening gambit. Unless their auditors can rally with a quick reference to what they observed at Inuvik, they are outdistanced for the rest of the evening.

* * *

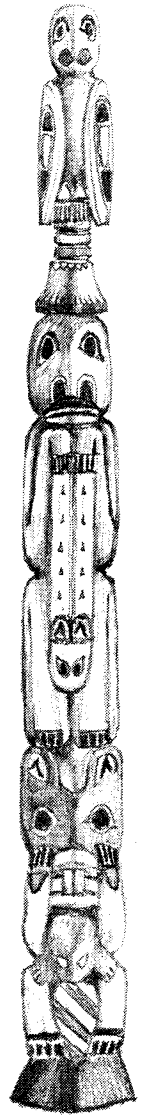
"From Desolation to Desolation in 100 Years" might make a good title for a book on the popular conception of the North. Many issues of nineteenth century maps of North America indicated that the extreme northwest of the continent was "desolation." That wasteland image was removed temporarily by the northern gold stampedes and certainly the great oil boom should have had the effect of erasing it forever. Unfortunately, however, the old image still prevails. Ironically, our plight is the direct result of the discovery of mineral riches. The very development that has led us out of desolation will lead us back again. Mapmakers, noting the destruction of our fragile ecology, will again label the region "desolation." It's discouraging.

* * *

Oil slicks off the Alaska Peninsula caused a great stir during the Environment Week celebrated nationally this spring. Photos showing a dead whale and dead sea otters were offered as grisly illustrations of the oil's peril. It was front-page news until it was discovered that the whale had earlier died of other causes and the dead sea otters were live seals photographed a year earlier. A very close scrutiny of the Fairbanks newspaper revealed a small note hinting that the captions might have been wrong. It is apparently no news that Associated Press sometimes uses whatever material is on hand.

* * *

Good news has been received concerning the Soviet icebreaker **Lenin** over whose disappearance we have agonized recently. According to a visiting Soviet scientist, the **Lenin** has been extensively refitted and is expected to be in service on the northern sea route this season. If this proves true the icebreaker gap between the United States and the other northern powers seems likely to widen.



TIDES AT POINT BARROW

J. BRIAN MATTHEWS

Most people are familiar with the daily rise and fall in the sea levels, the tides, and the course of these tides is predicted with fair accuracy for most parts of the world. However, in the Arctic Ocean we are faced with quite a different situation. There, not only the ocean water must rise and fall, but its icy lid must move as well. **The Tide Tables for the West Coast of North and South America** list only four tidal stations from MacKenzie Bay in Canada to Kotzebue on Alaska's northwest coast.

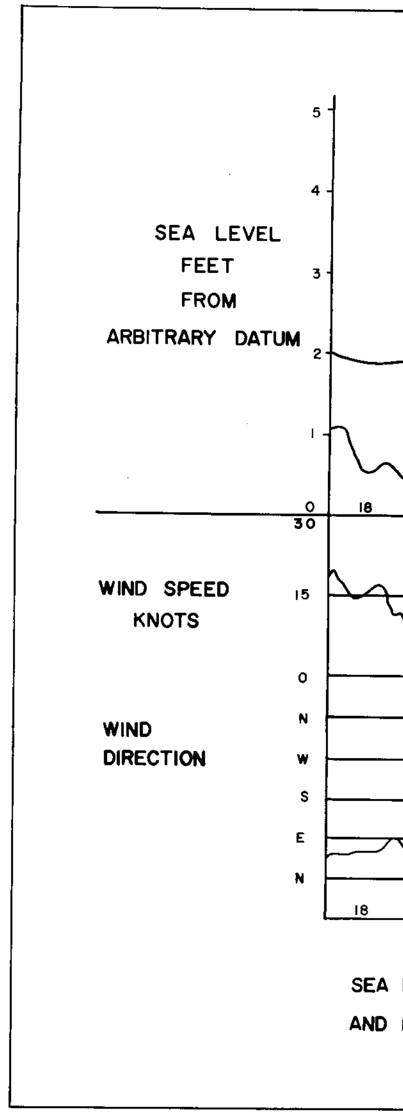
Tidal stations have been successfully operated year-round both on the Canadian and USSR Arctic coasts, but only at Point Barrow has this been attempted in Alaska. One of the great problems in making tidal observations in the Arctic Ocean is measuring the position of the water surface with respect to a fixed mark. The standard procedure used by the U.S. Coast and Geodetic Survey is to use a stilling well of about 10-inch diameter fixed vertically with its lower end below the lowest anticipated water level. The bottom of the pipe is sealed, except for a small pipe which connects it to the ocean and serves as a damper to eliminate sea and swell waves. The water level in the pipe is measured by a float mechanism. Direct comparisons between the float recorder and the water level as read from a tide staff are made regularly. The tide staff is surveyed accurately to tie in with fixed bench marks.

Such a system is difficult to operate in the Arctic Ocean. Allan Beal of Scripps Institution of Oceanography attempted to run such a system at Point Barrow in connection with the International Geophysical Year. His well was sunk into the gravel some thirty feet from the ocean, using a layer of oil on the water in the well to avoid freezing. The measurements obtained contained a hydrologic factor since the measurements of sea level were made through a gravel spit. The layer of oil in the well also caused the instrument float to be raised higher than the actual ocean level. He made some comparisons of the level recorded in the well with those from a recorder on the ice, but was unable to make tide staff comparisons.

J. Brian Matthews, Ph.D., Assistant Professor of Marine Science, Institute of Marine Science, University of Alaska, College, Alaska 99701.

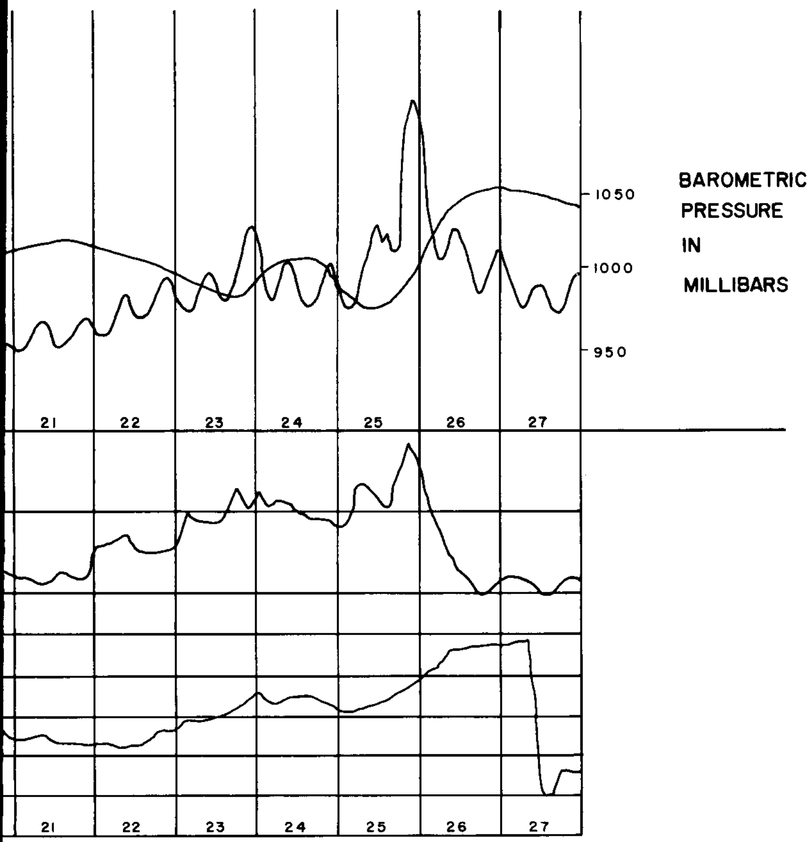
With the cooperation of the U.S. Coast and Geodetic Survey (USC&GS) and the Naval Arctic Research Laboratory at Barrow, the Institute of Marine Science has installed a bubbler pressure gauge in the ocean at Eluikak Pass. It has operated continuously since the end of September 1969, and comparisons with a fixed tide staff are made whenever ice conditions permit. The bubbler gauge bubbles nitrogen gas through an orifice fixed near the ocean floor in permanently unfrozen water. The back pressure in the connecting tube is measured and recorded in a heated hut on shore. This type of instrument is quite widely used now by the USC&GS and produces reliable results since there is no hydrologic factor nor freezing to worry about.

The mean lunar tide range for the Arctic coast of Alaska east of Cape Lisburne is roughly a foot. At first sight then, the tides appear not to be important along this coast. Our records show a semidiurnal tide, as other investigators have reported. The most notable features of the record, however, are the non-tidal components. These are probably the result of wind and pressure fields which, at the time of the equinoxes, can cause changes in sea level of as much as five feet over a period of a few days. In addition to these storm surge effects, there are also steric effects which result in



seasonal variations of sea level as much as three feet in the offshore waters. These variations occur because the sea water density in the Arctic Ocean changes greatly in the surface layers from summer to winter.

An example of the changes in sea level which can occur is shown in Figure 1. The sea level is shown for the 18th through the 27th of October, 1961. A tidal variation is clearly seen, but it is superimposed on a much larger general rise in level. The wind fields show the wind swinging from easterly to southerly through westerly to a northerly direction, and generally increasing in strength over this period, which has the effect of piling water onto the shore. The barometric pressure also tended to decrease through the 24th of October, but through the 25th and 26th the pressure suddenly



OCTOBER 1969

S FROM ELUIKAK PASS, POINT BARROW, AND WIND
ORDS FROM THE WEATHER BUREAU, POINT BARROW, ALASKA

increased and the wind dropped, resulting in a very rapid decrease in sea level. The variations in this case are fairly clearly linked to the passage of an atmospheric pressure system (See Figure 1.) Many of the other changes in the sea level are not as simple to explain.

The implications of these phenomena for coastal regions can be quite serious. The storm of 1963 at Point Barrow, for example, piled up enormous quantities of ice on the beaches and caused millions of dollars worth of damage to equipment stored on the foreshore. Our work is aimed at finding out the relationships between the wind, pressure, sea level, density and ice movement in an effort to make useful predictions. This will become increasingly important with the development of the Arctic Ocean as a year-round shipping lane.

We are presently working on this problem and hope to be able to expand the work to include tide gauges at other sites along the coast so that better predictions can be made. The instrumentation, however, requires a heated hut and operator attention every other day as well as a coastal area with about 10 feet of water near shore. There are not many places in Arctic Alaska which fill all these requirements. Moreover, there does not appear to be a more suitable sea level recorder than the one now being used. We are designing an instrument for tide and current measurement in the Arctic but this is still in the planning stage.

The operation of the present gauge has not been easy. It involves a five-mile journey across a frozen lagoon or a seven-mile trip along the spit from NARL at Point Barrow. During the dark winter period and at other times when winds cause complete white outs, this becomes almost impossible. Moreover, even the Arctic foxes have tried to hinder our work with their taste for our rubber pressure hose. Originally, it was planned to couple the sea level measurements with measurement of sea-ice movement and weather records. Shortage of funds has so far made this impossible, but we hope to do this at a later date. At present we are relying on weather data from the Barrow weather bureau which is nine miles from the tide gauge. A timely grant from the Arctic Institute of North America has allowed the continuation of the project at its present level.

Preliminary spectral analysis of the sea level records shows long term variations to be of greater magnitude than the diurnal and semidiurnal constituents. This is, of course, quite different from the results found in other oceans. In a "normal" ocean the greatest energy is in sea and swell waves. In the Arctic Ocean sea and swell are measured in microns rather than meters, and the energy spectrum tends to have the greatest power in the long period waves which can travel relatively unhampered by the surface ice. Our work, with six-month's continuous hourly data, is filling in some of the gaps at the long period end of the spectrum.

Our interest in tide and tidal models in general has directed our attention to related problems in the Arctic. Data analysis has been facilitated by the ready availability of computer programs from work in these other areas. Last year we completed a numeric model to predict tides and currents in Cook Inlet. One of our students is presently studying shallow water modeling techniques with the world experts in Holland and England. We are hopeful that in the not-too-distant future we shall be able to include the near-shore ice movement in our models and thus make Arctic Ocean shipping operations more predictable.

Heat Loss and Condensation In Northern Residential Construction

AXEL R. CARLSON

Axel R. Carlson, M.S., Associate Professor of Extension, Cooperative Extension Service, University of Alaska, College, Alaska 99701, a farm and home structures specialist.

Many people think of insulation only as a method of reducing heating costs. Insulation is also necessary for the control of condensation, convection drafts and radiation of body heat to cool surfaces. Some temperature gradients, insulation "R" and "U" values and the relative humidity (RH) at which condensation may occur on typical wall, floor and roof sections are illustrated in Figures 1-4. The inside temperature is assumed a constant 70°F. in all cases and two outside temperatures, 20 and -40°F. are used in each case. Values for heat conductance, U(BTU/ft^2—hr—°F); heat flow resistance, R(1/U); and relative humidity, RH, at which condensation occurs, are given for each example.

Cool wall surfaces result in stratification of the air and uncomfortable

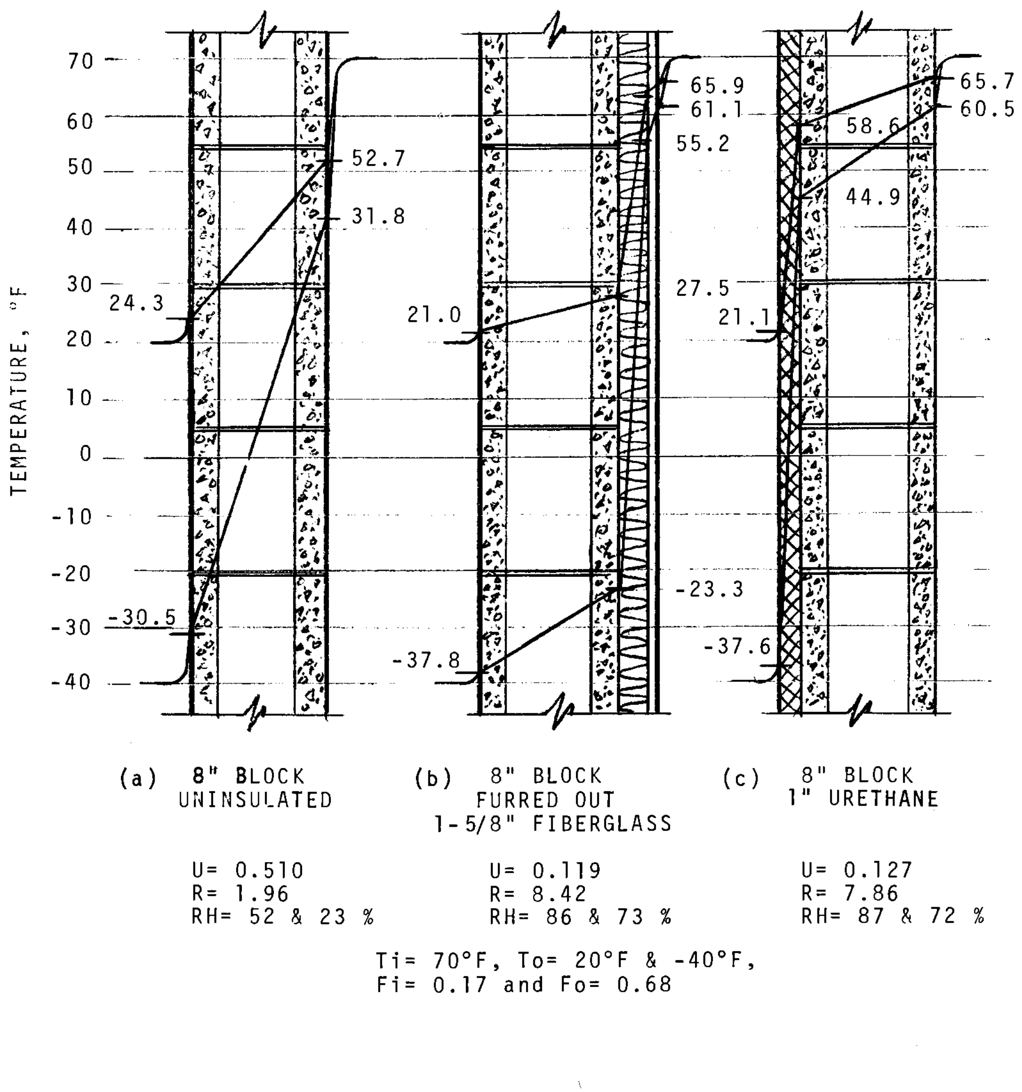


FIGURE 1. TEMPERATURE GRADIENTS OF MASONRY WALLS

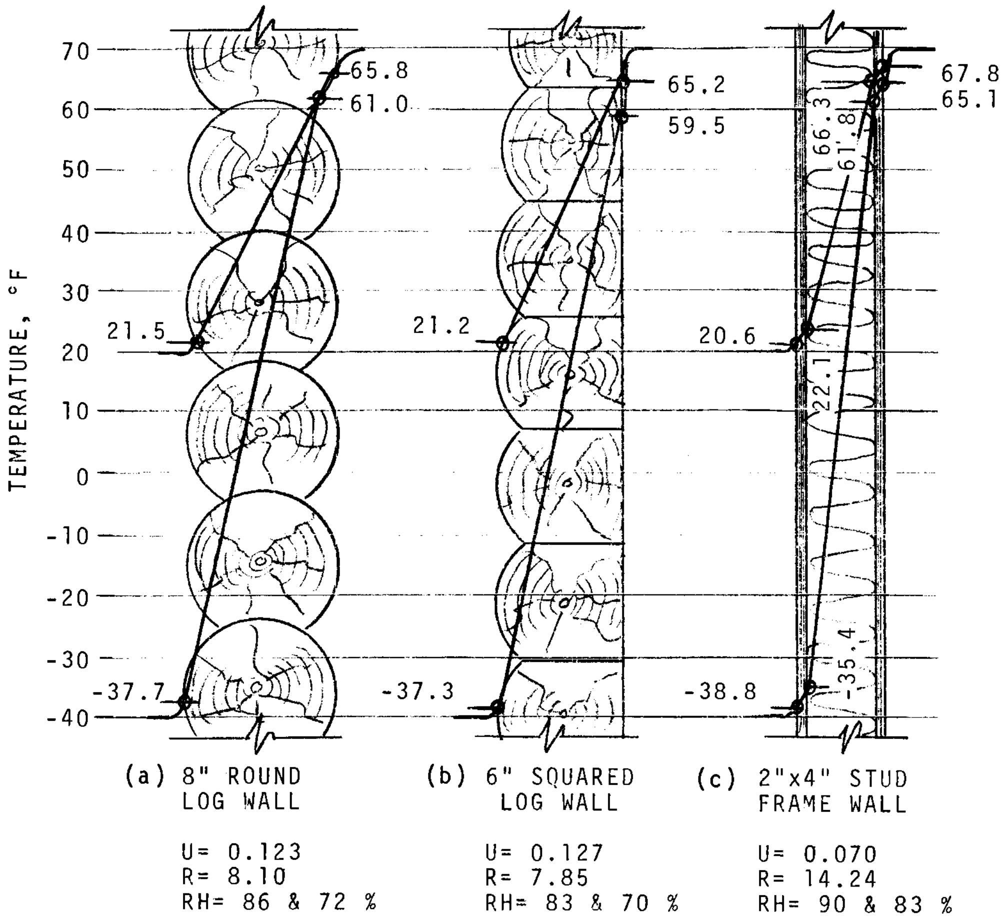


FIGURE 2. TEMPERATURE GRADIENTS OF WOOD WALLS

convection drafts down walls and across the floor. In Figure 1(a) the uninsulated masonry wall would have an interior surface temperature of 52.7°F. at outdoor and room temperatures of 20.0 and 70.0°F. respectively. At -40.0°F. outdoors an interior wall surface temperature of 31.8°F. would result. Furring out the wall and insulating with 1⅝ inches of fiberglass as shown in Figure 1(b), would increase the interior surface temperature from 52.7 to 65.9°F. at 20.0°F. outside. At a -40.0°F. outdoor temperature, the interior surface temperature would be increased from 31.8 to 61.1°F.

Condensation would occur on the uninsulated wall in Figure 1(a) at a relative humidity of 52 and 23 percent respectively. With the 1⅝ inches of insulation, condensation would occur at humidities of 86 and 73 percent respectively.

A new technique, spraying the exterior of masonry foundation walls with foamed-in-place urethane, is illustrated in Figure 1(c). This technique allows the interior face of the wall to be used as a finished surface. Note that the exterior face of the masonry is 58.6 and 44.9°F. as compared respectively to 21.0 and -37.8°F. in Figure 1(b). Other types of foam insulation may be used. The exterior surface of the plastic insulation must be protected from the ultra-violet light of the sun by an approved coating.

The heat loss (the U value) of 8-inch round logs and 6-inch squared logs is nearly twice as high as a 2" x 4" stud frame wall with full insulation (Figure 2). Condensation and ice may accumulate between the logs if the joints are not properly sealed with a non-hardening caulking compound. Convection drafts and radiation to cooler surfaces, however, can be eliminated with conventional hot water or electric baseboard radiation or perimeter hot-air registers. The smaller window areas, usually a part of log cabin design, often compensate for the higher heat loss of the solid wood walls.

Figure 3 illustrates floor heat losses. The special case for permafrost areas is considered in 3(b) and 3(c) with a crawl space at ambient temperature. The uninsulated floor with a closed crawl space (unheated), Figure 3(a), has an interior floor surface of 58.6°F. with a crawl space temperature of 35.0°F. Unfortunately, in the permafrost areas of Alaska, heating of the crawl space or basement would melt the ice, causing uneven heaving and settling of the foundation.

With an unheated crawl space to prevent rapid thaw of permafrost and three inches of fiberglass in the floor as shown in Figure 3(b), a floor surface temperature of 66.9°F. would occur at an outdoor temperature of 20.0°F., while a temperature of 63.1°F. would occur at -40.0°F. Not only would direct body radiation to the cool surfaces cause discomfort, but an anticipated air stratification of 6 to 12°F. between the floor and ceiling would cause further chilling of the body. Although pumping heat into the crawl space or basement would warm the floor, melting of the permafrost may cause uneven heaving and settling of the foundation. In permafrost areas the foundation should generally be left open for natural ventilation, and the floor should be insulated to prevent melting of the permafrost.

One of the most practical methods of providing a warm floor in permafrost areas is to pump warm air between the floor framing members as suggested in Figure 3(c), leaving the crawl space open for natural ventilation. In this example the floor surface would be warmed to room temperature, allowing the surface temperatures within the cavity to drop to an anticipated low of 66.4 and 61.9°F. for outdoor temperatures of 20.0 and -40.0°F. respectively.

The temperature gradients for

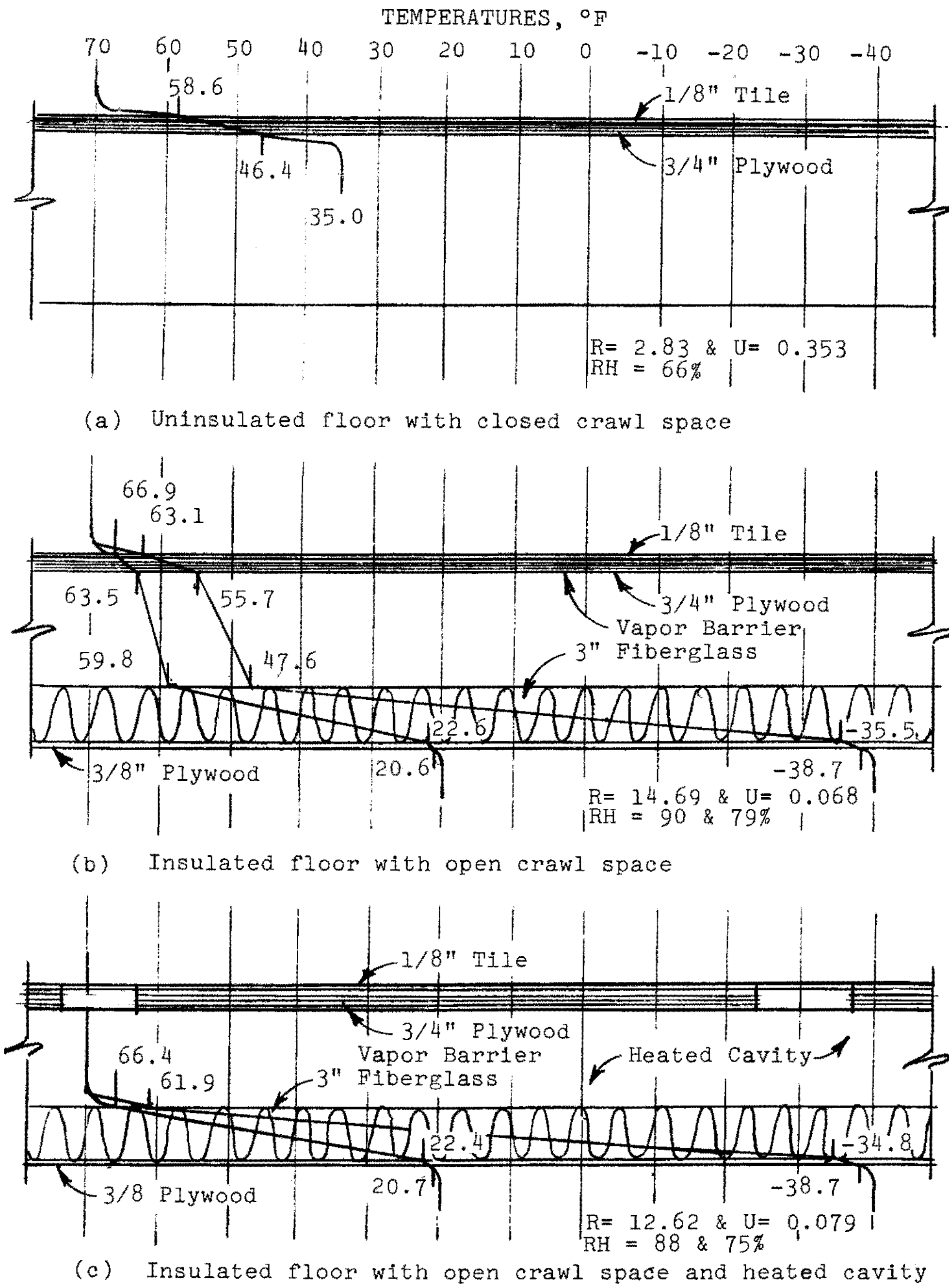


FIGURE 3. TEMPERATURE GRADIENTS OF FLOORS

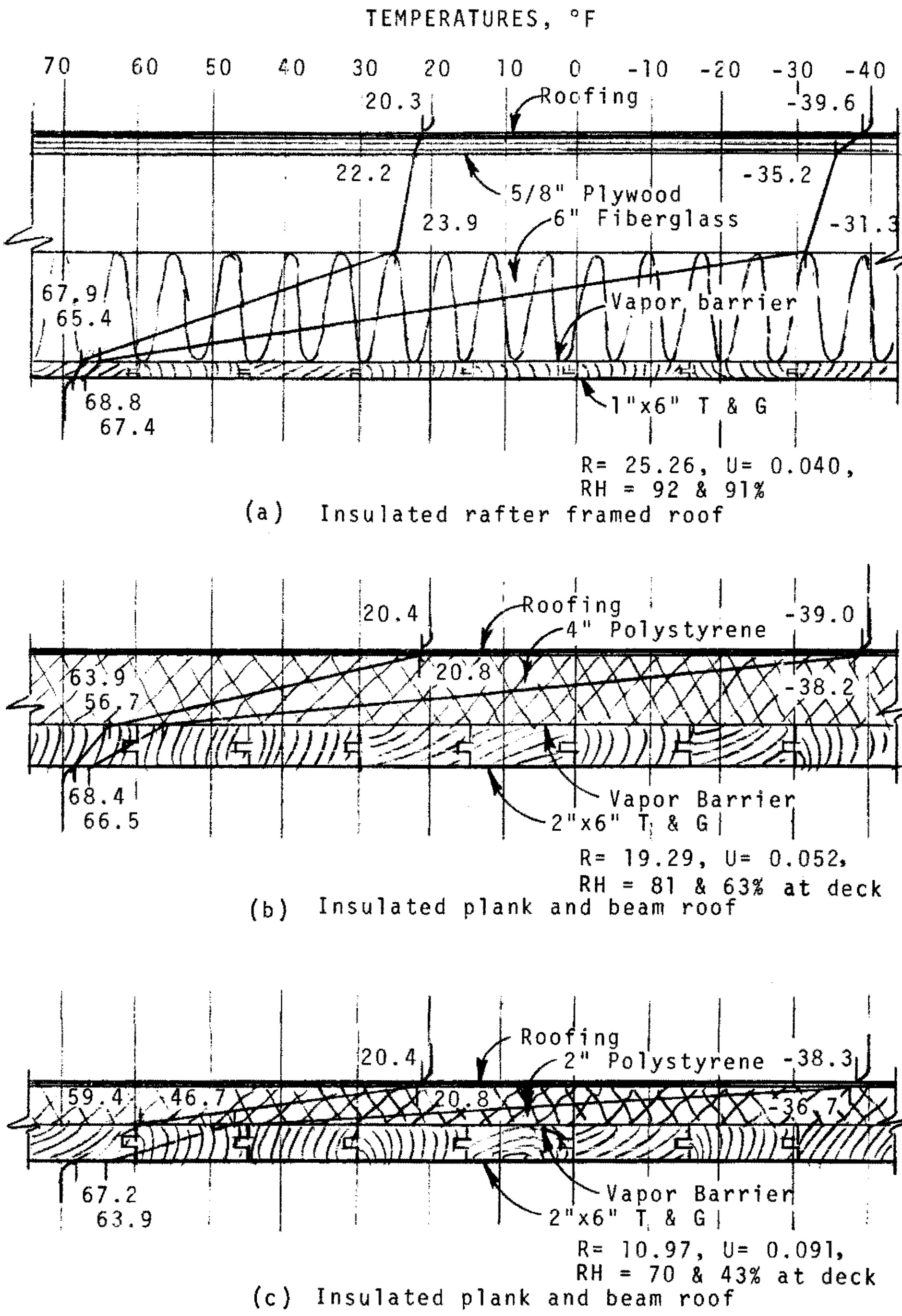


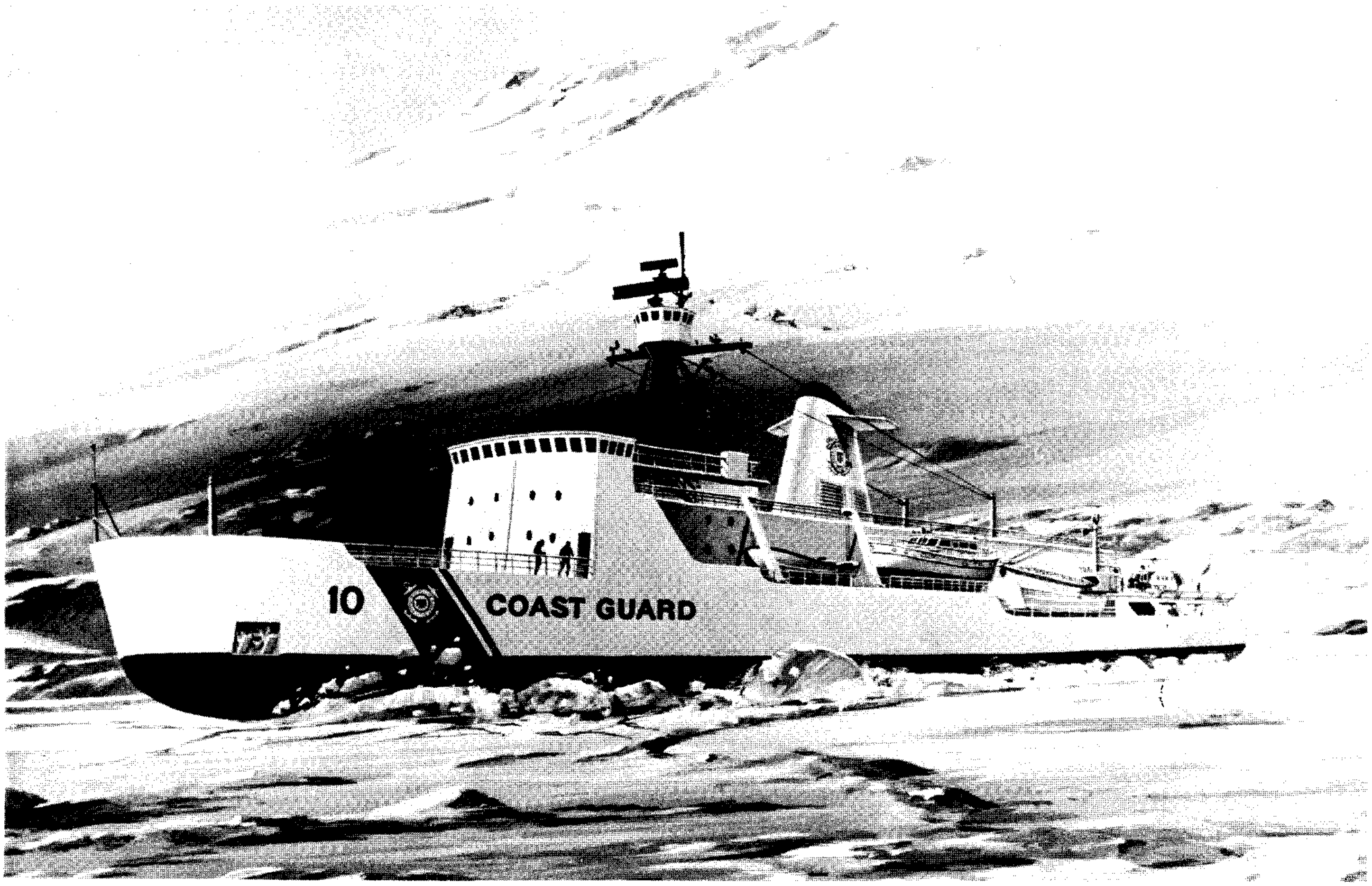
FIGURE 4. TEMPERATURE GRADIENTS OF ROOFS

roofs, illustrated in Figure 4, are a lesser problem. Although adequate insulation is necessary to control heat losses and condensation, stratification of warm air near the ceiling has a tendency to shield against radiation heat losses. Usually the greatest amount of insulation is placed in the ceiling; such design tends to compensate for excessive heat losses through windows and doors. Internal temperature gradients of roof sections are often a cause of insidious moisture leaks. Such leaks in the roof are caused by inadvertent rupturing of the vapor barriers with the accumulation of water or ice in the roof cavity.

A conventional frame roof with six inches of fiberglass insulation is examined in Figure 4(a). At outdoor temperatures of 20.0 and -40.0°F. the inside surface temperatures would be 68.8 and 67.4°F. respectively. Usually a vapor barrier in a plank-and-beam roof, Figures 4(b) and 4(c), is placed on top of the roof decking. In spite of a vapor barrier, one must be extremely cautious about the amount of insulation and the relative humidity of the heated space. A condensation problem may occur between the vapor barrier (rigid insulation) and the roof deck. This sort of problem generally becomes visible on the exposed surfaces of the ceiling. Failure to seal the joints of rigid plastic insulation may result in a serious condensation problem with accumulation of ice under the roofing during subzero temperatures followed by melting and seepage during warmer weather.

In summary, the temperatures of interior surfaces can be brought closer to ambient room temperatures by increasing the "R-value" (reducing the "U-value") of the particular section. In most situations it is more practical to supplement the wall insulation by baseboard radiators or perimeter hot-air heating systems. In permafrost areas where open crawl spaces are required, it may be necessary to supplement floor insulation by forcing heated air into the floor framing cavity.

Coast Guard Announces Plans for New Icebreaker



The U.S. Coast Guard has released general design details and an artist's rendering of a new icebreaker included in the Service's proposed 1971 budget.

Design plans for the icebreaker call for an engineering plant rated at about 40,000 shaft horsepower. Its 385-foot length and 12,200-ton full-load displacement will make it both the longest and heaviest cutter in the Coast Guard.

The Coast Guard's new icebreaker will be powered by an engineering plant combining diesel engines with gas turbines. For most operations and economy's sake, the diesels will be used. In extremely heavy ice, such as that to be found in the Northwest Passage and off the North Slope of Alaska, the cutter will have the full power of its gas turbines available.

The new icebreaker will also serve as a scientific and oceanographic research vehicle. Incorporated into the hull design are spaces for both wet and dry laboratories. The ship will also be capable of carrying up to three portable vans which can be rigged for several types of scientific activity. Additional plans provide for the installation of a computer center for on-scene processing and analysis of data.

Two Coast Guard helicopters will be carried by the ship. They will be used in logistic operations, ice reconnaissance, and rescue work.

The Coast Guard has spent three years of study in perfecting the cutter's special icebreaking characteristics. The bow configuration is based partially on studies done by Coast Guard Commander Roderick M. White, whose ideas were incorporated into the bow design of the icebreaking tanker MANHATTAN. In the hands of the Coast Guard's Office of Naval Engineering, the basic design has undergone a number of modifications and successive refinements. Model basin tests of four different hull shapes led to the design which has now been approved. Tests have indicated that 60 to 70% of the resistance encountered in breaking ice results from pushing broken ice aside.

When constructed, the new cutter will be the first addition to the U.S. icebreaking fleet since the Coast Guard Cutter GLACIER was built in 1954. GLACIER is destined to remain in service through the 1970's. The Coast Guard operates six other polar icebreakers, built between 1943 and 1947, which will be phased out as new ships are constructed. Long-range plans, based on a 1968 study of polar transportation requirements, call for construction of four new icebreakers to replace the six whose ages will approach thirty years by the time construction takes place.

Canadian Research

L. W. GOLD

The Division of Building Research of the National Research Council of Canada has carried out an active program of research in the North of Canada during the past 20 years on permafrost and ice. Permafrost research has included mapping the distribution of permafrost and studies of the design, construction and performance of engineering structures in the North; ice engineering studies have included investigations of the forces that ice exerts on structures, the bearing capacity of ice covers and the formation growth and breakup of ice in lakes and rivers.

PERMAFROST RESEARCH

The culmination of many years of field studies on the distribution of permafrost was the publishing, in 1967, of a map that delineates the southern boundary of the permafrost region. This map was published jointly by the Division and the Geological Survey of Canada. The collection of information on the distribution of permafrost is continuing; it is planned to revise the map in 1970.

There is a rapidly growing need for information concerning the factors that control the natural occurrence and stability of permafrost. A study was undertaken of these factors in 1967 at Thompson, Manitoba, located in the discontinuous permafrost zone. Ground temperatures to a depth of 25 ft. and the depth of annual freeze and thaw are being observed at four sites with different surface characteristics. Observations are being made as well of air temperature, precipitation, snow depth and density. Measurement of the energy exchange at the surface was begun in 1969. A net radiometer, anemometer and two heat meters placed at a depth of 12 inches were installed at each site. Observations of the moisture regime and detailed mapping of the area are being carried out in 1970.

A drilling program has been carried out at Yellowknife, N.W.T., in the northern part of the discontinuous zone, in cooperation with the Department of Geography, University of Alberta, as part of a study to delineate the boundary between the continuous and discontinuous permafrost zones. Fifty-foot thermocouple cables and frost gauges were installed at four sites; similar instrumentation will be placed at four additional sites in 1970. Air temperature, snow cover and ground temperature measurements were begun in October 1969, and will be continued for several years. It is planned to undertake similar observations at Port Radium, N.W.T., Churchill, Man., and Rankin Inlet, N.W.T.

A long-term study has also been undertaken of the distribution of permafrost in the mountainous area of western Canada, in cooperation with the Department of Geography, University of British Columbia. Installation of thermistor cables at microwave stations on selected mountain summits was begun in 1969. Additional sites will be instrumented in 1970 and 1971.

Investigations were carried out in cooperation with the Flight Research Section, National Aeronautical Establishment (N.A.E.) of the National Research Council of Canada, on the possible use of infrared sensing techniques to map the distribution of permafrost. A 1200-mile traverse was flown at altitudes of 500 and 2000 ft. in July 1969, in the discontinuous zone of northern Manitoba to test this method. The North Star aircraft belonging to NAE was equipped with an infrared point scanner (3-5 and 8-14 micron bands) which was operated continuously throughout the flight. Continuous coverage was also obtained on 35-mm black and white panchromatic film, and selected stretches of terrain were photographed in 70-mm color and 70-mm false color.

Studies to assess the effect of a large fill on permafrost were begun at the airport of Inuvik, N.W.T., in 1957. The runway fill (300 ft. by 6600 ft.), taxistrip and parking apron were constructed of crushed rock having a minimum thickness of eight feet. The first phase of the study was completed in 1969 when asphalt pavement was laid, thus changing the surface characteristics of the fill. Ground temperature observations made at two-week intervals on the parking apron and the runway during the period 1957-68, i.e., prior to paving, showed that the permafrost rose about two feet into the fill. It is expected that the asphalt pavement, which is kept clear of snow, will absorb more solar radiation than the original, relatively light-colored, crushed rock surface on which snow was compacted during the winter months. Additional instrumentation was installed at several locations in the runway and taxistrip in 1969 to determine the effect of the pavement on the ground thermal regime. Ground temperature cables and heat flow transducers placed at shallow depths are being monitored continuously. Spot measurements of the albedo of the crushed rock were made prior to paving. The second phase of this study will continue for several years.

Ground temperature observations are made regularly throughout the year in the Inuvik townsite to assess the performance of different types of building foundations and other structures founded on permafrost. Level surveys are made on selected structures during the spring and fall to determine foundation movements. Observations of tie-rod strains and ground temperature changes are being made on the Inuvik wharf.

Field testing of different types of anchors in permafrost is being conducted at Thompson, Manitoba. The anchors are being subjected to constant loads for varying periods of time to evaluate their capacity and to determine if any movement occurs. Some have been under load for more than two years. The program will be completed in 1970. Observations are being made on thermal siphon devices

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L. W. Gold, Geotechnical Division, National Research Council, Montreal Road Laboratories, Ottawa 7, Ontario, Canada.

installed in 1967 and 1968 at Thompson and Ottawa.

Ground temperatures in rock and soil are measured at regular intervals at Thompson for information on the ground thermal regime in permafrost and non-permafrost areas. A cooperative study of a water supply line laid in permafrost at Churchill has been undertaken with the Federal Government Department of Public Works. Thermocouple cables were fabricated and installed and observations begun upon completion of the line in the fall of 1969.

Ground temperature and settlement surveys are being carried out at dykes constructed on permafrost near the Kelsey Generating Station on the Nelson River. Instrumentation, including ground temperature cables, piezometers and settlement gauges, has been installed and observations begun for a similar program on two major dykes at the Kettle Generating Station (downstream from Kelsey) in cooperation with Manitoba Hydro and their consultants.

ICE ENGINEERING

A study is just being completed on the variation in breakup date for about sixty Canadian lakes. The period in which breakup can be expected to occur 95 percent of the time was found to be 30 to 40 days for continental lakes, and 50 days or longer for lakes subjected to mild, coastal weather. Correlation of date of breakup with melting degree-days, accumulated from the time that air temperature goes above 32°F, was not found to be satisfactory where wind and currents have an influence. Even for relatively small lakes which are not greatly affected by wind and currents, the standard error of estimate ranged from 3½ to 8.0 days. Better correlation was obtained between date of breakup and the two variables: date when accumulated melting degree-days reached 50, and deviation of actual air temperature from the long period average air temperature during the melt period. Regression equations must be developed for each lake in order to use the latter method. The accuracy of the forecast equations is limited by variable factors such as wind, initial ice thickness and weather forecasts.

A study is being conducted on the physical process of lake ice melting, particularly the role of solar radiation. Observations on the amount of solar radiation that penetrates ice covers of different types, and on water temperature profiles under melting ice covers, have been carried out at Ottawa, Ontario, and Thompson, Manitoba.

A large proportion of incoming solar radiation can penetrate clear ice of considerable thickness, resulting in a warming of water under the cover. Water temperatures as high as 7.5°C (45°F) were measured under melting ice covers in the Ottawa area. This warm water can significantly increase the rate at which ice is cleared from a lake if the cover is broken up by wind action. If the cover has a substantial thickness of white ice on the surface, solar radiation does not penetrate through it, and the water under the ice does not warm up.

A study was undertaken on the strength and deformation behavior of ice from the St. Lawrence River. Observations were made under conditions of approximately constant rate of strain for four types of ice. Information was obtained on the behavior of the ice when it changed from ductile to brittle. It was found that from an engineering point of view, the deformation behavior of fresh water granular ice and columnar-grained ice with the axis of symmetry tending to be perpendicular to the long direction of the grains, can probably be considered the same.

The Geotechnical Section is also carrying out a program of research on avalanches, avalanche defense methods, and soil mechanics. Further information concerning the work of the Section can be obtained by writing to the Division of Building Research, National Research Council of Canada, Ottawa 7, Ontario.

Letters To The Editor

4345 Ivy Mount Court
Annandale, Virginia 22003
18 May 1970

Mr. William Hunt
Editor
The NORTHERN ENGINEER
University of Alaska
College, Alaska 99701

Dear Sir:

It is with "high dudgeon" that I reply to an article by Mr. J. E. James entitled, "Icebreaker Gap"! (Spring 1970)

First, while I dislike having to soft pedal the U.S. Coast Guard's technical expertise, I suspect that a rigorous historical review of icebreaker design will indicate that the design of WIND Class vessels was in many respects influenced by European and Soviet developments. **Our** contribution was primarily in the area of propulsion system improvement. The pilothouse controlled Diesel Electric Propulsion plant designed for the WIND Class has been copied for many ships and has given excellent service for 25 years.

The U.S. Coast Guard Cutter GLACIER **is** in some respects an enlarged WIND Class ship. The statement that she is not as effective as the WIND Class has not been substantiated. At her maximum power rating of 21,000 HP, GLACIER develops approximately 425,000 lbs. of thrust. Hence, she is theoretically capable of moving continuously through 1.5 meters of sea ice. The WIND Class Full Scale Experiments indicate a capability to move continuously through 0.9 meters of uniform sea ice. The theory of Kashteljan indicates that the WIND Class can handle 1.0 meters continuously.

I will not comment on the motivation to produce a new U.S. icebreaker and the operational requirements for the vessel. But I will say that Mr. James is sadly mistaken on the present plans for the icebreaker. The ship which the U.S. Coast Guard plans to build has the following Gross Parameters:

a. Length between perpendiculars	— 352 ft.
b. Beam (extreme)	— 83.5 ft.
c. Draft (Designer's waterline)	— 28 ft.
d. Displacement	— 12,200 tons
e. Machinery	— 18,000 Diesel Electric Mode — 40,000 Gas Turbine Mode
f. Propellers	— 3 Controllable Pitch
g. Maximum continuous icebreaking capability	— 5.8 ft. uniform cold sea ice ($o_f = 7.0 kg/cm^2$)

The Propulsion System will be a combined Gas Turbine **or** Diesel Electric plant which means one or the other may be operated alone but not jointly. Triple controllable reversible propellers will provide good propulsion efficiency over a wide range of operating conditions.

The ship represents a revolutionary concept in polar icebreaker design. It is a result of four years of extensive engineering research in the field of interaction between ships and ice. To back up this design, experiments have been conducted in model and full scale regimes to determine ice resistance, propulsion plant behavior (including the effects of ice impact on CRP propellers) and maneuverability. The Coast Guard will continue this research and continue to improve the state-of-the-art in Icebreaker Design.

As a parting shot; your readers, familiar with the gradual slope of the Alaskan coast will not, I am sure, agree with Mr. James' suggestion that your tax money be spent on a ship, the draft of which (40-45 ft.) will not enable it to approach the majority of population centers on the Alaskan coast to within 10 miles.

Sincerely yours,
R. Y. EDWARDS, Jr.
U.S. Coast Guard

J. E. James Replies:

"Naturally there is a wide divergence of views between users and designers. I favor the cast alloy steel fixed pitch detachable blade screw used on the WIND class ships over the controllable pitch screws planned for the new icebreaker. It also seems to me that the fuel capacity of the new vessel is woefully inadequate for some of the more difficult operations the Coast Guard could be asked to undertake.

As for Mr. Edward's parting shot, a glance at the charts will indicate that off such major Alaskan centers as Nome, Kotzebue, Barrow, and Prudhoe Bay, a ship with 28-30 feet of draught cannot go in much closer than one of 40-45 feet. Thus the question remains one of providing a vessel with adequate size and power, and I still argue for larger ships."

BERING SEA SYMPOSIUM

A Bering Sea Symposium was hosted by the Geophysical Institute of the University of Alaska from June 26 through July 4. About 40 distinguished scientists from the North Pacific nations of Canada, Japan, the Soviet Union and the United States presented papers on the geology and geophysics of the Bering Sea Basin and contiguous land areas.

Working-group sessions helped establish closer personal and professional relationships among the participants.

The Symposium was opened with the inauguration of the Geophysical Institute's new facility, named for former director C. T. Elvey. Geologic field trips to McKinley Park, the Yukon-Tanana area, Katmai National Monument and Kodiak concluded the program.

Meetings

The 1970 **Alaska Science Conference** slated for August 16-19 on the University of Alaska campus has added one more symposium to its roster, which already included those in Polar Meteorology and Cold Regions Engineering as well as technical sessions. The addition is Alaska Plans and Research Needs for the 1970's. This symposium, which is for groups and organizations engaged in or needing northern research, is jointly sponsored by the Alaska Division of the American Association for the Advancement of Science and the Governor's Office. Mr. Keith Hart, State Federal Coordinator to the Governor and F. Neil Davis, President of the Alaska Division, are co-chairmen. Information on the Governor's Symposium or any other portion of the Conference may be obtained from the AAAS Conference Secretary, Geophysical Institute, University of Alaska, College, Alaska 99701.

CONFERENCE

The Geotechnical Engineering Division of the Engineering Institute of Canada has chosen "Geotechnical Problems in Transportation" as the theme of the **23rd Canadian Geotechnical Conference** to be held in Banff, Alberta, November 19 and 20, 1970. Preliminary announcements invite papers on topics associated with all modes of transportation such as pipeline and vehicleway location and design problems; earth and soft rock excavation for roads, railways, airports, waterways, etc.; design and construction of embankments; terminal facilities; frost action and permafrost problems; soil stabilization; and related topics. Persons interested in obtaining information regarding the program and registration details should contact:

A. B. Hamilton
Department of Civil Engineering
The University of Calgary
Calgary 44, Alberta, Canada

Reviews

Permafrost in Canada: Its Influence on Northern Development, by Roger J. E. Brown. University of Toronto Press, $12.50

Permafrost is of great interest in Canada as the Canadians are actively developing the resources in the permafrost-bearing northern half of their country. Mr. R. J. E. Brown, a research officer with the Division of Building Research, National Research Council of Canada, has prepared this comprehensive introduction to Canadian permafrost and its influence on northern development. Broad factual information on permafrost has been and continues to be difficult to obtain, although the subject is one of great importance in Alaska as well as Canada. Because it is outside the experience of most, several attitudes have developed. Some ignore it, although even the Texans are beginning to respect it. Others fear it and write off the permafrost areas. Still others consider it a manifestation of nature, enshrine it and seek to preserve it along with the associated tundra. This book should do much to put the subject in proper perspective.

While Dr. Brown is a particular authority on the distribution of permafrost in Canada and the physical factors affecting this distribution, he covers these subjects in the first chapter. Succeeding chapters discuss engineering considerations and the interrelationship of permafrost with buildings, utilities, transportation, mining, oil production and agriculture. Much of the book is composed of individual experiences with permafrost. In these narratives the background is given first and the successes and failures in coping with the permafrost are then explained. This approach successfully conveys an understanding of this natural phenomenon.

The book is authoritative and highly readable, and should be in the library of anyone interested in or involved with the north. —P. Johnson

Windows and Environment, edited by D. P. Turner (Design Consultant, J. G. Bedford, MSIA), McCorquodale and Co., Ltd., for Pilkington Environmental Advisory Service.

Windows and Environment, edited by D. P. Turner, treats the subject of windows both philosophically and technically in a complete manner. Though the editor and authors practice in Great Britain they have approached the subject of window design in a general way — presenting basic physical concepts that are valid for design over the whole world. Roughly fifty per cent of the book is dedicated to the aesthetic or philosophical reasoning behind the design of openings and windows. The remaining portion of the work is broken down into sections that deal with heat, light and sound transmission through windows and openings. The section on sound is dealt with most lightly, which is unfortunate because of the growing "sound pollution" problems of large cities. For the designer of sub-Arctic and Arctic structures, though, sound is one of the lesser problems to be dealt with.

One of the real values of the book is the inclusion of an appendix of design aids that allow the user to see the results of his design while the design is still on paper. By use of the plastic overlays included in the book one can trace the daily progress of the sun throughout the year. The system is set up so that a building that may block the sun for part of the day can be included in the view mock-up and the effect of sun shades of different descriptions upon the interior light and heat budget becomes obvious.

The theory and design information presented in the book is generally good for work from the pole to the equator. In fact, sun charts are included to 90° north or south.

It seems to me that the use of **Windows and Environment** with the ASHRAE guides could enable the designer to most logically create plans of structures that are to be inhabited by northern people.

—M. Fryer

Thomas G. Manning, **Government in Science: The U.S. Geological Survey 1867-1894.** University of Kentucky Press, 1967.

Raymond H. Merritt, **Engineering in American Society 1850-1875.** University of Kentucky, 1970.

Robert Harris, **Canals and their Architecture.** New York, Praeger, 1969.

T. Ritchie, **Canada Builds 1867-1967.** University of Toronto, 1967.

Mary Louise and Shelly Grossman and John N. Hamlet, **Our Vanishing Wilderness.** New York, Grosset & Dunlap, 1968.

Carl O. Sauer, **Northern Mists.** University of California Press, 1968.

All engineering projects begin with a survey, and the extent to which our nation's westward expansion was supported by the work of the U.S. Geological Survey is made clear in Manning's book. Only after the 1898 gold rushes did the U.S.G.S. interest itself in Alaska, thus there is no account of northern work here.

"They wanted to be known as men with inquiring minds who were professional problem solvers," writes Raymond H. Merritt of the American engineers of the third quarter of the last century. Merritt sees that period as the key one in the annals of engineering progress and not just because of the bridges, tunnels and other projects which were carried out. It is his thesis that engineers introduced a new set of urban and cosmopolitan cultural values to the nation, values that reflected their own mobility and commitment to efficiency. Particularly interesting is the author's analysis of the teaching techniques developed in engineering schools at this time.

Canals are not entirely a subject for nostalgia. The great age of canal building preceded the railroad era, yet engineers are still utilizing these functional waterways. Harris' leisurely consideration of canal design in England and North America is supported by hundreds of good illustrations.

Canada Builds is also historical and pictorial in its focus, though the text describes those who did the building and the technology and materials they employed.

Striking photographs illustrate **Our Vanishing Wilderness** which concerns the nation's ecology and the threats to it. The book's geographic treatment does not include specific reference to the North but otherwise considers most animal, bird and marine life on the continent. All conservationist books reveal the indignation of their authors at what has been done by man to imperil our ecology, but only those which call for the ban of the automobile should be taken seriously.

Northern Mists is too good a title not to use again so Carl Sauer reconsiders the problems propounded earlier by Fridtjof Nansen in **In Northern Mists.** Some lifting of the obscuring veil time has placed between the earliest North Atlantic explorations and our understanding of them results.

Bill Hunt

Current Publications

Arctic Health Research Center
U.S. Public Health Service
College, Alaska 99701

Cold region water storage practice, by A. J. Alter and J. B. Cohen — reprint from Public Works, 100(10): 109-111, 1969.

R-102 **Design and operation considerations for aerated lagoons in the arctic and subarctic,** by L. C. Reid, Jr., Env. Eng. Sect., November 1968.

R-104 **Air quality study Elmendorf Air Force Base,** Env. Eng. Sect., March 1969.

R-105 **North Pole groundwater study,** Env. Eng. Sect., March 1969.

National Research Council (NRC)
Division of Building Research
Ottawa 7, Ontario, Canada

NRC 11131 **Frost heaving forces in Leda clay,** by E. Penner — reprint from Canadian Geotechnical Journal, Vol. VII, No. 1, February 1970, p. 8. (DBR Research Paper No. 419)

NRC 11156 **Sealed double-glazing in Canada,** by K. R. Solvason and A. G. Wilson — reproduced from Build International, Vol. 2, No. 5, June 1969, p. 5-9. (DBR Research Paper No. 420)

CBD 123 **Cold weather masonry construction,** by J. I. Davison. March 1970, 4p.

CBD 125 **Cladding problems due to frame movements,** by W. G. Plewes. May 1970, 4p.

Inland Waters Branch
Department of Energy, Mines and Resources
588 Booth Street
Ottawa, Ontario, Canada

Rept. Ser. No. 7 **Ice studies in the Department of Energy, Mines and Resources — 1969.** 92 p. Detailed catalogue of the department's currently sponsored studies investigating ice as a material, as well as projects specifically concerned with land-based and floating ice.

National Academy of Sciences
Printing and Publishing Office
2101 Constitution Avenue
Washington, D.C. 20418

Committee on Polar Research, National Research Council, **Polar research: a survey.** 204 p., $15.00. This new report reviews past research and current knowledge of the polar regions and directs attention to critical areas for scientific investigation by presenting numerous recommendations and plans for action in all areas of study. The book emphasizes the importance of international scientific cooperation in the study of these regions, and should prove of interest to all scientists, students, and others concerned with research in the Arctic and in Antarctica.

U.S. Geological Survey
(Alaskan Geology Branch)
345 Middlefield Road
Menlo Park, California 94025

Selected references on permafrost, and related engineering problems in Alaska, compiled by Oscar J. Ferrians, Jr., September 1969, 21 p. Carefully chosen list of pertinent Geological Survey bulletins, papers, maps and circulars; journal articles; conference proceedings; U.S. and Canadian military reports and manuals; and bibliographies covering the period from 1912 through 1969. Invaluable information source guide for those directly concerned with research and study in Alaska.

Registers Unlimited
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Calgary 1, Alberta, Canada

A new service has been initiated for those who are engaged in or deal with the oil and gas exploration and producing industry in Western Canada. **Register's Unlimited** is a listing of all companies active in the industry and their office locations and key personnel, such as officers, engineers, geologists, landmen, purchasing agents, scouts, and accountants. The directory will be updated on a monthly basis on pages which slip easily into a looseleaf binder.

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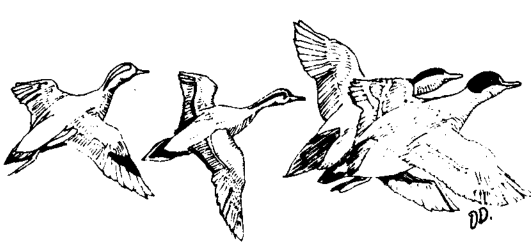

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